UniServe
SCIENCE

NEWS

Vol. 9, March 1998

In this issue . . .

From the Director

The good news is, we live on.

As those of you who have been following this column will know, our funding which originally came from CAUT has run out after three years. We had thought that the UniServe network had been set up as a proof of concept, to answer the question: is there a need in this country for a centralized national service that would collect and disseminate information about the place of the new technologies in university teaching? Our brief was to show that the concept could work. In our last two newsletters we appealed to you to tell us how you thought we had gone. The responses we got, while not overwhelming, were strongly supportive. According to most of you who sent us your opinions, a clearinghouse of the kind we have been running is indeed needed, and we seem to have been running it as it should be run.

However it seems we were wrong in our assumptions. In the view of the new Committee for University Teaching and Staff Development (CUTSD), we were just another "project". When the money runs out, it runs out. What are you complaining about?

We believe that is a short-sighted view. The service we have been giving is a national service. If it is worthwhile, it should be funded nationally. But what's done is done, and there's no point in crying over spilt clichés.

We looked for funding elsewhere and the University of Sydney, which had in fact been supplying 60% of our funding up till now, has decided to fund us completely for a further three years. We are extremely grateful to the three branches of the University who have decided to do this: the College of Sciences and Technology, the Faculty of Science and the Information Technology Committee. It shows far-sightedness to make this offer, especially as they are prepared for us to retain our national perspective.

Since we believe passionately that this national outlook is important we will continue to provide our current service. We will maintain our network of contacts in departments all over the country, though we might try to get them to work more effectively. We will keep putting out QuicKards, and upgrade them every few years. We will continue to run workshops, at least one per year, to give science teachers a chance to meet one another. We will continue to review and evaluate new software. We will maintain our web-site and the searchable database. And of course we will keep publishing these newsletters.

Furthermore we are planning to broaden our client base from the seven experimental sciences, to include mathematics and computer science. We figure that this expansion will take us three years to achieve. You could help us by telling your colleagues in these disciplines and asking them to volunteer as departmental contacts. Please ask them to email us.

We do, of course, have a greater responsibility to look after the interests of the University of Sydney, and to that end we plan to develop some new programmes. But we believe we can take on board these new responsibilities while maintaining the service we provide. After all, much of the work in the last three years was in setting up things. That much at least is finished now.

So keep reading. We'll be back.

UniServe Sites

Information about, and links to, other UniServe sites may be found on the UniServe Australia homepage
http://uniserve.edu.au/uniserve/

Published by: UniServe Science, Carslaw Building (F07), The University of Sydney, NSW 2006
Editor: Anne Fernandez
ISSN: 1329-7724 (print version)
ISSN: 1329-1645 (online version)

The Flexible Learning Approach to Physics (FLAP)

Mike Tinker, FLAP Project, University of Reading

In the November 1997 issue of UniServe Science News, Sarah Turpin gave an account of the Teaching and Learning Technology Programme (TLTP) in the UK. The Flexible Learning Approach to Physics (FLAP), described here, is one of the TLTP projects.

Introduction

FLAP is unique amongst TLTP projects in that it began life as a text-based project, rather than as a software-based project. It arose as a response of the UK physics Higher Education community to the problems raised by the changing intake into physics degree courses. Over recent years the students entering these courses have shown an increasing diversity of backgrounds and show less familiarity with the use of mathematics in physics. The response to greater diversity must be to employ greater flexibility in teaching and learning, particularly in the first year programmes. The route to high quality teaching and learning lies in differentiated flexible learning, recognizing that students differ significantly at the point of entry. If we couple this with the advantages of active and interactive learning then the FLAP solution to the problem emerges — a flexible supported self study resource, jointly developed and made available to all departments. Local academic staff may then select those parts of the resource needed by their students and these students then study this material actively, with staff support. In this way, both staff and students have ownership of the teaching and learning. The need to put the mathematics back into the physics arises from the increasing separation of the two at school level. It is no longer the case that a student studying physics at A-level will also be studying mathematics at A-level and vice-versa. The two subjects are now on separate evolutionary tracks, with the inevitable consequences that A-level physics syllabuses contain less mathematics and A-level mathematics draws on fewer examples from physics. A major task facing the physics degree teacher is to put the mathematics and the physics back together in the minds of students. The new flexible resource had to include physics and its associated mathematics, presented rigorously and from a common physical standpoint.

FLAP was delivered to the UK sector in September 1995, after three years of production and with about a million US dollars of support from the Funding Councils, through TLTP. The scale of FLAP needs to be appreciated. It includes about 2250 pages of text, as 83 free standing modules of physics and mathematics, supported by audio, video and software. Although FLAP is a multi-media resource it is not presented primarily on a computer platform but as photocopiable text on paper, equivalent to about five major textbooks in physics and mathematics, covering first year and foundation year university physics and its associated mathematics. This large scope requires extensive use of high quality text and to introduce this to the learner for the first time on a computer screen is not sensible, although appropriate computer technology can bring considerable added value. The design of the free-standing modules is the key to the flexibility and success of FLAP. A student entering a module can quickly compare his/her background knowledge with the module content, its aims,

Mike Tinker
FLAP Project
The FLAP Office
JJ Thomson Physical Laboratory
Whiteknights
University of Reading
Whiteknights
Reading, UK, RG6 6AF

m.h.tinker@reading.ac.uk

objectives and required pre-knowledge, to determine whether or not to proceed with the module. The student is then guided into appropriate actions. Each module has a careful teaching structure, with interactive text containing many questions and examples. Equal attention is given to developing both the skills and the knowledge base needed by a physicist. Take-up of FLAP in the UK sector has been very high, with use in first year and foundation year programmes. Since the situations addressed by FLAP are global it is also finding increasing use world-wide.

It is also notable that many of the approaches adopted in FLAP are recognizable as those subsequently identified and extolled in the recent UK report of the National Committee of Inquiry into Higher Education (The Dearing Report, 1997), with its focus on the quality of the student learning experience. The next round of teaching and learning quality assessments in UK Higher Education (Subject Reviews) will undoubtedly be based on these principles.

The FLAP materials

Content of the resource

FLAP includes about 2250 pages of printed text, comprising 83 small free standing teaching modules in physics and mathematics, together with supporting audio-visual and computer materials. Its scope extends from A-level entry to the end of a first year physics degree course. Purchase of FLAP carries with it a photocopy licence which allows institutions to make copies for their own students. The resource contains material equivalent to about 200 lecture hours or 500 study hours and includes the following items:

- 83 FLAP modules as single-sided A4 monochrome photocopy masters on card
- 1 Index, Student Guide and Maths Handbook (also as photocopy masters)
- Photocopying license for an institution to use for its own students
- 1 ring bound browsing copy of all 83 FLAP modules (4 files)
- 1 ring bound copy of Glossary (about 2500 entries), Biographies, Maths Handbook and Index (1 file)
- 1 Tutor Guide Part 1, including product description, module outlines and guidance on use (1 file)
- 1 Tutor Guide Part 2, including the question bank of about 1700 additional questions (1 file and disks)
- 1 Hyper-glossary and Index on disk (about 2500 entries and 15000 hyper-links)
- 1 CAL package (interactive simulations and tutorial material) on disk
- 1 CAT-FLAP package (self assessment diagnostic and testing material) on disk
- 8 C60 audio-cassette tapes, including interactive tutorials
- 4 E30 video tapes, including animations and demonstrations

Modules and blocks

The main teaching text has two parallel strands of material covering physics and associated mathematics. The two may be studied separately, as stand-alone subjects, or integrated. Each strand is divided into a number of blocks dealing with broad topics such as differentiation and fields and within each block is a set of free-standing modules. The details of the module lists can be found on our Web site. In mathematics, they range from simple algebra (such as the expansion of brackets) in M1.1 to discussion of the time-dependent Schrödinger equation in M6.4. In physics, the range is from linear motion in P2.1 to the angular momentum eigenstates of atomic hydrogen in P11.3.

Structure of the modules

The internal structure of the modules is one of the most powerful innovations of FLAP. This structure gives flexible access for students, allowing them to measure their backgrounds in relation to the topics to be introduced and to target their study time most efficiently. Despite the use of printed text the structure is reminiscent of a computer programmed approach, with interactive decisions controlling the route followed.

Each module begins with a section entitled Opening items, which sets the scene, introduces the topics and invites students to assess their background knowledge. The material may be mostly old knowledge, mostly new knowledge or a reasonable extension of old knowledge. There are Fast-track questions to test whether it is old knowledge and Ready-to-study questions to test whether it is too hot to handle. Solutions are given for all these questions to guide students in their choice of route. The Fast-track route leads quickly to the Exit test at the end-of-module, where the wisdom of this choice of route can be self-tested. Students who are unhappy about their performance on the Ready-to-study questions are directed through the Glossary to other FLAP modules, for any help needed. Students who decide that they are ready for the material move on to the main teaching text of the module. Field tests show that students quickly develop the skills to use this diagnostic front end to make best use of the modules and their study time.

At the end of the main teaching text there is a section entitled Closing items. This contains a detailed but concise Module summary, followed by a list of the Achievements, or target objectives for the module. These list the skills and knowledge that the student should acquire by studying the module. They are written in operational terms, explaining what students should be able to do, and identifying what is required for assessment purposes. The Closing items finishes with the Exit test. Successful completion of the Exit test confirms the attainment of these learning objectives. Detailed solutions to all the questions asked, both in the main text and in the various tests are included at the end of the module, so students can assess their own progress. The answers to the Exit test are provided but an institution may choose not to photocopy them into the student copy of the module, thus forcing an evaluation and discussion point of contact with staff. The Closing items section of a module is also useful for revision of the module. An average module is equivalent in content to about 2 or 3 lecture hours or 5 to 6 study hours, with study times depending markedly on the route.

Glossary and Hyper-glossary

An extensive Glossary gives the definitions of about 2500 terms used in FLAP. Since it may also refer the student to other modules for a more comprehensive discussion it is also the main routing document in FLAP. Within a module there are no explicit references to any other FLAP module and all such links are made through the Glossary. This feature maintains module independence and maximises flexibility, allowing them to be read with no particular order. The Glossary is available as text in hard copy and as a hyper-linked document, viewable through a Web browser.

The hyper-glossary is possibly one of the largest HTML documents of its kind ever produced. It takes the form of a relational glossary, combining the functions of index, dictionary and thesaurus, not only listing definitions but also showing how they relate to one another across the full range of the package. The HTML files contain about 3000 imbedded graphic links and 15000 intra-glossary links and is supplied on floppy disks. It includes an index of terms and biographies of many of the scientists and mathematicians who have contributed most to the development of the field. It illustrates a clear added value as compared to the paper glossary, being much quicker and more convenient to use.

CAL software

There are five computer software packages associated with FLAP, designed to increase understanding of some of the modules. The packages contain interactive simulations as dry labs on electric fields, a bubble chamber, gas simulation and an orbiter, together with a tutorial on forces. The packages run under *Microsoft Windows 3.1* or higher on a PC. They are provided on a 3.5 inch disk, with their own installer, and require approximately 1MB of disk space.

CAT-FLAP

This self assessment testing tool contains a bank of over 400 multiple choice questions and solutions on the FLAP modules. Modules may be attempted in any order and a printed report can be generated for tutor discussion. The materials are used by students to assess their need to study particular FLAP modules or as additional Exit test questions after studying the modules. CAT-FLAP also contains three longer access tests, two for physics and one for mathematics. These tests contain questions covering a wide range of topics and are intended to be used to assess readiness to study particular FLAP modules. The tutor tool kit can be used to input additional tutor generated questions.

Coming soon — Electronic FLAP

Early in 1998 we expect to make available the full set of FLAP modules on CD-ROM, mountable on a local network. This will be an option for purchasers of the full FLAP resource. The files will be pdf documents, viewable through *Adobe Acrobat Reader*, and will be formatted exactly as in the paper version, allowing printing of individual pages or modules. For copyright reasons it will not be possible to edit the pdf files but notebook comments may be added.

Using FLAP

FLAP as a textbook replacement

To appreciate the innovative solutions offered by FLAP it is helpful to compare and contrast FLAP with the more familiar standard textbooks. Both support teaching and are intended to be used alongside lectures, tutorials, workshops and laboratories. Both are text intensive and are produced primarily on paper, with electronic delivery providing added value for reference and storage. However, the differences are profound. FLAP takes the textbook format into the 21st century, differing from standard textbooks in several key ways.

- It is much larger in scope and more detailed in its explanations, covering physics and its associated mathematics over a wide range of levels, yet its modular structure maintains portability — without wheels!
- It provides a common approach to physics and mathematics, presenting mathematics thoroughly, yet within a physical context whenever possible and with due regard to dimensions and units.
- Its use of supported self study engages students in active learning, developing self reliant skills such as reading for information, organizational skills and general skills for lifelong learning.
- It is much more flexible for the student, delivering differentiated learning and giving them ownership of the learning. It allows them to measure their background against module content, establishing fast track routes, normal routes or additional help as needed.
- It is much more flexible for the course designer, consisting of free-standing modules rather than the interlinked chapters of a conventional text, and with pre-requisite knowledge clearly specified for each module. This is quite unlike the chapters of a standard textbook. Students can enter or leave the resource at any appropriate module, determined only by their background and the course objectives.
- It is sufficiently detailed and clearly written to form a primary teaching vehicle, not just lecture support — so it may be used successfully to replace some routine lecturing and thereby free some time for teachers to give more targeted support.
- An institution may photocopy FLAP for its own students, making it an institutional resource rather than a student product, such as a textbook. An institution can effectively create its own textbooks at a fraction of the price of a normal textbook, avoiding students having to purchase unwanted material or becoming victims of the *elatae editionis* scenario.

Summary of uses and benefits

FLAP is not a course. It is a very large high quality supported self study resource from which institutions can create a wide variety of courses to their own design, to meet their own purposes. It supports but does not replace the teacher. There are as many ways to use FLAP as there are styles of teaching, ranging from the most conventional to the most innovative. FLAP leaves all these decisions firmly in the hands of the teacher.

Some of the more common uses of FLAP are:

- for diagnostic testing;
- as preparatory reading or as background materials;
- to support main stream lecture courses;
- to replace some lectures (up to two thirds of the total) in a physics or mathematics course; and
- to construct full term or full year programmes (for Year 0 or Year 1).

FLAP brings benefits both to the institution and to the students. These accrue from the high quality of the material and from its flexible self study format. Institutions may adopt a broader intake strategy and can deliver enhanced teaching quality without additional staff resource. Staff time may be used more effectively, with savings in lecturing, assessment preparation, marking and course design. Along with this is the potential for an improved student support system, since staff effort can be more focused and the clear structure of the modules allows postgraduate and other teaching assistants to make a more positive contribution in classes and workshops. Students can take a more active part in their learning, developing a strong study discipline within a more flexible study programme, with material selected and delivered at a rate which matches their individual backgrounds. Self-assessment allows students to develop their problem solving skills without additional staff marking. Evaluation has shown that most students using FLAP are enthusiastic about it and confirm that the learning curves expected are realistic. They like the increased ownership of the learning gained through the FLAP approach, responding with increased motivation and commitment.

The FLAP URL is:
http://yan.open.ac.uk/flap/

Production of Video Images to Enhance Teaching of First Year Undergraduate Botany

Leone Bielig and Gordon Bailey, James Cook University

Introduction

The effectiveness of computer based learning in science education has been extensively analysed at several Australian universities. Summing up the Proceedings of the Dry Labs Workshop (1996), Johnston and Peat state that computer based technology should be regarded as an opportunity to "enhance the laboratory experience" rather than as a means of replacing "wet" laboratories. Pamula *et al* (1996) and Whittington (1997) describe its use in teaching biology.

In recent years, severe funding cuts to tertiary education, combined with large student numbers and reductions in establishment staffing levels have required an increased dependence on casual staff. In lectures to large first year classes of up to 300 students, there is little opportunity for synthesis of information. Laboratory based practical classes and the associated tutorials are critical in providing an opportunity for two way communication between student and teacher. To date we have been able to allocate two staff to every 24 students in each laboratory. Even with this apparently favourable staff to student ratio, one or two students may engage the attention of staff members, to the exclusion of other students. To circumvent this, we have used computer software to develop videotaped images of plant tissue sections, which can be projected simultaneously into several first year teaching laboratories.

In first year botany courses at James Cook University, we try to maximise the student's "hands on" experience. The merits of this in terms of information processing and retention are well established (Richardson, 1995). Our course on the Diversity of Plant Life, provides an introduction to the biology of plants for students with varying backgrounds. Most of them will have completed Senior Biology, but others previously have not studied biology. The subject encompasses anatomy, reproduction, classification and evolution of the whole range of organisms generally regarded as members of the plant kingdom. The approach is descriptive/analytical rather than generating data which requires subsequent processing. In this respect it differs from some other branches of science that have recently been addressed, such as biochemistry (Learmonth 1996) and chemistry (Capon 1996).

Aim

We aimed to enhance the efficiency of first year teaching, and to provide a means of quality control with respect to the delivery of teaching in a subject that relies on the use of casual, relatively inexperienced staff. To achieve this, we developed a series of videotapes that were projected into several laboratories simultaneously at those times when the students were examining the specimens concerned.

Leone Bielig
Tropical Plant Sciences
School of Biological Sciences
James Cook University

Leone.Bielig@jcu.edu.au

and

Gordon Bailey
Tropical Plant Sciences
School of Biological Sciences
James Cook University

Gordon.Bailey@jcu.edu.au

Methods

The material that we have so far captured on video includes stained sections of plant tissues in stems, roots and leaves and whole mounts showing reproductive structures such as the receptacle of the brown alga, *Fucus* and zygospore formation in the fungus *Rhizopus*. To use these images as effective teaching tools, we added appropriate labels, as shown in figures 1 and 2.

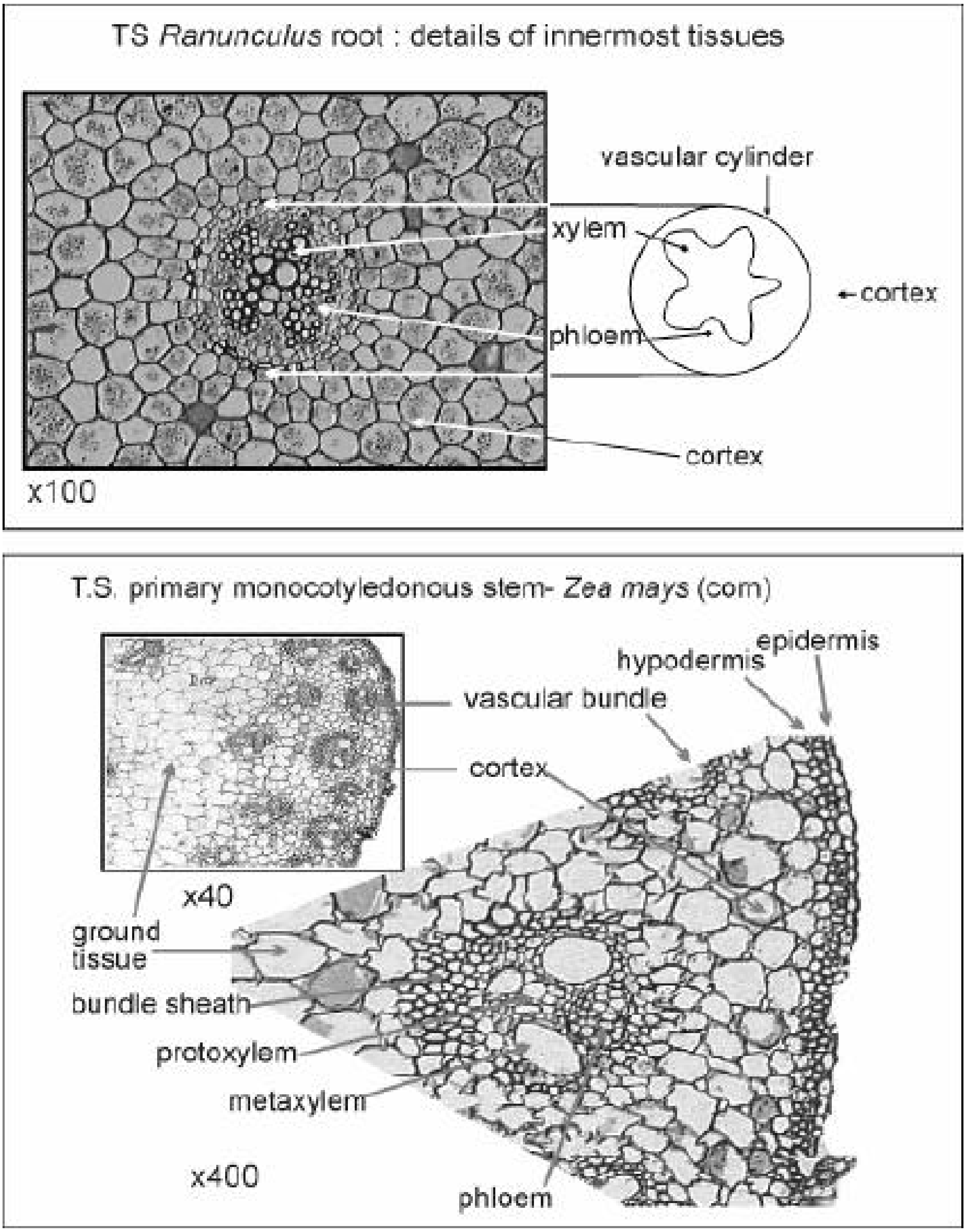

Figure 1.

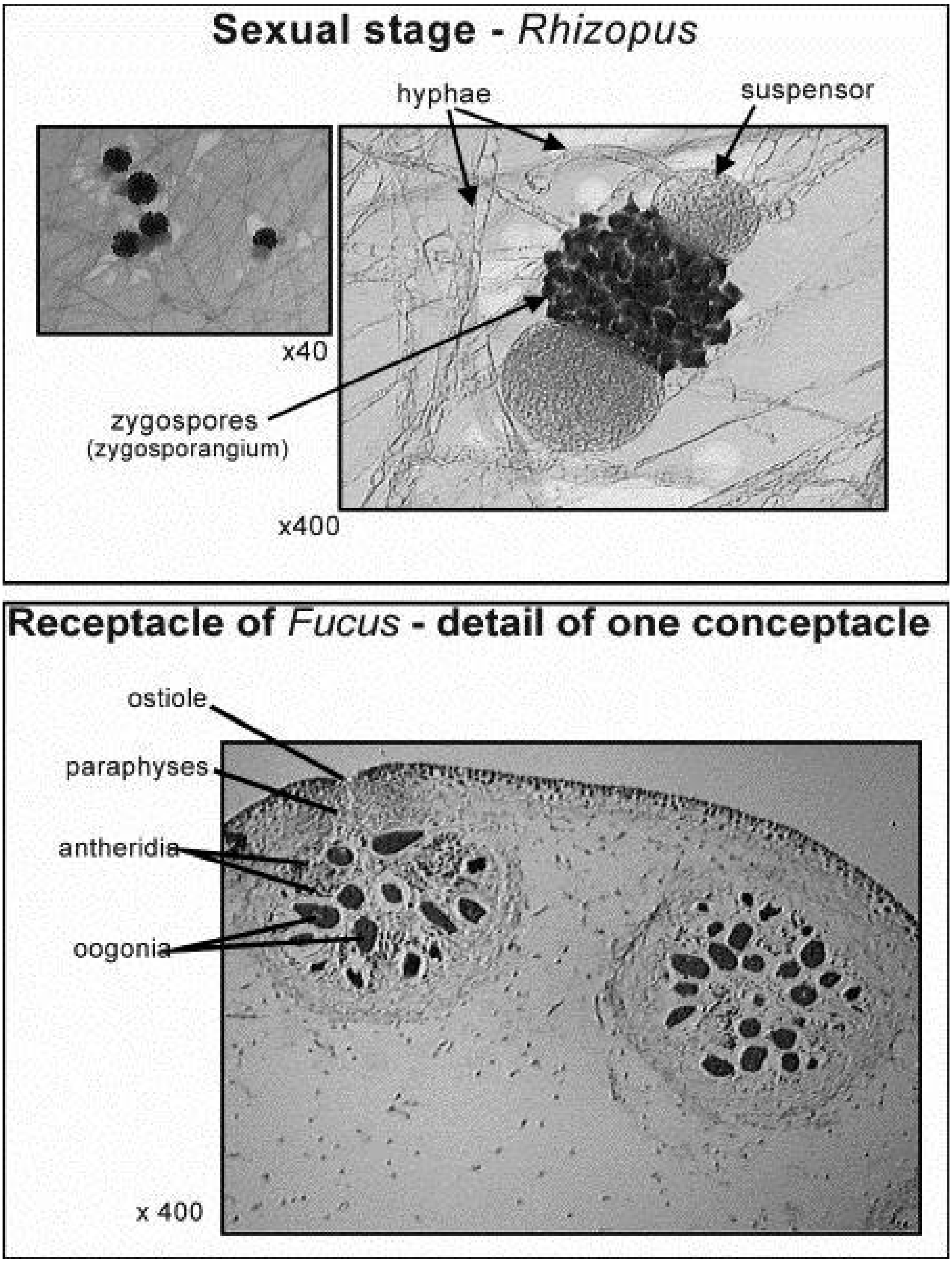
Sexual stage - Rhizopus
hyphae
suspensor
x40
zygospores
(zygosporangium)
x400
Receptacle of Fucus - detail of one conceptacle
ostiole
paraphyses
antheridia
oogonia
x 400

Figure 2.

The videotapes were displayed through the audiovisual system already established in the first year laboratories. The graphics, which formed the basis of the videotapes, were developed using computer software, then transferred to videotape. This was a three-step process, involving:

1. Image capture
2. Image tuning
3. Image output to videotape

The need to compromise between purchase price, image quality and compatibility with existing hardware dictated the choice of hardware/software packages used.

1. Image capture

Images were taken from microscope slides of stained plant tissue sections via a CCD camera mounted on the drawtube of a high power microscope. The video signal was passed through a Video-Vue board, which permitted real time preview of the image on the computer monitor. Colour balance, contrast and focal adjustments were then performed. The image was captured and saved to the computer hard drive in a 24 bit true colour or 256-colour TIF file format.

2. Image tuning

The image was then loaded into *Photofinish* and enhanced by cropping, removal of artefacts and colour balancing. The enhanced image was resaved and imported into *Corel Draw* where labels, identifying arrows and scale bars were superimposed over the bitmapped image. Using *Corel Draw*'s preview facility, the image was then displayed on full screen without showing menu bars or control cursors.

3. Image output to videotape

This was created using *AverKey* , a PC to TV signal converter. *AverKey* produced a composite image of the computer screen onto an attached TV monitor. After adjusting the location and colour balance of the image on the computer screen to suit the dimensions of the TV monitor, the image was recorded to videotape via an attached VCR. Each image was recorded for a set period of time depending on the rationale for using each specimen. Some were intended simply for the identification of cell and tissue types, others were to assist the students construct cell detail diagrams.

Effectiveness of the videotaped images

Practical classes are conducted concurrently in four laboratories. The video images of labelled tissue sections can be viewed by all students simultaneously. This permits students to identify the structures on the slides being viewed on their own microscopes, without placing excessive demands on tutors' time. The system has multiple benefits for both students and staff:

1. It provides quality control with respect to teaching effectiveness. Undergraduate laboratory classes typically employ a large cohort of casual tutors. The use of labelled video images ensures that the correct information is being disseminated and that students attending different class sessions have access to the same information.

2. Rather than being "tied" to one student, tutors are able to respond quickly to student questions as well as to comment constructively on diagrams. New terms and concepts can be introduced in a consistent and authoritative way. Thus, the practical classes permit student-staff interaction but provide video images, to which students relate well.

3. At tutor briefing sessions, the tutors can confirm that they understand the relevant plant material. The presence of the labelled images also strengthens tutor self-confidence, provides an opportunity for them to address several students at once and enhances their enthusiasm for the subject.

4. This system has overcome the concern that the use of computer software means a lack of "hands on" experience. The images are integrated with the use of whole plant specimens and tissue sections. Opportunities are provided for interaction and re-enforcement: students prepare slides of tissues they have cut and stained. Their preparations may be transmitted through to other laboratories and this has generated greater enthusiasm for plant anatomy.

5. Finally, the use of videotaped images allows students to work at their own speed. The duration of video presentation can be varied to allow time for other practical exercises.

Conclusions

Working within severe financial constraints (a budget of $1,800) we have developed a series of labelled videotaped images which have been effective in enhancing student confidence, motivation and analytical skills. There is a new sense of cohesiveness in these classes. A question about the videotape may reveal to the tutor a potential difficulty for many students. By referring to the image on the TV screen, the tutor can address the group, pre-empting difficulties before more students encounter them. Since our initial hardware purchases, video capture technology has improved in definition and costs have been reduced. However, we envisage that the system we have developed will continue to be an important component of our first year practical classes in botany, given the capital investment (estimated at $100,000) that would be required to fully equip our four first year laboratories with computers.

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The VisChem Project: Molecular Level Animations in Chemistry — Potential and Caution

Roy Tasker, University of Western Sydney Nepean

Roy Tasker
School of Science
University of Western Sydney
Nepean

r.tasker@nepean.uws.edu.au

Introduction

This paper shows how multimedia can provide a structured approach to the 'thinking levels' of chemistry — the laboratory, molecular, and symbolic levels. In particular, computer animations offer the potential to portray the dynamic 3D molecular level more accurately than static 2D diagrams in textbooks, or static physical models (e.g. ball & stick). The article concludes with a warning about misleading molecular animations, published on CD supplements to some leading textbooks, with their potential to generate serious and deeply embedded misconceptions at this crucial thinking level.

Educational research into practice

A rich understanding of chemistry involves being able to link what one *sees* substances doing in the laboratory, to what one *imagines* is happening within these substances at the invisible molecular/ionic level. Only then can these ideas be *communicated* meaningfully using abstract symbolism (e.g. chemical formulas), terminology and mathematics. Johnstone[1] refers to the three levels as the *macro*, *sub-micro*, and *symbolic*, and pictures them at the corners of a triangle. Thinking in chemistry is then likened to "moving between a series of points within the triangle, depending on the proportion of the three levels at any one time".

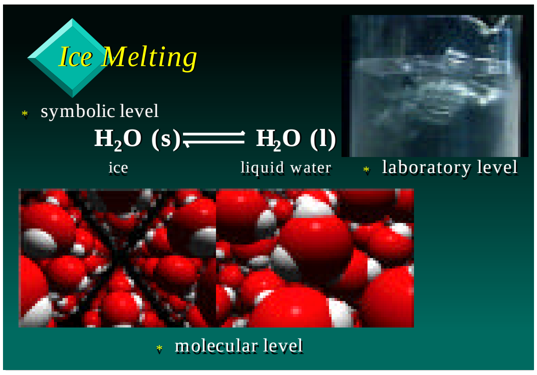

Figure 1. Ice melting and the three 'thinking levels' - the *symbolic* (chemical equation), *macro* or *laboratory* (ice melting in beaker), and *sub-micro* or *molecular* (frames from an animation[2])

Due to a shortage of high quality resources that portray the molecular level most chemistry teaching occurs at the laboratory and symbolic levels, in the hope that mental models of the molecular world will 'develop naturally'. Students are therefore left to develop these models from the static, often oversimplified two-dimensional diagrams in textbooks, or static, often confusing ball and stick models, or from their own imagination. However, there is convincing evidence[3] that many student difficulties and misconceptions in chemistry stem from inadequate or inaccurate molecular models.

Computer animations — the potential to portray the molecular world

In the VisChem project[2] a team of chemical educators is producing multimedia resources in video and CD formats to explicitly link the molecular, laboratory, and symbolic levels. The most novel resources are a series of computer generated animations which portray substances at the level of molecules, atoms and ions in the solid, liquid, and gaseous states; during phase changes (e.g. melting); and when they react together.

Great care has been taken in the representation of molecular structures and processes because research by Ben-Zvi[4] and others has indicated that misconceptions can be generated easily, and perpetuated, with poorly drawn images.

Visualising the invisible molecular world to generate mental models requires imagination. For example, the speed of atomic and molecular movements, and the uncertain (non-Newtonian) nature of electrons in atoms, require substantial 'artistic license' to enable the structure and collisions at this level to be represented. For this reason students need to be constantly reminded that these animations are only 'models' of reality.

Animations can show the multiparticle nature of chemical reactions. For example, the laboratory observation of silver crystals growing on the surface of copper metal (Figure 2) are hardly consistent with the misleading diagram, often found in textbooks, of one copper atom donating an electron to each of two silver ions. An animation can show reduction of *many* silver ions on the copper surface, with concomitant release of *many* copper(II) ions, in a two to one ratio (Figure 3).

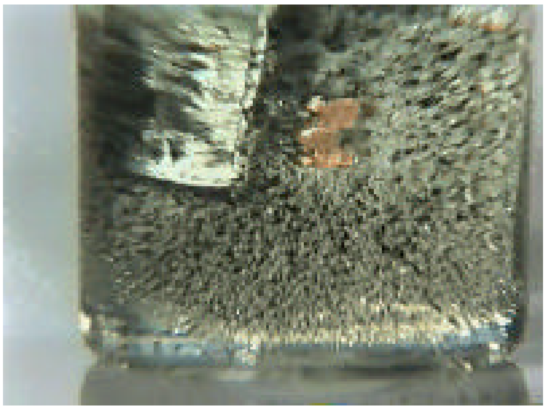

Figure 2. Silver crystals form on the surface of copper metal as the solution gradually becomes blue.

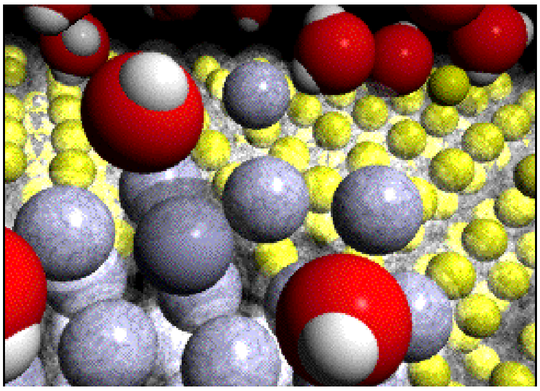

Figure 3. Frame from a VisChem animation showing reduction of silver ions to silver atoms, with the release of copper(II) ions.

Students need a refined model of hydrated ions in ionic solutions. The exchange of water molecules around the ions (as an introduction to formation of complex ions), the occasional formation of ion pairs (as an introduction to precipitation), and the migration of ions in the solvent are important images (Figure 4).

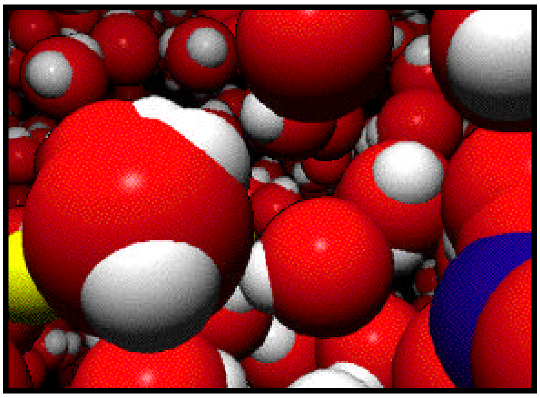

Figure 4. A frame from a VisChem animation portraying a hydrated copper(II) ion about to collide with a hydrated nitrate ion in a 1M copper(II) nitrate solution.

A 'feeling' for ion concentration can be gained by 'looking into' the solution when most of the solvent molecules are 'removed' (Figure 5).

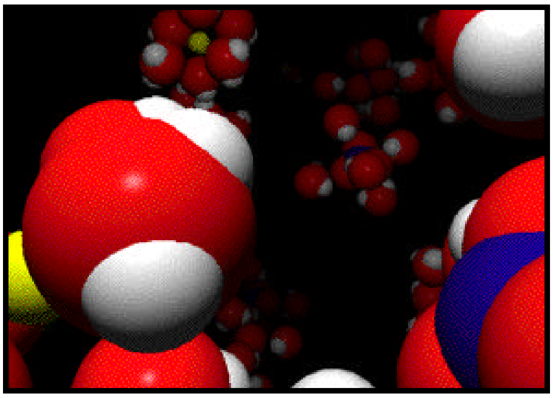

Figure 5. A frame from the same animation with most of the solvent water molecules 'made invisible'. Hydrated anions and cations can be seen in the background.

The separation of ions by an average of three water molecules in a one molar solution conveys a concrete image of an otherwise abstract concentration unit.

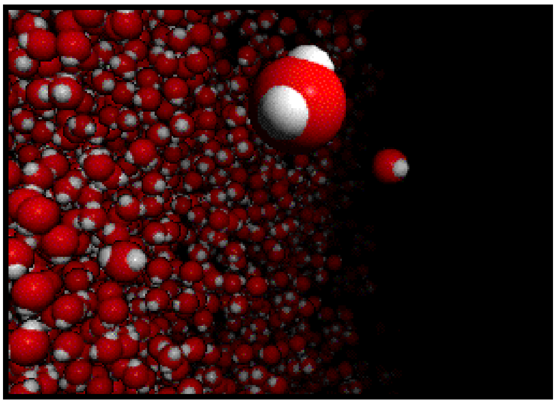

Figure 6. A frame of the VisChem animation which attempts to visualise gaseous water molecules 'pushing back' the walls of a bubble in boiling water.

Animations of the molecular world can stimulate the imagination, bringing a new dimension to learning chemistry. What is it like inside a bubble of boiling water (Figure 6), or at the surface of silver chloride as it precipitates (Figure 7)?

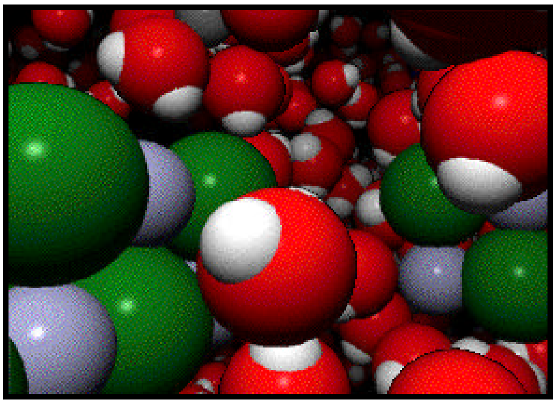

Figure 7. A frame from another animation which depicts the precipitation of silver chloride after mixing solutions of sodium chloride and silver nitrate.

Analysis of an evaluation pre-test/post-test survey[5] on the VisChem video *The Molecular World of Water: Let's look into it*, involving 21 educators and 160 students at both secondary and tertiary levels around Australia, was encouraging. The responses from students indicated that after a single viewing of this video they corrected their misconceptions and/or enriched their understanding. For example, after 61% of university students communicated the misconception that bubbles of boiling water contain air, only 25% gave this incorrect response after having viewed the video which included the animation described in Figure 6.

However, our work with students in small group interviews has also highlighted the potential for new misconceptions to be generated by some students from VisChem animations. For example, two students were curious about the reasons why the water molecules appeared to be 'carrying the silver chloride ion clusters' towards the growing silver chloride crystal. This unintentional impression was communicated by not showing sufficient exchange of hydrating water molecules around the cluster as it migrated towards the lattice.

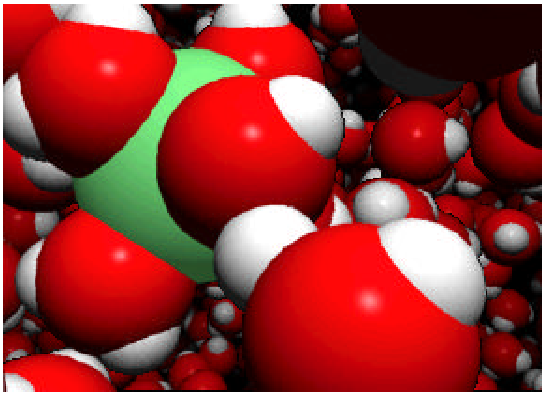

Figure 8. Frame from a VisChem animation showing the 'tug-of-war' for a proton on an iron(III) bound water molecule with a solvent molecule.

Many molecular processes involve a competition between competing forces. An example is the 'tug-of-war' competition for a proton on an iron(III) bound water molecule with a solvent molecule (Figure 8), and between lattice forces and ion-dipole interactions when sodium chloride dissolves in water (Figure 9).

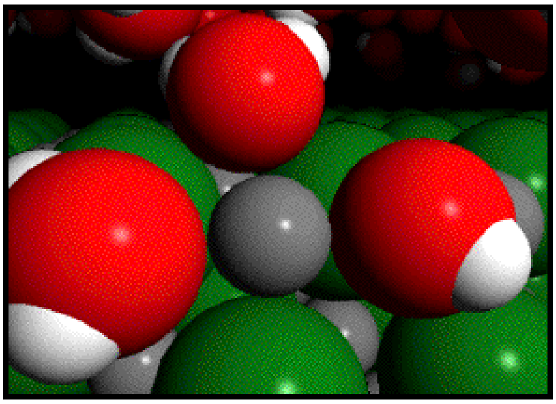

Figure 9. Frame from a VisChem animation showing the hydration of a sodium ion on the surface of sodium chloride despite strong attractive forces from the rest of the lattice.

Misleading animations

Unfortunately, there is a wide range of quality in molecular animations published internationally, and available on video, CD or over the Net. Compare the frame in Figure 10 below from one animation with Figure 9. They both attempt to portray the same process — NaCl dissolving in water. What messages are communicated by these images? Each animation conveys implicit and explicit information.

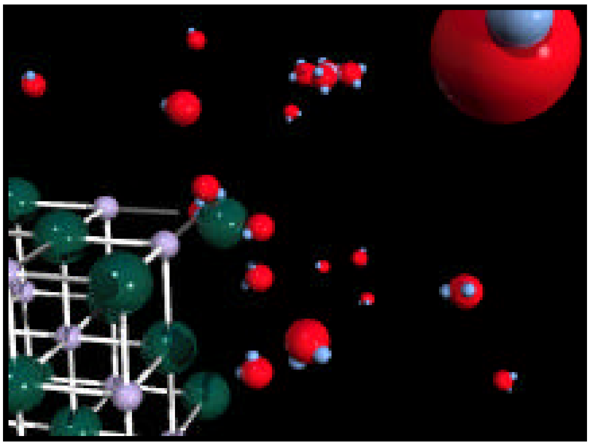

Figure 10. Frame from an animation depicting NaCl dissolving (from *Chemistry: Interactive*, the CD supplement for Ebbing's *General Chemistry*, 5th Ed).

The animation in Figure 10 suggests that:

- water molecules in the liquid state are widely separated; and
- solid sodium chloride is composed of ions separated from each other by 'stick' bonds. This image is reinforced by the image of a water molecule 'passing through' the structure (sic!) to hydrate an ion, and by the space left when an ion, with its 'sticks', is removed from the lattice.

In contrast the VisChem animation in Figure 4 portrays:

- water molecules in the liquid state as much closer together; and
- solid sodium chloride as composed of ions, *constantly vibrating*, and closely packed together.

Another example of a misleading animation is represented by the frames in Figures 11 and 12. This animation is supposed to portray the reaction occuring when aqueous solutions of hydrochloric acid and sodium chloride are mixed. Figure 11 shows distinct HCl molecules in solution shortly before reaction with water molecules!

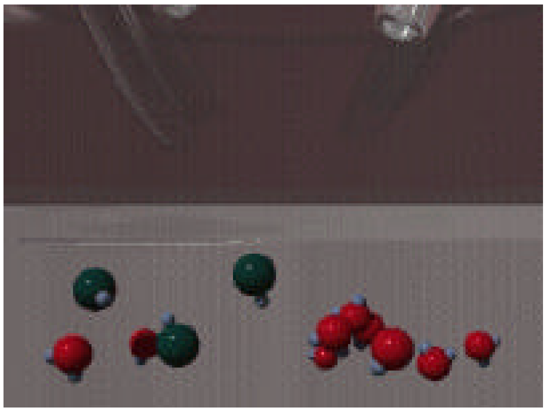

Figure 11. Frame from an animation depicting hydrochloric acid which shows HCl molecules moving amongst water molecules, shortly before reacting with them!

Figure 12 shows NaOH 'molecules' being added in a drop of solution. Animations such as these reinforce the misconception that 'molecular' formulas for strong electrolytes, such as:

$$HCl(aq)$$

and 'molecular equations' such as:

$$HCl + NaOH \dashrightarrow H_2O + NaCl$$

actually describe the species and processes occurring at the molecular/ionic level. Little wonder students have trouble with understanding electrolytes, and concentrations of ions in solution!

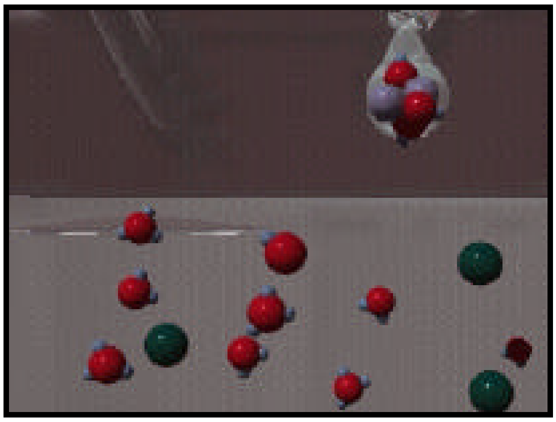

Figure 12. Later frame from the same animation, just before a drop of sodium hydroxide solution, containing NaOH ion pairs, is added from a tube above. (Animation from *Chemistry: Interactive*, the CD supplement for Ebbing's *General Chemistry*, 5th Ed.)

The above animation also clearly illustrates the problem of mixing the laboratory and molecular levels in imagery. Could students develop the idea that a drop of water contains only a few ionic species? Could students develop the image of water composed of water molecules surrounded by some other 'watery matter' indicated by the grey background? Questions such as these are the focus of action research conducted in the *VisChem* project.

Conclusion

In the new millenium most information will be communicated using computer generated multimedia. We need to ensure that the same high academic standards we demand from text-based information are applied to visual information, which is arguably more effective in conceptual change, for better or worse.

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[1] Johnstone, AH. (1991). Thinking about Thinking. *International Newsletter on Chemical Education,* 36, 7-11.

[2] animation from the *VisChem* project - see *VisChem* Web page - www.nepean.uws.edu.au/science/vischem/

[3] Lijnse PL, Licht P, Waarlo AJ and de Vos W (Eds.) (1990) *Relating Macroscopic Phenomena to Microscopic Particles*. Proceedings of Conference at Utrecht Centre for Science and Mathematics Education, University of Utrecht, and references therein.

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[5] Tasker RF, Bucat R, Sleet R, and Chia W. (1998) *Research into Practice: Improving Students' Imagery in Chemistry* Manuscript in preparation.

For a review of *VisChem: Visualising the Molecular World* see page 21.

SEARCH!

UniServe SCIENCE *NEWS*

The UniServe Science newsletter can now be searched by keywords via the Web.

http://science.uniserve.edu.au/su/SCH/newsletter/search.html

When searching the newsletter index, items which contain all of the search words are retrieved. To find items that have any word, use **OR** between the words.

To truncate a search term use *****
e.g. chem* will retrieve: chemical, chemist, chemistry, etc.

The section headings used in the newsletter allow some refinement of searches.

For example:

to search on geology or geography articles
`article geology or geography`

to search on chemistry or chemical software reviews
`review chemi*`

Biochemical Education and the ASBMB, 1997

Robert Blakeley, Department of Biochemistry
University of Queensland blakeley@biosci.uq.edu.au

Seven recent developments in Australian biochemical education were presented in a 1.5 hour symposium at the Australian Society for Biochemistry and Molecular Biology (ASBMB) 1997 Annual Conference at the Melbourne Convention Centre. Some sixty enthusiastic attendees would probably have quizzed the seven speakers for another 1.5 hours had the extra time been available! It was a privilege for me to join Gareth Denyer as co-chair of this symposium.

Three talks focussed on methods of teaching which utilise small groups of students, peer teaching and/or peer assessment. Each talk described the successful use of educational concepts that would be anathema to many if not most academic biochemists. However, there is ample evidence to suggest that the majority of university students now do not work or comprehend in the same way that most of their lecturers did (a decade or more ago). Elizabeth Deane, Gareth Denyer, Marian Dobos, and Sylvia Grinpukel (the latter two having perfected the art of tag-team presentations!) are among the Society's academic leaders whose development of new methods of teaching biochemistry should be strongly applauded.

Three talks focussed on development of computer-based teaching material for replacement or supplementation of lectures and laboratory experiments. The talks demonstrated that excellent computer based material can be written, but only with a high degree of soul searching and effort by the authors and a lot of feedback from students. Peter Janssens, David Day and Beverly Bencina demonstrated that teachers can use computers effectively in their teaching. Some university administrators in Australia appear to be planning that first year university be taught largely with CDs and teacher-aids in place of lecturers, on the grounds of "efficiency". In my opinion this would be a recipe for reducing a good university to 4th rate by world standards. The experience being gained now with use of computers in teaching has the potential to save some Australian universities from self-destruction in the future.

An incisive presentation by Mary Peat focussed on the activities of UniServe Science. This organisation has recently distributed a Biochemistry QuicKard summarising computer programs commonly used for teaching biochemistry in Australia, to all relevant departments. This talk also served as an introduction to the Biochemical Education Group booth at which Mary Peat, Mark Nearhos and (usually) several members of the Group were always ready to demonstrate current biochemical education software on a Macintosh computer (courtesy of the MILL at the ANU and Apple Australia) or a PC (courtesy of the School of Biochemistry at Melbourne University).

The Biochemical Education Symposium and the Biochemical Education/UniServe Science booth were focal points of activity for many delegates at the Melbourne Conference. The biggest insight for me at this conference was realisation that a significant number of current ASBMB members appear to want more opportunity to hear about and discuss developments in biochemical education.

I'd like to express special thanks to the foundation chair of the Biochemical Education Group and, for four years until the end of 1997, the Editor of the ASBMB Newsletter - Graham Parslow. Largely because of his efforts and those of colleagues that he has inspired, the Society now has an excellent opportunity to match its Biochemical Education efforts to the challenges to be faced by lean university administrations and lean biochemistry departments in the 2000s. At a good U.S. university, Graham would probably now be a Professor of Biochemical Education, in analogy to the many Professors of Chemical Education in Chemistry Departments at leading research universities in that country.

Asian Physics Education Network (ASPEN), 1997

Ian Johnston, Director UniServe Science
The University of Sydney idj@physics.usyd.edu.au

On December 2-6 of last year, a conference entitled "University Physics Education for the 21st Century", was held in Shah Alam, Malaysia. This was the second conference in a series: the first had been held in Manila the year before. It was organized by the Asian Physics Education Network (ASPEN), a group which operates under the auspices of UNESCO to promote and communicate developments in university physics education in the Asian region.

The conference was attended by representatives from all over Asia - Australia, Bangledesh, China, India, Indonesia, Japan, Korea, Laos, Malaysia, Pakistan, Papua New Guinea, Philipines, Sri Lanka, Thailand and Vietnam. There were six invited keynote speakers, who also ran whole-day workshops. These were:

- Diane Grayson (Mathematics, Science and Technology Education College, Pietersburg, South Africa) who described a new institution and courses given to practising teachers in South Africa to upgrade their qualifications;
- David Wheeler (Mahanakorn University of Technology, Bangkok, Thailand) who explained how his institution copes with large classes and inexperienced lecturing staff, and how they also help school teachers;
- Mike Tinker (University of Reading, UK) who spoke about the FLAP (Flexible Learning Approach to Physics) project;
- Dean Zollman (University of Kansas, USA) who gave an overview of the use of multimedia in physics teaching and some new examples;
- Ian Johnston (UniServe Science) who spoke about whether multimedia had been successful in Australia in the last decade; and
- Priscilla Laws (Dickinson College, USA) who described the use of microcomputer based laboratory tools in physics teaching.

Contributed papers covered all areas from impressive new course textbooks to small scale equipment for lecture demonstrations. It would be invidious to single out individual speakers, but the topics which I found particularly interesting included: UNESCO funded projects in India and China to write textbooks for the Asian education scene, and the piloting of these courses in the Philipines; problems with poor school eacher training and how universities in PNG are trying to help; interesting research from India into students' ability to apply skills learned in the physics laboratory to the real world; the bad state of physics teaching in Laos and the need for national institutions; difficulties in physics teaching in Vietnam and problem of falling enrollments (this problem is the same the world over!)

As usual with conferences like this, what is most important is the opportunity to meet others in different parts of the world and find out at first hand how they handle the same problems we ourselves face. You will not be surprised that I tried my hardest to persuade all I talked to what a wonderful organization UniServe Science is, and why didn't they set up such an organization in the different countries represented. One of the most interesting ideas much talked about at the conference was the Multimedia Super Corridor (MSC), an initiative of Dr Mahatir to encourage something like Silicon Valley in the heart of Kuala Lumpur. Perhaps once that comes to fruition (after the current currency crisis has passed) one of its features will be a UniServe Asia. How's that for an idea?

Product Information

Mineral Master is available from:
Micronex Mineral Services Ltd
4356 - 148 Street, Edmonton
Alberta, Canada, T6H 5V5

CD-Physics is available from:
Jacaranda Wiley
PO Box 1226
Milton, Qld 4064
Tel: (07) 3859 9755

ECBM is available from:
Oxford University Press
253 Normanby Rd
Sth Melbourne, VIC 3205
Tel: (03) 9934 9123

VisChem is available from:
ICV International Pty Ltd
Tel: (03) 9348 2199 OR
Video Education Australia
Tel: 1800 034 282

Mineral Master

Ross Ramsay, Department of Geology, University of Ballarat
r.ramsay@eureka.ballarat.edu.au

Mineral Master, an interactive learning package intended for use in teaching determinative Mineralogy (the recognition/identification of minerals), comprises two 3.5” diskettes and a CD-ROM. The package can be run readily on a PC *Windows 95* format with — if possible — facilities to view 256 colours.

The menu comprises: a readily usable mineral data base; student tests of variable difficulty; a search-and-match facility for hand specimens and petrographic thin section identification; general mineralogical references; and a slide show showing images of crystals, crystallographic forms, and crystal lattice images.

The mineral data base is extensive, easy to use and contains a wealth of useful information. A welcome addition would be chemical or electron probe analyses together with structural formulae in the manner of the classical text by Deer, Howie, and Zussman (1992).

The test component has a number of useful aspects from the point of view of student teaching, especially the graduation in difficulty of the questions. However, in a number of instances one is required to identify minerals essentially from an image on the screen and in the absence of additional data (SG, hardness, cleavage, etc.) such images are unlikely to replace hand specimens.

The search-and-match facility has the potential to be very significant and I envisage that such files for cross-referencing will become more valuable with future developments in software marketing. This section is relatively easy to use, once one becomes accustomed to the abbreviations used.

The general reference section is useful whilst the slide show of various crystal models, lattices, and minerals, to my mind, is unlikely to be of significant help in the laboratory. Here I declare my prejudice in that we still have a long way to go to replace teaching using hand samples that students can hold and touch.

In summary I find the package to be a useful adjunct to hand specimens and text books. Possibly the more significant aspect of the package lies with the search-and-match facility which is likely to be helpful to both students and researchers.

(See page 18 for product information)

CD-Physics

Geoff Swan, Physics Programme, Edith Cowan University
g.swan@cowan.edu.au

CD-Physics is based on the popular first year textbook “Fundamentals of Physics” by Halliday, Resnick and Walker. *CD-Physics* (version 2.0) contains a complete hypertext version of the textbook (5th edition, extended), the student solutions manual, and the study guide. In addition, it contains simulations and interactive learningware tutorial software. It is easy to install, run and master.

The structural design and content of the second version is far superior to the first. A user friendly graphical interface has been introduced as well as video “puzzlers” from Jearl Walker to motivate students at the beginning of each chapter. The overall layout and features have been much improved.

The main menu and tool bar icons situated at the bottom of the screen make the material easily accessible and often in a number of ways. Students can quickly select the appropriate chapter and section through the “table of contents” icon. Pages, which contain text, illustrations and photos, are turned back and forth using the tool bar icon rather than a scroll bar. Important terms are linked to relevant pages through the use of hypertext and can also be found using the “search” icon. Students are able to highlight text (in a variety of fluorescent colours), bookmark pages and write their own notes which of course can be printed out. The “key info” icon allows students to swiftly look up key formulas, concepts and miscellaneous data. The study guide can be accessed through the “key info” icon, the “browse” icon, or directly from the main menu. Questions, exercises and problems can be individually selected at the end of each chapter. Answers, hints, text references, worked solutions, or even a learningware tutorial may be sought by clicking on the corresponding icon, provided it exists for the particular problem. For example, answers are only given for odd numbered problems.

CD-Physics version 2.0 is a comprehensive first year tertiary physics package with helpful tools included to help students learn and study effectively. Many students will benefit from this package and I will therefore be recommending it to our students for purchase in 1998.

(See page 18 for product information)

Electronic Companion to Beginning Microbiology

Mark O’Brien, School of Life Science
Queensland University of Technology m.obrien@qut.edu.au

Overview

An Electronic Companion to Beginning Microbiology (ECBM) was developed by three highly respected American microbiology researchers and educators and has been specifically designed as a study guide to complement most introductory microbiology courses irrespective of the teaching strategy used or the textbook recommended. The software package consists of a CD-ROM with multimedia coverage of key concepts in both review and self-test modes together with a hardcopy workbook providing topic summaries, exercises, questions and answers for interactive study. Subject areas covered include: Microbiological methods; Microbial anatomy; growth and metabolism; Genetics; Microbial classification; Microbial diversity; Host defenses; Microbial diseases; Microbial pathogenesis; Disease control; Microbial ecology; and Uses of microorganisms. Technical support is available.

Facilities and capabilities of the package

The workbook, divided into 17 topics, consists of questions and answers arranged in a sequence similar to that of the CD-ROM topics. Each workbook topic also includes a self-assessment section with short answer/essay-type questions. A set of workbook answers is included as is a 12-page glossary. The workbook is predominantly text-based, but includes relevant annotated diagrams, graphs and tables.

Clear, easy-to-follow installation instructions are given on the frontleaf of the package; installation takes only a few minutes. For this review, *ECBM* was run under *Windows 3.1* by using a 486-DX2 50Mhz PC and 8MB RAM. It was also tested under *Windows NT4.0* using a Pentium Pro200 with 32MB RAM. The software performed well on both systems with an expected enhanced speed and multimedia capability on the latter system.

The program begins by offering two options: Resume and New Session. The latter option launches the main screen of *ECBM* which has a cardfile-like interface consisting of three categories or "tabs": Welcome; Review Topics; and Test Yourself. The Welcome page has action buttons enabling the user to access: Main Menu topics; Software instructions; Diagram lists; and so on. An Options button on the Navigation bar provides useful facilities such as: Search; Bookmarks; Notes; Help; and Print Screen. Review screens present concise summaries of key concepts employing animation, interactive diagrams, video clips, photographs, and/or interactive worked examples. Review screens are organised by Topic, Section and Sub-section. Hyperlinks (red) and glossary terms (blue) are colour-coded for ease of access. User notes can be saved electronically or printed.

Facilities for self-testing on single or multiple topics/sections are available. Each new test presents questions in random order. The program automatically compiles scores to measure progress. Testing allows for drag and drop, multiple-choice and user input. In the latter case, three incorrect choices are allowed then the correct answer is revealed. Hints are available on-screen. Detailed (% correct, no. questions skipped and so on) results of scoring are provided.

Ease of use

The program is easy to install and intuitive in its operation. However, extensive on-screen help is available at all levels. The developers assertion that, "We want you to be thinking and learning about Beginning Microbiology, not about how to operate the Companion, so we've done our best to make it easy to use", is fully justified.

Suitability for use in teaching

ECBM is well suited for any student majoring in microbiology at university level to allow for self-paced instruction and interactive learning at the introductory level. Due to its multimedia-based and interactive teaching/learning style, advanced students may find the package a useful tool to refresh their knowledge of fundamental concepts. Similarly, non-majors in microbiology (e.g., nursing and related public health students) may find *ECBM* useful to gain a better understanding of some relevant topics at the introductory level. It is important to emphasize that *ECBM* is a teaching/learning aid and should not be viewed as a replacement for a good microbiology textbook. Information contained in the package is scientifically accurate and up-to-date.

Overall evaluation

ECBM is a well designed teaching/learning aid for introductory microbiology. Its coverage of fundamental microbiological concepts in keynote form is excellent and its use of dynamic multimedia styling to enhance the learning process is very impressive.

(See page 18 for product information)

VisChem: Visualising the Molecular World

Rowan Hollingworth, Division of Chemistry
University of New England rholling@metz.une.edu.au

Recent advances in computer graphics are now providing teachers of chemistry with a new standard of teaching resources, which can fundamentally change the way students gain an understanding of atoms, molecules and their physical and chemical behaviour. Students need to be able to operate effectively at three levels — the laboratory, molecular and symbolic levels, to construct a meaningful understanding of basic molecular concepts. Educational research indicates many students have great difficulty in making adequate connections between these levels, which imposes a significant block to their deeper learning of chemistry.

The *VisChem* project aims to produce multimedia resources explicitly linking these levels to assist students build accurate mental models and overcome misconceptions. The materials produced contain highly detailed 3D animations of processes at the molecular level. With repeated, careful and guided viewings of these animations, students can start to build up more meaningful mental models of molecular processes and to make the important links to chemistry at the laboratory level. To date the project has produced videos of water in its different physical states and undergoing phase changes; the processes of dissolving, precipitation and complexation in water; ionic equilibria, acid base and redox chemistry; and an interactive CAL interface for studying these topics. The CD-ROM under review (beta version) is a resource bank of all these materials on disk.

The Beta version disk under review came with no other documentation, so no comments can be made about what may accompany it on release. Teaching notes for the videos have been excellent in their scope and detail. Testing on a Macintosh Performa 5200CD with 16Mb RAM presented no problems whatsoever. Double clicking the ‘VisCmac.Go’ icon started the program, navigation through the disk was obvious and I never experienced any crashes. The disk contains 23 information screens describing the VisChem Project and the intended uses of the materials on the disk. These include: producing teaching resources, lecture slide and computer presentations, assessment and student group work. The main contents of the disk are the multitude of QuickTime animations including all the topics mentioned above. These provide a wealth of opportunities for use by the teacher in developing their materials and assisting their students learning.

With this resource and similar items from other like initiatives around the world, the teaching of chemistry can indeed make some bold steps forward.

(See page 18 for product information)

Developing Software to Support the Collaborative Use of Hypertext in Learning

Stephen Provost, Department of Psychology
University of Newcastle provost@psychology.newcastle.edu.au

The tension between science and practice in Psychology presents some interesting and unusual challenges for the university academic. Psychology is the scientific study of behaviour and its causes, but it is also the name of a profession whose goal is the improvement of human welfare through the use of these scientific principles. Psychology programmes are accredited by the Australian Psychological Society (APS), which has promoted a "scientist-practitioner" model of the discipline, ensuring that both aspects of the discipline are represented within any programme with an emphasis on the scientific knowledge base at an undergraduate level. Getting this balance right is not an easy task: an undergraduate programme which focuses heavily on the scientific understanding of psychology may meet APS requirements but find itself under some pressure from students and other stakeholders to be more "applied", while one which pays more attention to professional training may find itself under uncomfortably close scrutiny from the APS accreditation team. Finding the right mix of science and practice is an issue which has exercised most academic psychologists minds at some point in time.

This CAUT funded project involved students enrolled in a conventional psychology subject with a clear emphasis upon the scientific basis of the discipline (PSYC311, Associative Learning). One component of their assessment required the students to participate in the collaborative development of a hypertext document on any topic relevant to the subject. Hypertext is non-linear text, and it requires the author(s) to consider how texts may be connected in order to provide the reader with a pathway, or pathways, through the material. The intention of collaborative hypertext is to "force" students to consider the relationship between their work and others, in order to successfully link the group's documents. This should create an environment in which a superior understanding comes about through the social processes engaged by the common task which, in an ideal situation, models the ways by which academic material is created and disseminated (see, for examples, Barrett 1992).

Students received instruction in writing hypertext markup language (HTML) documents for delivery on the World Wide Web (WWW) in two, two-hour long laboratory sessions. Only one student in the class was familiar with HTML, and about half of the students had "surfed" the WWW on previous occasions. They were then organised into groups and began work on a topic of relevance to the subject. The only instructions were that each person should produce at least a couple of "screenfulls" of information for the group, and that each group should then organise itself around whatever work was necessary to link these documents into a single hypertext. During the semester two further laboratories were set aside for problem-solving on this task as well as other assessed tasks in the subject. During the final laboratory session students gave a brief presentation on their work, and submitted the final HTML document for assessment.

Following the presentation students were asked to complete a questionnaire evaluating the HTML project, as well as attitudes to technology, and teaching in the subject, as well as providing some demographic information. Students enjoyed the collaborative hypertext project, and believed that it had enhanced their understanding of the subject. Their evaluation of teaching reflected this positive attitude to the HTML design. However, those students with a negative attitude to technology tended to like the collaborative hypertext project less, and also tended to be less complimentary about teaching. Some examples of the students' work may be found at http://psychology.newcastle.edu.au/~provost/homespun_hypertext_96/index.html

Although the work was generally of a higher standard than I would have expected in essays or lab reports, the most impressive feature of almost all of the hypertexts was the students' ability to integrate the scientific information with their interests in the practice of psychology, rather than enhanced understanding. The hypertext medium had also allowed them to demonstrate an ability to "pitch" their work for quite disparate audiences, including the lay public. The hypertexts created by these students encapsulate the importance of understanding the scientific basis of associative learning for psychological practice, freeing me to focus upon the content of the subject area. Finally, the quality of the HTML was quite astounding, given the level of instruction received. This last feature was almost irrelevant from an assessment perspective, but students had spent considerable effort, outside normal class times, in acquiring these skills. This project was certainly the most enjoyable experience I have had in undergraduate teaching, and I hope that it has left the students with some useful skills and ideas to consider.

Further information regarding this project will be provided at the Web Workshop being planned by Uniserve Science on 17-18 April.

Barrett, E. (1992). Sociomedia: An introduction. In E. Barrett (Ed.), Sociomedia: Multimedia, hypermedia, and the social construction of knowledge (pp. 1-10). Cambridge, MA: MIT Press.

'GECKO': Computer Modules for First Year Biology Practical Classes

Kristine French, Department of Biological Sciences
University of Wollongong kris@uow.edu.au

Overview of project

The teaching of biodiversity and organism structure and function in first year suffers from the limited range of examples that can be studied because of resource and logistic limitations. There is difficulty in keeping fresh specimens alive and finding them each year, and the alternative of providing bleached, preserved specimens fails to interest students.

Students also have difficulty in accurately identifying features of specimens from written instructions. There is concern that they "can't see the widgoblast". Furthermore, demonstrators find that for difficult slides and specimens, students require individual attention causing logistic problems in the lab class. The result is often that students leave with incorrect knowledge.

Teaching biodiversity and the structure of organisms can be enhanced with the use of multimedia tools. A computer package, *Gecko*, was developed using *Macromind Director* to facilitate the teaching of biology to first year undergraduate students at the University of Wollongong. *Gecko* has facilitated learning in practical sessions through providing accurate information, a method of self learning and a method of checking progress.

The program has been operating in various forms for two years with improvements occurring each year. Students have assessed its value, providing feedback for us about the value of the program to their learning and our observations during practical sessions have further provided new ideas for improvement. A version that will be available to other institutions is currently being completed.

The program is currently used in 6 practical sessions. These practicals involve looking at material and organisms, identifying features in the material and drawing specimens/slides. Other practicals teach students skills in carrying out experiments, dissections and research protocols and do not lend themselves to this learning tool. However, for practicals where students view a range of specimens to understand diversity or structure and function, this mode of teaching is ideal.

The practicals with computer modules are:

- Plant structure
- Plant reproduction
- Cell structure
- Cell division
- Invertebrates (2)

Structure of a 'GECKO' practical session

The general structure of these practical sessions involves a series of tasks explained in a practical manual. The manual provides all background information and all information required to complete the task. The manual is the main learning tool allowing students to work individually at their own pace through the series of tasks. As the student completes the task, he/she can check the computer if necessary to ensure accuracy of interpretation and their diagrams. Not all tasks are found on the computer — only those specimens that the student finds difficult to interpret or are important features of the practical.

Some specimens can only be viewed on the computer, where there is difficulty in getting fresh or preserved specimens. In this regard, the program provides an ideal backup if, for example, one year a specimen was not available. Students are still able to view an example of the specimen on the computer.

Each computer module is self contained but linked within the package through a frontispiece. Within this front section is a glossary for exploration. The glossary is also accessible from within each module but only for the words selected. Each module is menu driven and students choose a particular section and then a particular page within each section (Figure 1). Simple arrows allow students to move within any section of the module. Each page has a picture with labels that point to the feature when clicked (Figure 1). A double click opens the glossary which provides a definition for the word that has been double-clicked.

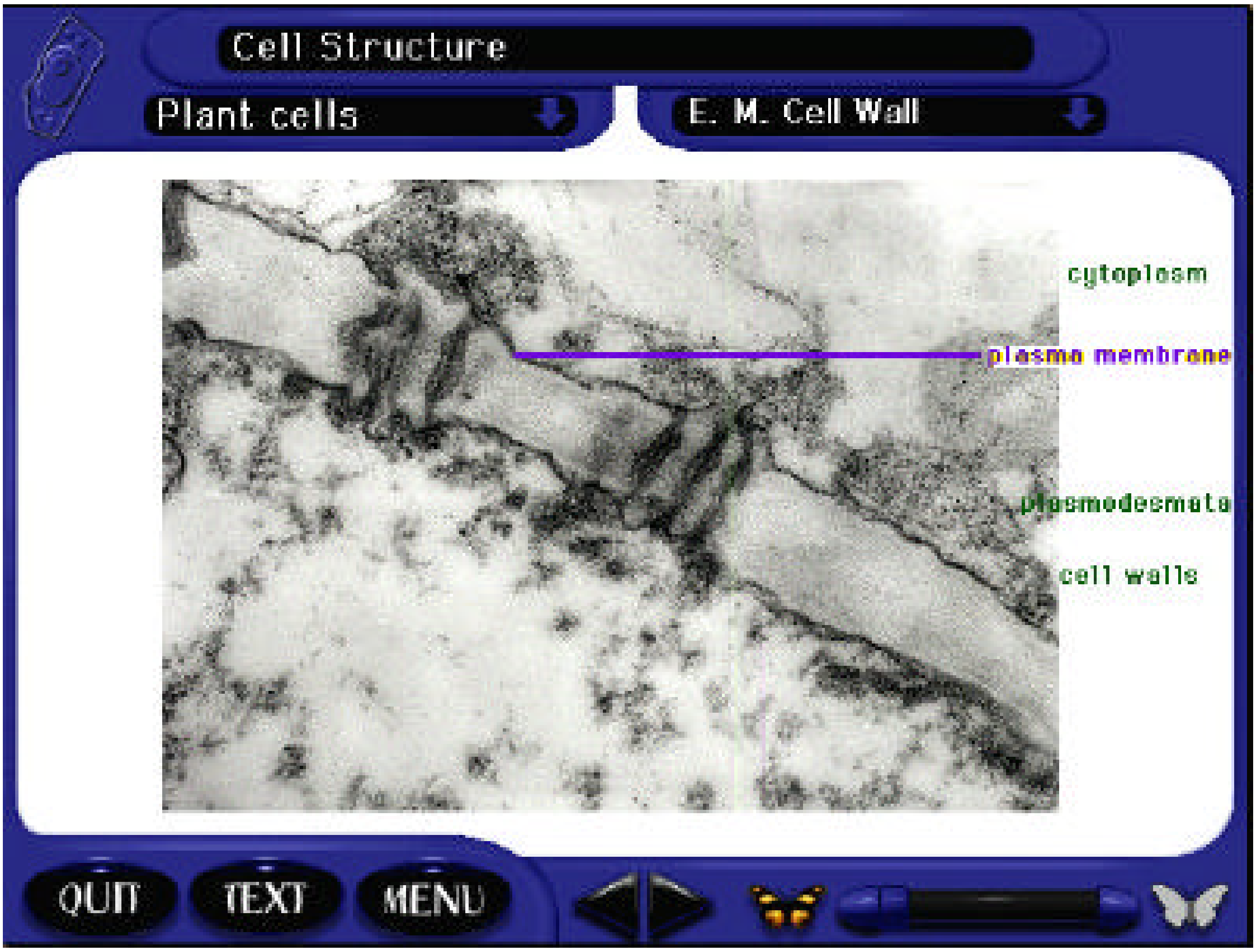

Figure 1. A page from the computer module on cell structure, showing the menu boxes at the top which move the student within the Cell structure module. The lefthand box [Plant cells] refers to the section whilst the righthand box [E.M. Cell Wall] allows a choice of pages within the section. One of the labels is highlighted (a click with the mouse) and has a line pointing to the relevent structure. The butterfly scroll bar at the bottom can be moved to scroll between a line drawing and the photograph.

For some pictures, particularly slides and electron micrographs, a line drawing has been added. Students can use a scroll bar to change between the photograph and the line drawing. This enables features that are often difficult to see to be highlighted easily. For other pictures the line diagram is provided next to the picture.

A textbox can be opened on each page which provides a more detailed explanation of the material pictured (Figure 2). The idea of the textbox is to take students further than the practical manual or to emphasise particular points.

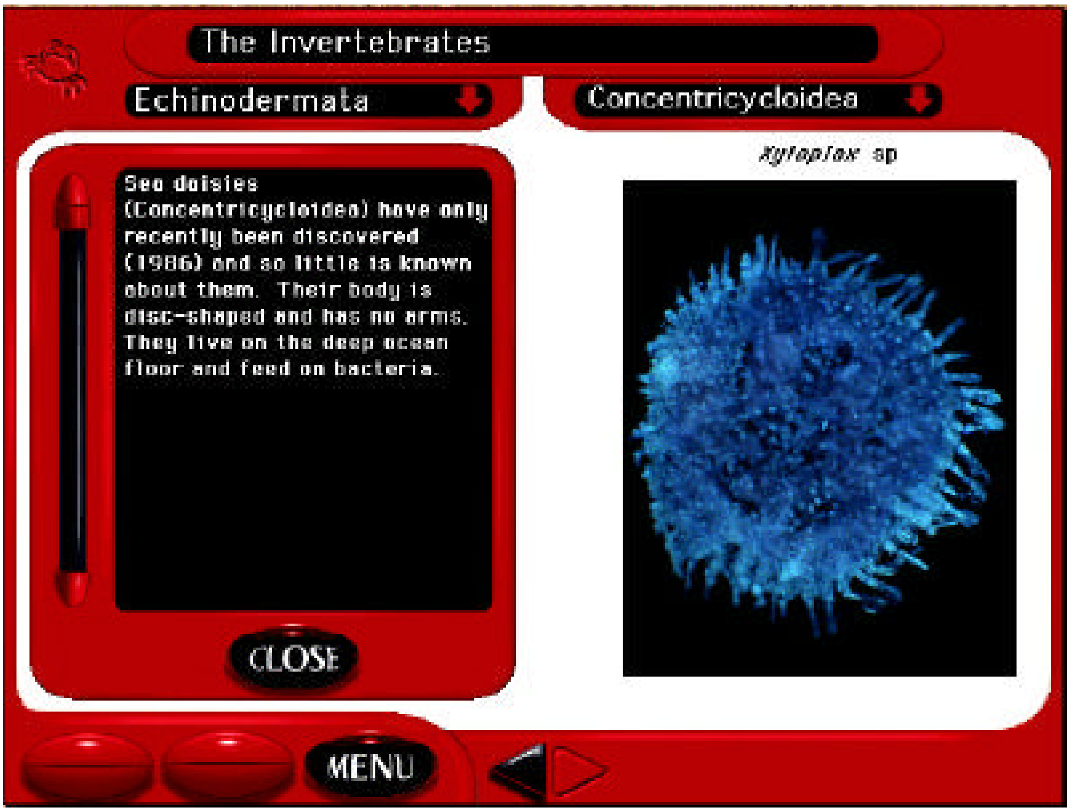

Figure 2. A page from the computer module on Invertebrates where the text has been selected and appears on the left hand side of the page.

Some problems identified

The emphasis on a thorough practical manual should be considered further. One of the difficulties that we encountered early in the development of each module was the necessity for a complete practical manual that matches the computer module. We found many students copying all information from the computer and making drawings from the computer before doing the exercise themselves. This tied up the computers and meant that demonstrators had to intervene in the time allowed on the computer. Following discussions, it was realised that the practical manual was not giving enough information for them to complete the task. For instance, the practical manual must include a description of the material being examined and an explanation for each label required in the drawing. If this is not the case, students need to consult the computer to determine what labels are needed and what the structure looks like that needs to be labelled, instead of using the computer to confirm their observations. For example, the task might be: Examine and draw the moss plant provided, labelling the thallus, rhizoids, gametophyte, sporophyte and capsule. Unless there is a preceding paragraph describing what each of these features look like, a student has to ask the demonstrator or check on the computer. So instead we included:

> The main photosynthetic part of the life cycle is the GAMETOPHYTE. The gametophyte consists of a leaf-like structure, the *thallus*, and a series of root like structures, *rhizoids*, which permit the uptake of water and nutrients..... The resulting SPOROPHYTE grows out from here [archegonia] as a long stalk. At the top of the stalk is a capsule which produces the spores.....

Whilst some students will always focus heavily on the computer package, we have always emphasised the importance of the practical component in the laboratories, stressed in the practical exam which only uses fresh specimens!

Learning and practical outcomes

In 1996 we assessed these practicals during the standard evaluation report for the subject. The results suggest that the computer modules helped the majority of students learn in the practicals and helped them enjoy the practical session more than other practicals. The information provided in the modules was considered useful with over 80% of students using the computers regularly. Students wanted greater access to the computers (currently 8 operate for 80 students) but it was likely that this was due to some students spending too long on computers gaining information which should have been in their manual.

Demonstrators also noticed fewer questions and explanations required, indicating that students were gaining greater independence in their learning.

Preserved specimens are frequently colourless and fresh specimens are frequently hard to obtain. The atlas provides a way of introducing a level of reality to the specimens in the practical session. For example, the computer module will show movement in worms using a film clip; a hard thing to demonstrate with a preserved specimen! We have introduced a number of specimens into the modules which can not be seen in the practicals but which enhance their learning experience. For example, there is an electron microscope photograph of a nuclear pore which is explained in the module but which does not match a task in the practical. This will extend understanding of cell structure. We have also included a photograph of the newly discovered group of Echinoderms, the Concentricycloidea (Figure 2).

Students complete the practical with a more accurate knowledge and correct diagrams from which to study. This is despite the increased student/demonstrator ratios we have been facing. In fact, we hope to reduce the need for as many demonstrators in these practicals as this self teach program is completed.

Future developments

Such a program is constantly being developed and changed as new ideas and material becomes available to improve the modules. It is planned to continue to add new material to each of the currently developed modules and to develop a new module on vertebrates in the future.

The National Clearinghouses: Life After Death

Anne Fernandez, UniServe Science
The University of Sydney PhySciCH@mail.usyd.edu.au

Introduction

In 1994 CAUT funded the UniServe pilot project for a period of three years. The purpose of the project was to establish a network of clearinghouses to collect and disseminate information on the use of IT within tertiary teaching with the view to improving teaching methods. The network consisted of: a central co-ordinating centre at the Australian National University (UniServe Australia); the engineering clearinghouse at the University of Wollongong (UniServe Engineering); the medicine, health sciences and nursing clearinghouse at the University of Newcastle (UniServe Health); the law clearinghouse at the Australian National University (UniServe Law); the humanities and social sciences clearinghouse at the Royal Melbourne Institute of Technology (ultiBASE); and the science clearinghouse at The University of Sydney (UniServe Science). CAUT funding for the project has run out and so all the clearinghouses have had to look elsewhere for financial support. On Tuesday February 17, 1998, representatives from all clearinghouses (except Law) met in Canberra to review the project and discuss future directions.

Success of the project

All clearinghouses present agreed that although they had each approached the task given to them in different ways they had achieved their goals and delivered the required services. This was inspite of some rather adverse conditions — the project was under-funded, lacked Federal support after changes in government, and was ill-defined. All felt it unfortunate that continued Federal funding was not forthcoming as the need for a national information dissemination group for the tertiary sector was vital. Universities need to share materials and move beyond the current situation where most products developed within a university are only used within that institution. Mind you, the sharing of materials and innovative methods of teaching is becoming a touchy subject in the current environment where universities are being made to compete aggressively with each other for students in order to gain funding. To make this happen there must be an organisation which transcends institution boundaries and facilitates discussion and the exchange of ideas between academics. The clearinghouses are ideal for this and have already set up quite extensive programmes and structures towards this end.

Future of UniServe

Each of the clearinghouses has managed to secure a level of funding to continue operating, at least in the short term. In most cases the funding is being provided by the host institution, so each clearinghouse will have a greater responsibility to their own university, which is unfortunate as the group should be above local politics. However, all see the value of the national network and so will continue to deliver a service to all tertiary academics.

Since co-ordination between the clearinghouses is seen to be minimal from this point on, the Co-ordinating Centre in Canberra will wind down their operation over the next few months. UniServe Science, based at The University of Sydney, will then take responsibility for any remaining co-ordination activities. Sadly we farewell the UniServe Australia staff, Tim Marples (Director, UniServe Australia), Cathy Clegg and Aileen McCulloch who have all contributed a great deal to the success of the project.

Conclusion

The UniServe project has brought together forward thinking teachers, across disciplines, who felt isolated in their departments. Ideas and experiences have been shared, leading to improvements in teaching and learning.

UniServe Science PERSONNEL

Director: Associate Professor Ian Johnston

Co-director: Dr Mary Peat

Deputy director: Professor David Patterson

Educational technologists:

Mark Nearhos (Biological Sciences)
Tel:(02) 9351 2960
BioSciCH@mail.usyd.edu.au

Anne Fernandez (Physical Sciences)
Tel:(02) 9351 5783
PhySciCH@mail.usyd.edu.au

Correspondence to:
UniServe Science
Carslaw Building (F07)
The University of Sydney
NSW 2006
Fax: (02) 9351 2175

UniServe Science PUBLICATIONS

http://science.uniserve.edu.au/su/SCH/pubs/

- **UniServe Science News** is available on-line and in Portable Document Format (PDF)
- **Proceedings of UniServe Science Workshops** are available in PDF (Dry Labs Workshop and Computer Assessment Workshop)
- **UniServe Science QuicKards** summarise the software most commonly used in Australian universities for teaching first year classes and are available on-line
- **CAL-laborate** is a collaborative publication from UniServe Science, the UK CTI centres for Physics, Chemistry and Maths and the Swedish Council for Renewal of Undergraduate Education and is available on-line
- **Proceedings of UniServe Australia Workshop** *Putting you in the picture* is available in PDF

Calendar of Coming Events

UNESCO Asia-Pacific
Education for the 21st Century in the Asia-Pacific Region
March 30 - April 3, 1998, Melbourne
http://www.dse.vic.gov.au/cis/unesconf/

World Wide Web 7
April 14 - 18, 1998, Brisbane
http://www7.conf.au/

UniServe Science Workshop
University Science Teaching and the Web
April 17 - 18, 1998, Sydney
http://science.uniserve.edu.au/
PhySciCH@mail.usyd.edu.au

JCII forum
Learning Together - Collaboration in Open Learning
April 20 - 22, 1998, Perth
http://www.curtin.edu.au/curtin/centre/jc/jcii/programs/learning.html

IASTED 98
Computers & Advanced Technology in Education
May 27 - 30, 1998, Cancun, México
http://www.iasted.com/cate98/cancun.html
iasted@iasted.com

CALISCE 98
Computer Aided Learning and Instruction in Science and Engineering
June 15 - 17, 1998, Goteborg, Sweden
http://www.pedu.chalmers.se/calisce98.html
calisce98@pedu.chalmers.se

Learning On Line 98
Building the Virtual University
June 18 - 21, 1998, Roanoke, Virginia, US
http://ebbs.english.vt.edu/Learning-98/

ED-MEDIA/ED-TELECOM 98
World Conference on Educational Multimedia and Hypermedia &World Conference on Educational Telecommunications
June 20 - 25, 1998, Freiburg, Germany
http://www.aace.org/conf/edmedia/
AACE@virginia.edu

STLHE 98
The Voices of Learning: Student and Teacher
June 24 - 27, 1998, Sackville, New Brunswick, Canada
http://www.mta.ca/stlhe98/

CEC 98
Chemical Education Conference: Bridging the Gap
July 2 - 6, 1998, Rockhampton
http://science.cqu.edu.au/chemistry/RACI_chem_ed_conf
a.lee@cqu.edu.au

Edtech 98
Planning for Progress, Partnership and Profit
July 5 - 8, 1998, Perth
http://cleo.murdoch.edu.au/gen/aset/confs/edtech98.html
edtech98@cleo.murdoch.edu.au

IUT 98
Learner-Centred Universities for the New Millennium: Part 1
July 6 - 9, 1998, Dublin, Ireland
http://www.umuc.edu/iut/

RUFIS 98
Role of Universities in the Future Information Society
July 22 - 24, 1998, Monterrey, Nuevo León, México
http://www.rufis98.ur.mx/

ISL 98
Improving Student Learning Outcomes
September 7 - 9, 1998, Brighton, UK
http://www.brookes.ac.uk/services/ocsd/ISLtop.html

ALT-C 98
Lifelong Learning on a Connected Planet
September 21 - 23, 1998, Oxford, UK
http://www.tall.ox.ac.uk/alt/alt-c98/
altc98@conted.ox.ac.uk

ASBMB/ASPP
September 28 - October 1, 1998, Adelaide
http://www.asbmb.org.au/
asbmb@camtech.net.au

OzCUPE4
October 1 - 2, 1998, Perth
http://www.physics.curtin.edu.au/OzCUPE4/
Rlossrd@cc.curtin.edu.au

ASCILITE 98
Flexibility: The Next Wave
December 14 - 16, 1998, Wollongong
http://cedir.uow.edu.au/ASCILITE98/
ASCILITE98@uow.edu.au

UniServe Science is funded by The University of Sydney through the College of Sciences and Technology, the Faculty of Science and the University Information Technology Committee