

Subject areas

- Biochemistry
- Biology
- Chemistry
- Geography
- Geology
- Physics
- Psychology



UniServe•Science News

Newsletter of the Science Software Clearinghouse

Vol. 2, November 1995

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From the Director

The lessons of history

We at UniServe•Science believe strongly that the new Information Technologies have almost unlimited potential for improving university teaching. We hope you who are reading this newsletter feel the same way. We also hope you will agree that we should try to persuade our colleagues to use IT in their teaching and to convince university administrators to put up the necessary money. But perhaps a cautionary word might not go amiss before we are too far along that track.

Continued page 2

The image shows the cover of a CD-ROM titled "Exploring Perception" by Colin Ryan. The cover features a red and blue abstract pattern with a large grey 'X' overlaid. The text "EXPLORING PERCEPTION" is visible at the bottom. A small window in the top right corner shows the name "Colin Ryan" and a close button (X).

Colin Ryan of the Psychology and Sociology Department at James Cook University of North Queensland has produced a package on CD-ROM that allows interactive real-time exploration of 288 key concepts in human sensory perception.

See page 3

UniServe•Science is funded by the Committee for the Advancement of University Teaching, the Faculty of Science, and the University of Sydney

From the Director

From page 1

There are some of us who will be aware that we have been through this before. In the late 1960s, early 1970s, the great white hope of university teaching was television. From the pages of learned journals and the platforms of educational symposiums the message came forth. Our students spend hours each day glued to their television sets. They gain most of their knowledge of and opinions about the outside world from what they see on the box. Why cannot we harness television to teach them what we would like them to know? Research says that lecturing is not a particularly effective way to teach. Why not replace lectures with television programs?

We all know what happened. Universities the world over invested heavily in television units. Departments made elaborate series of teaching programs. Some were awful and were quickly scrapped, but some got it right and they were used to teach students effectively and well.

Yet today, to our knowledge, there is not any university anywhere in the world which still uses television programs as a significant component of its teaching effort. In the end, that kind of television teaching has to be judged a failure. Yet the original arguments are still valid. Students still watch television and they still get much of their knowledge of the world that way. What went wrong?

There are many opinions about that, but a significant factor must surely be the demands that television placed on departments. Good television programs are unbelievably expensive to make, both in money and in time. Yet departments insisted on making their own. Very, very

few were willing to use materials that had been produced elsewhere. This was all right at the beginning, when we were all young and enthusiastic, but when the programs came to be remade, resources just could not be found. Even departments who had used television successfully, quietly went back to talk-and-chalk lecturing.

Today we are at the same cross-roads as we were a generation ago. We believe we can see the right road ahead and we must sell others on the idea of taking that road. But we must be careful not to oversell. This newsletter contains a salutary article by Roger Lewis, telling us that increased teaching effectiveness (at least in terms of exam grades) will not necessarily accompany enthusiastic use of new technologies. We will still have to work hard to achieve that.

This newsletter also contains articles on innovations that do seem to be successful in psychology, in biology, in geology. The message we would like to get across is that, if these are to be *truly* successful, other departments in other universities must use them. That's why UniServe•Science exists — to get you to consider incorporating these materials in your teaching and not simply to see them as templates for what you might write for yourself. If we do not succeed in persuading you to do that, then we believe that in another thirty years university teachers will be asking: what went wrong with IT in teaching?

To quote from George Santayana:

“Those who cannot remember the past are condemned to repeat it.”

Ian Johnston

Aims

- *collecting and disseminating information about ...*
- *advising on and promoting the use of new technologies in ...*
- *publicising new developments in ...*
- *encouraging communication about ...*

Information Technology in tertiary science teaching

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Article

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Exploring Perception

Interactive real-time exploration of 288 key concepts in human sensory perception

Human sensation and perception is a joy to teach! It's chock-full of enough curiosities, paradoxes, movement, illusions, colour, surprises and just plain wonder to beguile even the most world-weary and obsidian-eyed of post-Dawkins students. So much for the good news.

Demonstrating many of the key concepts and perceptual phenomena is often a *logistical* nightmare for both teachers and the technical staff. In these quality-assured times, it becomes progressively more difficult to justify four hour's work to mount a two minute demonstration, whatever its pedagogical merit.

So, while sensation and perception's message is inherently fascinating and entertaining, getting it across in the classroom and laboratory can be often unacceptably expensive in terms of time and physical and technical resources — particularly in newer departments without generations of accreted teaching-aid infrastructure in place. Worse still, the opportunity for individual, hands-on, student exploration has been very nearly zero in all but the best-equipped departments.

And these problems multiply as the discipline becomes more sophisticated and complex. It takes a great deal of energetic arm-waving, for instance, to get Fourier analysis of spatial patterns across to students, or to convincingly integrate trichromatic and opponent process theories of colour vision with chalk and talk. Yet modelling demonstrations of these phenomena in the classroom can be tricky and prohibitively resource-intensive.

And the textbook publishers — as I used to remind them relentlessly — hadn't been much help. I made the mistake of complaining to a visionary acquisitions

editor who cared and — two years of intolerable workload later — *Exploring Perception* is the consequence.

Targeted at advanced undergraduates, *Exploring Perception* allows for real-time exploration of almost 300 key concepts in psychophysics; colour vision; shape, movement and space perception; sensory physiology; perceptual constancy, development and adaptation; and size, distance, lightness, form, pattern and contrast perception. The package has a modular structure. Stand-alone investigative interactions can be tackled in any sequence. We tried to avoid the usual linear, cumulative, 'talking-book' approach to educational multimedia and narrow 'author-as-guru' didacticism in favour of go-anywhere, click-tinker-monitor-tune-tinker exploration.

Unlike much interactive multimedia — where the interaction is in the spaces between the learning experiences and consists of little more than program management and control of information flow — each element of the package is designed to be highly engaging and activity-oriented. Each interaction allows students to investigate the consequences of tuning key variables using a variety of on-screen tools. On-screen text is kept to an absolute minimum.

Students can explore, for instance, the coding of colour by the visual system by tracking the activity levels in various photoreceptors as they sweep a cursor across the colour spectrum. In the same way, they can run a simple psychophysical experiment to determine their difference threshold for size judgments; quantify visual illusions under a variety of conditions; or monitor simulated cortical simple cell firing rates as they vary the orientation of a visual stimulus.

So, each screen requires the student to

interactively tune key physical variables while monitoring system outcomes and/or perceptual consequences. This might involve simply sliding a cursor to vary the saturation of the colours of a butterfly; monitoring the firing rate of simulated opponent cells in the visual system while changing the wavelength of illuminating light; or exploring how the world looks to a deuteranope. The emphasis is on independent exploration, prediction, investigation and discovery. Topics covered include:

- gestalt laws of organisation
- figure ground and spatial frequency
- moving illusory contours
- figural, colour, tilt and other after effects
- rotary induced movement
- textural contours
- colour vision deficits
- disparity and retinal location
- apparent movement and figural selection
- monocular and binocular depth cues
- theories of colour vision
- gratings
- kinetic depth effects
- motion parallax
- the Horopter, corresponding points and convergence

Exploring Perception provides instructors with a friendly custom lecture-making environment, where a sequence of demonstrations can be planned in advance (just click) and run automatically in class. An on-board electronic glossary and tour/tutorial are provided, together with detailed click-and-check references to the six best-selling international sensation and perception texts. A tightly-focussed quiz is integrated with each interaction, guiding observation and providing a check on knowledge acquisition. The programme keeps track of the interactions successfully completed.

Arrangements are in place to market the

CD-ROM in North America, Europe and Asia, both as a stand-alone package and as a complement of the new edition of Brooks/Cole's best-selling text *Sensation and Perception* by Bruce Goldstein.

Colin Ryan
Colin.Ryan@jcu.edu.au

Putting it all together

Julie McNab of Melbourne publishers Thomas Nelson Australia, believed in the project, sensed the time was right, but knew that it would take a commitment from their ITP associate Brooks/Cole in the USA to be viable. Development costs would be high and, because the market was relatively small and specialised, world-wide distribution was imperative to commercial success. In California, Brooks/Cole's senior psychology editor Marianne Taflinger liked the concept well enough to back an academic she hadn't heard of, at a University she hadn't heard of, in a town she hadn't heard of, in a country that wasn't the USA. Courage indeed!

Eventually, a co-publication agreement was signed and near-meltdown ensued on the Internet! Scripts and concept designs were outlined in Townsville for exhaustive review by academics scattered across the USA; technical development was steered by Brooks/Cole's Multimedia Editor Bob Beede at UCS, and University of Pittsburgh perceptionist Bruce Goldstein; The project was coded in Melbourne by multimedia house, PMS; Brooks/Cole carried out final editing and voiceover production in Pacific Grove, California; and graphic design was supervised out of Thomas Nelson's Melbourne office by Tony Palmer. We are talking seriously complicated communications here! Had the Internet not existed, the project probably could not have happened.

Requirements:

PC requirements: Windows® 3.1, 2 MB swap file, SVGA or compatible video graphics card, virtual memory enabled, and sound card

Macintosh® requirements: System 7.1

Both require: 8 MB RAM, CD player and 3.5" FDD, colour monitor

Cost: Yet to be set. Contact Julie McNab at Thomas Nelson, juliemcnab@iaccess.com.au

Supplier: Thomas Nelson Australia, 102 Dodd St, South Melbourne Vic 3205

Tel. (03) 9685 4105 juliemcnab@iaccess.com.au

A handbook with instructions and background notes on each interaction is included.

Psychology Sites of Interest

Software Archives in Psychology

<http://psych.hanover.edu/Krantz/software.html>

Cognitive and Psychological Sciences on the Internet

<http://matia.stanford.edu/cogsci/>

Article

James Baggott is an Associate Professor in the Department of Biochemistry at Hahnemann University School of Medicine, Philadelphia.

Sharon E. Dennis is the Head of Computer and Media Services at the Eccles Health Sciences Library of the University of Utah, Salt Lake City

NetBiochem: A Biochemistry Resource for all to use

<http://www.hahnemann.edu/Heme-Iron/NetWelcome.html>

The complete text of this article can be found at

<http://www.ncsa.uiuc.edu/SDG/IT94/Proceedings/BioChem/baggott/baggott.html>

NetBiochem is a centre for Biochemistry education, communication and research on the World Wide Web. The current prototype version of NetBiochem incorporates representative materials that illustrate our goal of creating a complete resource for these activities.

Education

Two major types of resource are available. The first is an interlinked database of educational material consisting of text, sound, graphics (animated and with sound when appropriate) and self-testing with feedback, covering the complete content of a typical biochemistry course at the medical school level. One module is complete; others are in a text-only stage, and still others are at earlier stages of construction. The other resource is a library of animated and still graphics illustrating biochemical processes and phenomena. Users are invited to download any of this material and modify it as desired for local use, *e.g.*, as visual aids in lectures or as documents on local networks that reflect a different emphasis preferred by local faculty.

Communication

Examples of full papers (augmented with colour graphics and animations) and complete poster sessions (with colour

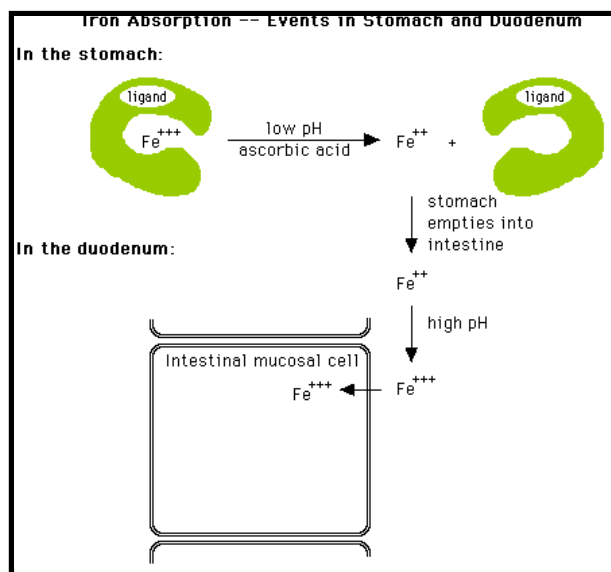
graphics) demonstrate to the Biochemistry community the power of the World Wide Web as a tool for exchanging research information.

Research

Anchor to HTML documents and gopher sites of major interest (databases, grant information, *etc.*) to biochemistry and molecular biology have been provided. Students experienced with computer based learning have tested the earliest elements of NetBiochem, have judged them satisfactory learning

tools, and have made attainable recommendations for improvement.

James Baggott & Sharon E. Dennis
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Learning materials available at NetBiochem:

- Heme and Iron Metabolism (complete)
- Macromolecules (53 K, text only)
- Membranes (27 K, text and two animations only)
- Nucleic Acids (26K, text only)
- Purines and Pyrimidines (complete)

(Additional topics are being prepared; an entire course is planned.)

- Animated and still graphics

NetBiochem is also available at <http://www-medlib.med.utah.edu/NetBiochem/NetWelco.htm>
All files can be downloaded via ftp from <ftp://medlib.med.utah.edu/Slice/NetBiochem/> for modification and local use (see copyright agreements).

Computers in first year teaching: Biology at University of Sydney

Mary Peat is the
Director of First
Year Biology at
the University of
Sydney and is the
Co-director of
UniServe•Science

Traditionally, science-based courses utilised lectures, laboratory sessions, workshops and tutorials for their teaching modes. At the University of Sydney we were no exception. However, with an increasing diversity in the background and ability of our incoming students, we are presented with the dilemma of how to engage all our students in appropriate active learning. Whatever we presented to them some would have done it all before, some would be comfortable with our offerings, and some would have little understanding at the end of the year. This dilemma of diverse student background has been faced by most large biology departments around Australia and a variety of solutions is in place. Some departments have streamed students, creating more homogeneous groups that are more easily managed. Some have invested time and money into creating self-paced learning environments. More recently many departments have embraced computer technology.

At Sydney we still have a large first year class, although there is a move towards more streamed course offerings. In Biology 1 there are currently more than 800 students enrolled in different Faculties, with a wide range of university entrance scores. The format for the course is three lectures a week and a three hour laboratory session (60 students in each class). We have no budget for the more expensive teaching formats of workshops or tutorials, although the junior academic staff who are assigned to first year offer a 'duty tutor' service and the lecturer of the week gives a voluntary tutorial.

We have been using computers in our teaching since the introduction of PLATO in 1984. More recently the School of Biological Sciences has increased its use of computers in teaching and has installed a Macintosh® teaching network in the

laboratories. In late 1992 the First Year Biology Teaching Development Group was set up to develop materials for the course. To date we have utilised the computer network for student self-registration, which gives us an enormous saving in administrative time; for delivering and marking multiple choice quizzes during the formal laboratory sessions; and for offering students interactive modules associated with the course.

The modules being developed (in *Authorware™ Professional*) fall into one of four categories — tutorial, pre-lab instruction, revision, and self-assessment. The tutorial modules are designed to present information in an exciting and interactive manner to students and are designed to be resources for students to use in conjunction with paper-based materials. They contain a large amount of information to explore, at a variety of depths. They enable biological processes to be illustrated in an animated manner which would otherwise not be available in the laboratory by other means.

Pre-lab modules are introductions to the use of laboratory equipment which would have previously been given by the teaching staff to small groups of students. The students are able to practise on the 'computer equipment' before using the laboratory-based equipment. Revision modules review practical material previously seen in the laboratory but do not offer any new materials. The emphasis is on visual stimuli utilising our vast collection of images, 35 mm slides, and prepared microscope slides. The student self-assessment modules enable students to take a series of formative tests and exercises aimed at helping them monitor their level of understanding. These modules help to promote deep learning approaches and offer students an

enjoyable feedback and reinforcement session.

Evaluation of materials

Since 1992 we have held discussion with staff and students, observed the students using the modules and surveyed students perceptions of the introduction of a variety of computer-based materials. Feedback from both staff and students is used to identify problems and mistakes in the modules.

In 1992 student perceptions of the introduction of computers in teaching were investigated using a questionnaire. This study of 118 students out of a class of 1200 was limited to students' perceptions and did not attempt to evaluate changes in performance after using computers as an instructional tool. The results show that 28% of students had previously used computers often; 67% of students had previously used computers occasionally; and 4% of students had never used computers before. Despite this, 90% of students used the computers in our laboratory classes and of these 92% had no difficulty in using the programs, navigating through them, and using the mouse. 83% of these students thought that the programs increased their understanding. 53% of the students found the animations of most use in their understanding of the topic while 23% of students found the self-help questions of great use.

In 1994 the use of computers for laboratory quiz delivery and marking was investigated. 350 students were surveyed using a questionnaire. The results showed that 74% of students preferred using a computer for the quiz rather than filling out a paper-based question sheet and waiting a week for feedback on performance; 47% of students requested more control over the order in which they answered the questions; 78% of students wanted the opportunity to review answers and make changes; 80% of students requested more feedback on incorrect answers; 66% of students preferred the inclusion of graphics in the

questions; and 55% of students found the quizzes a useful guide to their progress in biology. This user feedback was used to modify the program used in 1995.

Testing the effectiveness of a mini-tutorial was carried out in 1995. The tutorial was written to address an overcrowding situation with respect to demonstration materials. Students were given a pre-test (Quiz 1) on the content of the module before using it and a post-test (Quiz 2) one week after using the module and again ten weeks later (Quiz 3). 110 students were involved, with half of them using a computer-based module and half of them using paper-based materials. The results showed no significant difference in the academic achievement of students. Students are not disadvantaged by this teaching method, and the problem of congestion in the laboratory has been addressed.

	Mean score for paper-based material	Mean score for computer-based module
Quiz 1	3.17 ± 1.24 SD	3.80 ± 1.06 SD
Quiz 2	4.18 ± 1.43 SD	4.24 ± 1.96 SD
Quiz 3	3.98 ± 1.28 SD	3.82 ± 1.15 SD

The future

We believe that biologists around Australia should collaborate and cooperatively develop small modules that can be incorporated into first year biology courses. We need to set an agenda for this and define the areas of expertise among the developers. The project *New Technologies in Biology Teaching*, funded by DEET in 1994, produced a catalogue of some of the known Australian made biology software. This catalogue material will shortly be available through UniServe•Science.

Mary Peat
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The work described has been funded by the Apple University Development Fund, a CAUT Teaching Development Grant, the Faculty of Science's (University of Sydney) Teaching Development Fund, and by University of Sydney 1993 'Quality Money'. Some of the content of this paper was presented at the Apple University Consortium Technology '95 Conference in Perth in July 1995.

Courseware for Earth Science teaching from the UK

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A suite of twenty-one interactive courseware modules for use in Earth Science degree level teaching is being developed in the UK as part of a government funded Teaching and Learning Technology Programme (TLTP). Six modules have been in use in UK universities for about a year and the remainder will be released over the next 18 months. Both Macintosh[®] and Windows[®] versions, produced using *Authorware™ Professional*, are now being made available world-wide and can be purchased for use in Australasia.

The courseware is being developed within UK universities under the auspices of the UK Earth Science Courseware Consortium (UKESCC), an organisation comprising the fifty or so Earth Science departments in UK tertiary educational institutions. As a representative of this consortium, I visited several universities in Australia earlier this year to demonstrate the courseware and discuss ways in which it could be used in this part of the world. The general impression I left with was that significant efforts are being made in Australia to use of information technology in Earth Science teaching, and that the UKESCC courseware could represent a valuable addition to other CAL material already in use.

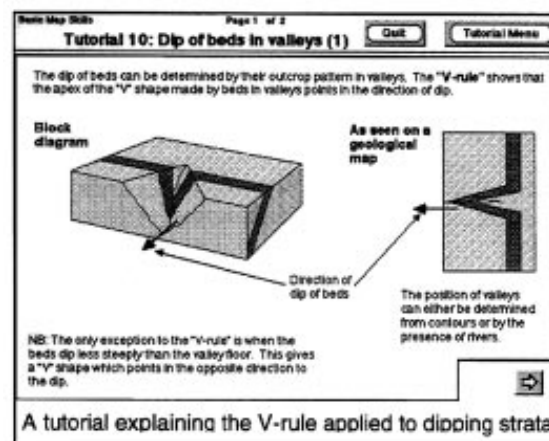
The courseware modules cover a range of Earth Science topics. About half cover material studied at first year level, with the remainder being suitable for second and third year teaching. The topics covered are mainly those which students find difficult, which can be difficult to teach using conventional methods, or for which the computer is superior in presenting material.

While some of the courseware modules can be considered complete teaching packages, most have been designed to be

Modules available from the UK Earth Science Courseware Consortium:

- Crystallography
- Preparing for Field Work 1: Using the Compass/clinometer
- Optical Mineralogy
- Geological Map Skills
- Visualising Geology in 3D
- Petrogenesis of Granitic Rocks
- Dynamic Stratigraphy: Controls and Products
- Basic Skills for Earth Sciences
- Radiogenic Isotopes in Geological Sciences
- Systematic Palaeontology: the Phylum Mollusca
- Rock Deformation and Geological Structures
- Using Stereonets in Geology
- Fossils as Palaeoenvironmental Indicators
- Preparing for Field Work 2: Fieldwork Safety
- Exploring the Shallow Subsurface using Geophysics
- Arc Magmatism
- Aspects of Earth Resources
- Ocean Crust and Ophiolites
- First Year Petrography
- Phase Diagrams
- Basic Geochemistry: Origin and Distribution of the Elements

used by students as just part of a range of learning resources including lectures, practicals, traditional library facilities, and



in some cases field work. Thus most of the modules are perhaps best considered as providing tutorial material that can be accessed by students in their own time and which they can work through at their own pace.

The material in most modules would probably take an average student about four hours to complete. However, it is not envisaged that a student would work through a complete module in single sitting, and so most are divided into several sections, each of which can be studied separately. Graphics and animations are used extensively and a range of types of interaction employed to retain students' attention. Types of interaction include multiple choice and true/false questions, labelling diagrams, entering answers via the keyboard and simple drawing (typically lines). Although rigorous assessments and recording of the results obtained are not included, there are assessment sections at end of most modules so students can gauge their level of understanding.

Up-to-date information about the courseware, its availability and how it can be purchased can be found on a World Wide Web page with the following URL:

<http://info.mcc.ac.uk/Geology/CAL/index.html>

A demonstration disk containing parts of the first six courseware modules is available for both Windows[®] and Macintosh[®] machines. Information on downloading these is given on the WWW page. Copies of the demos, as well as literature about the individual modules have been lodged with UniServe•Science, and are also available from the Central Unit of the UKESCC at Manchester, UK. Copies of all the complete modules and some modules still under development have been lodged with UniServe•Science for demonstration purposes.

Considerable experience has been gained over the past three years, not only in the mechanics of courseware production, but also in keeping members of a consortium involved and informed

during both courseware development and its introduction into UK Earth Science departments. This expertise will be maintained as the main phase of courseware development comes to an end and the emphasis changes towards making the courseware available world-wide, and making the Consortium financially self-sufficient. We expect to play a greater role in trying to ensure that both teaching staff and students in Earth Science departments are aware of and use the courseware, and that it becomes regarded as a teaching and learning resource that is integrated into a department's everyday activities. The income generated from sales of courseware will be used primarily to provide technical support to users, and to keep the courseware maintained and updated.

Plans are being formulated to allow institutions outside the UK to become affiliated to the UKESCC. This will mean that, rather than merely purchasing courseware modules on a one-off basis, institutions will receive, in return for an annual fee, all the courseware modules and associated materials that are produced during the year, as well as technical support. The hope is that this arrangement will encourage users to exchange ideas and experiences, will lead to suggestions for new courseware modules, and result in the production of new modules using templates supplied by the UKESCC.

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The use of colour graphics and scanned images as an integral part of these modules means there are certain minimum hardware requirements to run the courseware effectively. Most modules use 256 colours.

Requirements: Macintosh[®] these are 4 MB RAM and a colour monitor with a screen resolution of 640 x 480 pixels (14" monitor).

PC: Windows[®] 3.1 or later, 4 MB RAM, a VGA colour monitor and 386 processor or better.

Supplier: Contact ukescc@man.ac.uk

A demonstration version of this material can be downloaded from http://www.usyd.edu.au/su/SCH/UKESCC_Demo/ukescc.html

Physics, students, & videotape

Roger Lewis is a Senior Lecturer in Physics at the University of Wollongong

Mick Pope is the Educational Technologist (Physical Sciences) at UniServe•Science

In a multimedia age, it is sometimes easy to forget about simpler and more accessible technologies such as video. The VITUL project (Video Introductions to Undergraduate Laboratories) is a series of 28 pre-lab videos. The project was funded by CAUT in 1993-4 and led by Roger Lewis of the University of Wollongong's Physics department. Recently, Lewis wrote an article for the American Journal of Physics [1], commenting on the impact of the video on students marks. The following is an extended abstract of that article.

The *Video Introductions to Undergraduate Laboratories* videotapes are used as supplementary material, which aim to give students a brief overview of the experiment before they undertake it and concentrate on how to use equipment and how to perform measurements. The perceived advantages of using video in this manner are (i) a consistent standard of pre-instruction across all classes, (ii) presentation of core material by an experienced teacher, (iii) some student control of learning in replaying chosen parts of the tape, (iv) reduction in time spent by staff repeating basic information.

The videotapes are used in both calculus and non-calculus first year courses, with students undertaking twelve experiments. A survey of student opinions (1992-1993) showed they thought the videos to be: helpful, of good quality, of appropriate length, related to the experiment and to have a positive impact on their understanding and performance of the experiment. Lewis conducted a carefully controlled experiment to test if understanding and performance were actually effected. Students were split into two groups, each seeing the videos before the experiment in different halves of the semester. Student were given a 'book mark' and a 'class mark'. The book mark was given by a marker who did not know when videos were shown, thus eliminating bias. The class mark was given by the demonstrators, so bias may be present. For each student, the 'relative difference' between their marks in each half of the year were calculated. The marks were relative to the average class mark, to

remove variation due to the difficulty of individual experiments. This mark also compares individual students, with and without the video, eliminating between-student variation. The results show no statistically significant changes in the marks!

Lewis concludes that the student responses suggest that poor content or presentation are not to blame. He suggests that perhaps the methods used were insensitive to the changes that occurred, or that ten minutes of a two to three hour lab are not likely to produce large changes. He also suggests that video is passive and thus unlikely to produce large changes. Whilst not improving marks, the videos have the positive outcomes of; providing a uniform introduction to the experiments, saving staff time, and introducing flexibility as the students viewed the videos at their convenience.

This paper represents a more complete appraisal than the commonplace "the students liked it". The videos are a useful innovation, and suggest that assessment techniques need to be looked at more closely so as to more accurately measure the effect on student learning.

*Abstracted by Mick Pope from an article
by Roger Lewis*

[1] R.A. Lewis, *Am. J. Phys.*, **63**, 468 (1995)

The videotape can be purchased for \$19.95 from:
Marcom Projects
PO Box 4215
Loganholme DC
Qld 4129

Article

Dianne
Chambers is the
Educational
Technologist for
the Biological
Sciences at
UniServe•Science

Formative Evaluation of Instructional Material

A vital part of the development of any Computer Aided Learning (CAL) package is evaluation of the package *during the development* of the package. This *formative evaluation* of a package will feed back into the development process at numerous stages of development. This is critical as much time, effort, and money may be wasted by developing a package that, for any of a thousand reasons, may be unsuitable. If evaluation of materials occurs during the development process then the production of a useful package is more likely. This process of evaluation leading to revision is known as formative evaluation.

Formative evaluation is also known by the names of 'developmental testing', 'student tryout', and 'learner verifications and revision' (Russell and Blake 1988). It is this last point that is critical in the definition of formative evaluation - its purpose is evaluation that will dictate further revisions of material being prepared and thus is undertaken during the development of CAL materials. Formative evaluation is often done by the developers of a package, though if materials are being developed as part of a consortium then formative evaluation by other consortium members or a central group may be appropriate (e.g. Laurillard, 1994a and 1994b).

There are a number of ways to undertake formative evaluation - these can be divided into informal and formal means. Informal formative evaluation takes place in the development space often through asking the opinion of colleagues. For example asking another developer for their opinion of a particular part of a CAL package, or challenging them to find bugs in a CAL package, and getting subject matter experts to review the content. This type of formative evaluation takes place

throughout the development of instructional materials and will be repeated many times. Through feedback the design and content of materials will be modified. At a slightly later stage in development (when the obvious technical 'bugs' have been ironed out), but still well from the end of the developmental stage, then more formal formative evaluation will take place, that is at a 'rough draft' phase of development.

Formal formative evaluation may include having small groups of potential users use the instructional materials in a situation much like those in which the materials will finally be used. These users should be typical of the target user, that is not exceptionally able or challenged students, unless these groups are the target audience. The users should be observed while they work through the CAL package. Often the best feedback from the users can be gained if the users are in pairs and they discuss their perceptions of the package, its navigation, and its content as they work through it. An alternative to having an observer is to videotape users 'think aloud' as they work their way through the instructional material. The use of a camera rather than an observer may lead to users being less self-conscious, leaves a record that can be reviewed many times, and allows the users to work out for themselves navigation rather than asking the observer for help. A negative aspect is that reviewing videotape can be extremely time consuming.

The purpose of formative evaluation is to get feedback so that further development of the package can occur and the package can be the best instructional material possible. This will mean that from the results of student/user comments

continued page 17

Review

96,000 high resolution images on one disc? In your dreams!

It is hard to describe this product without sinking to expletives, but in principle Jeremy Pickett-Heaps' disc on cells (*Living Cells: Structure, Diversity and Evolution*) is *#!# brilliant.

We are offered a trek around the high grounds of light microscopy and cell biology, in this both glorious and instructive compilation of material about living cells. In it we have images of living cells by many types of light microscopy — dark ground, phase contrast, polarized light,

Nomarski — and at a level that sets the standards. This allows us to view in living material cell components such as Golgi bodies, mitochondria and single microtubules. This material should be obligatory in any course on cell biology,

as we can imagine no better way to introduce students to the spectacle of cell biology. Obligatory viewing might alert both them (and even some of their teachers) to the amazing things that cells can do and lead them to understand what it is that captivates hordes of cell biologists world-wide. Not only does the microscopy set the standard, but the disc is also peppered by delightful little bits of whimsy which serves to add to the fascination.

This disc is arranged in a series of sections, referred to as chapters. In most, the images are presented in excess of 20 per second — so providing flickerless movie reconstruction of the original phenomena. The chapters cover: Introduction; Cell membrane; Nucleus and nucleolus; Mitochondria; Endoplasmic

reticulum (yes you can see it in living cells); Golgi bodies; Interphase microtubules; chromatophores; Axopodia in heliozoans (sic); Mitosis in animal cells; Mitosis in higher plant cells; Actin and cytoplasmic movement; Actin and streaming in plant cells, Streaming in *Chara* and *Nitella*; Actin and cell cleavage; Flagella and motility — biflagellated algae; multiflagellated algae and protozoans (sic); Flagella and prey capture; Sexual

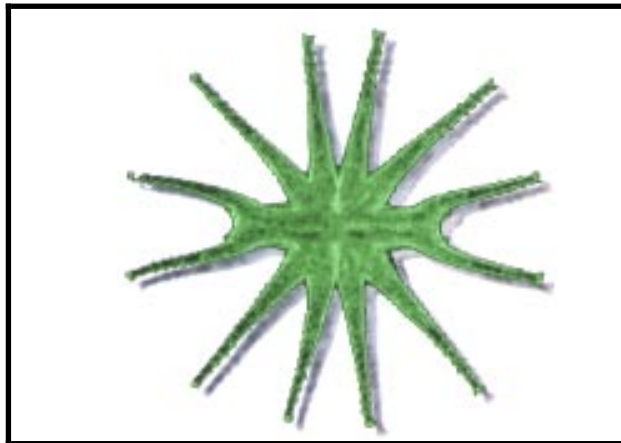
reproduction in *Chlamydomonas*, Feeding in *Epipyxis*; Cell walls; Contractile vacuoles; Vacuoles and turgor pressure; Vacuoles and the evolution of defence mechanisms: *Diffenbachia*; turgor pressure and growth; Symbiosis and chloroplasts.

The chapters are accompanied by two sound tracks which explain what is being observed. One of the sound tracks is suitable for the secondary level and the other for tertiary level. In addition there is a handbook with a short description of the contents of each chapter (although these do not always accurately describe the contents of the chapters). The book also includes bar codes so that the disc player can be programmed to play selected sections of the disc. Between many of the chapters are clusters of still images — sometimes of electron micrographs. There are also reconstructions from confocal microscopy.

The material is ideally suited to use as illustrative materials in lectures, or for small group seminars, or to illustrate practical classes in cell biology or

David Patterson is Head of the School of Biological Sciences at the University of Sydney and Deputy Director (Biological Sciences) at UniServe•Science

Dianne Chambers is the Educational Technologist for the Biological Sciences at UniServe•Science



microscopy. Indeed, it shows some phenomena which could be easily adapted into experiments for undergraduate students. The material is (rightly) very rich in protistan examples, and could have an effective role to play in microbiological courses. The quality of the microscopy is outstanding. The images are staggeringly beautiful. The product is an excellent extension of the earlier IWF cell biological disc. Does it have any faults? Extremely few. Every now and then we have oxymorons such as single celled animals, or *Noctiluca* is referred to as an alga. But most users will not detect these small items.

So how do you get almost 100,000 images of such dazzling (full size) quality on one disc. By using analogue technology, of course. The potency and power of this medium has been largely overlooked with the emergence of digital technology. But to get this number of pictures at postcard size onto magnetic discs, you would need to have over a thousand of them. If you went up to full screen images, and if you were also willing to accept the degradation into a pixelated condition, and if you were to use CD-ROMs for their higher capacity, you would still be faced with having to buy many CDs. Even with the emerging MPEG technologies, individual frames cannot be viewed as MPEG compression technique does not allow it.

So why not treat yourself to this wonderful spectacle. And then open your world to the array of discs available from people such as IWF, BBC, and Videodiscovery who can serve the image-rich needs of Biology in a way that can only be realised by digital technology at extremely high cost.

David J. Patterson & Dianne Chambers

Living Cells: Structure, Diversity and Evolution Jeremy & Julianne Pickett-Heaps
1994 Sinauer Associates, Sunderland, Mass.
Supplier: Micron BioSystems, 650 South Cherry Street, Suite 440, Denver Co 80222-1806 USA
Cost: US\$600 includes companion Macintosh® or Windows® accessing software.

Resource List

UniServe•Science aims to provide an easy means for academics to access information. Part of this aim is to provide referral to other services that offer information to academics. Listed below are contact details of a sample of information services you may wish to know about.

CTI Biology

CTIBiol@liv.ac.uk
<http://www.liv.ac.uk/ctibiol.html>

CTI Chemistry

CTIChem@liv.ac.uk
<http://www.liv.ac.uk/ctichem.html>

CTI Geography (with Geology)

CTI@le.ac.uk
<http://www.le.ac.uk/cti/>

CTI Physics

CTIPhys@surrey.ph.ac.uk
<http://www.ph.surrey.ac.uk/cti/home.html>

CTI Psychology

CTIPsych@york.ac.uk
<http://www.york.ac.uk/inst/ctipsych/>

DA Electronic Media

648 Whitehorse Road, Mitcham Vic 3132
(03) 9 873 4411

Dataflow Computer Services

PO Box 123, Artarmon, NSW 2064
Tel: (02) 417 9700, Fax: (02) 417 9797
dataflow@applelink.apple.com

Edsoft: Australian Educational Software Suppliers

PO Box 314 Blackburn Vic 3130
Tel: 008 674 899; (03) 9 878 4899; (02) 922 1234
Fax: (03) 894 2016

Jacaranda Wiley Ltd

Jacaranda Wiley, PO Box 1226, Milton Qld 4064
Tel: (07) 3 859 9755
<http://www.wiley.com/>

Physics Academic Software 1994-1995

Prof. John Risely, Editor
Department of Physics, North Carolina State University, Raleigh, NC 27695-8202 USA
Risley@ncsu.edu

Trinity Software

PO Box 960, Campton, NH, 03223-0960, USA
<http://206.14.56.63/trinity.html>
trinity@hfk.com

Videodiscovery

1700 Westlake Ave N
Seattle 98109-3012, USA
Tel: (206) 285 5400 Fax: (206) 285 9245
vdisc@applelink.apple.com
<http://www.videodiscovery.com/vdyweb/>

Interactive Physics II

Suzanne Hogg is
a Senior
Lecturer at the
University of
Technology,
Sydney

Interactive Physics is a very powerful program, which, however, needs to be mastered by the instructor before letting the students loose on it. Documentation is good, except in the scripting language needed to write formulae to provide control of objects, customized graphs, *etc.* Security is impressive, if irritating. A ten-pack license means very definitely that, while twenty machines on a network may have the program loaded and 'passworded', only ten may boot up. I was quite dismayed to find that I could not then extend my ten-pack to a twenty-pack, but rather had to purchase a second ten-pack license. The installation on new machines is also tiresome as you not only have to type in a long password but also have to have your manual with you so that you can answer individualised questions such as "enter the second word in the last sentence on p 61 of the manual". Operation is easy, and very predictable — after initial teething problems, such as remembering which direction you need to drag a force or constraint so that it is not operating on thin air. Care needs to be taken in using the program in demonstration, because if the system is at all complex, the first run takes a very long time to calculate — later runs use calculations made previously so are greatly sped up.

Special Features

- i) the ability to turn gravity on and off, also create customized force fields *etc.*
- ii) the ability to save the running simulation as a QuickTime movie, for either immediate playback, step by step, or for inclusion in other applications.
- iii) the ability to show real-time vector quantities as motion proceeds.
- iv) the available problem examples provided by textbook authors such as Serway, for illustrating real physical problems, which can be used as the basis for other examples.

v) it is particularly valuable in rigid body dynamics in a plane, oscillations (though calculation of period is difficult) due to springs *etc.*

Difficulties

- i) the program does not handle well motion of, say, a point particle, on a curved surface, being constrained by its honesty in calculations — this is good, but limiting to the lecturer.
- ii) choices of velocities, masses *etc.* are obviously important for displaying on the screen within the view chosen. Some skill is needed in making these choices — this is the chief reason why the lecturer needs to become familiar with the program usage and continue to be familiar with its usage.
- iii) while it is possible to constrain the motion, *e.g.* body B starting to move 5 seconds later than body A *etc.*, it takes practice to set this up easily.

Overall

A brilliant program in the hands of an interested lecturer, it keeps the lecturer honest in demonstrations and can be extremely valuable in demonstrating effects such as the conservation of momentum during a collision, regardless of whether gravity is 'turned on' or not.

I use it as a lecturing tool in teaching Dynamics to Civil Engineers and Applied Mechanics to physics students and also have the latter students doing an exercise in rigid bodies, pinned together and rotating about each other, as an assignment. As a remedial tool I have the program mounted on three borrowable PowerBook Duos, for students taking Civil Dynamics who have not met Physics at school.

Suzanne Hogg
s.hogg@uts.edu.au

Interactive Physics v2.5 Macintosh [®] : 2 MB RAM, System 6.0.5+; hard disk PC: Windows [®] 3.1, 4 MB RAM, 368+ Price: \$545. Upgrade from 2.0 \$220 5 pack \$995; 10 pack \$1495

Review

Gareth Denyer is
a Lecturer in
Biochemistry at
the University of
Sydney

IMDAD Viewer

for Stryer's *Biochemistry* (4th Edition)

It is almost impossible for most students to visualise, with the mind's-eye, the complex three-dimensional structure of biological macromolecules. Furthermore, no amount of static textbook pictures can allow the student to actually *explore* macromolecular structure. *IMDAD VIEWER*, which accompanies the 4th Edition of Stryer's *Biochemistry*, allows 35 selected computer-generated, macromolecular models to be viewed in three-dimensions, from any angle, and along any axis.

With the Power Macintosh version, the molecular rotations are seamless with even the perspective and shadings being rapidly updated as the model tumbles. The program allows different sections of the molecules to be highlighted and, also, for models to be depicted in space filling mode. This is useful: otherwise it's like trying to visualise the fine features of an animal from its skeleton! A feel for the enormous complexity of protein tertiary structure is also provided by other options which bring the amino acid side chains into view. The rotation of each macromolecule is, however, severely slowed by viewing anything other than a ball and stick model, particularly on the pre-Power Mac versions. It is possible to magnify and reduce the molecule using a zoom tool, but magnification, too, slows down rotations. A great feature for teachers is that screen images can be captured as PICT files — no longer will it be necessary to scour all the textbooks to find that seminal view!

The power of the software is best illustrated by the models of the leucine zipper. Trying to explain to students how the peptides in this protein twist around each other *and then* intercalate a 3-D DNA-double helix is exceptionally difficult. The computer rotations not only allow each facet of the molecular contacts to be explored, but also for the key residues in each coupling to be viewed in

isolation from the other interactions.

My most serious criticism is that far too much room is given to reproducing pictures from the accompanying textbook. It is unlikely that students need 3-D rotations to understand the structure-function relationships for most of the molecules included, *e.g.*, glycogen phosphorylase. Illustration of simple, classic structures, such as collagen and keratin, would be more helpful. In some cases the graphics are not used to good effect: *e.g.*, rotating and exploring the model of the antibody-antigen complex does not reveal how these two molecules interact

At no stage does the program help student appreciate *why* proteins fold the way they do. The lack of fundamental secondary structures such as α -helices and β -sheets are glaring omissions. It seems almost pointless to depict large macromolecules unless the user understands these basic structures. In this respect, the software is a clearly behind *Kinemages*, another 3-D macromolecular viewing program which accompanies a competing textbook!

It is unlikely that students will purchase the program, but the facility to save the screen image, and the increasing availability of computer-projection facilities, means that this software may be very attractive to lecturers in macromolecular structure. It certainly beats trying to draw proteins with a blackboard and chalk!

Gareth Denyer
gareth@biochem.su.oz.au

Platform: Macintosh[®], PowerMacintosh[®], Windows[®]
Cost: Free if text is adopted, \$22.95 for students
Requirements:
Macintosh: System 6+, 5 MB RAM, 2 MB free hard disc space
PC: Windows[®] 3.1+, 386DX with math co-processor or 486DX or Pentium, 8 MB RAM.
Author: Michael Levitt
Supplier: Jacaranda Wiley Ltd, PO Box 1226, Milton Qld 4064 Tel: (07) 3 859 9755

Interactive Computer Tutorials in Basic Biology

This project is currently funded by a CAUT grant to Paul Whittington of the Department of Zoology at the University of New England

Introductory Biology is a demanding subject and many students new to Biology are prone to underestimate its difficulty. Here are some common problems that students face:

- Biology is a veritable sea of facts and ideas, most of which are couched in unfamiliar jargon.

- There is a relatively small set of unifying concepts (*e.g.*, the mechanism of evolution, properties of the organism or an organ are determined by the properties of its cells, the flow of genetic information) which links together and makes sense of these seemingly disparate facts and ideas. However, grasping these concepts can be frustratingly difficult. On the one hand, you need to be familiar with a certain number of facts before a concept has any meaning. On the other, cramming too many facts into your brain can make it difficult to see the wood for the trees.

- Biological objects are astonishingly complex in their form and structure. To understand that form, you need to identify the component parts of the object at several levels of organization and understand how those parts fit together. This often requires some considerable mental gymnastics, as biological things are usually three-dimensional.

- Just to compound the problem, the structure of biological objects seldom remains static in living systems. Understanding how objects and the relationships between objects change in space and time is not easy, yet is central to grasping many biological ideas.

The present CAUT funded project was designed to address these specific

problems. Few would claim that lectures alone are an adequate vehicle for delivering an understanding of theoretical knowledge in Biology. Regular, small-group tutorials with committed, experienced instructors arguably provide one of the best forms of assistance to students. But the resources, both financial and human, to provide such tutorials to large first year classes are seldom available.

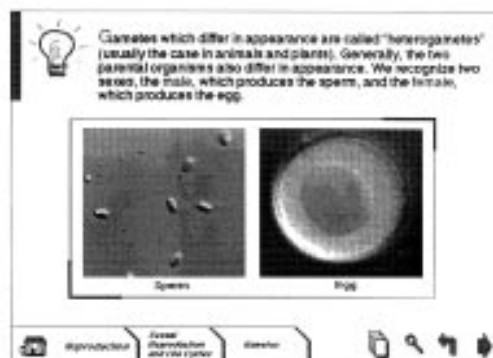
The computer tutorials, which we are developing in this project, may provide an alternative solution. Indeed, this particular learning aid may provide certain advantages over conventional tutorials: computer tutorials can be used by the student repeatedly, at their own convenience; dynamic biological phenomena (*e.g.* cell division) can be explained using animations and digitized video, media which are not normally available in the conventional tutorial setting. Furthermore, computer tutorials could be of particular value to external students who do not have direct

access to advice/feedback from academic staff outside of residential schools.

In designing these tutorials we have assumed the sort of fragmented, incomplete knowledge which an average student gleans from a typical lecture.

From this starting point, we carry the student down a reasonably tightly structured path. The emphasis is on the development of basic concepts, rather than the presentation of factual information *per se*. A central element in the design of the tutorials is a high level of interactivity – an inherent advantage that the computer medium provides over a textbook.

We chose *Authorware Professional* as



our authoring program, largely because it enables the use of quite sophisticated, multimedia/interactive techniques while at the same time being 'programmer-friendly'. It has the additional benefit of allowing cross-platform development; this is an important factor as our students comprise a mixture of Macintosh and Windows users. Animations are authored using Macromedia *Director*TM.

The general structure of the tutorials is to pose a question, drawing upon assumed knowledge, then to provide feedback and use this response to lead into the next question. Questions take the form of text, identifying a part of a diagram or image, or positioning an object in a particular location. Feedback comes in the form of text, presentation of an image, animation, sound or a QuickTime movie. We are making extensive use of 3-D models and images of real biological objects.

Each tutorial is divided into topics. Navigational tools (which are built into

version 3.0 of *Authorware Professional*) are provided to enable the student to move both within and between topics and to jump to related topics in a different tutorial. A glossary of terms (another in-built feature of *Authorware Professional* v3.0) is permanently accessible from the menu bar.

By the end of 1996 we aim to have finalized a number of tutorials which cover the core areas of Cell Biology, Metabolism, Reproduction (including Genetics and Developmental Biology) and Evolution in our First Year Biology Syllabus. These will be made available in two forms: a 'full' version incorporating all of the tutorials on one CD-ROM to enable easy cross-navigation between tutorials; and a 'light' version, minus the QuickTime movies and some of the colour graphics, which will be distributed in compressed form on floppy disks.

Paul Whittington
pwhiting@metz.une.edu.au

Formative Evaluation

(continued from page 11)

any technical or content problems found will be corrected and the package will be modified to reflect the users' comments. Once these modifications and revisions have occurred, then another round of formal formative evaluation may take place.

However, the instructional materials being prepared must eventually be released. Thus, although formative evaluation is vital and should go through a number of cycles before the CAL package is released, the time frame and budget of a project will determine when the CAL package will be released. It must be accepted that the first release of any instructional materials is unlikely to be perfect (although there should be no content errors or major technical bugs) but that there must be an end point to the development of the first release version. Getting the balance between adequate

formative evaluation or getting trapped in an endless spiral from which the product (or you!) may never emerge is a constant danger of which one needs to constantly be aware.

Dianne Chambers
BioSciCH@extro.ucc.su.oz.au

Laurillard, D. (1994a) *Evaluation Planning*, Technology Enhanced Language Learning (TELL), CTI for Modern Languages, University of Hull, UK.

Laurillard, D. (1994b) *Evaluation Procedures*, Technology Enhanced Language Learning (TELL), CTI for Modern Languages, University of Hull, UK.

Russell, JD and Blake BL (1988) Formative and summative evaluation of instructional products and learners. *Educational Technology*, Sept. 1988: 22-28.

Evaluation Sites of Interest

Teaching with Independent Learning Technologies
<http://rank-gw.elec.gla.ac.uk/TILT/E-Eval.html>
Evaluation of Learning Technology in Higher Education
<http://annick.stir.ac.uk/elthe>

CAL in Earth Sciences

One path in a quality teaching environment

This project is currently funded by a CAUT grant to Andrew Gleadow and Mark Warne of the Victorian Institute of Earth and Planetary Sciences, School of Earth Sciences, LaTrobe University

The recent introduction of computer-based education as part of the geology curriculum at LaTrobe University arose from the need to assimilate field and classroom (lecture and practical) teaching, and the desire to provide a better method by which the large diversity of geological materials and processes could be linked within a broad concept of earth evolution.

The modules are on field geology, palaeontology, optical mineralogy, geological hazards and sequence stratigraphy. These have different specific educational objectives, but, all address the issue of integrating the teaching of basic principles and skills with the global perspective of earth and planetary dynamics.

First Year: Palaeontology & Field Geology

These are two interrelated modules that aim at providing assimilation and integration of theoretical and field concepts related to a first year excursion, lecture and laboratory program on Historical Geology. The modules are based on topics that stimulate student inquisitiveness in the Earth Sciences and encompass ideas that challenge student perceptions of the enormity of space and time. They also provide a highly motivational underpinning for the whole introductory Geology course and act as a medium for inculcating basic geological knowledge. They are both well suited to the graphical and interactive features of the CAL environment.

Second Year: Optical Mineralogy

An introductory course on the optics of minerals is foundational to much of the practical work undertaken by geology students through their second and third year studies. This subject involves a number of concepts which are difficult for most students and must be taken at the beginning of second year because of the sequential development of the overall

course. Many of the students require extra time outside normal classroom to assimilate this material and need to refresh the subject regularly during the course. The teaching of this subject can be demonstrator intensive and the demands on staff time are alleviated by this CAL program. The module also provides remedial education in the basic physics of light refraction and reflection necessary to the understanding of how light microscope techniques enable mineral identification.

Third Year: Sequence Stratigraphy

The principal problem at this level, is the difficulty in tackling complex concepts under the considerable time pressure of the joint teaching initiative in Petroleum Geology between the University of Melbourne, Monash University and LaTrobe University. One particular aspect of the joint petroleum geology course is the relatively new discipline of sequence stratigraphy which requires a quite revolutionary reorientation of ideas from traditional geological thinking. Animation is being used as a particularly valuable tool in dynamic parts of this course module.

Third Year: Geological Hazards

Another approach at third year level has been explored in a new course being developed on Geological Hazards. In this course students are asked to prepare a case history study of a particular geological event such as a major earthquake or volcanic eruption. Rather than submit an essay-type compilation, we are experimenting with having the students prepare their own multimedia program with easy to use software on their particular case history for presentation to the rest of their class. This program has produced some quite remarkable results and a very significant engagement of student interest.

Mark Warne
mwarne@mojave.latrobe.edu.au

These projects have just been announced as to be funded by CAUT grants in the sciences

CAUT Grants for 1996

BIOLOGICAL SCIENCES

Teaching Laboratory Techniques in Molecular Microbiology

James Cook University, Dr RJ Coelen, robert.coelen@jcu.edu.au

Dynamic Ecology: Understanding population processes through interactive simulations

University of Melbourne, Dr R Day & Associate Professor MW Nott, robdlay@ariel.uics.unimelb.edu.au

Improved Practical Teaching in Vertebrate Physiological Ecology

James Cook University of North Queensland, Dr WJ Foley, zlwj@jcu.edu.au

Integrated practical/tutorial coursework in first year biology using multimedia resources

University of Wollongong, Dr K French, k.french@uow.edu.au

Interactive Computer Approach to Develop Student Working Models of Physiological Concepts

University of Melbourne, Professor PJ Harris, Mr T Petrovic & Dr RE Kemm, pjh@rabbit.phsiol.edu.au

A Multimedia approach to problem areas in Human Health Science

University of New England, Dr GL Jones & Dr PM Whittington, gjones2@metz.une.edu.au

A new approach to practical biochemistry using interactive multimedia

University of Melbourne, Professor BG Livett, livett@Biochemistry.unimelb.edu.au

An Interactive Multimedia package to assist learning about genetics and gene manipulation

Deakin University, Professor MD Martin, Ms DY Gleeson (University of Melbourne) & Professor JF Kinnear (University of Sydney), mdm@deakin.edu.au

Blood Cells revisited by Interactive Multimedia — Stage 2

Curtin University of Technology, Mr R Oostryck & Ms L Devenish, ioostryc@info.curtin.edu.au

Raising the Dead: Interactive Multimedia Solutions to Teaching Comparative Zoology

University of Sydney, Dr MB Thompson & Dr O Hoegh-Guldberg, thommo@extro.ucc.su.oz.au

The Teaching of Fish Ageing Through Video Imagery

Australian Maritime College, MA Wilson, m.wilson@fme.amc.edu.au

Facilitating Independent Student Learning Through a Computer Simulated Animal Dissection

University of Western Australia, Dr R Bencini, rbencini@uniwa.uwa.edu.au

CHEMICAL SCIENCES

Instruments on Computers: Teaching Chemical Instruments through Interactive Simulations

University of Western Sydney, MA Williams & Dr RJ Blanch, m.williams@st.nepean.uws.edu.au

EARTH SCIENCES & GEOGRAPHY

Interactive animation for developing weather map interpretation skills

Curtin University of Technology, Dr RK Lowe & Associate Professor MJ Lynch, lower@educ.curtin.edu.au

A Multimedia CD ROM Learning and Assessment Kit for Remote Sensing Studies
University of Canberra, Dr BJ Button & Dr G Cho, button@science.canberra.edu.au

Improved Experiential Learning about Land and Water Resources Management
University of Western Sydney, Dr BL Maheshwari, Mr J Zarb & Professor P Cornish, b.maheshwari@uws.edu.au

PHYSICAL SCIENCES

Interacting With Real World Physics

University of Melbourne, Dr MK Livett & Mr J Pearce, michellelevett@muwayf.unimelb.edu.au

Physics in a Suitcase — Portable Lecture Demonstration Kits

Swinburne University of Technology, Dr AP Mazzolini, apm@brain.physics.swin.oz.au

Calendar of Coming Events

If you know of other relevant conferences, let us know so that we can publish the details

ASCILITE (Australian Society for Computers in Learning in Tertiary Teaching)
Conference: 'Learning with Technology'
University of Melbourne, Melbourne, December 4-6, 1995
email: ASCILITE95@unimelb.edu.au
<http://ASCILITE95.unimelb.edu.au/info.html>

ICCE 95 — International Conference on Computers in Education (Asia-Pacific Chapter) Singapore, December 5-8 1995
email: aace@virginia.edu

3rd International Multimedia Symposium

Perth, 21-25 January 1996
Tel: (09) 364 8311 Fax: (09) 3165 1453
email: promaco@cleo.murdoch.edu.au

CiP 96, Computers in Psychology

CTI Centre for Psychology, University of York, UK. 25th- 27th March 1996
Tel:+44 (0)1904 433154 Fax:+44 (0)1904433181
email: ctipsych@york.ac.uk
<http://www.york.ac.uk/inst/ctipsych/web/CiP96call.html>

EdMedia '96

World Conference on Educational Multimedia and Hypermedia Boston, USA June 17-22, 1996
email: aace@virginia.edu

Slice of Life - Multimedia in Health Science Education

Copenhagen, Denmark 19-23 June 1996
Fax: +45 35 32 61 50
email: mhse@odont.ku.dk
<http://www.odont.ku.dk/mhse/mhse.html>

12th Australian Institute of Physics Congress

University of Tasmania, Hobart 1-5 July 1996
email: mures@hba.trumpet.com
<http://www.utas.edu.au/docs/physics/>

M²E² A conference on Multimedia in Education

IEEE 2nd International Conference
University of Melbourne, Melb, 3-5 July 1996
email: f.crusca@eng.monash.edu.au
Tel: (03) 9775 3255 Fax: 9776 8821

Chemistry: Expanding the Boundaries

14th International Conference on Chemical Education, University of Queensland, Brisbane, 14-19 July 1996
Tel: (07) 3365 6360 Fax: (07) 3365 7099
email: ChemEd96@ceu.uq.oz.au

14th Biennial Conference on Chemical Education: Chemistry: The Challenge of Change

Clemson University, South Carolina, USA
August 4-8, 1996
email: bcce@clemson.edu
<http://tigerched.clemson.edu/bcce/bcceinfo.html>

UniServe Sites

Co-ordinating Centre

Dr T. G. Marples, Director
UniServe Australia
Chifley Building
ANU, Canberra, ACT 0200
email: director.uniserve@uniserve.edu.au
<http://uniserve.edu.au/uniserve>

Engineering

Department of Civil and Mining Engineering
University of Wollongong
Northfields Avenue
Wollongong NSW 2522
email: director.engineering@uniserve.edu.au
<http://engch.uow.edu.au/clearinghouse>

Humanities and Social Sciences

ultiBASE (business, art, society and education)
FSSC
Royal Melbourne Institute of Technology
Vic 3001
email: director.humanities@uniserve.edu.au
<http://ultibase.rmit.edu.au/>

Law

Dr B Moles
UniServe Law
Chifley Building
Australian National University, ACT 0200
email: director.law@uniserve.edu.au
<http://uniserve.edu.au/law/>

Medicine, Health Sciences and Nursing

UniServe•Health
Medical Sciences Building
Faculty of Medical and Health Sciences
University of Newcastle, NSW 2308
email: info@health.uniserve.edu.au
<http://health.uniserve.edu.au/>

Science

UniServe•Science (F07)
University of Sydney NSW 2006
Tel: (02) 351 2960
Fax: (02) 351 2175
email: director.science@uniserve.edu.au
<http://www.usyd.edu.au/su/SCH>