

ComGen: The **community college genomics** research initiative mini-graduate school experience

M. Gita Bangera¹, Chris Shelley¹, Jim Ellinger¹, Lynne Sage¹, Robin Jeffers¹, and Andrea Gargas²
¹Bellevue College, Bellevue WA; ²Symbiology LLC, Middleton WI



BELLEVUE
COLLEGE

Background

Education needs to adapt to cope with the avalanche of new information that teachers and learners have to deal with and the rapid rate at which it is generated. Teaching all the content will soon become impossible. The emphasis needs to be on guiding students to be self-directed learners comfortable in a changing environment, with confidence to deal with ambiguity and to make decisions with incomplete information.

Bellevue College's ComGen is an innovative program that teaches the skills of self-directed learning, critical thinking and analysis in a mini-graduate school experience for community college students.

ComGen's students partner with USDA/ARS Root Disease and Biological Control Research Unit to sequence the genomic library of the patented biological control bacterium *Pseudomonas fluorescens* strain L5.1-96 and interact with graduate students, post-docs and world-renowned scientists.



Teaching Methods

Self-directed learning

- Prerequisite only a basic biology course
- Socratic method with almost no lectures
- Students collaborate on learning concepts and techniques
- Connect new protocols to underlying theories
- Real-world lab product assessment

Original Research

- Authentic problems
- Unknown answers
- Lab notebook as documentation
- New discoveries

Journal Club

- Pairs or small groups of students analyze current primary research articles for presentation to the class

Internships

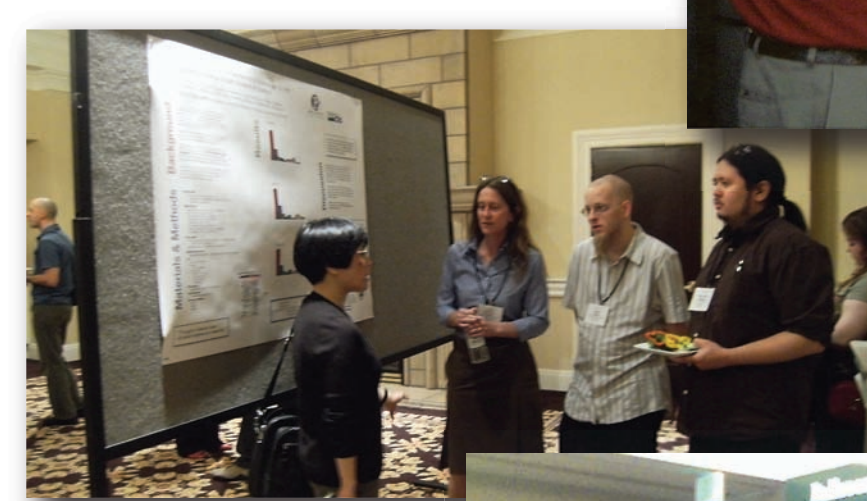
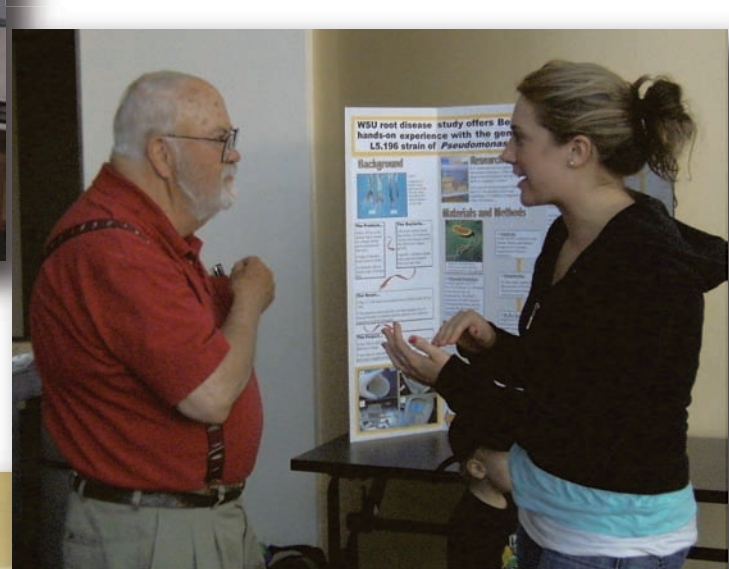
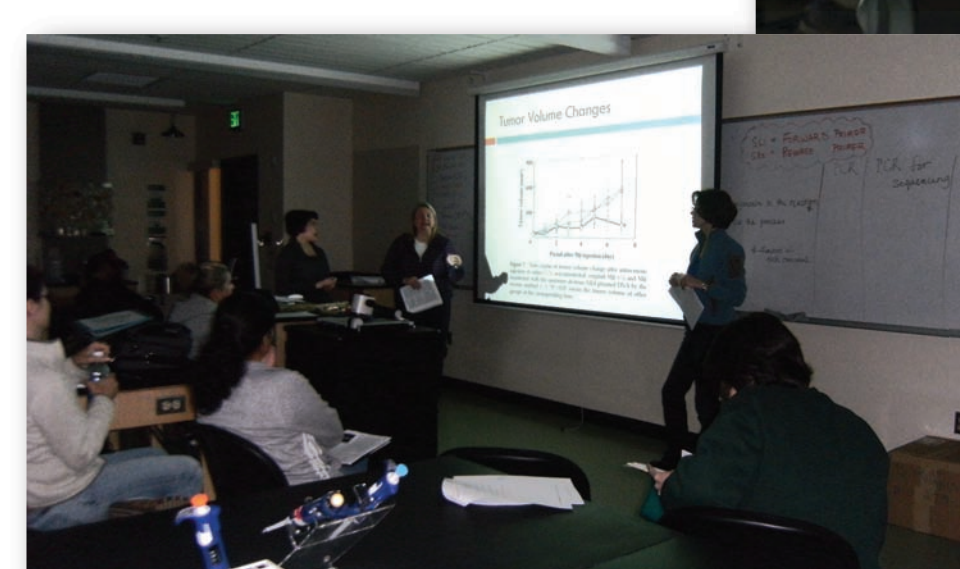
- Extend course knowledge
- Generate collaborative data with world-renowned scientists

Research Presentations

- Design and production of posters
- Presentation and defense of project at USDA Minisymposium

Scientific Meetings/Conferences

- Practice optimizing the conference experience
- *Plant Growth Promoting Rhizobacteria Intl, April 2009
- *USDA ARS/WSU Minisymposium June 2009
- American Association of Pharmaceutical Scientists, June 2009
- *Botanical and Mycological Societies of America, July 2009
- *American Phytopathological Society August 2009
- *Conferences where students presented posters



Assessment

Student-Learning Assessment Tools

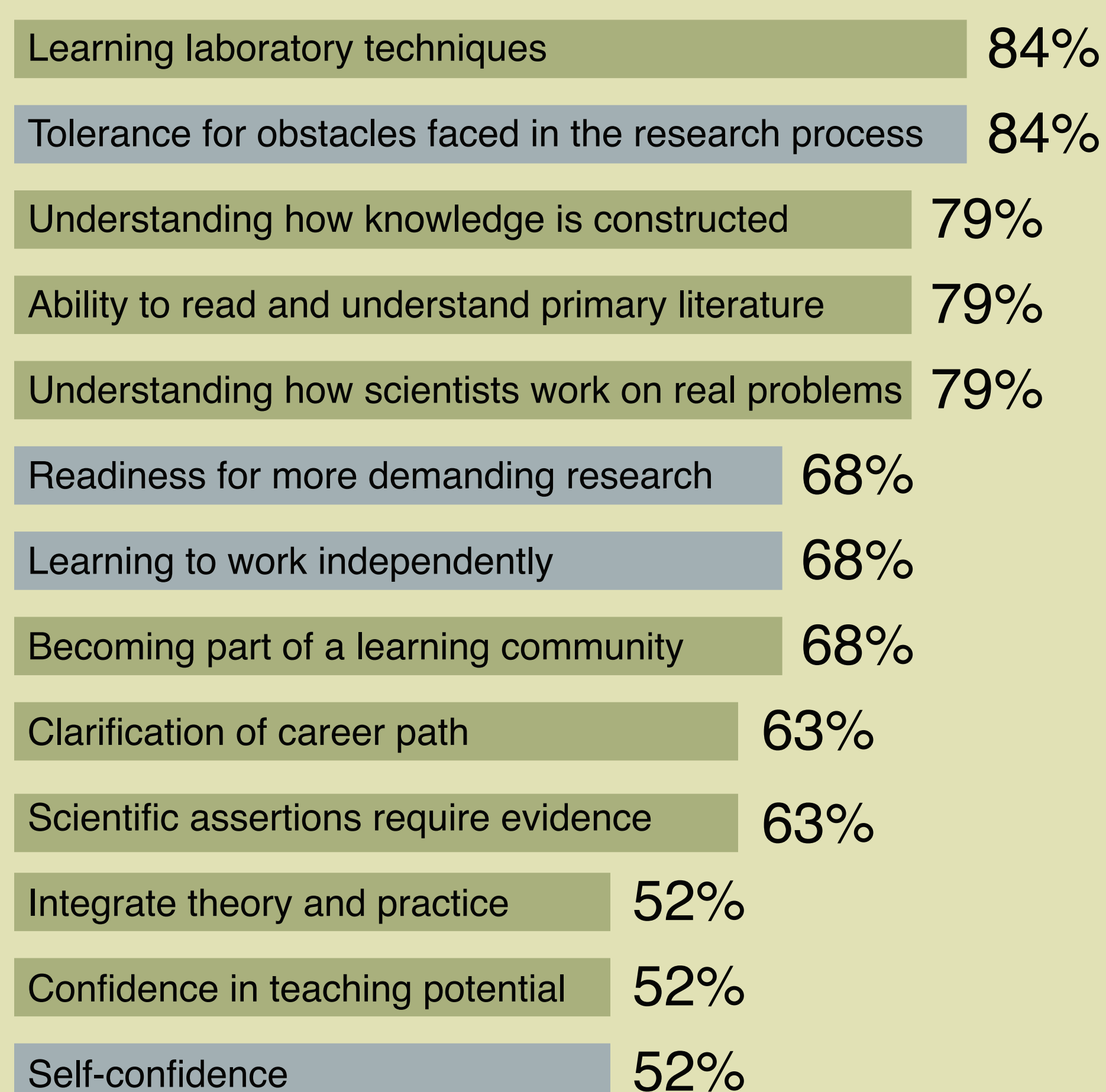
- Take-home exams
- Oral Exams
- Student Portfolios
- Drawings
- Protocol analyses
- Lab notebook
- Poster

Student-Impact Assessment Tools

CURE Pre- and Post-surveys

With permission from Dr. David Lopatto of Grinnell College, designer of the original CURE (Classroom Undergraduate Research Experience) survey and Dr. Sarah Elgin of Washington University, who produced a genomics-oriented version, we developed our new survey incorporating elements of each.

Of 20 possible benefits at least 50% of students rated gains on these 13 as "large" or "very large:"



Items in blue are behavioral characteristics important for student success. "Understanding how knowledge is constructed" suggests taking a "meta" stance to the material or activity — an intellectual move typical of expert behavior. Overall, perceived benefits relate to feeling at home or as if belonging to a community of practice — the scientific community.

Students overwhelmingly found *Journal Club* worthwhile and articulated how it was improved them as students, citing:

- Thinking critically
- Learning and then using technical vocabulary
- Familiarizing themselves with cutting edge research
- Becoming the expert as they taught the article to others

Every student found the *Research Experience* worthwhile for the hands-on learning it provided them.

Elements of the work that showed up regularly in comments were:

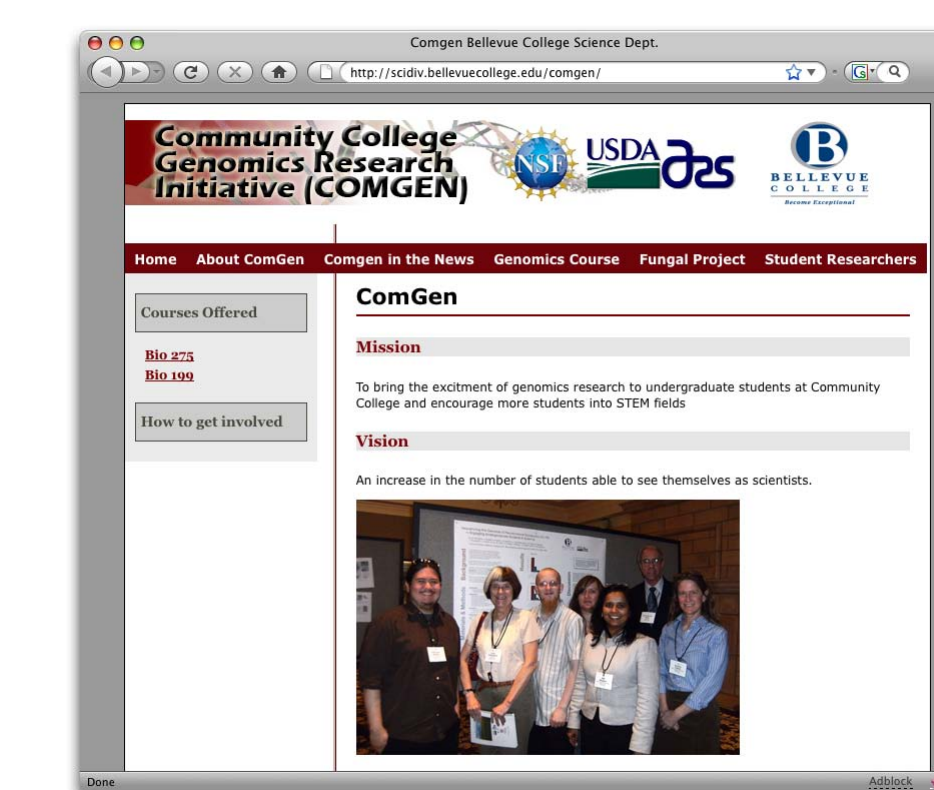
- Learning protocols (some called these procedures)
- Analyzing results
- Troubleshooting failed experiments

"I never thought frustration could be fun."

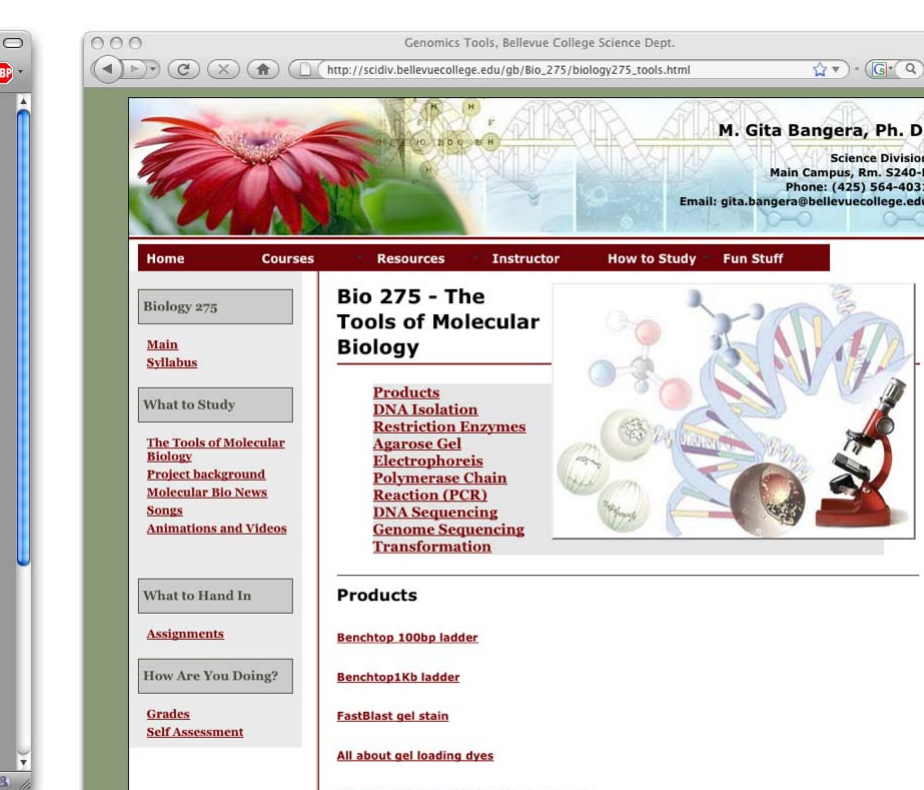
Dissemination

- Conferences Northwest Biology Instructors Organization, May 2008 & 2009
- American Association of Colleges and Universities Nov. 2008
- Course Curriculum and Lab Improvement-PI (NSF) Aug. 2008
- Botanical and Mycological Societies of America, Jul. 2009

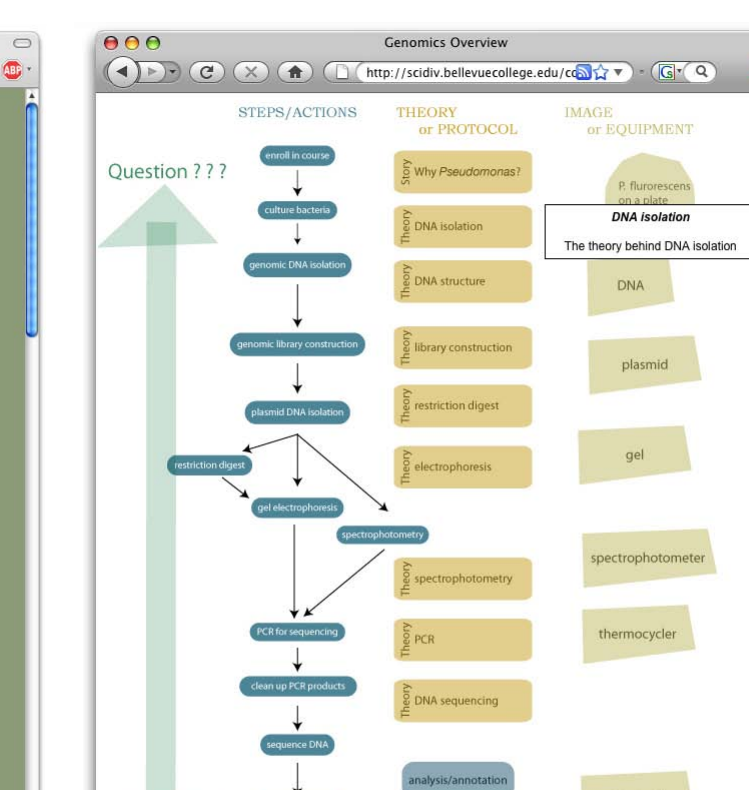
Web Tools



ComGen front page



Course web site - Bio 275

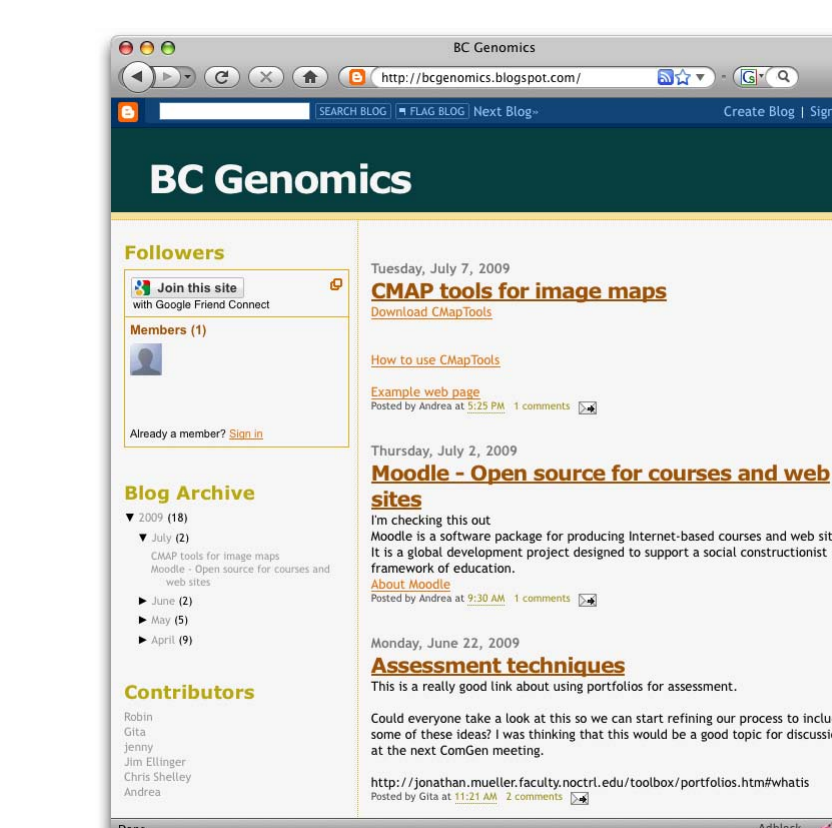


Course overview, clickable map

Modules



Modules on DNA plasmid isolation



Blog for curriculum discussions another option is to develop a course wiki)

Challenges: Responses

- Student recruitment: Email, social networking sites, course transfer agreements with local universities
- Assessment of student learning: Refine portfolio requirements
- Training instructors: Focus on up-and-coming graduate students and post-docs

"I came in as someone who did not know much about DNA sequencing to now feeling confident enough to teach people not only about the lab protocols but the reasons and background materials."

"I have learned to reason through what is going on during a procedure- chemically and physically how the procedure works. I have also learned not to gloss over something that appears strange or incorrect, rather, I welcome them as wrinkles that need to be explored and that will lead to new understanding."

Discussion

Students progress from knowledge consumers to *knowledge creators* through transformative hands-on research experiences. Students are emerging as self-directed learners as evidenced by the number of hours spent in the lab outside of class time and on weekends, and by continuing the *Journal Club* during summer on their own. After refining this course over the past year, we are developing curriculum modules adoptable for teaching undergraduates and also training graduate students and postdocs — the teachers of the future.

Our goal is transformation of not just the classroom, but also the teaching experience.

Support

Qing Gao, Bellevue College
David Weller, USDA/ARS
Linda Thomashow, USDA/ARS

This material is based in part upon work supported by the National Science Foundation under Grant CCLI - 0717470. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

<http://scidiv.bcc.ctc.edu/ComGen>
gita.bangera@bellevuecollege.edu