Program review activities in the Biology Department during the past academic year included collecting examples of student work into a portfolio during the year and administering the Biology Major Field Test to selected first year and senior students. The four basic goals for the Biology major 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.

The department dedicated mornings during the week of May 5-9 to reviewing the results of the Major Field Test (goal #1) and evaluating student performance on laboratory reports written in BIO 114, Genetics (goal #3). In addition, we began looking ahead to assessing goal #2 by revising the language of the goal and developing a survey to be completed by students and faculty in the department’s research courses (BIO 198, Major Honors and Summer Research).

I. DATA COLLECTED IN DEPARTMENTAL PORTFOLIO

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>2007-2008.

1. Major Field Test Results

For the second year, the Biology Department administered the Biology Major Field Test to one half of the students in BIO 5, the first course in the major, and to a selection of graduating seniors. The data and analysis obtained from the Educational Testing Service are archived in the departmental portfolio.

2. Genetics Lab Reports

Genetics (BIO 114) is the writing-intensive course in the Biology major, and the focus of instruction in that course is on writing laboratory reports using the format of scientific research reports. Electronic copies of the papers submitted by students in the Spring 2008 Genetics class are archived in the departmental portfolio.
3. 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. 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 28 Powerpoint files from the Spring 2008 class are saved in the departmental portfolio.

4. Student Research Symposium Posters

Each Fall, students who have been involved in the summer research program in the sciences, present their work in posters at the Celebration of Summer Research symposium. Three Biology students presented posters from last summer’s work, and these have been saved in the departmental portfolio. These students also presented their posters at the 15th Annual Conference of the Southern California Conference for Undergraduate Research at California State University, Los Angeles on November 17, 2007. In addition, students who have been involved in research with faculty during the fall or spring semesters similarly present posters at the Westmont College Student Research Symposium every spring. This year, 8 biology students authored or co-authored a total of 6 posters (also saved in departmental portfolio). Two of the students also presented their co-authored poster at the 33rd Annual West Coast Biological Sciences Undergraduate Research Conference at Point Loma Nazarene University on April 12th, 2008.

5. 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 8 Powerpoint files from Fall 2007 are archived in the departmental portfolio.

II. DEPARTMENTAL REVIEW OF ASSESSMENT DATA

A. MAJOR FIELD TEST RESULTS

1. Test Administration

Thirty-one first year students in BIO5 and ten graduating seniors took the Biology Major Field Test in the Spring semester. The BIO5 students were selected randomly from the class, and they constituted one half of the enrolled students. In contrast to 2007, there was no single course from which we could draw graduating students to take the exam. Accordingly, we tried to recruit students by appealing to their sense of being departmental citizens and by offering them an appreciation gift. Unfortunately, only ten students – not quite one third of the graduating seniors – responded to our appeal. Consequently, for comparing Westmont Biology graduates to those from other institutions, we chose to pool the test scores from 2007 and 2008.

2. Comparison of First Year and Graduating Students
Although the Major Field Test is designed as an assessment tool to measure content mastery and analytical skills at the end of a college Biology major, we have administered the exam for the past two years to a sample of our first year science students. In two years, we will begin to be able to compare the performance of students at the beginning and the end of their time in our program, but for the moment, we are restricted to comparing first year and senior students in a particular year. The results of this year’s testing are illustrated in the graphs below. The Educational Testing Service reports student performance both as scaled scores and as percentiles. The scaled scores are a little difficult to compare directly, but it is clear from percentile rankings that graduating seniors did substantially better than first year students on all parts of the exam.

3. Comparison of Graduating Students (2007 and 2008) with Students from Other Institutions

The performance of our graduating seniors was compared both to students from all institutions using the Major Field Test (184 institutions) and to graduates from a more select group that contained schools from the top tier in the US News and World Report survey (19 institutions). The graph on the left describes the performance of individual students relative to other students taking the MFT while the graph on the right compares our means to the means of other institutions. Based on their performance on this one measure of content mastery,
our graduates’ knowledge of the field is comparable to that of students graduating from the select group of colleges, with both individual and institutional mean percentiles around the 50% level in relation to these institutions. The individual and institutional total score means for our students were at the 65th and 85th percentiles respectively, compared to all of the students and institutions participating in the examination.

4. Conclusions

a. We are not planning any major changes to our program based on the results from the past two years of administering the Major Field Test to our students. On the other hand, we have been discussing a variety of curricular changes over the past few years, and if we do implement some of these, we now have a baseline with which to evaluate the effectiveness of any new approach we take.

b. As we discussed the results from the MFT, we began to question the strategy of administering the exam to first year students. We currently have two years data comparing their performance on the exam to that of graduating seniors, and in three more years of having our seniors take the test, we will be able to compare the performance of individual students before and after going through our program. We already know that our seniors do better than our first year students, as one would hope they would. It does not seem likely that continuing to administer the test to our first year students will give us enough additional information to warrant the cost of the exam ($26/student).

c. One thing that became clear from our experience with our seniors this year is that we need to embed the exam in courses with heavy senior enrollments. Recruiting students to take an assessment exam outside the normal course structure simply did not work. The three courses that best fit that description are our two seminar courses, BIO195 and BIO196, and BIO197, Biology and Faith. All of our students take one or more of these courses to fulfill their major requirements. Thus, taking the exam will be a course requirement for any graduating senior. All three courses are offered each Spring, and the two seminar courses are also offered in the Fall.
**B. DEPARTMENTAL REVIEW OF GENETICS LAB REPORTS**

1. **Review Procedure**

Genetics (BIO 114) is the writing-intensive course in the Biology Major, and as such it is the course that most directly addresses our third departmental goal – that Biology students will be able to present the results of scientific research through written research reports, oral presentations and scientific posters – as well as the college Written and Oral Communication standard. Students in all of our tracks take this course, typically in the Spring of the Sophomore years. They write a series of four research reports based on their work in the laboratory component of the course, and the department reviewed six examples of student work on the final, culminating paper. The papers were selected by the course instructor to represent the range of performance on the assignment, and we did not know the identities of the students. Department faculty members scored the papers with respect to four basic aspects – (a) the students’ use of the format for scientific research reports, (b) their presentation of experimental results, (c) their writing style, and (d) their citation of relevant literature. For each of these, there were a number of specific points, and reviewers rated the papers for each of these points on a scale of 1 to 5. The scoring rubric we used along with reviewers’ evaluations is Appendix I at the end of this report. In what follows, these data are summarized for the four basic aspects identified above.

2. **Quantitative Assessments**

The scores assigned for various aspects of the students’ papers were a complex function of the students’ performance and the reviewers’ interpretations of the rubric as well as their perceptions of how well the students handled the assignment. The ranges of reviewer responses for each of the four factors in individual students’ papers are reflected in the standard deviations of the means presented in the graphs below. In reflecting on the

![Graphs showing Correct Format for Scientific Literature and Effective Presentation of Experimental Results for different student identification numbers.](image-url)
experience of reviewing the papers, we concluded that the scoring rubric would need to be refined in the future in order to achieve a greater degree of consistency between reviewers in the evaluation process.

Combined averages for the four areas are shown in the graph on the next page. The means ranged from 3.3 for correct use of the format for scientific literature to 4.2 for proper citation of background literature in the papers, with standard deviations that reflect both differences between students and differences between reviewers’ scoring, as discussed above. Although there is some room for improvement, particularly with the students’ command of the format for scientific literature, these results suggest that the students are largely meeting our goals for their writing at this stage of their academic careers.

3. General Observations

   a. In following the format for scientific literature, most of the students did well with the abstract and introduction. There was more variation in the completeness with which they described their methods and in the extent to which they described their results
rather than simply listing them in tables. Finally, they tended to focus too much on the problems they encountered in their discussion sections rather than emphasizing the results they obtained.

b. There was a range in the writing styles of the six students. Although they all appropriately used passive voice in their writing, their choice of words and word order sometimes interfered with the passages being easily readable.

c. By and large the students cited well for this assignment. There was one student out of the six who used inappropriate web sites as references, and the instructor for the course stated that this proportion was representative of the class as a whole.

4. Plans for Change

a. Reading the papers suggested some refinements that could be made in the instruction given to Genetics students.

i. By making a stronger distinction between experimental techniques and the experiment itself, we hope to see tighter organization in both the Methods and the Results sections. The techniques will be described in Methods, while the experiment will be presented along with the results obtained in the Results section.

ii. Greater emphasis will be placed on the Discussion section being an opportunity to focus on what was learned in the experiment rather than spending quite so much time analyzing what went wrong.

iii. More instruction will be given relating to the number and use of tables in the Results section.

b. We also discussed the effectiveness in general of our approach to writing instruction in this course. After considering a number of alternatives, we decided to drop the number of lab reports down from four to two papers to allow the students more time to work on producing good final products. The students will use these papers to report their work on two laboratory exercises that are more open-ended and that lend themselves more naturally to the research report format.

c. A final observation that emerged from reading the Genetics papers was also expressed by a student in his senior interview. That is that students need to have more opportunities to read scientific literature in order for them to get the sound of scientific writing in their ears. One way to begin will be to devote a lab period to reading a scientific research report in BIO 5. This will take the place of the week that has been used for administering the Major Field Test for the past two years.

III. PLANNING FOR FUTURE ASSESSMENT

For the past three years, Biology Department assessment activities have focused on our first and third goals. As we look ahead to the coming year, we are planning to expand our efforts to include our second goal which deals with the mentoring our students receive in conducting biological research. In our meetings in May, we reviewed the wording of the goal
and its associated specific objectives, and we worked on ways to evaluate how well our students are being engaged in research.

A. REVIEW AND REVISION OF GOAL 2

1. Our Research goal was worded as follows in our Program Review Proposal.

   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.

   Specific Objectives
   a. Students conduct their independent research with enthusiasm and commitment.
   b. Students have an appropriate understanding of the experimental question and of the previous research published on the topic.
   c. Students exhibit creativity and care in the design of their experiments.
   d. Students develop competence with current research tools and techniques.
   e. Students report their findings clearly using the appropriate format for scientific literature.

2. Revisions
   a. Acknowledging that when our students are engaged in research, they are typically working in collaboration with faculty members rather than being truly independent, we chose to revise the goal as follows.

      Students will collaborate with faculty in research and will grow in their ability to carry out scientific investigation of living systems beyond what is possible in regular courses.

      Similarly, specific objective c was revised to read,

      Students and faculty effectively collaborate in experimental design, data interpretation, and direction of the project.

   b. Since we already address the area of scientific communication in our third goal, for specific objective e, we chose to emphasize the means by which students would report the results of the research efforts. Objective e now reads,

      Students present their research findings at a conference/symposium, and, when appropriate, publish their results in peer-reviewed literature.

B. ACTIVITIES TO ASSESS RESEARCH INVOLVEMENT AND LEARNING

1. Quantitative Data

   We would like to know how many students are engaged in research at the various levels of our program. This year, we will establish procedures to keep track of those numbers. This will include students
a. taking courses with independent projects such as BIO 5, Cell Biology and Marine Biology,

b. enrolled in our research courses (BIO 198),

c. pursuing major honors,

d. participating in our summer research program, and

e. participating in summer research experiences at other institutions.

2. Assessing the Quality of Student’s Research Experiences

We have developed a feedback form for our students who are involved in research beyond in-course projects. The questions are designed to determine for individual students the degree to which they have achieved the objectives for this goal. The form is included in this report as Appendix II. The questions are a mixture of free-response and objective items, and these should enable us to track our progress in this area and to identify areas that could be improved.
APPENDIX I. COMPILED REVIEWERS EVALUATIONS OF GENETICS LAB REPORTS

1. Students use the IMRAD (introduction, methods, results, abstract, discussion) format for scientific literature correctly in their papers.

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There is a title page with a descriptive title and a list of all authors and their affiliation.

The abstract is an effective summary of the entire paper.

The introduction gives the background appropriate for the intended audience. It should progress from general to specific and include the experimental purpose.

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.

The results section gives a written description of the results, illustrated by tables and/or figures. It does not just report raw data but describes all the data to its completion.

The discussion draws conclusions, provides possible explanation for anomalous data, and suggests improvements and future directions. When appropriate it compares the results to other published work.

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

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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 and tables are professional and computer-generated rather than hand-drawn.

Figures and tables are in the appropriate format (e.g. Tables have a title but no legend. Figures have both. Tables and figures are numbered separately.)
3. **Students write or speak in ways that are stylistically appropriate for scientific communication**

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Students write with correct scientific tone (e.g. straightforward, concise, objective), using passive voice.

There are no spelling or grammar mistakes.

Each paragraphs has a clear topic sentence that encompasses the whole content of the paragraph. There is clear organization and logical flow within and between paragraphs.

Students communicate clearly and in a manner appropriate for the intended audience.

Sentences are constructed well, (e.g. no run-ons, incomplete sentences, or dangling participles).

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

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Students cite sources in their work in a way that honors academic integrity and which effectively directs their audience to the supporting literature.

Students use appropriate scientific sources that indicates their understanding of the differences between popular and scholarly literature.

Students include a Literature cited section that includes all the sources cited in text.

Students format their citations (both in-text and in the Literature cited section) in the manner described by the instructor.

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APPENDIX II. BIOLOGY RESEARCH FEEDBACK FORM

Name ____________________________________   M  F (circle one) Ethnicity ____________

Anticipated Graduation Year _______   Student Collaborators ___________________________

Faculty Supervisor ___________________________

Course (BIO198, Major Honors, Summer Research) _________________   Units ___________

How did you hear about research opportunities in the department (circle all that apply)?
   a. informed by a faculty member
   b. heard from another student
   c. departmental email/announced in class
   d. other

1. Why did you decide to pursue a research experience in the department?

2. How much time per week on average did you work on your project?

3. My interest in the project increased through the course of the project.
   Strongly Disagree  1   2   3   4   5  Strongly Agree
   Comments:

4. I worked hard to accomplish the goals of the project.
   Strongly Disagree  1   2   3   4   5  Strongly Agree
   Comments:
5. Please write a one paragraph summary of your project, including the experimental question(s), methodology and findings.

6. I always knew how a particular experiment I performed related to the goals of our project.
   Strongly Disagree  1   2   3   4   5  Strongly Agree
   Comments:

7. I can identify previous work that was foundational for our project.
   Strongly Disagree  1   2   3   4   5  Strongly Agree
   Comments:

8. I can explain the relevance of our project to someone unfamiliar in the field.
   Strongly Disagree  1   2   3   4   5  Strongly Agree
   Comments:

9. If you were able to continue working on this project for another semester or summer, what would be your experimental goals?
10. I was an active participant in determining the direction of the project.
   Strongly Disagree  1  2  3  4  5  Strongly Agree
   Comments:

11. I was given appropriate guidance in how to interpret my results.
   Strongly Disagree  1  2  3  4  5  Strongly Agree
   Comments:

12. I feel more confident in my abilities to design experiments and interpret data as a result of working
    on this project.
   Strongly Disagree  1  2  3  4  5  Strongly Agree
   Comments:

13. I used the following specialized instruments and experimental protocols in my research.

14. I was given sufficient guidance in using and trouble-shooting scientific equipment and performing
    experimental protocols.
   Strongly Disagree  1  2  3  4  5  Strongly Agree
   Comments:

15. I learned new research tools and techniques.
   Strongly Disagree  1  2  3  4  5  Strongly Agree
   Comments:
16. I became proficient in using the relevant research equipment and computer software.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

   Comments:

17. I was given instruction in laboratory and field safety procedures.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

   Comments:

18. Please list the papers or posters in which your project results were reported.

19. Is there anything else you would like us to know about your research experience in the Biology Department?