



Adventures along the road to inquiry: The journey so far

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"It's a dangerous business ... going out your door. You step onto the road, and if you don't keep your feet, there's no knowing where you might be swept off to." — J.R.R. Tolkien

Life science majors at the University of Maryland take an introductory sequence of two courses that are prerequisites for most upper level courses. BSCI 105 (cell and molecular) and BSCI 106 (ecology and evolution) are independent of each other, yet both have evolved learning goals that go beyond disciplinary knowledge to higher order skills of reasoning and synthesis. The labs have been moving towards an emphasis on science as a process, in parallel with national trends, and a concerted effort has been made to transition away from traditional exercises to an open inquiry model. Past lab exercises in both courses have been largely fixed inquiry with a focus on following protocols, data collection and analysis, and support of lecture topics. Over the last two years a coordinated effort has been made to change the labs to support open inquiry, focusing on hypothesis testing and experimental design. This Spring was the first semester with full implementation of these new goals.



Both courses shared challenges at an institutional level. As a nationwide trend towards adding inquiry-based labs into introductory courses arose, the administration gave its support to the courses to push for these changes. The reaction from the lecturers involved with the courses, as well as those in the higher level courses, was mixed. Undaunted, the Lab Coordinators and Supervisors from the two courses pressed on with the development of the new lab curricula. As we discussed what these changes would look like, it quickly became clear that the needs of the two courses, and the paths they would take to get there, were very different.

"Not all those who wander are lost."
— J.R.R. Tolkien

BSCI105 - A Gradual Leap

- Historically only a peripheral tie-in to the lecture material. Lab complements lecture, rather than supporting lecture.
- Opportunity to rearrange the lab material with only minimal concern for the impact on student performance in lecture.
- Lab exercises gradually shifted toward the end goal over two year period, integrating scientific method throughout the semester and partitioning material into three units
 - Tools of the Trade
 - Protocol Development
 - Molecular Biology Research
- Biggest transition was redesigning a large, multi-week fixed inquiry lab into an open framework.



Lessons After a Semester

- TAs need to be on board and confident
- Students need to understand goals of inquiry
- Students start out timid, but quickly gain confidence
- Biggest lesson: **Students can do it!!!**
- Biggest surprise: **Students liked it!!!**

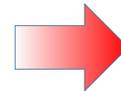
"Little by little, one travels far"
— J.R.R. Tolkien

The Future...

- Continue to improve exercises
- Increase/focus TA training
- Add more options to open inquiry activities
- Better integrate scientific method material throughout the course
- Help lecturers to integrate lab and inquiry content into lecture portion of course
- Assess higher order skills
- Evaluate the course/learning outcomes
 - How?

Fixed inquiry DNA lab sequence

Week I: Miniprep and Electrophoresis
 Week II: PCR
 Week III: Bacterial Transformation
 Week IV: Sequencing and BLAST



Open inquiry multi-week project

Week I-IV:
 • Scenario-based based problems
 • Review Protocols & Applications
 • Design and conduct experiments
 • Update design and repeat experiment *or*
 • Design and conduct follow-up experiment
 • Present results in poster session



BSCI106 – A Content Conundrum

- Faced with competing pressures: continue to use laboratory time to directly support lecture material and incorporate more of the scientific process.
- First semester of this integration proved to be difficult
- Students perceived the exercises as two separate things.
- Many felt that the Scientific Process material was less important and blew it off in lab.

Inheritance & Evolution

- Natural Selection
- Fixed inquiry experiment
- Meiosis
- Population Genetics
- Data Analysis

Diversity of Life

- Tree Thinking
- Plant Diversity
- Animal Diversity
- Hominid Evolution

Ecology

- Stream Ecology
- Aquatic Ecology
 - Fixed inquiry experiment



Added Scientific Method material to all of the labs

- Doubled Tree Thinking
- Replaced Plants, Animals, and Hominids with museum activity

Transform Aquatic Ecology to open inquiry experiment



TA Comments

- "They were mostly very excited to have more autonomy and come up with an experimental design on their own. I think they enjoyed this more than following procedures because they were directly involved in their experiment."
- "I liked the giant class experiment because students were more engaged and it gave them an opportunity to apply what they have been learning in lab and lecture."
- "Some really enjoyed it and felt like they understood the lab and process better by having to design it."
- "They seemed more invested than they did when it was a pre-planned lab."
- "Giving them flexibility in designing (their experiment) leads to a feeling of "ownership" of their education and project."

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