

Course Design to Defeat the “Content Squeeze”: BIOS 424



George Bennett, PhD

Clean up oil spills with microbes? Develop a new medicine? Plan a defense against biological weapons? The many roles of microbes in industry, medicine, and environmental management make George Bennett's Biosciences 424, “Microbiology and Bio-

technology,” a popular elective but a teaching challenge. With so many fascinating applications to explore, there's always pressure to include additional topics.

Bennett designs his course to include both fundamentals and the newest developments. Naturally, he wants students to develop basic microbiology knowledge and analytical skills; but recognizing that his students have so many possible career paths and individual interests, he also wants to enable them to study related applications they've chosen themselves.

His solution divides the course into three parts and weaves together rigorous reading (about 30 chapters), 15 lectures to reinforce and extend students' understanding of underlying mechanisms, and three 75-minute examinations. Into this framework he incorporates three team reports on microbiology and biotechnology in industry, environment, or medicine. The teams' reports enable each person and each team to study a topic in depth while learning the chief results of other teams' projects through oral presentations. The result is depth plus breadth.

Through course design Bennett ensures that students use knowledge gained from reading and lectures to interpret and master the research literature. As students discuss how to integrate their individual research efforts into a clear, concise, but complete team report, they learn how to review the literature on a particular topic, see connections between articles, build skills for working in a team, and improve their communication.

Bennett provides books and abstracts of articles as a springboard for each team, although teams are encouraged to seek additional articles on their own (see sample 1). In-class working time plus this “jump start” make it possible to accomplish three projects within the semester. Each team's presentation and written report add specialized knowledge related to textbook readings and lectures, defeating the content squeeze.

In course design, as in so much else, timing is everything. The overall syllabus scheme (see sample 2) reveals the rhythm of readings, lectures, projects, and exams. Excluding two sessions—the course introduction and the course review and evaluation—the remaining 26 course sessions are grouped in three series. Topic 1 ends with an exam in session 10, topic 2 with an exam in session 18, and topic 3 with a third exam in session 28. Woven into each topic series are three class sessions devoted to work on team reports.

Planning the literature search and team project

In the first of the three sessions, students form subgroups to cover each of the subtopics. These subgroups scour the text and books plus lists of abstracts Bennett brings to class. They examine the references and organize a brief outline of the subtopic. Each subgroup then assigns specific portions of the outline to each member. By the end of the second discussion period, a handwritten, more detailed outline of the group's subtopic has been prepared and turned in.

Becoming authors and presenters

About a week later, individual students turn in short written reports of about 1 1/2 pages summarizing their own findings, and based on the team's outline. The team members who have been chosen to present the report receive advance copies so they can prepare the presentation to the class. At the third meeting team representatives give 15- to 20- minute presentations. Teams must balance considerations of brevity, conciseness, and thoroughness in planning how to leave enough time for Q&A. Usually each student will present to the class once a semester.

Becoming reviewers and revisers

During the second and third rounds of team reports, copies of students' short reports are distributed at the second meeting to other students outside the subgroup for reviews due at the next class meeting. Students receive excerpts from these signed one-paragraph reviews along with the instructor's comments at the next meeting. These comments help students improve their final drafts and get ideas for the in-class presentations. Writing the reviews prepares students to comment on other scientists' drafts, just as they will be expected to do once they are part of a research or industry team. A schematic view of the course design is shown on the other side of this page (sample 2).

As a result of this carefully orchestrated design, students are able to

- learn fundamentals and processes
- choose topics of personal interest
- build team skills
- practice communication processes central to microbiology and research teams
- increase their skill in pulling important information out of the literature
- explain information concisely and completely to others
- learn independently, and
- be responsible to others in their subgroup and to the class as a whole.

Bennett balances independent responsibilities with collaboration because most scientists will work in teams and collaborate with others to develop a mutual understanding of topics or problems. Since the results of new research in microbiology are reported almost daily—revising and extending what is known—students must

become comfortable with constantly learning and evaluating new material and organizing and incorporating it into a framework of prior understanding. The course thus introduces students to the long-term process of scientific work that lies ahead.

Bennett participated in the week-long workshop on designing communication-enhanced courses sponsored by the Cain Project and led by Rebecca Burnett and Julie Zeleznik in summer 2000. He has been refining his courses ever since. Students are very happy with the current plan and feel they get a lot out of the projects both personally and professionally. Bennett recently was appointed as chair of the Department of Biochemistry and Cell Biology.

With all the responsibilities of leading such a large and active department soon to begin, it's great that he developed his course design for BIOS 424 in advance. You can contact George Bennett to discuss communication-enhanced course design at gbennett@rice.edu or call the Cain Project at ext. 6141.

Sample 1: Some Selected Topics for Reports

Environmental Topics

- Bioremediation of chlorinated solvents
- Environmental production and utilization of methane (anaerobic oxidation)
- Biopesticides and *Bacillus thuringiensis*
- Bacterial/algae/coral/sponge interactions

Industrial Topics

- Production of carotene compounds and dyes
- Bovine growth hormone and fish growth hormone
- Biological warfare
- DNA vaccines

Medical Topics

- Plague
- *H. Pylori* and ulcers
- Ebola and related viruses
- Bacterial meningitis

Sample 2: Syllabus Design for Bios 424 Class Session

- 1 – Introduction to the course
- 2 – Lecture / readings
- 3 – Lecture / readings and begin discussion of project 1
- 4 – Lecture / readings
- 5 – *Group meeting 1*
- 6 – Lecture / readings
- 7 – *Group meeting 2 – outline*
- 8 – *Group meeting 3 – presentations to class*
- 9 – Lecture / readings
- 10 – **Exam 1**
- 11 – Begin topic 2
- 12 – Lecture / readings
- 13 – *Group meeting 1*
- 14 – Lecture / readings
- 15 – *Group meeting 2 – outline*
- 16 – *Group meeting 3 – presentations to class*
- 17 – Lecture
- 18 – **Exam 2**
- 19 – Begin topic 3
- 20 – Lecture / readings
- 21 – *Group meeting 1*
- 22 – Lecture / readings
- 23 – *Group meeting 2 – outline*
- 24 – Lecture / readings
- 25 – *Group meeting 3 – presentations to class*
- 26 – Lecture / readings
- 27 – Course review and evaluation
- 28 – **Exam 3**