Program review activities in the Biology Department during the past academic year have included (a) completing a program review plan for the department, (b) collecting examples of student work into a portfolio during the year, and (c) meeting as a department to review selected examples of student work and to consider the implications of that review for the department's instructional program. When we submitted our program review plan in October 2005, we identified four basic goals for the biology program, ranging from students gaining knowledge of biological concepts to developing the competencies needed for participation in the scientific community as well as in the broader culture. These four goals are as follows.

1. Students in the Biology major grow in their understanding of life processes at different levels of structural organization.
2. Students will participate in independent research and will grow in their ability to carry out scientific investigation of living systems beyond what is possible in regular courses.
3. Biology students will be able to present the results of scientific research through written research reports, oral presentations and scientific posters.
4. Students will be able to identify and describe a wide range of controversies, positions, and approaches to the interdisciplinary and theological implications of biological theory. Advanced students will be able to assess the way in which their own understanding of these issues has developed over the course of their study, and to consciously reflect on how they deal with ambiguity.

Although these goals are expressed in terms of educating our majors, students achieving these goals will also have made significant progress toward meeting the institutional learning standards for the College as a whole.

Following the advice of our program review coordinator, we chose to focus our attention on just a single goal this year, assessing students’ abilities in the area of scientific presentation (goal 3), although we have begun planning for assessment activities directed toward the other goals as well. The department met for 2-3 hours each day during the week of May 15-19. In these meetings, we revised the set of specific objectives associated with Goal 3, we developed criteria for assessing the extent to which students are achieving each objective, and we applied the criteria to a sample of student presentations.

A. REVISION OF GOAL/OBJECTIVES AND DEVELOPMENT OF CRITERIA

When the department met in May, we began by reviewing the specific objectives for student presentations that we had identified in our Program Review Proposal. By the end of that discussion, we realized that, although the major emphasis of this goal is that our students be able to communicate well in scientific research reports, our aspirations for them in this area really encompass a wider range of genres. The language below is a minor revision of Goal #3 to reflect this broader understanding.

Revised Goal #3. Biology students will be able to present the findings and implications of scientific research through written reports, oral presentations and posters.

Listed below are the revised objectives along with specific criteria that we will use in assessing student work. Objectives 1 – 4 relate specifically to students’ mastery of the scientific research report format while objectives 5 and 6 are more general.
1. **Students use the IMRAD (introduction, methods, results, abstract, discussion) format for scientific literature correctly in their presentations and papers.**

   The Abstract is an effective summary (i.e., it describes purpose, methods and results). It does not read like an introduction.

   The Introduction needs to start out general and get progressively more specific so that, by the end, the question being posed in the presentation has been defined.

   The Methods section reports what was actually done. It should be thorough enough to allow someone to repeat the experiment. It should be written in past tense, a description of what was done rather than a series of instructions.

   The Results section gives a written description of the results, illustrated by tables and/or figures. It is not simply a series of tables and figures, although the balance between illustrations and text will vary to some extent between different types of presentations (e.g., posters compared to papers).

   The Discussion draws conclusions, addresses unanswered questions, and compares the results to other published work.

2. **Students develop the question posed in their presentation through a survey of the relevant background literature.**

   Students use different types of literature in their presentations in ways that indicate their understanding of the differences between popular and scholarly literature and between primary and secondary sources.

   Students can use a variety of bibliographic tools including on-line databases and review articles to locate published work that pertains to their project.

3. **Students present experimental results effectively in figures, graphs or tables.**

   Students know when to use a figure to illustrate their results and when using a table would be more appropriate.

   When presenting results in graphical form, they know the type of graph to use for the type of data being analyzed.

   Figures are computer-generated rather than hand-drawn.

   Graphs are drawn according to scientific standards with appropriate axis labels, and they are accompanied by a descriptive caption.

4. **Students write or speak in ways that are stylistically appropriate for scientific communication**

   They have good English usage.

   They write with correct scientific tone, using passive voice.

5. **Students are able to appropriately cite sources and provide complete bibliographic information.**

   Students cite sources in their work in a way that honors academic integrity and which effectively directs their audience to their supporting literature.
Students properly cite the sources for ideas, data and quotations in the body of their work.

Students cite sources using the format of the departmental style sheet (see section E.1 below).

6. **Students are able to use technology effectively in oral and poster presentations.**

Students produce poster presentations using Powerpoint or a similar program, formatting them as described in the departmental style manual (section E.1).

Students effectively use technology in oral presentations, following the guidelines of the departmental style manual (section E.1).

**B. DATA COLLECTED**

This year, the Department established a portfolio of student work. Students submitted their presentations to us electronically, and these have been saved on the departmental secretary’s computer. Not all of the work below was reviewed this year, but it may prove useful in future years as we expand the scope of our assessment activities. Beyond the archived work listed below, faculty also shared informal observations in our meetings about student presentations in other courses that suggested additional ways in which we might be able to improve our instruction directed toward this goal and which will be the focus of assessment efforts in the future.

1. **General Biology I Project Posters**

General Biology I (BIO 5) is the first semester of the introductory biology sequence for science majors. As part of the laboratory component of the course, lab groups (2-3 students per group) design, carry out and prepare a poster presenting the results from a small research project. Before this year, students had used traditional tri-fold cardboard display boards for their posters, but this year, we chose to introduce preparing posters digitally. The groups prepared their posters as Powerpoint slides and submitted them electronically to the department secretary who then arranged to have them printed at a local copy shop. The 32 Powerpoint files from the Spring 2006 class are saved in the departmental portfolio.

2. **Summer Research Symposium Posters**

Each Fall, students who have been involved in the summer research program in the sciences present their work in a poster symposium. Two Biology students presented posters from last summer’s work, and these have been saved in the departmental portfolio.

3. **Biochemistry Project Powerpoint Files**

Each year in the Biochemistry course, student lab groups carry out an independent project based on the laboratory exercises from the first part of the course. The students use Powerpoint in their oral presentations of their work, and the 13 Powerpoint files from Fall 2005 are archived in the departmental portfolio.

4. **Microbiology Project Papers**

Students each year isolate a bacterium from soil and use a variety of techniques to identify the organism. At the end of that process, they write a research report describing their work. Five of the six papers from the Fall 2005 class are saved in the departmental portfolio.

**C. DEPARTMENTAL REVIEW OF PROJECT POSTERS**
This year, the department chose to concentrate on the project posters prepared by our introductory students and by the two upper division summer researchers. This seemed an appropriate place to begin since scientific posters are such a common means of communicating research results within the scientific community. In addition, since BIO5 is the first course in the Biology major and thus, the students’ first introduction to scientific writing, we reasoned that if we could focus on improving our instruction with this group of students, the effects could carry through into their work in more advanced courses.

Department faculty reviewed a stratified sample of six of the 32 posters prepared by BIO5 students (ca. 19%) – two with the highest grades assigned, two with the lowest grades and two posters with intermediate grades. A file with these specific posters is saved in the department portfolio. Faculty observations about the posters are listed below by section.

1. Over-all Format
   All of the posters reviewed organized their presentation according to the IMRAD format.

2. Abstract
   Many abstracts read more like introductions than as summaries, and very few articulated the purpose of the study.
   Most did report the results of their experiments.

3. Introduction
   Although all of the posters stated the question they were going to address, they presented background material in a very general way that did not connect directly to their specific question.
   None of the posters cited literature references in the text of their introductions.

4. Materials and Methods
   Some listed materials in a way that was reminiscent of high school science writing more than professional scientific posters. We thought that it might be better to refer to this section simply as “Methods” in the future.
   Many of the Methods sections read more as lists of instructions than as descriptions of what the students had done.
   Many lacked sufficient detail for a reader to replicate the study.
   Many used incomplete sentences to describe the methods – i.e., the section read more like a lab notebook than like a research report.

5. Results
   Most of the posters presented their results graphically, although some redundantly presented them both in graphs and in tables.
   Many of the students presented raw data as results rather than calculating means and standard deviations, for example.
   Many of the posters simply presented graphs and tables without describing their results with text.

6. Discussion
Many of the posters had results presented in the Discussion section that would have been more appropriately placed in Results.

Most had no citations to literature sources in the text of their Discussions.

7. Literature Citation

There was no consistent bibliographic format when references were listed.

Some posters had literature references, but it was not clear how they related to the text.

Few cited references in the body of the text.

Some had sources that were not academic in nature.

Many of the sources were web sites, raising the question of how well students were assessing the value of web-based information.

8. Over-all Quality of the Writing

Many of the posters had punctuation/grammatical errors.

Many used an informal tone in their writing.

Many would switch between past and present tense and between passive and active voice. Most did not use passive voice.

Comparing the posters by the summer research students to those from the BIO5 students, the projects themselves, not surprisingly, manifested a much higher level of sophistication. The writing on the posters was characterized by a more scientific tone than was true of the work done by the introductory students, and the figures were clear and associated with descriptive captions. However, although one of the students cited a reference for a technique he was using, neither of the students referred to published literature in the introduction or discussion sections of their posters.

D. INTERPRETATION

College students are transitioning from the less formal context of their high school science classes to a more professional involvement in the scientific community, and part of this transition is learning to “talk the talk.” Students in the General Biology course receive instruction on the nature of scientific literature and on how to prepare a scientific poster, and their work showed that they had learned the basic structure for scientific literature. However, it was clear from examining examples of their work that additional guidance and feedback would facilitate their learning to express themselves much more effectively in this medium. They need to have a greater understanding of the basic format of scientific literature – what one is trying to accomplish with each of the sections of a scientific presentation – and they need to develop a better ear for the tone of scientific writing. In these two respects the posters by upper division students were written at a higher level of sophistication, reflecting the students’ growth in the discipline. However, for both groups of students, the use and citation of published studies in their writing was an area that needed considerable improvement. Although the General Biology students have a laboratory session dedicated to learning how to locate published sources related to a topic, it does not occur in the context of them working on their lab projects, and they are apparently not making the connection between the skill that they learned and the need to apply that skill in preparing their posters. The fact that the upper division students’ posters were similarly lacking in literature citations suggests that this is a problem that needs to be addressed consistently through the major.
The department chose to focus on scientific posters this year, but our review of these examples of student work led to more wide-ranging conversation about the quality of student presentations in general. One faculty member who teaches an upper division course which involves numerous student presentations observed that a quarter of the class was not familiar at all with presentation software and another quarter of the students lacked proficiency with this technology. All of these observations suggest that we need to introduce our students to scientific communication in a more systematic fashion.

E. PLANNED CHANGES IN INSTRUCTION

As department members discussed the strengths and weaknesses of the scientific posters prepared by our students, three ideas for ways to modify our instructional program emerged.

1. Developing a Departmental Style Manual

We want to provide our students with a more detailed introduction to scientific writing and presentations, and we want to have some consistency across the major regarding the standards for excellence in this area. The idea of producing a departmental style manual developed naturally from this goal. We decided that a printed version of the manual, given to the introductory students would be a little overwhelming, and that led to the decision to put the information on the departmental web site instead. Faculty will direct their students to the appropriate sections of the manual as part of introducing presentation assignments, and it will be made clear to the students how grading these assignments relates to the published standards. Although we anticipate revising the manual as we review the extent to which our students’ writing improves in the future, at present, our plan is to include sections in the manual covering the following topics.

   - Writing a Research Report
   - Preparing a Scientific Poster
   - Producing a Powerpoint Presentation
   - General Tips for Effective Writing
   - When and How to Cite References in Scientific Writing

2. Modifying the General Biology I (BIO 5) Laboratory Sequence

The course schedule for General Biology I has a laboratory session devoted to introducing students to scientific literature and literature searching. However, in the past, this instruction has occurred three weeks prior to the students seriously engaging the lab project assignment. Next Spring, we will make two changes in the lab schedule with an eye toward the students making more meaningful connections between the published literature and their own work. First, we will change the sequence of labs in the course so that the introduction to scientific literature occurs as a part of the work on their project. Second, we will have the students submit a list of references that they plan to use in their posters along with a statement about how the sources will contribute their work. This will provide an opportunity for feedback on their use of literature sources prior to them producing their posters.

3. Introducing the Use of Presentation Software in General Biology II (BIO 6)

By Fall 2007, we will add an assignment to the laboratory curriculum in General Biology II in which the students will make a brief oral presentation using presentation software such as Powerpoint. They will be given instruction in ways to use slides to enhance rather than distract from their presentations. Our expectation is that the skills they begin to develop in this course should impact the quality of student presentations in upper division courses.

Perhaps it would be appropriate to note here that students are introduced to writing research reports in Genetics (BIO 114). Genetics is the third course, along with General Biology I and II,
that is required of all of our majors, and it fulfills the general education requirement for a writing-intensive course in the major. When we have implemented the changes discussed above, each of the required courses for the major will provide an opportunity for students to develop their abilities in one of the fundamental means of communication in the scientific community.

F. LOOKING AHEAD IN PROGRAM REVIEW

Our assessment activities this year have provided us with a framework for program review that will serve us well in the future. We have identified four basic goals for our program, and we have developed the criteria for evaluating student progress in relation to Goal 3 – communicating scientific research results. As we move ahead, we will need to monitor student work in this area and to expand our review activities to take in the other parts of our program. There are two more years for us to collect and analyze data before our five-year report will come due in Fall 2008, and we anticipate being able to have a reasonably good sense of how students are doing in our program by that time.

1. Continued Review of Student Writing and Presentations – Goal 3

Our review of student poster presentations this year gave us a fairly good sense of what the students are doing well and the areas in which they need to improve. When we were done, however, we realized that the task of evaluating the posters would have been simplified if we had developed a form for tallying the strong and weak points of each poster. Since this would put the evaluation on a more quantitative basis, it should also facilitate the process of comparing student work from year to year and in relation to instructional changes such as those described in the previous section. We will be expanding our assessment activities to include oral presentations and written research reports in the next years.

2. Goal 1 – Assessing Student Knowledge

Our objective for the next year is to administer the Biology Major Field Test (Educational Testing Service) to a sample of our first year students and of our graduating seniors. We will be able to compare our graduating seniors to biology students nation-wide, and by giving the test to first year students, we will be able, in three years time, to demonstrate the extent to which their knowledge of biological topics has increased through their time studying with us. We are planning to have three of our summer research students take the exam this summer in order to gain some experience working with the test before administering it to larger groups of students.

3. Goals 2 and 4 – Research Involvement and Interdisciplinary Learning

We have specific objectives for both of these goals, and the next step to take will be defining measurable criteria that we can use to assess student accomplishments in these two areas. Since the next year of program review will emphasize ongoing attention to Goal 3 and beginning to work with Goal 1, we anticipate reviewing collected data relating to Goals 2 and 4 beginning in May 2008.

G. ARCHIVED DATA

The department’s Program Review documents, including the portfolio of student work, is saved on the limerick server (smb://limerick/biology). The path for the portfolio is Program Review>Program Evidence>2005-2006.