

# **Biology Discipline Assessment Report – Spring, 2009**

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## **I. The Biology Assessment Plan**

This spring the Biology Discipline completed development of an Assessment Plan, specifying goals and measures for the assessment process. This report summarizes the initial implementation of that Assessment Plan.

The Assessment Plan specifies the following Goals

### **A. Goals**

1. To provide students a broad base of fundamental biological knowledge and an appreciation of relevant safety and ethical considerations in evolution, genetics, cell and molecular biology, the diversity of life, and ecology
2. To provide students in our upper-level electives detailed knowledge in specific fields including experience collecting and interpreting data both in the field and in the laboratory
3. To provide students opportunities to apply knowledge of chemistry, statistics and mathematics to biological systems
4. To advance student skills in written and oral communication of biology
5. To prepare and encourage students to conduct original undergraduate research at UMM or at other institutions
6. To prepare students for postgraduate education, and/or a variety of careers in the fields of biology, including secondary education
7. To provide discipline-specific courses for non-majors to serve UMM's general education requirements

### **B. Schedule**

The Plan schedules reviews this year for “Cell and below” (i.e. smaller things) this year, along with our communications courses: Biological Communications I, Bio Comm II, and Senior Seminar. We met in February to review Bio Comm I (so that scheduling changes could be implemented before the spring round of registration), and in May to review the following courses, with emphasis primarily on the core (required) courses:

- Bio 2111 Cell Biology
- Bio 3121 Molecular Biology
- Bio 3700 Biological Communications I
- Bio 3701 Biological Communications II
- Bio 4111 Microbiology
- Bio 4211 Biochemistry
- Bio 4611 Biochemistry Lab
- Bio 4901 Senior Seminar

We are not assessing non-majors courses this year because two of our faculty who teach them are on leave (Anderson, Kuchenreuther), one other who has taught them will be retiring (Gooch), and of the three remaining faculty who teach non-majors courses, two (P. Wyckoff, Cole) are already putting in extra time launching the new Environmental Studies and Environmental

Science majors. Also, with rising numbers of students in our core courses and fewer faculty, the number of non-majors courses we can offer has declined and will remain lower.

## II. Prelude

Assessment activities began last year with Bio 1111 (Fundamentals of Genetics, Evolution, and Development)—commonly called “Fun Gen Evo Devo”, or simply “Fun Gen”, which was a new course introduced last year. Our assessment of that course led us to (1) increase the number of sections offered, to reduce class size; (2) increase the number of faculty teaching the course; (3) adopt a new book (Sean Carroll’s *The Making of the Fittest*), in addition to the text used previously. We made major revisions to the course lectures, and a new faculty member (Waye), who will be teaching this each year, sat in on the classes taught by both other faculty (Myers and Cole), while those two faculty met frequently in the fall— all of these efforts aimed at making the various sections similar in their content. Through Fall 2008, this 3-credit class had been scheduled for two, 100-minute classes weekly (i.e. equivalent to a 4-cr. course); since increasing the number of credits takes two years to move through the course approval process, beginning Spring 2009 we have reduced the class time to fit the number of credits (two, 75-minute classes weekly). We will review this course more thoroughly in the Fall, after we have evaluations from the Spring of 2009, so we will have evaluations for all three faculty who teach the course.

## III. Core Courses

### A. “Cell and below”

Bio 2111 (Cell Biology) is at the heart of the biology core. Because prerequisites include a full year of General Chemistry and at least one biology course, the course is taught at a somewhat more demanding level than is found in most intro bio sequences, and is taken primarily by students in the Fall of their sophomore year. Our assessment focused on the question, “Do students acquire the information expected for upper-level core and elective courses?” and, in particular, Goals 1 and 3 and the relevant measures for the Core [“Design questions on mid-terms and/or finals to assess student understanding of fundamental concepts (e.g. natural selection, central dogma processes)”. We examined

We worked with the Bio 2111 final exam from Fall 2008, looking at an open-ended question regarding the Central Dogma worth 15 pts (mean = 11.2, s.d. = 3.4; roughly 10 students had <6 pts). There was a choice of 3 questions, all open-ended. Goals: knowing the main points of the central dogma, the *lac* model, and differences between prokaryotes and eukaryotes. It appears that synthesizing & combining information remains a hurdle. Exams in upper-level courses drawing on Bio 2111 (Molecular Biology, Biochemistry, Microbiology) are ca. 70% recall, 30% synthesis. We also discussed use of homeworks and practice problem sets, including their use as exam prep. Students ask for homework problems, but their use varies a lot by course, as does the availability of past exams. For example, Biochem does have past exams available, Microbiology does not. We also discussed whether homeworks should be harder than exams (because students

have more time & resources to work on them) or the same as tests (to better indicate what level the tests will focus on). Should they be graded or not? Both?

Testing in the first 3 courses (Bio 1111 Fun Gen Evo Devo, Bio 2101 Evolution of Biodiversity; Bio 2111 Cell Biology) tends to be about details, lacking synthesis, relying more on memorization and multiple-choice questions because there are large numbers of students in the classes, rather than asking questions that draw on synthesis & explanation, e.g. essay-type questions.

We noted that, in all of these courses, there are always be problems with any simple math (arithmetic). Examples include calculating serial dilutions and reaction calculations. We have been increasing the number of problems for lectures and pre-labs dealing with these, and expect to increase these more in the future. There are also problems with students understanding the big picture of anaerobic glycolysis; students get caught up in trying to remember the details, and forgetting that, in the big picture, these linked reactions “are about getting NAD<sup>+</sup> back”.

A central question is the extent to which upper-level courses should repeat material in Cell Bio, vs. the extent to which those courses can assume that students recall material presented in that course. Do students know and remember what they learned from Cell Bio? It may be useful to have students get some material twice, from different people– e.g. Cell + Biochem, Cell + Molecular.

We discussed how (and how well) is our core (required courses) integrated? Are there thing missing? For example, cell signaling. Coverage of this has increased in Cells and in Mol. Bio., but is still limited, just a little in Molecular at the end of the semester. There is a little in Developmental Bio, but that has very small enrollment.

We note the commonly expressed desire of students to have an Immunology course; this would strongly develop cell signaling.

What do we do next? We do not see major changes needed in Cell Bio. We do see it integrated or articulated well with other courses, both core (e.g. Molecular) and electives (e.g. Micro, Biochem). We do see value in having some repetition, though we tend to want to avoid overlap & repetition. We see value in students hearing/seeing different presentations by different faculty, e.g. of Central Dogma or metabolism. We see a need for courses to emphasize and test synthesis-type questions, along with having practice for those kinds of questions. We also think that written essay type questions are important for assessing both recall and synthesis types of understanding. However, accommodating this with the large class sizes in these core courses remains an unsolved challenge.

## **B. Communications Courses (Bio Comm I & II, Sr. Seminar)**

### **Bio 3700: Biological Communications I**

Since our latest catalog revision, which instituted (or resurrected) Bio Comm I, the course has been taught by Dave Hoppe (now retired) and more recently by P. Wyckoff (last year) and

Myers, who brought copies of their syllabi for the course. Although the intent for this discussion was to focus on how Bio Comm I articulates with Bio Comm II, including what information search & bibliographic tools the students learn to use, it became apparent that there are more pressing issues regarding the lack of student preparation & writing ability coming into the course, and Bio Comm II faculty have been modifying their courses to deal with this.

Substantially more practice in writing and editing is necessary. There also is some need to help students prepare for oral presentations (e.g. Senior Seminar). The course has only met for the first half of semesters, but with the amount of “remedial” writing experience needed, there has not been enough time for students to adequately develop the background for their Bio Comm II papers, which would be finished in the second half of the semester. At the end of Bio Comm I, students should have appropriate skills for writing secondary papers, along with a complete bibliography, prospectus, and outline, and have made arrangements with a faculty member to supervise their Bio Comm II paper in the second half of the semester.

We discussed how the scheduling might work so that students could accomplish this, and do so before beginning the work for their Senior Seminars. Next year will be the first year in which the change of catalog requirements takes effect for juniors, i.e. those who will not have had Bio 1101 Freshman Seminar in Biological Thought, with its writing component, and instead will have Bio 1111 Fundamentals of Genetics, Evolution and Development, the writing component moved into Bio 3700 Biological Communications I.

The interlocking issues included

- (1) What writing abilities and experience the students should have;
- (2) What point in their Biology curriculum this should occur;
- (3) Whether this is best accomplished in one, two, or more semesters;
- (4) The number of Biology major students who will be taking these courses;
- (5) The number of students that can be accommodated in a section of Bio 3700 (the current limit is 15, and 20 seems to be too many– especially given that faculty only get one credit for teaching this writing-intensive course);
- (6) The number of bio majors indicates we probably do not have enough sections of the course scheduled, unless attrition increases, so we will probably need three sections per year;
- (7) The advisability of having an end-of-semester mini-symposium where students make short oral presentations of the background they have developed for their Bio Comm II paper, which would also serve as some practice for giving a Senior Seminar talk;

We are struggling with the number of students in our other core courses, and the availability of faculty to teach Bio Comm I as well as more sections of the core course, as we have been trying to keep class sizes small to improve campus retention (especially given how many incoming students indicate they want to major in biology), and contribute courses and faculty time to other programs (e.g. Environmental Studies, FYS, etc.) Next year we have planned to have two sections of Evolution of Biodiversity, four sections of Fun Gen Evo Devo, and two sections of Molecular Biology– these are unprecedented numbers of sections for our core courses. At the same time, we have one faculty member who will be on sabbatical (Paul), one retiring (Van will

be 1/4 time), and no indication that we will be able to hire replacements. We have had a different professor each time that it has been offered (Tracey and Dave Hoppe previously), which has reduced consistency.

We concluded that, regardless of the number of sections that we can actually deliver next year, it would be better to schedule the course to meet for a whole semester rather than just half a semester, for the same amount of class time.; we changed the class schedule accordingly.

One conclusion is that we need more thorough introduction to electronic / online access via the library web site and other routes, e.g. by working with Jayne Blodgett. We note that the course is only 1 credit, so can't require too much work. Also, there are some old exercises that were used when the Bio Comm I was resurrected, based on an older version of the course during the quarter system, before any electronic access tools were used (e.g. involving wandering around the library, digging through Biological Abstracts books, etc.) and several of these exercises need to be discarded or revised.

Students need introduction to the distinction between primary and secondary literature, as well as the various forms of "publication" and status of materials that they may access online.

Beginning this semester resulting from assessment discussions early in the semester), students are making some oral presentations, as practice for Senior Seminar. They also learn structure of research proposals.

We are not yet using End Note in the course, though the software is now free for students and faculty. Next year we should introduce this, although students do not seem to appreciate its utility.

Bio Comm I does not yet address synthesis adequately, but focuses more on individual papers. At the end of Bio Comm I, students should have decided on a topic, have a couple of relevant papers in hand, and have an agreement with a faculty member to be their advisor for Bio Comm II. It is especially important that they develop adequate search skills during Bio Comm I.

We also concluded that students need more practice fixing examples of poor writing– not just correcting grammar of sentences, but evaluating larger pieces. We don't have a library of examples for that purpose, but it would be very useful.

### **Bio 3701: Biological Communications II**

Students tend to recapitulate individual papers without synthesis. Probably should require an outline and more than one draft. Should there be points awarded for intermediate steps? e.g. points awarded if work is done on time, or if it meets a minimum set of criteria? What about quality? e.g. the Introduction should address 4 points: prior work, stating hypothesis, etc.

We discuss a "grade as you go" system, i.e. student is informed "this is the grade that the paper would get as it stands. We also discussed using a dual grading scheme she uses, each draft

getting two grades: one reflecting how good the paper is for this stage, the other what it would get as a final draft.

Our syllabi probably need more of a description of what is requested / expected in the course & for the paper.

Procrastination has been a problem. Deadlines (perhaps set by students) for intermediate steps might help with this. It also might help if there were points for meeting these deadlines. In some sections, students set their own deadlines for the intermediate steps; this often helps but not always.

### **Bio 4901: Senior Seminar**

The Biology Senior Seminar program was substantially modified with the introduction of the semester system. Grading was changed from S/N to A-F. Evaluation forms completed by audience members and returned directly to the student presenters were expanded, and faculty now fill out similar, 2-page evaluations that serve as the basis for grading. A specific rubric of activities has been implemented (e.g. specifying a required minimal schedule of meetings with faculty advisors). These have generally improved the quality of the students' seminars. However, the quality of the seminars remains more variable than we would like. Regardless of the formalized rubric, students still have the option of neglecting meeting with faculty advisors and, indeed, of presenting mediocre seminars.

Implementing a small oral presentation in Bio Comm I may help, particularly for the students who are most intimidated about public speaking and most tempted to put off preparations.

Key features contributing to the success of this program include:

- 1) Requiring attendance at a minimum number (9) of other students' seminars, so students see each other meet the challenge of public speaking
- 2) Requiring A-F grading
- 3) Allocation of students to faculty members based on the topics chosen
- 4) Requiring Bio Comm I & II as pre-requisites, so students learn how to collect and summarize (if not synthesize) information from multiple sources
- 5) Requiring students from Fun Gen Evo Devo to attend (so they can anticipate what they will be doing; and it helps with audience sizes for some seminars)
- 6) The formal rubric requiring specific meetings with the faculty mentor at a specific schedule
- 7) Scheduling at fixed times (and location) each week, so students can plan for attending
- 8) Requirements to provide an outline, bibliography, and snacks

#### **IV. Summary: Changes Made Based on 2008-09 Assessment Activities**

##### **A. Bio 1111**

Increased number of faculty (from 1 to 3) and number of sections (from 2 to 4).

Changed main text book.

Increased emphasis on recent and empirical studies, reduced emphasis on pre-1800 science.

Reduced class time to match credit load.

##### **B. Bio 2111**

Increased coverage of signal transduction.

##### **C. Bio 3121, 4111, 4211, and 4611**

Increased practice with “lab math”.

Increased number of sections of Molecular Biology to accommodate increased number of students.

##### **D. Bio 3700**

Changed schedule from half-semester to full-semester.

Added short oral presentations.

Plan increased instruction by library staff on web-based searches.