What is BioQUEST?
An Open Letter to a Distant Colleague

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Dear Colleague,

So you have seen the BioQUEST CD-ROM and you are wondering what all the fuss is about? "What is BioQUEST?" you ask. The following is a short answer. I am writing this on the same day as I participated in the student poster session for a microbiology laboratory simulation. The students vigorously presented and defended their results in the true BioQUEST manner, exhibiting the vibrancy that comes with presenting a problem that they chose and solved. This may color what I have to say.

Let us first distinguish BioQUEST, the CD-ROM (The BioQUEST Library) and BioQUEST, the educational philosophy.

Their CD-ROM is a useful tool, a piece of laminated plastic and metal. As with most tools, it takes training, time on the job, before one can find the right feel and get the most out of it. My apprenticeship developed during the BioQUEST Summer Workshops of 1994 and 1995 at Beloit College, Wisconsin. There I was drawn into the BioQUEST way of teaching science through immersion in the method at the hands of some of its earliest (and some of the latest) "practitioners."

The BioQUEST Curriculum Consortium is a loose but dedicated international group of biology educators (mostly at the university level), computer programmers, philosophers and poets. With origins going back over fifteen years, they have received substantial support from the Annenberg/CPB Project, NSF and others. 1995 saw the production of the third edition of their CD-ROM, available from the University of Maryland ePress Project. The hub of this diffuse wheel of activity is with a team led by John Jungck at Beloit College, Wisconsin.

So the BioQUEST approach is more than a set of related computer programs: it is a more complete way of approaching the learning of science. It seeks to prepare future scientists, technicians and their ilk by immersing them in a strong, supportive, challenging environment that simulates the real preoccupations of scientists. It should also provide others, nonscientists, with an accessible, insightful window on the world of science.

BioQUEST builds upon the forward-looking features of frontier research without denying the importance of understanding the underlying textbook science inherited from the past.

A deceptively simple catch-phrase captures the essence of the approach. BioQUEST's 3Ps are Problem Posing, Problem Solving and Peer Persuasion, which together serve as a teachable, learnable model of science education.

What do successful scientists do? They must examine their area of interest for suitable problems to tackle: problems that are within their grasp but stretch their resources. They must choose a path (or paths) to the solution of the chosen problem. They often must defend their choices of problems and solutions. They must execute the solution process, adjusting to the almost
inevitable roadblocks erected by chance or Nature. They must defend their purported solution in the company of their peers, for scientific knowledge is not "the Facts" but rather the common understanding of scientists in the particular field under examination.

This is what is distilled into the "3Ps". This is what we ask our students to do. And they love it. Success with the BioQUEST approach requires that teachers provide their students with a rich environment to explore, to question, to document, to internalize and to explain to others. It asks teachers to become co-experimenters and mentors rather than be the dispensers of knowledge. It encourages collaborative learning while placing the onus on the individual to participate and contribute.

Putting the BioQUEST approach fully into action means putting the student through an apprenticeship in science. That apprenticeship draws the student into identifying and solving problems they value in an environment they control.

Although wonder and discovery fuel the process, this is not the discovery learning which expects the student to personally evolve through all of Western scientific history using a hand lens and a few coils of wire. Instead, it builds upon the present and brings glimpses of the future. It encourages the student to go beyond textbook science and embrace the unknowns inherent in science-in-the-making.

One key BioQUEST strategy has been to harness computers to provide environments for this kind of learning. A growing library of programs tackle subjects as disparate as physiology (e.g. Axon, Cardiac Construction Kit), evolution (e.g. Inherit, Evolve), ecology (e.g. Biota, Environmental Decision Making), biochemistry (e.g. Sequencelt!, Purifylt! etc.), genetics (e.g. Genetics Construction Kit or GCK), and microbiology (e.g. microGCK) grace the 1995 CD-ROM. Many of the programs share interface features, which eases the computer-related learning burden. These programs are identified as having undergone differing degrees of testing in the hands of students. Some work extremely smoothly, others await further criticism and polishing.

Each computer program is crafted to provide a rich, safe, learnable environment for the investigative process. Experiments that would exhaust the time, space and funds of graduate programs can be performed in a matter of hours. The power our students sense as they manipulate these virtual worlds drives many of them well beyond our usual expectations. Remarkably realistic results, complete with opportunities for "experimental error," are attainable and in many of the programs each run is as unique in its outcomes as its real world research equivalent.

Using the BioQUEST approach with the BioQUEST software provides students with environments in which they can individually "own" problems and their solutions.

I have used several of these programs in small groups and labs of twenty, in courses for science students at several levels and those for non-science students. One of their strengths is that their use can be tailored to the clientele: they are not locked to one level of sophistication. Used the way they were intended, as collaborative learning environments, they demand relatively few computers: two or three (or more) students can share one machine at a time.

Real success with these programs depends upon a thorough appreciation of the 3Ps. My first attempt to use Environmental Decision-Making, before going to Beloit College, left something to
be desired. Now I am much more confident that valuable lessons are being learned in the new computer lab Champlain St. Lambert has established primarily for Biology and Creative Arts.

I feel that the best way for a teacher to internalize the approach is to really experience it: to be thrown into tackling the problem-posing, problem-solving and peer persuasion with the right tools, like-minded peers, and remarkably little philosophical introduction. Under the right conditions, the approach is absorbed through the activity itself.

That way, one can look at the problem, while keeping an eye on how one approaches the problem, while in turn considering how one might teach the process. These need not be simultaneous processes at the conscious level; they certainly were not for me during my first introduction. Only now is this "meta-meta-problem" coming into fine focus.

Given that neither the databases appropriate for these activities, nor the problems they suggest, are trivial, this process takes TIME. I am talking about up to several days for the complete meal, perhaps less for the hors d'oeuvre.

The 3Ps can be applied to otherwise conventional lecture and laboratory learning with advantage. For instance, I have adapted an Insect Diversity exercise so that the life cycles of several species of insects become the rich data field. By the end of the exercise each group has developed a fairly in-depth analysis of some aspect of insect life cycles which they share with and defend to their peers in the form of a poster session.

Moreover, the approach is not limited to BioQUEST software alone. I have been using MAGE, which displays molecules from Hydrogen through complex proteins and nucleic acids in a form that permits three-dimensional rotation, multiple measurements and the automatic calculation of angles. Students are introduced to the program, which does not take long to learn, and are then asked to explore their choice of molecules and "come back" with a useful presentation focusing on some key aspect(s) of what they have found. Believe me, molecules are much more fun in 3-D and many aspects of molecular structure which are a struggle to learn from 2-D textbook figures take on substantial perspective when examined this way.

Another program that lends itself to this approach is The Blind Watchmaker, by Richard Dawkins. I have used this computer icon breeder to encourage exploration of evolutionary theory in a non-science course with great success.

If you have made it this far, you know that I am an enthusiast. This letter, then, is my latest exercise in persuasion. You be the judge.

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