1st YEAR BIOLOGICAL SCIENCES TEACHING TEAM

FACULTY OF BIOLOGICAL AND CHEMICAL SCIENCES

THE UNIVERSITY OF QUEENSLAND

SUBMISSION

Represented by

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This case study describes the successes of a team approach with academics, tutors, PASS leaders and general staff from The University of Queensland to teaching large classes in 1st year biology, who make up the First Year Biology Teaching Team.

This team coordinates and delivers an innovative, modern and exciting biological curriculum to more than 1000 students. Over the past 5 years we have developed and refined an effective learning environment based on a multi-member team.

Delivering this program to our class of 1st year students has involved the formation of a multi-dimensional team, comprised of several team units, that work in a coordinated manner, through the leadership of key individuals. This has proven to be a very successful model as it has removed communication and discipline barriers that have existed in past departmental structures.

Like the evolution of organisms over a geological time scale, we too have evolved (but more rapidly) to a new, dynamic model that is innovative, practical and relevant for student learning in the 21st century.

The First Year Biology team encompasses a team teaching approach that transcends traditional discipline boundaries and encourages collaboration among molecular & evolutionary biologists, human physiologists and anatomists, ecologists, botanists, biochemists and zoologists. It is these new synergistic collaborations, stimulated by team building activities and strong leadership, that has delivered an innovative and student focussed curriculum and effective teaching model in the 1st year biology program. The central theme of this program is genetics and evolution.

Paralleling this biological information explosion we have seen unprecedented growth in information technology, notably the use of the Internet. New disciplines in bioinformatics and computational biology are emerging which use this technology to manage and interpret genomic data. Coupled with this rapid penetration of the new biologies, we are particularly sensitive to how this complex information is communicated to 1st year students.

As a research intensive university, our aim is to capture the 21st Century biological revolution by taking students on a journey from the gene to the environment. We have deliberately engaged our best research and teaching academics in the 1st year biology program, because we believe they are best able to achieve the two broad goals we are seeking to achieve: to enable students to construct a modern conceptual framework for biology, with a focus on genetics and evolution as the integrating them; and to inspire in students a real appreciation of science and scientific research as a human activity.

Our specific educational goals for our 1st year students have been to:

• develop an understanding of the centrally important concepts in modern biology and demonstrate how they apply across the disciplines
• facilitate the development of core laboratory and computer skills that are relevant to the new biologies
• develop an appreciation of the nature of scientific enquiry, the excitement and relevance of cutting edge biological research and its ethical and social implications
• encourage a collaborative, student-centred approach to learning which will set the pattern for lifelong learning

Since its introduction in 1999, three core activities have driven our program over that time: developing a coherent curriculum, building a collegial teaching team and creating a supportive learning environment for our students. The ways in which each of these has evolved will be described in turn.

Developing the curriculum

The development of the new curriculum was undertaken as a Faculty-wide process which crossed traditional boundaries between disciplines and Schools. In 1998, the University’s Teaching and Educational Development Institute (TEDI) facilitated a workshop on curriculum development, which was followed by a Faculty retreat to map the major elements of the program. Six courses were identified as representing the directions of the modern biologies:

- Genetics and Evolution
- Animal Biology
- Plant Biology and Biotechnology
- Molecular and Microbial Biology
- Human Biology
- Ecology and the Environment

Cross-departmental teams were then established to develop each of the courses with a high priority placed on:

- developing conceptual understanding as opposed to learning facts
- relevance and real world applications
- integration of different elements of theory and practice including laboratory work, computer-managed learning, lectures and small group tutorials
- improving computer literacy in the context of biology

The complete curriculum is fully documented and available to all students and staff. (See http://ilc.uq.edu.au/) and is updated annually. This allows ready cross-referencing by staff and students so that relationships between the courses can be identified and emphasise.

Building the team

Prior to 1998, our Faculty did not have a strong tradition of collaborative, team-based teaching and curriculum development. However, as our primary goal was to provide students with a unified approach to biology, a team approach was therefore essential. We particularly wanted students to view biological problems from a different perspective that focused on the molecular, organismal and ecological rather than the traditional cellular approach. The development of teams has been highly successful and resulted in a greatly improved collegial environment within the Faculty. This collaborative approach has also been an essential element in the teaching and delivery of an integrated, cohesive program of study for a large number of students.

The effectiveness of our First Year Biology Team can be attributed to our model which comprises five smaller functional team - cohesively bound and inter-connected units (see model insert). The team units comprise:

i. **Coordination Team:** The Director of Studies and course coordinators who provide effective linkage between the 6 courses delivered in the program and ensure coherent curriculum development.

ii. **Course Teams:** The lecturers, tutors, PASS leaders, general staff who deliver lectures, run labs and mentor students in individual courses.

iii. **Undergraduate PASS Teams:** The PASS coordinators, course coordinators and PASS undergraduate student leaders who run weekly sessions for 80% of our students. (Peer Assisted Study Sessions)

iv. **Learning Guide Team:** The educational designer, lecturers and PASS student leaders who develop and produce course learning guides for students.

Some examples of the specific ways in which the iLC is used in the context of teaching 1st year biology are:

- a 4-week project in bioinformatics, in which students access state of the art software for modelling protein structures and develop their own web page to showcase a molecular model they have developed
- a genomics project in which students examine the humane genome and track newly located disease genes
- “virtual fly laboratory” in which students play the role of a research geneticist and learn the
principles of the genetics of inheritance by studying the mating of flies
• formative assessment using a locally developed assessment tool, “BrainZone”
• on-line feedback from students
• combining a “traditional” wet-based microscopy laboratory with sophisticated, computer-based taxonomic software to identify plant material

Coordination team
The Director of Studies, Associate Professor Susan Hamilton, and the course coordinators work together to improve curriculum and maintain connectivity between courses in the biology program. It is innovative in that it has broken down traditional pre-existing discipline barriers in teaching biology. The course coordinators play a key leadership role both within their respective courses but also as part of the coordination team. Course coordinators, Craig Franklin (Animal Biology) and Jimmy Botella (Plant Biology) have been awarded UQ teaching excellence awards and Vaughan Kippers (Human Biology) has been nominated for an excellence award in teaching in 2003. They are also internationally renowned for there research (see profiles) and this underlies our strong commitment to deliver our 1st year course by the best teachers who are also outstanding researchers.

Course teams
It is the responsibility of course teams to deliver core content and these lecturing and laboratory teams provide the main contact point for students. The course team approach is practical and effective for staff because it provides a mechanism whereby the knowledge base is shared, especially between lecturing “buddies”. Because of this, staffing changes do not incur a major loss of knowledge or expertise because pairs of lecturers present the same material. At the same time, distributing responsibility for different components to pairs of lecturers provides an avenue for ongoing improvement in teaching because the lecturing buddies provide informal peer review, identifying areas for improvement and working on these year to year. Coordinators for the 1st year biology courses are all recognised as outstanding teachers and provide effective leadership and assist in mentoring junior staff. Coordinators regularly sit in on lectures by junior staff in their courses to provide advice and constructive feedback. Teams are about achieving the highest goals possible working as a tightly knit unit, hence the supportive and inspiring environment created within our course teams is both innovative and highly practical.

v. eLearning Support Team: The faculty IT director and staff and eLearning coordinators who provide eLearning support for the program and students
A distinguishing feature of our 1st year biology teaching team is that it involves many of our Faculty’s best researchers in the planning and teaching of the courses. These researchers are also recognised for the quality of their teaching. For example, among those profiled in this application, three have received UQ Teaching Excellence Awards while another has been nominated for the 2003 awards. A
number of our teaching staff are profiled on the accompanying CD-ROM. What you see in the disc is what our students experience in their 1st year classes. Our teachers in this program are excellent researchers who enjoy teaching 1st year students. Because they are national and international leaders in their respective fields of research, they can present current material in a convincing and thought-provoking manner. They are also well equipped to address the challenging ethical and social issues raised by much of the new science, for example the potential role of genetically modified food for a rapidly expanding population.

Another distinguishing feature of the team is the group of talented, enthusiastic, 2nd and 3rd year biology students who are employed as PASS leaders. Each year this group contribute in new, creative ways to the program. The PASS leaders have become an integral part of the academic life of our Faculty. They engage with both the 1st year students and the teachers, providing invaluable insights on the 1st year students’ learning.

eLearning support team

Our interest in promoting student learning is also evidenced by our commitment to provide the most appropriate learning environment for the students. As stated in our objectives, a high priority in developing the new curriculum and team approach was the to improve computer literacy in the context of biology and to provide computer facilities appropriate for the purpose. As a result, a state-of-the-art computing facility, the Interactive Learning Centre (iLC), was established by Dr Alan Cody for first year students in 1999 (http://ilc.uq.edu.au/). It contains 150 networked computers with full multimedia capabilities including one of the first educational digital video libraries in Australia that can be streamed to a student’s home computer. The computers run dual operating systems (Macintosh and Windows 95/98) for maximum accessibility and extensive software resources are provided. Major developments focussed on a doubling of the number of available workstations which required the development of two new laboratories and the associated infrastructure together with the vertical integration of all Faculty course material (480 individual courses). This enables a seamless transition of the 1st level student into the 2nd and subsequent years of their undergraduate program. For the period 1999 to mid 2003 student use has grown from just over 1000 to in excess of 4000 students visiting the Centre on a weekly basis.

The Interactive Learning Centre is designed to be a ‘home away from home’ where students learn in a formal or informal setting, mix socially with other students in a relaxed, visually stimulating environment and feel that this facility is their “home” rather than just another computer laboratory. This is particularly important given the size of the 1st year classes and the relative anonymity of the individual student. The students have ‘unlimited access’ to e-mail and the Internet in two designated time slots each day and at any time outside scheduled formal classes. Students also have direct access to printing, scanning and photocopying facilities within the Centre. To encourage a community spirit, the students have established a computer games club. In return for ‘super user’ privileges, the members of the club assist in the management of the facility, providing over-the-shoulder and technical assistance to the students using the facility.

The iLC provides the ideal environment for students to access the course web sites. Each course web site is a comprehensive communication tool which provides access to all information relating to the course: lecture notes, assessment details, contact details for lecturers and importantly “Bulletin board” and “What’s new?” facilities for student-lecturer, student-student communication.

Creating a supportive learning environment

Important human factors shaping the learning environment for our 1st year biology students include: the number of students (~1000); the diversity of their backgrounds, career aspirations, motivation to study biology, work, family, and travel commitments and English language skills. Despite the size and diversity of our class, we are committed to engaging all students in the excitement of the new biologies.

A primary focus has therefore been to enhance the quality of the student learning environment in the biology program. Investigations of the 1st year experience at The University of Queensland, undertaken through the BACS Faculty, and informed by national studies (eg. McInnes, et al & 1st Year Experience Conferences), consistently indicated a number of issues which impact on students’ learning experiences and outcomes. The three we have particularly sought to address are the students’ needs:

- for personalisation from first contacts with the University
- to feel part of a learning community
- to be part of a stimulating learning environment - taking into account the needs of high achieving
students and those with a significantly lower level of achievement.

We have developed some core strategies to meet these needs including a major role in welcoming students on their first day at the university to providing ongoing academic advice, support and mentoring. The faculty takes this role very seriously and has committed significant resources to provide and extend these services. In addition to these more general strategies, the 1st Year Biology Team have developed some core strategies that are designed to meet the specific needs of our 1st year students. These include PASS, learning guides and the Interactive learning centre.

**Peer Assisted Study Sessions (PASS)**

PASS is a central component to the first year experience and forms an important part of the 1st year experience. PASS is a voluntary study program using small, collaborative groups led by a pair of 2nd or 3rd year undergraduate students working as a team. PASS has proven of value to both high-achieving and less able students, and meets the learning and social needs of 1st year students more effectively than conventional tutorials because of its informality and fun. PASS creates a sense of community, provides a stimulating learning environment and brings learning back to a more personalised level. Over the past two semesters, 152 groups have met each week with an average group size of 20 students, facilitated by 163 student leaders. With approx 1000 1st year students. It is important to note that the PASS sessions are provided in addition to the formally scheduled classes of lectures, labs and practicals.

PASS team

In PASS, the team approach allows course content presented in lectures to be discussed and demystified. PASS coordinators and student leaders design structured activities as a team, to allow students to practice and construct their own knowledge. PASS leaders not only provide students with the team developed exercises but are free to develop their own student activities.

Lecturers, leaders and coordinators meet regularly to discuss the extent to which course objectives are being met. These team meetings are a valued source of information and reassurance for both leaders and lecturers: lecturers are given feedback from leaders and lecturers provide guidance to leaders concerning course content changes or directions to take in the structure of learning activities.

A unique feature of our PASS program is the availability of activities designed by previous leaders which current leaders can use or adapt. By being able to build on the knowledge of past leaders and by working together in pairs, leaders can now create their own activities to best address the specific learning needs of their students. Practically, this team effort produces a proven and effective student centred learning environment. The involvement of high quality undergraduate students in such responsible roles as PASS leaders is an innovative approach at UQ. It is also practical as they represent a teaching resource that has not traditionally been utilised. It is not a one-way street. The PASS leaders gain useful employment and teaching experience.

In PASS, when first year students are familiarly grouped together in school class sized study groups, in a socially interactive environment, learning can also extend beyond the purely cognitive dimension. Students can engage with the discipline through the practice of this new ‘language’ in the informal setting of PASS. This engagement, or perceived ‘ownership’ for the course, has a positive effect on student attrition, with fewer students tending to drop out of the course, or tertiary studies altogether. As students gain some control over their own learning from attending PASS, they are more willing to tackle more conceptually challenging learning tasks in future years of study, knowing that they are building on a solid grounding of the vitally important first year foundational material. Teaching can proceed more smoothly, with student learning difficulties alleviated to a great extent by students studying in PASS, and activities in PASS supporting the constructive alignment of curriculum objectives with any on-going course assessment. Participation as a PASS leader is a rewarding experience for 2nd and 3rd level undergraduates. They develop valuable teaching skills, improve their own knowledge and understanding, and interact closely with academic staff.
Learning guides

Learning guides were introduced in 2001 to provide 1st year students with a paper-based ‘personal tutor’ for each biology course. The guides focus on “critical concepts” contained in lectures or blocks of lectures. Importantly the guides direct students to other available learning resources that supplement the lectures. Through the provision of student-created learning activities, the guides are leading the students through the initial skills of self-directed learning. This ‘personal tutor’ approach is also designed to relieve the feeling of isolation felt by many first year students. The development of these guides has been a collaborative venture with the PASS leaders and educational designer. The PASS leaders provided most of the activities, links and cross-references as well as personal insights into the 1st year experience. (See Supporting Material for some examples)

Learning guide team

Our commitment to developing and promoting student learning is also apparent through the introduction of course-based learning guides. The Learning Guides provide an excellent example of an innovative and practical approach to teaching large 1st year classes. Learning Guides were introduced in 2001 to provide 1st year students with a paper-based ‘personal-tutor’ for each biology course. Importantly the guides ‘direct’ students to relevant available learning resources which supplement specific lectures. These resources may be textbooks, research papers, websites, study hints, relevant laboratory practicals or videos, and cross-referencing to other sections of the course where complementary material is being learnt. Through provision of student-created learning activities and study hints, the guides are teaching the students the initial skills of self-directed learning through modelling effective methods and approaches to learning and study. This ‘personal tutor’ approach is also designed to relieve the feeling of isolation felt by many first year students, and optimise their learning by guiding their use of the available resources.

The Learning Guides are an important part of the overall approach taken in this highly collaborative teaching initiative of the Faculty of Biological and Chemical Sciences - where the success of this approach is greater than the sum of its individual parts. In particular the Learning Guides fit effectively within the aims of the PASS program and integrate to increase learning benefits for the students. Where the PASS program provides a small-class environment for face-to-face interactions, the Learning Guides then enable students to ‘take home’ with them access to study hints from PASS leaders and critical concepts pin-pointed by lecturers from specific lectures. The Learning Guides are just another example of the success of that team teaching approach - they are a student-focussed resource within an overall integrated approach.

Interactive Learning Centre (iLC)

One of the stated goals of the program has been to improve computer literacy in the context of biology. To meet this goal significant resources were allocated to implement a state-of-the-art computer facility specifically for 1st year biology students. Known as the Interactive Learning Centre, this 155 workstation facility is used to provide virtual laboratory practicals, and exposure to real-world applications of computing in biology from the first day the students arrive on campus. For example, the iLC hosts a sophisticated bioinformatics workshop which powerfully illustrates the application of computing to biology. The facility is also used for formative and summative assessment and to gather feedback using computer-based surveys.

In addition to the use for the iLC for formal contact, student are also encouraged to use the facility as a ‘home room’ - a place to meet, socialise and communicate, and is an important element of the learning environment we wish to foster. In 2004, we are introducing a new use for the iLC: the creation by each 1st year biology student of a personal portfolio of achievement, which is maintained throughout the student’s degree program.

In summary, the 1st year biology program is a highly collaborative and proactive team-teaching initiative of the Faculty of Biological and Chemical Sciences which fosters an innovative and integrative approach to biology as a central science. The members of the “Biology Teaching Team” represented here lead a much larger group of staff and students who are actively engaged in teaching, mentoring, review and managing the entire program.
3 Benefits of this approach for the teaching of large classes

The multi-dimensional team approach described previously provides a supportive environment for teachers and students alike. The combination of an innovative curriculum, a research-based context for learning, combined with PASS, the iLC and the Learning Guides creates an overall approach which is effective and a proven successful model for teaching large classes within first year. Through feedback, evaluation and responsiveness, the 1st Year Biology Teaching team continues to develop and refine a successful student-centred learning environment for 1st year biology at UQ.

The benefits include:

- promoting interaction between staff areas across different disciplines (for example, biochemists talking with anatomists, molecular biologists with ecologists, educational designers with researchers, second and third year students with teachers, etc)
- providing an opportunity for improved teaching practice through cross-fertilization of teaching ideas and professional discussions
- a forum for discussions of on-going curriculum content and reform, facilitating improved quality of curriculum for students
- providing a platform for further achievement and collaboration for teachers
- a valuable immediate feedback loop from 1st year students through PASS leaders to teachers and feeding back through into improved teaching to the 1st year students
- mentoring of junior staff by experienced teachers
- a structured approach for linking critical science concepts (through the curriculum) across to current cutting edge-research (through individual teachers). For the students this means optimizing their exposure to the best of UQ biological research for which UQ is renowned.

5 Degree of student satisfaction with this approach

The program has been extensively evaluated both informally and formally over the past 5 years.

“fun, relevant, interesting...the lecturers were cool”
“the research examples that were shown through lectures helped in the understanding of the material”
“very informative, lectures well structured with additional, useful information (research examples) detailing more specific topics”
“lecturers to be commended on helping students understand objectives”
“loved the last 3 special topics lecture - really shows where a science degree could take you”
“interesting material, presented with enthusiasm, lecturers who can relate lecture
6 Success of this approach based on formal and informal evaluations

Our 1st year biology teaching team has evolved over the past 5 years and we have made improvements in response to students responses and suggestions, evaluations and as part of the team processes where issues are raised through the different team processes.

The PASS program is evaluated each semester, attendance and grades are monitored and both the students and PASS leaders participate in surveys and focus groups. Several reports have been written over the years and papers have been presented at national and international conferences. It is regarded as one of the best examples of a PASS program in Australia for the quality of the student learning outcomes, the ongoing and sustained nature of the program, and the numbers of students who regularly participate. The PASS coordinators are regularly invited to other universities to discuss the 1st year Biology PASS program.

The team structure means that by the very nature of its organisation, the team is continuously recursive nature of the meetings and team processes. Mean that all of the 100 or so people involved in delivering the program are informed, engaged and responsible for the success of the program. The success of this team approach has been recognised in the national AUTC project on large class teaching.

Students are regularly surveyed through the formal CEVAL and TEVAL student feedback questionnaires. Research carried out by TEDI has shown that student satisfaction ratings generally decrease in large classes, are lower in 1st year classes than in later years and are generally lower in sciences when compared to arts or humanities. Our courses have gone against these international data trends with satisfaction ratings consistently rising over the past 5 years in the context of increasing student numbers. For example, the student rating of the Animal Biology course have steadily improved (albeit with a slight decrease in 2002) over the 5 years. Between 300-500 students take this course in their 1st year science program.

Each year, the CEVAL results of all courses are reviewed by the Coordination and Course teams. Any actions that are identified are planned for implementations the next time the course is offered or if it is a more general issue, appropriate steps are taken in the next semester.

Changes made over the past few years in response to feedback and evaluation include the introduction of the learning guides, better eLearning support and increasing PASS to 5 of the 1st year courses. This has resulted in a significant increase in student satisfaction, which has taken place in an environment of increasing student numbers.