DEPARTMENT OF BIOLOGICAL SCIENCES
INDIANA UNIVERSITY SOUTH BEND

Third-year review (2001-2004) - Report to the IUSB Assessment Committee

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1. OVERVIEW OF ASSESSMENT PROCESS

The primary goal of the Department of Biological Sciences at IUSB is to provide students with high quality education by maintaining high standards in teaching, research, classroom and laboratory facilities, and service. As explained in our Assessment Plan (Appendix I), we have developed a program with the following objectives.

Provide students with experiences that will enable them to

1. demonstrate mastery of a given body of biological information,
2. demonstrate mastery of biological techniques including laboratory, field and computer skills,
3. develop an appreciation for the historical perspective of biology,
4. improve writing and speaking skills,
5. develop high level cognitive thinking including observation and experimentation, collection and analysis of data, synthesis of conclusions, and extrapolation of information and data.
6. understand ethical issues related to Biology,
7. develop the ability to learn independently,
8. develop a clear understanding of the relationship between science and society.

Our assessment program directly measures how well students master items 1, 2, 4, 5, and 7. We use three methods to assess the performance of the Biology program in relation to student learning outcomes. First, **entry-level assessment** is used to ensure that students have the skills necessary to succeed in introductory-level and upper-level classes. We strictly adhere to prerequisites for our courses. We assume that certain skills and information are obtained in specified prerequisite classes (chemistry, math, introductory biology or upper level courses, etc.), and we examine the grades of those classes before advancing students through the curriculum. Individual instructors monitor student performance and change prerequisites or adjust how background material is covered to ensure that students have the skills necessary to succeed in the course. In addition, Biology majors are advised by Ann Grens every semester before registration, which ensures that a faculty member assesses each student's progress regularly and frequently.

Second, we use a variety of **course assessment** tools in our courses to measure student mastery of material and skills. All courses taken by biology majors include assessment techniques that evaluate student understanding of content, laboratory skills, ability to apply information, or ability to communicate in writing and orally. Skills such as interpreting data, mastering lab techniques, synthesizing scientific literature, and writing and speaking require repeated practice in many different situations before students really "master" these skills. The Biology department has designed the curriculum to introduce these skills at the introductory level and build on these skills in higher-level courses. Three skill areas that are emphasized throughout our curriculum include training in analytical reasoning and application of concepts, training in biological techniques and experimental design, and training in scientific writing.

Training in analytical reasoning and ability to apply concepts is assessed through exams, homework, and laboratory assignments. Exams that require higher order analytical reasoning and synthesis, in addition to mastery of knowledge are used in some form in all courses. For example, examinations in entry-level courses (e.g. L101) use subjective questioning that require students to explain concepts in writing and apply ideas to new situations. Upper-level courses that emphasize analytical reasoning in

exams and homework include L211, L311, L312, M310, L308, L317, L318, L319, L391, L473, L474). Objective methods of examination are also used in some courses with larger enrollments. Entrance exams to professional and graduate programs (such as the MCAT and GRE) primarily use objective testing, thus it is important that our students practice this method of testing.

Training in biological techniques, experimental design, and data analysis is evaluated primarily in the laboratory. Students are required to perform experiments, collect data, organize data in a suitable form (i.e., graphs, tables, etc.), evaluate data, comprehend the relevance of controls, draw conclusions and apply information to new situations. Students are then asked to write a summary from the data collected. Students receive hands-on training in computer literacy through regular use of data spreadsheets, use of web databases such as GenBank and National Center for Biotechnology Information (NCBI) to analyze DNA sequences, use of statistical software to analyze data, and use of software to calibrate instruments and digital data acquisition software (photograph gel images). In order for students to pass lab courses they must acquire proficiency in the use of computers beyond just word processing.

Training in scientific writing begins in the introductory classes with a scientific review paper in L101 and laboratory reports in L102. In all major level biology classes, some essay questions are required on exams. There are substantial writing components required in upper level courses (L211, B205, L308, L317, L318, L391, L473, L474). Typical writing assignments include scientific review papers, laboratory reports, and analysis of primary literature. By the time a student completes the requirements for BA or BS degree, his/her ability to learn material, synthesize information from scientific literature, and present this in both writing and orally is assessed in the capstone experience (described below).

Third, we use a **Capstone course** (L403) and **Independent research** (in courses such as L308, L474, and L490) to encourage students to meet more demanding standards of scientific writing, oral presentation, and provide students an opportunity to master knowledge independently. All students working towards the BA and BS degree are required to take L403 in either their junior or senior year. In this course students analyze primary scientific literature, write a scientific review paper, and present a seminar to the faculty on their research. Independent research projects are a component of some upper level labs and many students participate in research with faculty (See Appendix III, Table 1). Independent research is assessed internally by faculty and externally by faculty from other Universities. Students that do research with faculty typically write summaries of their work, write grant proposals to the SMART committee or Indiana Academy of Sciences, and/or present the results of their work at local, regional and national meetings. Acceptance of abstracts to present work at either an undergraduate or professional meeting provides a measure of the quality of work by faculty independent of IUSB. Please see Appendix III for further discussion of independent research.

We are able to use a variety of examination methods and provide extensive training in writing, laboratory technique and data analysis due to small class size. Small classroom size also benefits students by providing instant feedback, which typically improves student performance, as well as lead to course improvement.

Indirect methods of assessment

Preparing students for careers ranging from the biotech industry to professional careers in medical fields or academia requires training students in current laboratory techniques and access to scientific journals. Recruitment of students and faculty, retention of students and faculty, and maintaining our ability to properly train students for careers in the Biological sciences requires attention to infrastructure and facilities. Although we do not have direct control over improving these issues, we monitor the following items:

1. number and type of scientific journals in the IUSB library,
2. number and general subdiscipline of monographs in biology in the IUSB library,
3. inventory of equipment and number of majors per instrument in the laboratory,
4. class size limits,

5. space available to train students in research and teaching labs
6. maintenance of professional expertise by faculty such as use of new (updated) texts, attendance at workshops, meetings or conferences related to biology, etc.

2. ANNUAL ASSESSMENT REPORTS ARE CONTAINED IN APPENDIX II

3. INSTRUMENTATION AND DOCUMENTATION

Methods used to assess student-learning outcomes

A) Threshold courses (L101, L102):

L101 - L102 is a two-semester introduction to the Biological Sciences; each course includes a 3-credit lecture and 2-credit laboratory. These two courses are designed to introduce students to fundamental concepts from molecular to ecosystem levels of biology, introduce the process of scientific inquiry, and have students begin honing their skills in scientific communication, data analysis, and analysis of scientific literature. Each student must pass these courses with a C- or better before he/she can take upper-level courses in Biology.

L101: The major goal for Biology L101 is to introduce students to the process of scientific inquiry through an introduction to the modern study of ecology, Mendelian genetics, and evolution. The course is divided into overlapping units devoted to each of these three main topics. Lectures and laboratory activities are fully integrated to promote multiple ways of experiencing and learning the facts and concepts covered.

Assessment is accomplished through homework assignments, exams, term papers, laboratory quizzes and summaries, and oral presentations. The following nonexhaustive list of skills is emphasized in the course:

a) collecting, manipulating, analyzing, and interpreting quantitative data
b) improving computer skills related to writing, data manipulation, and oral presentation
c) reading and analyzing scientific literature
d) working productively within groups
e) scientific writing - students are required to write lab summaries and one scientific review paper.
f) organizing information from the scientific literature and presenting it orally

L102: The major goal for Biology L102 is to give the students a broad background in cell biology and organismal structure and function. Students should leave the course with a basic knowledge of biological concepts from the level of atomic composition to the level of organismal form and function. In addition, students should improve their skills in analyzing data, writing laboratory reports, performing literature searches, and understanding primary literature.

Assessment is accomplished through lecture quizzes and exams, laboratory quizzes and summaries, and two formal laboratory reports. The following nonexhaustive list of skills is emphasized in the course:

a) collecting, analyzing, and interpreting quantitative data
b) improve observational skills and knowledge of organismal structure.
Lab practicals given during the semester and a cumulative lab practical at the end of the semester are used to test mastery of plant structure, animal diversity/structure, and animal reproduction/development.
c) scientific writing and interpretation of scientific literature. Students are required to write two formal laboratory reports.
d) mastery of laboratory technique and experimental design is assessed through lab summaries, quizzes, and formal lab reports.

B) Mid-level course assessment (L211):

All Biology majors are required to take L211 (Molecular Biology), and this course is typically taken the Fall semester after completing the Introductory course sequence. The major goal for this course is to have students learn the fundamental concepts of molecular biology. Secondary goals include:

- expanding the student's ability to analyze and interpret experimental data
- increasing the student's ability to use previously learned concepts to make and support predictions when faced with a novel situation or problem
- improving the student's ability to accurately communicate scientific information

Student mastery of material and skills in analytical reasoning, synthesis of material, and application is assessed through:

a) problem sets/written assignments every week which require students to develop both analytical/problem-solving skills and written communication skills

b) exams that require problem solving, application of concepts to novel situations, synthesis of information on multiple topics, analysis of experimental results, and written explanations/justification of answers

C) Capstone course (L403):

All Biology majors (BA and BS degrees) are required to take L403 in either their junior or senior year. In this course each student must demonstrate their ability to synthesize scientific information from a variety of sources and present it both orally and in written form.

To meet these objectives, students are required to read and analyze a substantial amount of primary scientific literature, prepare two oral presentations based on the literature they have read, and submit two major pieces of written work, again based on their reading of the scientific literature. They are also required to attend several research seminars given by active scientists and to prepare a critical summary and analysis of each seminar. Finally, students are expected to actively participate in the discussion of each other's presentations. Faculty from the entire department attend the student's seminar presentations. This provides faculty feedback on how well our graduating seniors are meeting goals of #4 (writing and speaking skills), 5 (ability to synthesize scientific information), and #7 (ability to learn independently). Comments from students during the course and on course evaluations are used to modify the structure of the course. An example of how student input is used to improve courses is explained in the 2003 assessment of L403.

D) Monitor success of graduates:

The real test of the Biology program is the ability of our graduates to advance their careers in biology by being accepted into professional or graduate programs (e.g. acceptance into medical school and graduate schools), and find employment in industry, government, private sector, and non-profit organizations. To the extent possible we track what Biology graduates do after graduation. Results from 2001-03 are presented in Appendix IV.

E) Survey current students for interest in upper level course offerings:

In 2003, the department used a course survey to determine student interest in upper-level courses. This survey was developed in response to students requesting more choice in upper-level electives and in response to hiring of new faculty that are in the process of developing new courses. Implementation of new courses as a result of this survey and discussion by faculty is discussed in section 5.

Documentation of assessment

We annually assess our introductory courses (L101, L102), one mid-level course (L211), and the capstone course (L403) to determine how well students are progressing towards mastering the seven

objectives described above. From 2001-2003 we used a narrative report written by instructors involved in these courses.

The entire department meets at least once a semester to discuss course assessment and coordination of curriculum. Changes in the sequence of courses, content of courses, and skills taught in courses are modified in response to feedback from students and our assessment. Examples of how discussions among faculty and feedback from student evaluations result in changes in courses and curriculum structure are discussed in section 5. The Department of Biological Sciences has in the past, always operated well through discussion and consensus and we use this as our primary vehicle for change.

Documents and records relating to assessment are kept with departmental records in the Chair's office and by the Assessment coordinator. Advising records for every student and results of the Student course interest survey are maintained by Ann Grens.

4. ANALYSIS OF DATA

Analysis of assessment information occurs in two ways. First, the department frequently reviews strengths and weaknesses in student preparation for upper level courses. Changes in course content and structure at lower levels impacts upper level courses, thus a relatively high level of coordination in our curriculum is necessary. Changes in response to this type of assessment are discussed in section 5. Second, the Capstone course (L403) is used to determine how well graduating majors have met the objectives of our program. As discussed above, faculty attend these seminars and discuss student performance. Reflections on strengths and weaknesses of student performance and feedback from students on how their education has prepared them for their career goals is best measured at this point. Students tend to be more focused about their future goals and more reflective of their education at IUSB during this time period. Some of the changes in L403 in the past couple of years have been in response to student suggestions. For example, instructors of L403 increased flexibility in choice of research topic in response to students who wanted the opportunity to research areas that directly related to their future career goals. Also, an increased number of writing assignments, attending research talks by professional scientists, and more discussion of scientific literature has been implemented over the past ~6 years. All of these changes have helped students improve their ability to communicate in writing and orally, and in their ability to critically analyze scientific information.

Graduating majors have in general demonstrated that they have mastered biological concepts, can synthesize information from primary literature, understand scientific inquiry, and can organize ideas in writing and orally. The faculty have characterized the performance of our graduating majors from 2001-03 as an average performance (as well as expected), with a few students performing remarkably well and a few doing not as well as expected. Differences in motivation and long-term goals of students partly explain the range in performance. One general observation from 2002 and 2003 is that students who performed most poorly in L403 were transfer students. These students appeared to be at a disadvantage from taking fewer courses that emphasized synthesis and application of concepts. This is not to imply that all transfer students are at a disadvantage, but students coming from weaker Biology programs do tend to struggle in their first few courses at IUSB.

A final example of how Biology faculty analyzed assessment data is the course interest survey that was done in Spring 2003. As mentioned above, students had expressed interest in having more choice in upper level Biology electives. We have also experience a large turnover in faculty due to faculty retirements; 4 of the 9 tenure-track faculty have been hired within the past 5 years. In order to better match the development of new courses and modification of existing courses with student interests and needs, students filled out a course interest survey during advising. Student interests tend to fall into two general tracks: those who are interested in organismal biology and those who are interested in molecular/cellular biology. Faculty discussed the results of this survey and two new courses - Entomology and Histology will be offered this next year. These courses expand our elective offerings in both organismal and cellular-level biology. Another course that will be added to the curriculum soon is

Animal Behavior. This will expand our course offerings in Zoology (an area that is weak in our current curriculum and based on the course survey is a topic that generates a lot of interest among students).

5. SUMMARY OF ACTIONS TAKEN

The main changes that we have made in response to assessment by students and faculty is in the areas of increased frequency of student advising, course revision, modification of prerequisites for both introductory level and upper level courses, and development of new courses. The Biology department has also made some substantial investments in equipment for laboratories including purchase of 13 laptop computers for use in labs, purchase of digital data acquisition systems for photographing gels and use with fluorescent microscope imaging, and investment in Molecular, Genetics, Organismal Physiology, and Field Biology labs. Changes that have been made to improve the Biology program are briefly discussed.

A) Increase frequency of advising and percentage of biology majors advised

In Spring 2001, the department shifted from multiple faculty advising students to centralized advising in which Ann Grens became the primary advisor for all Biology majors. The department has benefited in several ways from this approach to advising majors. First, over 90% of our majors are advised every semester. This helps detect problems early in terms of choosing appropriate courses and making progress towards the degree. Ann has also done a remarkable job of keeping track of students who drop out of school for a semester or two. By keeping in contact, a higher percentage of these students have returned to finish their degrees - thus increasing our retention rates. Second, centralized advising has the advantage of quickly identifying problems in class scheduling. One of the adjustments we have made in the past 3 years is to shift the offerings of course electives to improve the balance of upper-level electives offered in even and odd years. Third, receiving student feedback from a large percentage of our majors on issues such as interest in course electives is easy to do by administering surveys during times of advising.

A drawback of centralized advising is the large time commitment. The number of biology majors has grown from 2001-03, thus significantly increasing the time commitment that Ann has devoted to advising. The biology department will be revisiting this issue and making adjustments as necessary. Although Ann formally advises students, all faculty are involved in mentoring students in career choices and helping students figure out the best steps to take to reach their personal goals.

B) Entry-level assessment: change in Introductory-level classes as a result of assessment of student preparation for courses

In 1999, a major change in the organization of the Introductory-level biology courses was made from a 2-semester lecture course with a 1-semester lab to our current system of 2-semester combined lecture and lab courses. There was a relatively high withdrawal and failure rate in 1999 and 2000 due to students lacking basic math skills. In 2001 we changed the math prerequisite for L101 and L102 to Math level 4 (completion of University level Algebra) and have strictly held to this prerequisite since this time period. This change has helped lower the withdrawal and failure rate in these courses.

C) Course assessment: changes in Major classes as a result of assessment and coordination of curriculum

Two courses that have been extensively restructured in response to assessment are Genetics (L311) and Cell Biology (L312).

Genetics (L311) - taught by Kirk Mecklenburg

Major changes to the upper level Genetics course for majors were made in response to curriculum improvements in lower level courses. For example, students enter L311 with a greater understanding of molecular genetics due in large part to Molecular Biology (L211) taught by Ann Grens, L211 has been streamlined into the Biology Curriculum, and is now a requirement for L311. Topics covered in L211 were reviewed and used as the basis for deciding which redundant topics to drop and which new subjects could be added to L311. The result of this review was that the middle 1/3 of L311 was dropped, and more depth was added in the areas of Classical and Modern Genetics. Greater depth was also added in new research areas such as Gene Therapy, Developmental Genetics, Genome research, and Bioinformatics. In addition, the structure of homework assignments was changed. Although, homework has been assigned in previous semesters, the homework was not formally graded and students tended to not do it. Including homework as part of the course grade served as appropriate motivation, and consequently helped students do significantly harder problems on the tests.

Cell Biology (L312) - taught by Robert Pope

Major changes to the upper level Cell Biology course were made in response to student performance and discussion with faculty teaching lower-level courses. To ensure that students had skills necessary to succeed in this course, L211 (Molecular Biology) was added as a prerequisite. Based on a review of the syllabi for Molecular Biology (L211) and Genetics (L311), molecular biology, biochemistry, and genetics were removed from the cell biology syllabus. This allowed extensive discussion on the topics of protein targeting and folding, nuclear import and export, cell cycle regulation, ribonucleoprotein production and assembly, membrane structure and function, the electron transport chain, cell junctions, cell signaling, lipoproteins, and many other important areas of cell biology. In addition, a new textbook was chosen for the class entitled The Cell: A Molecular Approach by Geoffrey Cooper. The new textbook is easy to read, much shorter than the previous text, and liked by most of the students. The exams were reduced in number to one midterm exam and one comprehensive final exam. Weekly quizzes and discussions of current literature kept the students' attention, and the class turned out to be a great success.

D) Courses in which prerequisites were changed to improve student performance

L101 and L102 - increase required math level to Math level 4 (University-level Algebra)

L308 - require L101, L102 and L211 to ensure that students have the scientific maturity and experience in scientific inquiry and data interpretation to handle material taught in this course.

L312 - change prerequisites to include L102 and L211 so that all students have more uniform background and can handle material covered in course. Prior prerequisites were L102.

L473 - require L101, L102, L211, and one other upper-level biology course to ensure that students have the maturity and skills necessary to handle the level of data interpretation and discussion of scientific literature necessary to do well in this course.

E) Investments in laboratory equipment

As mentioned earlier, our ability to properly train students for careers in the Biological Sciences requires attention to infrastructure and facilities. The major investments in equipment for laboratories include purchase of laptop computers for use in labs, purchase of digital data acquisition systems, and investment in molecular, genetics, organismal physiology, and field biology labs. These investments were made in response to the increased importance of computer literacy, bioinformatics, and biotechnology. Some specifics on how these technological changes were incorporated in courses are highlighted below.

L101 and L102 lecture and labs taught by Andy Schnabel, Robert Pope, Deborah Marr. Faculty involved in teaching labs include Tom Clark, Jim McLister, and Loy Pike.

The purchase of laptop computers has made it possible to give students more training in use of data spreadsheets, construction of graphs, and basic statistical analysis.

L308 Organismal Physiology lab taught by Tom Clark

Technological changes in labs from 2001-2003 included extensive use of laptop computers and digital data acquisition software to do experiments involving measuring heart rate and contraction force. Students learn how to calibrate instruments, learn software, and practice working with data spreadsheets and constructing graphs.

L319 Genetics Laboratory taught by Kirk Mecklenburg

There were several substantial technological improvements in the upper level Genetics Lab. A digital camera for the Biology Department was purchased which could be attached to the Olympus dissecting scope. New lab procedures were written for the students so that they could photograph and manipulate high quality images of their specimens. The photography for DNA gels was also switched to digital imaging. Dr. Robert Pope cobbled the apparatus together using existing materials in our Department. While we need to work on the sensitivity of the apparatus, if the students used appropriate amounts of DNA in their gels, the pictures turned out quite nice and we saved money by not using more expensive film based photography.

Two new computer labs investigating the Genetic aspects of Bioinformatics were also added. The labs were designed to teach how database searches and analysis are done with DNA and protein sequences. Each student was given a different DNA sequence, and were instructed in the new Wiekamp computer labs how to search the National Center for Biotechnology Information (NCBI) databases with BLAST and use other sequence analysis software available on the web.

The Genetics Lab Manual that was written to accompany the course was also updated. The lab manual is customized so that we may take advantage of existing Departmental equipment.

L474 Field Biology Lab taught by Deborah Marr

This course was substantially revised in Fall 2003 in response to student performance and a better understanding of gaps in our curriculum in statistical analysis of data. One of the major revisions in this lab was providing more instruction on experimental design, data organization, and data analysis. Most labs involved multi-week experiments in which students designed an experiment, collected data in first week, and then completed data analysis in the second week. This revision has resulted in regular use of laptop computers and instruction in more advanced statistical methods and software.

6. PROPOSED NEXT STEPS

We are in the process of developing new courses due to the number of new faculty who have recently joined the department, and we are in the beginning of studying the feasibility of adding a Masters program in Biology. All of this means we are in the midst of revising our assessment procedure to better match the changes in our program. The basic structure of annually assessing introductory level courses, a mid-level course, and the capstone course has worked well in providing checkpoints for identifying strengths and weaknesses in our curriculum. The changes in prerequisites, revision of existing courses, and addition of new courses highlight some of the changes made in response to this method of assessment. However, the use of narrative summaries of the threshold, mid-level, and capstone course has not provided some of the information we would like to have. The department has begun discussing the following issues in an effort to strengthen our program and methods of assessment.

A) Adding an independent evaluation of student mastery of knowledge.

Idea: use of pre-test and post-test or use of a cumulative test given as part of L403 to assess how well our graduates compare in mastery of material to other institutions

A subset of our students take the MCAT (Medical entrance exam), DAT (Dental Admissions exam), and GRE (Graduate Record examinations), which provides a measure of how well our students compare with other students applying for similar post-graduate education. However, this is an anecdotal measure because we do not have direct access to student scores and rely on students sharing their scores with us. The summary of graduates (Appendix IV) shows that our students are successful in being admitted to Professional post-graduate programs and Graduate School. Only a subset of our students choose these professions. Therefore, it would be helpful to have a more complete measure of how well our students are doing.

Another avenue for comparison with other institutions is through faculty involvement in national research conferences and conferences such as Project Kaleidoscope (PKAL) Assembly. For example, Andy Schnabel attended the PKAL conference in Nov. 2003 - "Shaping General Education Programs Focused on Scientific & Quantitative Literacy" and gave a report on issues of undergraduate science education to the entire faculty. In addition, faculty have colleagues at a variety of academic institutions, which also provides an informal avenue for comparing how our program matches that of other institutions.

In terms of undergraduate research, we already have a mechanism for evaluating student performance in relation to peer institutions. Acceptance of abstracts for students to present their work at regional and national meetings and acceptance of papers for publication indicate we are doing very well in this area (See Appendix III for complete list of student research presentations and papers).

B) Restructure the narrative summary of assessment

The value of the narrative summary is that it documents observations of faculty that are otherwise difficult to quantify. However, the faculty have begun discussing use of a more structured course evaluation so that we are more consistent in the types of information that are recorded for each course. Increase in structure will hopefully make it easier to compare changes across courses, across years, and make it easier to identify strengths and weaknesses in our program.

C) Areas of Concern

In the past 3-5 years there has been an increase in the number of students doing research (Appendix III). Research experience is critical for our undergraduates because it provides hands-on experience with problem-solving, practicing lab techniques, and experiences necessary to be competitive for jobs, professional schools and graduate schools.

The increase in undergraduate research is great, but has led to a very real space crunch. More space is needed for faculty to have room to engage students in research. Our research labs are relatively small and research space for some of the faculty is spread out over several areas. The lack of consolidation of research space makes it difficult to supervise students when they are working far away from our offices. Also, limited space means that only a few students can work with a faculty member at any one time.

APPENDIX I

ASSESSMENT PLAN
DEPARTMENT OF BIOLOGICAL SCIENCES
(This report is being submitted to the Division of Liberal Arts and Sciences Ad Hoc Committee on Assessment for review and comment).

MISSION

The Biology Department offers programs to students in a geographical region that serves a dozen counties in Northern Indiana and Southern Michigan. The primary mission is to offer quality programs at the undergraduate level that includes the Bachelor of Arts and Bachelor of Science degrees. In pursuing this mission, the department is dedicated to maintaining the highest standards in teaching, scholarship, research, and service by providing students with the best possible faculty, classroom and laboratory facilities and other support elements.

Further, Biology is committed to offering general education coursework that would satisfy requirements for students in the Division of Liberal Arts and Sciences, the School of Nursing, the Division of Education, The Division of Business and Economics and Radiography/Allied Health Services.

GOALS

Assessment has great value in measuring how effective a department or an institution is in educating students as well as determining what students learn during their university experience. Assessment that is thoughtfully and carefully done will allow faculty to identify strengths and weaknesses in courses and programs. Once the results of assessment are realized changes can be made with greater confidence.

Assessment will be used to determine how well the Biology Department is achieving its goals. Identification of goals "seems to be a logical way to avoid wasted effort and improve the efficiency of the educational enterprise" (Cox). Establishment of goals facilitates curricular planning, and tends to focus teaching practices and departmental priorities. It should be clearly understood that no two biology departments will necessarily develop the same goals since they exist in different academic environments. Thus the goals of IUSB may not be the same on all counts, as the goals of IU Gary or IU Bloomington.

The Department of Biological Sciences at IUSB seeks to provide experiences that will enable the student:

1. to demonstrate mastery of a given body of biological information,
2. to demonstrate mastery of certain biologically related manipulative skills such as laboratory,
   field and computer skills,
3. to develop an appreciation for the historical perspective of biology,
4. to improve writing and speaking skills,
5. to develop high level cognitive thinking including observation and experimentation, collection and analysis of data, synthesis of conclusions, and extrapolation of information and data.
6. to understand ethical issues related to Biology,
7. to develop the ability to learn independently,
8. to develop a clear understanding of the relationship between science (biology) and society.

INDIRECT METHODS OF ASSESSMENT

Indirect methods do not measure what the student is learning but what is being taught. This is important in biology because resources are important in determining the level of student opportunity to learn. Each indirect method below will be part of the curriculum review previously mentioned:

1. number and type of scientific journals in the IUSB library,
2. number and general subdiscipline of monographs in biology in the IUSB library,
3. inventory of equipment and number of majors per instrument in the laboratory,
4. class size limits,
5. level of maintenance of professional expertise by faculty such as use of new (updated) texts, attendance at workshops, meetings or conferences related to biology, etc.

DIRECT METHODS OF ASSESSMENT

ENTRY-LEVEL OR NEAR ENTRY-LEVEL ASSESSMENT

In the Department of Biological Sciences, two general types of assessment are employed. One is "value added," or what the student leaves with as compared to what he/she enters with. The other is "absolute" or how much of the designated subject matter a student has incorporated at the end of the class.

The "value-added" approach is used in the way we admit students to the classes, and the "absolute" approach is used in the final class evaluations. In Biology, our "value-added" approach is based on a strict interpretation of prerequisites for our courses; we assume that certain skills and information are obtained in specified prerequisite classes (chemistry, math, basic biology or upper level courses, etc), and we examine the grades of those classes before advancing students through the curriculum.

In addition, initial assessment is done by counseling Biology majors every semester before registration, so that a personal assessment of progress is made by some faculty member regularly and frequently.

CLASS OR COURSE ASSESSMENT

The style of assessment used in individual classes is the "absolute" assessment, total knowledge gained as a function of the material covered in the class. Each major-level class is assessed using a variety of methods after initial evaluation of student readiness in courses demanding prerequisites.

All courses taken by biology majors employ measures which not only observe and evaluate student understanding of content, but also cognitive, communication and laboratory skills. The pattern in biology is to design examinations that employ subjective questioning from the entry level course (L101) on. Because of the relatively small numbers of students per course, student class participation is encouraged. These methods lend to almost instant feedback from students (course improvement), and improved student performance.

Content and understanding of subject matter is also evaluated in term papers which measure the ability of the student to develop a topic, locate sources of pertinent information (literature review), assimilate and synthesize the information and draw logical conclusions.

Understanding scientific procedure is evaluated primarily in the laboratory. Students are required to perform experiments, collect data, organize data in a suitable form (i.e., graphs, tables, etc.), evaluate data, comprehend the relevance of controls, draw conclusions and apply information to alternate situations. Students are then asked to write a summary from the data collected.

CONTINUED PROCESSES OF ASSESSMENT

The Department of Biological Sciences finds value in continued assessment of learning and skills. This is done through writing, laboratories, a junior/senior seminar, and a capstone experience. Continually more demanding standards are expected of students and evaluated on progress.

Writing across the curriculum - Ever-increasing standards of writing are expected from our students. In all major level biology classes, some essay questions are required on exams. In the introductory class a research paper updating some topic covered in class is demanded. In the organismal physiology class (L308), the students write up their laboratory experiments extensively. In the ecology class (L473), an essay on the field trip is written. The writing culminates in the capstone experience, to be described in a later paragraph.

Laboratories - There is a constant assessment of skills in the laboratory experiences demanded of all majors. The introductory level labs are preparatory for the more sophisticated laboratories of the higher level courses. Computer literacy in the laboratory is expected in the ecology (L473) class. For the BS degree, assessment of laboratory skills should culminate in the capstone experience, to be described in the next paragraph.

Capstone Experience - At present, the capstone assessment for both the BA and the BS degree is the Proseminar course (M403), in which the students do a library research paper and present their results orally to the faculty and other students. This exercise gives them an opportunity to synthesize their backgrounds, skills, and understanding.

However, the department unanimously agrees that the most reasonable capstone experience is a thesis summarizing independent laboratory research conducted by the student. This capstone experience will be called the senior thesis (L490). Original research done by the student under the supervision of a full-time faculty member will culminate in a written report which will be defended before a panel of three faculty members other than the supervisor. The thesis must include an extensive literature review. It is hoped to have the senior thesis in place no later than the Fall semester, 1994, and will act as our terminal "absolute" assessment tool.

DOCUMENTATION OF ASSESSMENT

To document our assessment process the Department of Biological Sciences will study and compare student preparations, class grades, laboratory requirements and student writing skills over time. To do this, we will each collect relevant data individually and meet at least once a semester to discuss these data and observations which will then be formally documented.

In addition, the Department will periodically review the results of the capstone experience to see if students are performing at a reasonable level.

Also, we will compare our curriculum to that of other institutions to remain aware of national trends.

The Department of Biological Sciences has in the past, always operated well through discussion and consensus and that will remain our vehicle for change.

POSTGRADUATION ASSESSMENT

Since so much that leads to success in a field is intangible, the ability to apply what is learned is an important measure of student ability. The Biology Department is incorporating a formal study of our graduates over the years as an assessment tool. We are checking their professional achievements, and the level of preparation they feel they received at IUSB, with a view to improving the curriculum in our major. It is also viewed as another student feedback mechanism.

COSTS

The only costs anticipated for pursuit of the above assessment plan reside in the senior thesis. It is estimated that costs over and above the present Biology annual budget will amount to approximately $750 per student per semester for supplies including glassware, chemicals, duplicating, etc.

Further costs to cover expenditures for certain students to attend meetings to present their research findings should be covered. Not all students would fall into this category, and the biology faculty would determine which student(s) (and research) was appropriate for presentation before some scientific body. The annual Fall meeting of the Indiana Academy of Sciences would be an excellent forum for this type of experience.

To send one student to a meeting of the IAS would cost approximately $75. This would include registration fee, two meals, and gasoline/mileage. If lodging was necessary, another $50 would be added.

At present, Biology has 3 to 5 senior-level students in any one year. This number is expected to climb in the near future, based upon significant higher numbers of students declaring Biology as a major in the last two Freshmen classes (1990-91, 22 students; 1992-93, 32 students).

In summary, it would cost between $825 - $875 per student for supplies ($750) and attendance at an IAS meeting ($75 - $125). This would be the minimum costs. If five senior level students participated, the cost would be $4125 - $4375.

If funding were unavailable, the Biology faculty would select one or two students on a competitive basis. Money might be available from the Biological Sciences Foundation account or some other source.

SOURCES CONSULTED OR CITED

Bonner, Jose, Yean Choose Odle, Cory Etchberger, Craig Nelson, Ann Richmond and Al Ruesink. A Preliminary Assessment For the Biology Major. Indiana University-Bloomington, 21 April, 1989.

Cox, Donald D. "Goals of Biological Education." Bioscience, 21(1971):1172.

Harrison, Anna J. "Goals of Science Education." Science 217(1982):110.

Winicur, Sandra. Department of Biological Sciences Assessment Plan. January, 1991.

APPENDIX II

Please see attached Annual Assessment Reports for 2001-2003

APPENDIX III - Undergraduate Research in the Biology Department at IUSB.

Table 1. Number of Undergraduates who did research between 2001-2003. Students may do research for L490 credit, volunteer, or receive funding from grants awarded to faculty, SMART fellowships from IUSB, or other outside funding such as Research initiatives (REU) from the National Science Foundation (NSF). The number of credit hours awarded for research is listed below.

Year	Number of students doing research	Total number of L490 credits
2001	17	29 credit hours
2002	16	8 credit hours
2003	21	10 credit hours

APPENDIX III continued

Table 2. IUSB Undergraduates who presented their research at regional or national research conferences from 2001-2003. Undergraduate students are italicized, and IUSB undergraduates are italicized with an asterisk.

Abstracts are reviewed by faculty at other Universities and categorized as accepted for presentation, accepted with revision, or rejected from the conference. All of the abstracts (100%) submitted by IUSB undergraduates have been accepted to research conferences. This high rate of acceptance reflects the quality of research, quality of scientific writing, and mentoring by faculty.

PRESENTATIONS WHERE IUSB STUDENT PRESENTED WORK

Regional Research Conferences

2001

**Loftus J*, Schnabel A, Marr D (2001) Studies of pollination and reproduction in two *Asclepias* species from sand prairies in Indiana. Indiana University Undergraduate Research Conference, Indianapolis IN

**Orr S,* Marr D, Schnabel A (2001) A comparison of plant species diversity between restored tallgrass prairies and native prairie remnants. Indiana University Undergraduate Research Conference, Indianapolis IN

**Perkey J*, Wendel, J (2001) Phylogenetic analysis of *Gossypium* allotetraploids: a formal evaluation of monophyly Indiana University Undergraduate Research Conference, Indianapolis IN

**Rizk R* , Walczak C (2001) Localization of Kinetochore-associated XKCM1 in PtK2 cells support. Indiana University Undergraduate Research Conference, Indianapolis IN

**Willoughby J*, Grens A (2001) Isolation and characterization of MyoD Homolog from Hydra vulgaris. Indiana University Undergraduate Research Conference, Indianapolis IN

2002

**Guard VM*, Schnabel A, Marr D (2002) Comparison of herbivory and reproductive success of *Asclepias incarnata* between restored and remnant prairies. Indiana University Undergraduate Research Conference, Indianapolis IN

**Milton B*, Pope R (2002) Subcloning Recombinant Archvillin Specific Insert-1 From Human Skeletal Muscle cDNA & Purification of Recombinant Protein. Indiana University Undergraduate Research Conference, Indianapolis IN

**Orr S,* Marr D, Schnabel A (2002) A comparison of plant species diversity between restored tallgrass prairies and native prairie remnants. Indiana University Undergraduate Research Conference, Indianapolis IN

**Pysh V, *Hingle S*, Pope R (2002) Isolation and Purification of Human Skeletal Muscle Archvillin DNA Sequence. Indiana University Undergraduate Research Conference, Indianapolis IN

2003

Cohen A, Pope R (2003) Cloning and Analysis of Zebrafish Supervillin. Indiana University Undergraduate Research Conference, Indianapolis IN

Duleh S, Pope R (2003) Isolation of Membrane from *Dictyostelium discoideum*. Indiana University Undergraduate Research Conference, Indianapolis IN

Galvin M, Bushnell P (2003) Oxygen-binding in sandbar sharks. Indiana University Undergraduate Research Conference, Indianapolis IN

Hoshiyama, H (2003) X-ray crystallography of ornithine decarboxylase in new conditions for improved resolution. Indiana University Undergraduate Research Conference, Indianapolis IN

Kubalanza K, Schnabel A, Marr D (2003) Experimental studies of pollination in *Baptisia leucantha.* Indiana University Undergraduate Research Conference, Indianapolis IN

Marshall ML, Marr D (2003) Role of Fusarium sp. on reproduction in Hydrophyllum appendiculatum. Indiana University Undergraduate Research Conference, Indianapolis IN

Merino A, Grens A (2003) Development of a two hybrid screen for bHLH transcription factors in *Hydra*. Indiana University Undergraduate Research Conference, Indianapolis IN

Morris G, Pope R (2003) Developmental Expression and Distribution of *Aedes aegypti* Archvillin. Indiana University Undergraduate Research Conference, Indianapolis IN

Orr S, Marr D, Schnabel A (2003) Changes in Plant Species Diversity in Restored Compared to Remnant Tallgrass Prairies in Northwest Indiana. Indiana University Undergraduate Research Conference, Indianapolis IN

* *Pysh V*, Pope R (2003) Isolation and Identification of *Anopheles gambiae* Archvillin. Indiana University Undergraduate Research Conference, Indianapolis IN

National Research Conferences

2002

* *Loftus J*, Schnabel A, Marr D (2002) Studies of pollination and reproduction in two *Asclepias* species from sand prairies in Indiana. National Conferences on Undergraduate Research. University of Wisconsin-Whitewater.

* *Orr S*, Marr D, Schnabel A (2002) Plant species diversity in tallgrass prairie restorations compared to native remnant prairie sites. National Conferences on Undergraduate Research. University of Wisconsin Whitewater

* *Willoughby J*, Grens A (2002) Isolation and characterization of MyoD Homolog from Hydra vulgaris. National Conferences on Undergraduate Research. University of Wisconsin Whitewater

Perkey J, Wendel, J (2002) Phylogenetic analysis of *Gossypium* allotetraploids: a formal evaluation of monophyly National Conferences on Undergraduate Research. University of Wisconsin Whitewater

Rizk R , Walczak C (2002) Localization of Kinetochore-associated XKCM1 in PtK2 cells support. National Conferences on Undergraduate Research. University of Wisconsin Whitewater

2003

Orr S, Marr D, Schnabel A (2003) A comparison of plant species diversity between restored tallgrass prairies and native prairie remnants. Ecological Society of America, Savannah, GA

PRESENTATIONS WITH STUDENT CO-AUTHORSHIP

2001

Clark TM, *Hutchinson MJ*, Moffett DF (2001) Apical surface morphology of the stomach region of the larval mosquito midgut. Society for Integrative and Comparative Biology annual meeting, Chicago, Il

Schnabel, A, **McDonel, Patrick*, Jonathan Wendel (2001) Intercontinental biogeography of *Gleditsia* based on nuclear and chloroplast gene sequences. 4th International Legume Conference, sponsored by The Australian National University and various Australian botanical organizations. Canberra, Australia

2002

Clark TM, **Flis BJ*, and Remold SR (2002). Effects of salinity and pH on life-history parameters of larval *Aedes* mosquitoes (Insecta: Diptera). Entomological Society of America, North Central Branch meeting, E. Lansing MI.

Clark TM and **Flis BJ* (2002). Physiological aspects of the broad pH tolerance of larval *Aedes aegypti* (Insecta: Diptera). Entomological Society of America, North Central Branch meeting, E. Lansing MI.

Marr D, * *Greenslee T*, * *Martz J* (2002) Ecological causes of phenotypic variation in seed production: a comparison of seed size variation in three species of Hydrophyllum. Indiana Academy of Sciences. Butler University, Indianapolis, IN

Schnabel, A, Marr, D., **Orr, Stuart* (2002) Comparisons of plant species diversity in remnant and restored prairie communities of northwestern Indiana. Indiana Academy of Sciences. Butler University, Indianapolis, IN

2003

Clark TM, **Flis BJ* (2003). Identical pH tolerances of saline water and freshwater Aedes mosquito larvae. Society for Integrative and Comparative Biology, annual meeting, Toronto, Ontario, CA

Marr D, **Orr S*, Schnabel A (2003) Comparison of plant species diversity in remnant and restored prairies at the Kankakee Sands Macrosite. Indiana Academy of Science (Fall Meeting - with special symposium devoted to research at Kankakee Sands). Anderson, IN

Schnabel A., Marr D, * *Kubalanza K* (2003) Estimates of reproductive success, herbivory, and seed predation in *Baptisia leucantha* from the Kankakee Sands restoration and surrounding remnant prairies. Indiana Academy of Science (Fall Meeting - with special symposium devoted to research at Kankakee Sands). Anderson, IN

PUBLICATIONS WITH STUDENTS

Clark T.M., * *Flis B.J.,* and Remold S.K. (in press). Differences in the effects of salinity on larval growth and developmental programs of a freshwater and a euryhaline mosquito species (Insecta: Diptera, Culicidae). Journal of Experimental Biology

Clark T.M., * *Flis B.J.,* and Remold S.K. (in press). pH tolerances and regulatory abilities of freshwater and euryhaline *Aedes* mosquito larvae (Insecta: Diptera, Culicidae). Journal of Experimental Biology

Schnabel, Andrew, *Patrick E. McDonel**, Jonathan F. Wendel (2003) Phylogenetic relationships in *Gleditsia* (Leguminosae) based on ITS sequences. American Journal of Botany 90: 310-320

APPENDIX IV

Table 3. Summary of Biology Graduates (BA, BS, and Biology minor) from 2001-03 and the category of current positions held by those graduates. Number in parentheses indicate the number of students who are in the process of applying for this type of position.

Career Category	Year graduated				
	2001	2002	2003	Total	Percentage
Research Lab Technician	2	2(1)	4(2)	11	34%
Post-graduate Professional (Medical, Dental, Optometry, Veterinary, Law)	2	0	3(2)	7	22%
Graduate School	0	4	(1)	5	16%
Environmental Organizations	0	2	1	3	9%
Advance degree programs (Medical technician, Physician Assistant, Radography)	1	1	0	2	6%
Other	2	1	1	4	12.5%