

UT College of Natural Sciences

Information Technology Vision Plan

2009-2010

Note to the reader: This report is intended to be read on-line. Hyperlinks located throughout the document provide access to in-depth information, narratives of specific projects, and photographs of facilities located on the College of Natural Sciences web site.

Overview of Facilities

The [College of Natural Sciences](#) is expansive. On the main campus, we occupy thirteen buildings and have a presence in seven more. Our facilities include [McDonald Observatory](#), [Lady Bird Johnson Wildflower Center](#), [Texas Memorial Museum](#), [Brackenridge Field Lab](#), and the [Marine Sciences Institute](#). All of our facilities enrich the educational experience of our students.

Technology Classrooms

The College of Natural Sciences has 54 general purpose classrooms, all with standardized teaching technology. Additionally, departments have more than 33 classrooms and seminar rooms, most of which are equipped with standardized technology. Web resources: [inventory of general purpose classrooms](#) and [inventory of departmental classrooms](#).

Computer Labs

The College of Natural Sciences has 31 computer labs with about 750 computers. Of these, four labs (WEL 2.302, RLM 7.306, ESB 101, and ESB 103) having a total of 177 computers are open to every UT student, regardless of major and current coursework. Web resource: [inventory of computer labs](#).

Science Labs

Students experience what they learn in the classroom in the college's more than 75 teaching labs, most of which include information technology. Computers are used to control scientific equipment, gather and analyze experimental data, and create and print lab reports. Web resource: [inventory of science labs](#).

Wired and Wireless Network

The College of Natural Sciences has the largest 802.11g (54Mbps) wireless network on campus, covering virtually 100% of its dozen buildings on main campus. More than 20 telecom closets filled with networking electronics provide 10/100 and gigE wired networking to classrooms, laboratories, and offices. Web resource: [network overview](#).

Specialized Facilities

Several departments, as well as the dean's office, have multimedia labs offering students access to high-end computers with specialized software, large format printers, color printers, and scanners. Most departments run their own servers, providing web space, file storage, and e-mail to students.

Maintaining Facilities

The College of Natural Sciences has been entrusted with millions of dollars of student fee money over the last decade, and we are dedicated to protecting that investment for the benefit of current and future students. Maintaining instructional facilities and repairing/replacing equipment as it ages is a huge expense.

Some examples: The college places more than 1,000 computers in front of students. With a four year life cycle, 250 must be replaced each year at a cost of around \$300,000. The college has more than 100 LCD projectors in its technology classrooms and science labs. Replacing aging projectors at a cost of \$4,000 each costs \$100,000 a year. Replacing projector lamps when they burn out costs more than \$50,000 per year.

The college funds two full-time staff and 25 student assistants to maintain its classrooms. We employ off-campus specialists to clean the fabrics and floors in our rooms, remove gum and food stains, and repair and repaint when needed. Web resources: [Classroom Maintenance and User Support Team](#)

Innovation

In addition to maintaining its existing facilities, the College of Natural Sciences uses ITAC funds to support innovative uses of information technology in its instructional programs. The college has leapfrogged traditional Podcasting and provided its students with recorded lectures that include multiple video windows in addition to audio. Students can now watch a recording of their instructor working a math or science problem on a document camera while listening to the explanation. Web resource: [Lectures on Demand](#)

Technology is enriching the experience of students in science labs. Cameras attached to microscopes allow the instructor to project the image from any microscope onto the projection screen for viewing and discussion by the entire class. Scientific equipment now interfaces directly with computers, so students in labs can focus on learning instead of transcribing and graphing data.

Natural Sciences leads the university in the use of student response systems, which allow faculty to ask students questions during class to identify misunderstandings or miscommunications. Every general purpose classroom is equipped with a radio frequency student response system from eInstruction.

Information technology provided with ITAC funds plays an important part in several innovative programs in our college, including the [Freshman Research Initiative](#), [UTeach](#), and the [Division of Statistics and Scientific Computation](#).

Natural Sciences' Role in Serving the Entire University

The College of Natural Sciences – not unlike the College of Liberal Arts – allocates a significant amount of its resources to students in other colleges and schools at UT. We teach physics for Engineering majors, chemistry for Nursing students, and calculus for Business and Economics majors. When we spend our ITAC allocation on “our students”, they are majors from across the university. For example, we just purchased 27 laptops to use in laboratories for a new sequence of science courses for Elementary Education majors. These laptops will never be touched by anyone but students in the College of Education. Yet, Education in no way contributes to their funding.

Most classrooms in the College of Natural Sciences are general purpose classrooms, used by students and faculty from across the university. The ITAC funding we spend on technology for these rooms and the classroom support help desk we operate benefit every almost every college and school at the university. Our three largest computer labs – with almost 200 computers – are open to students across the university. Our wireless network is used by the thousands of students who visit our buildings.

ITAC allocations to colleges that teach a large number of service courses and that manage university-wide resources are allocations to the entire university.

Synergy of Multiple Funding Sources

The College of Natural Sciences combines revenue from multiple student fees (including the ITAC fee, the CNS IT fee, and the CNS Equipment Fee) to accomplish projects that would have once been impossible. For every dollar of ITAC funding received, the college invests more than \$1.50 of its own IT fees.

ITAC provides the A/V technology in classrooms that are renovated using other fees. ITAC provides the computers that control scientific instruments in renovated teaching labs. ITAC provides the high-speed wireless networking in newly created student study area. Web resources: [renovation of Welch Hall auditoriums](#), [renovation of introductory Biology labs in Painter](#), [creation of student study areas](#).

Noteworthy 2008-2009 Expenditures

Our 2008-2009 ITAC funds are being spent largely as outlined in our 2008-2009 vision plan. While it is impractical to list every item purchased with last year's ITAC funds, a few large projects are worth mentioning.

- Five auditoriums have been equipped with Accordent systems that provide for recording, live streaming, and audio pod casting of lectures: WEL 2.224, WEL 2.246, WEL 3.502, WEL 1.308, and WEL 1.316.

- The first release of the Quest Learning and Assessment System was developed and deployed. More than 10,000 student course enrollments occurred during Fall 2008. Students are regularly using response pads to take in-class exams in Physics courses.
- Fourteen new undergraduate teaching labs in the School of Biological Sciences were created in the last year: six in Painter Hall, three in Bio Labs, and five in the Biomedical Engineering Building. These new labs were equipped with standard A/V technology and computers for the students and instructors.
- All computers in the Physics computer lab – which is open to every student on campus – were replaced with machines offering dual core processors, two gigabytes of memory, 22” widescreen monitors, CD and DVD burning capability, and 19-in-1 media card readers. 22” widescreen monitors were added to all computers in the Welch joint-use computer lab. Fifty new computers were deployed in undergraduate compute labs in the Computer Science department.
- Network electronics in Welch and Gearing Halls were replaced with state-of-the-art equipment that will ensure reliable network access for years to come.

Specific Funding Requests for 2009-2010

Classroom Recording Systems: \$150,000

After an extensive evaluation, the College of Natural Sciences has chosen Accordent as their provider for classroom recording systems that provide streaming video, pod casting, and recorded lectures. We currently have five auditoriums operational and over the next year plan to add systems to our remaining large general purpose classrooms: GEA 105, PAI 2.48, PAI 3.02, PAI 4.42, RLM 4.102, and WEL 2.122.

Software Licenses: \$90,000

As hardware prices fall, the cost of software licenses increases. We pay \$16,000 a year for a Mathematica site license, so that every student taking our courses can install this software on their computer. The software that interfaces with a single type of scientific instrument in an undergraduate lab can cost \$10,000. We teach courses that require students to use special purpose software, including statistical analysis programs and Adobe software. Since the university does not have a site license for much of this software, we pay per computer in our labs to provide this software to our students.

Replacement of Aging Computers: \$300,000

One quarter of our approximately 1,000 computers in computer labs, science labs, and technology classrooms need replacement each year. We budget \$1,250 for each PC and \$1,300 for each Apple.

Network Upgrades and Expansion: \$250,000

By virtue of our size, the College of Natural Sciences has the largest wired and wireless network on campus. Each year we must replace about one fifth of our network electronics and expand our network to meet growing demands. We expect to replace aging electronics in several buildings next year including . Each switch costs about \$3,000 and each wireless access point costs about \$1,000.

Servers, Storage, and Backup: \$160,000

In addition to the computers in our general purpose labs, we contribute to the cost of departmental servers used for instruction: web servers, file servers, database servers, mail servers, etc. The systems serve up class related information, allow students to apply for jobs, scholarships, and awards, and move email between students and faculty. We also contribute to the systems that back up the data on these servers.

Existing Technology Classrooms: Upgrades and Operation: \$250,000

Each year, we must replace about one quarter of the more than 100 LCD projectors in our classrooms. We also replace microphones, control systems, touch screens, VCR/DVD players, etc. And, each year we use hundreds of projector bulbs and thousands of batteries.

Quest Learning and Assessment System: \$220,000

The attached detailed proposal for Special Funding for IT Innovation to Support Student Learning describes the Quest system and our request for funding for the second year of development.

Total of above: \$1,420,000

Request for Funding for IT Innovation to Support Student Learning

The QUEST Learning and Assessment System

The *Quest Learning and Assessment System* (<https://quest.cns.utexas.edu/>) has now been in use for a full year. Developed with ITAC funding, this system enhances the educational experience of students in Physics, Mathematics, Chemistry, and Biological Sciences. Outside the College of Natural Sciences, several hundred students are using Quest in Electrical and Computer Engineering courses.

The following statistics for Fall semester 2008 illustrate the impact of Quest at our university:

11,000 student-course enrollments (a student may be enrolled in multiple Quest courses)
135 course sections taught by 62 instructors using Quest
More than 3,500 assignments and exams created using Quest

Students use Quest to retrieve homework assignments, submit solutions to problems, and then view correct answers and explanations. Students take in-class exams generated by Quest and – at the option of their instructor – use hand-held response pads to enter their answers. Using these response pads, students can know immediately how they are performing on the exam and can be given a chance to rework missed problems for partial credit. Usually within two hours of taking an evening exam, students can see the solution to the exam with explanations of correct answers, their grade and which problems they missed, and statistics on class performance. Grades may also be downloaded to Blackboard by instructors.

The database of problems available through Quest contains more than 60,000 templates which – with the inclusion of randomly generated values – can produce an almost unlimited number of different problems for students to solve. This database has been under development for more than a decade and continues to be enhanced and expanded. It is arguably the largest and best database of its kind in the world for the teaching of undergraduate science and mathematics.

While the current version of Quest has positively impacted the lives of thousands of UT students, the future potential for Quest to help students succeed at UT is enormous. Over the next year, year we propose to evolve Quest in several directions described below.

The Need for Quest

The College of Natural Sciences develops its own software systems only as a last resort, when no other practical alternatives are available. This was the case with Quest. Only two or three other universities and a few book publishers have created systems that are somewhat comparable. Commercial systems are oriented toward the more lucrative market of high schools and community colleges, and fall short of the needs of a top tier university. Other systems do not support the extensive mathematical notation and graphics needed for science and mathematics. And, our content – the database of problems – is years ahead of that found in any other system. Quest should not be confused with systems like Blackboard, which do not have assessment and learning as their goal.

Supporting Teaching and Learning Styles

Quest is not intended to impose any particular teaching or learning style. It will instead support the highly diverse styles of our teachers and students. Faculty may ask students to solve a Quest problem at various times during a lecture to assess if they have the needed background, to determine if they have studied the assigned material, to see if they can apply concepts just taught, or to discover what parts of the lecture need further clarification. Students may use Quest before taking a course to assess their readiness or to make up deficiencies in their background, or they may use Quest during a course to drill themselves on a particular type of problem, to build their confidence by taking practice exams, and to guide their studying alone or in groups. The university may use collections of Quest problems to place students in the appropriate course of a sequence or to verify that students are ready to advance to the next course. All these uses have one thing in common: increasing the success rate of our students in our courses.

Serving the Entire University

Although developed in the College of Natural Sciences, Quest is a tool for the entire university. Thousands of students having majors outside the sciences and mathematics are already using Quest. Indeed, the heaviest use of Quest is in service course such as general chemistry, introductory biology, and calculus. Other departments are using Quest in their courses or have expressed an interest in using it. Natural Sciences will host any university course on its Quest servers and will support any faculty members wishing to create content or use Quest in their courses.

Integration of Digital Content

An increasing amount of digital content is becoming available for use in undergraduate instruction. E-books are replacing printed books; classroom lectures are being recorded for review by students. Quest will not only help students assess their strengths and weaknesses, it will guide them in learning what they need to know. A student unable to work a problem in Quest will have the ability to click on links that take them to the relevant passages in e-books or to the sections of recorded lectures where the best teachers explain difficult concepts. Infrastructure will be added to Quest allowing faculty to create learning modules that bring together digital media on a given topic. Students will be able to watch videos of scientific experiments, see animations of complex processes, and access other resources available on the web.

Exam Preparation

Students often see as a key to their success in a course the ability to obtain and work exams created by their professors in previous semesters. For years this need has been met by fraternities and tutoring services which amass files of old exams for courses. But, access to these exams require that students either be a member of an organization or pay for a service. Quest can level the playing field by making available to students a large number of practice questions on specific topics. For example, a student preparing for a calculus exam may wish to practice problems that require integration by parts. Quest's ability to generate random problems gives the student a

virtually unlimited number of problems to work, along with the correct answers and explanations of how to work the problems. Faculty may also create self-contained practice exams for the students to take.

Interactive Response Mode

In addition to retrieving an entire assignment from the web, the next version of Quest will allow students to retrieve individual questions and provide responses one at a time. This will make possible a number of new uses of Quest. Exam preparation, as described above, is often best done question by question until the student feels confident they can work that type of problem. An e-book or learning module may contain a link to a problem using the concepts just described. An interactive response mode in Quest will allow exams to be given in testing centers instead of in large auditoriums at night. Placement and assessment exams can also be given in testing centers, ensuring students enroll in the most appropriate courses and master the material before progressing to the next course.

Analysis of Student Performance

Quest has the potential to analyze the performance of a student on a series of problems, to assess the student's strengths and weaknesses, and to guide the student to digital content that will help them address their weaknesses. To accomplish this, problems must be tagged with the concepts and skills required to solve them, and statistics must be kept for every problem solved correctly or incorrectly. Students can do self-assessments that will help them spend their study time more efficiently. And, instructors can monitor class performance, allowing them to emphasize in lectures the concepts with which the students are having the most difficulty.

The Big Picture

When fully evolved, Quest will impact every aspect of students' learning and success in courses. Before the first class day, students will use Quest to verify that they have the needed background for a course. Quest will interface with e-books and recorded lectures to help students master course material. Nighttime exams will be replaced by visits to Quest testing centers at the convenience of students. With statistics from Quest, students and instructors will be able to concentrate their efforts to achieve the greatest benefit. And, should university accreditation require it, students can use Quest to demonstrate their knowledge at various times during their education.

2009-2010 Proposed Budget

Continued progress on Quest requires programming and support staff, faculty time to expand the database, and maintenance of the servers on which Quest is hosted.

One full-time programmer to design and implement enhancements to the Quest system
\$ 90,000

One full-time staff member to administer the system, to provide help desk support to faculty and students, and to manage the content of the database

\$ 50,000

Summer support for faculty to develop question banks for new courses and support for graduate students to assist them

\$ 80,000

TOTAL BUDGET

\$220,000