ASSESSMENT OF STUDENT LEARNING OUTCOMES IN
GENERAL EDUCATION FOR NATURAL SCIENCES
BIOLOGY DEPARTMENT

**Designated Courses:**
The Biology Department has identified the following courses to satisfy the SUNY General Education learning outcomes for Natural Sciences; 31101 General Biology I, 31102 General Biology II, 31105 Anatomy & Physiology I, 31106 Anatomy & Physiology II, 31112 Avian Biology, 31115 Environmental Conservation, 31120 Field Biology, 31121 Introduction to Biology, 31122 Human Biology, 31123 Diversity of Life, 31201 Study of Biological Habitats, 31212 Genetics, 32201 Animal Structure and Function, 32202 Animal Diversity, 3220 Plant Structure and Function, 32204 Plant Diversity.

**Learning Outcomes**
These courses will be assessed to determine if students will be able to demonstrate: an understanding of methods scientists use to explore natural phenomena, including observation, hypothesis development, measurement and data collection, experimentation, evaluation of evidence, and employment of mathematical analysis, an application of scientific data, concepts and models in one of the natural sciences.

**Assessment Methods**
Every course will be assessed once when offered in a three year cycle. 31101 General Biology I, 31121 Introduction to Biology and 31123 Diversity of Life will be evaluated the first year. 31212 Genetics, 31122 Human Biology, and 31102 General Biology II will be evaluated the second year. The remaining courses will be evaluated the third year.

31101 General Biology I, 31102 General Biology II, 31105 Anatomy & Physiology I, 31106 Anatomy & Physiology II, 31112 Avian Biology, 31121 Introduction to Biology, 31122 Human Biology, 31201 Study of Biological Habitats, 31212 Genetics, 32201 Animal Structure and Function, 32202 Animal Diversity, 32203 Plant Structure and Function and 32204 Plant Diversity embedded test questions as the General Education Assessment Tool for the Natural Sciences. These questions will be administered during the lecture or laboratory component of the course. As each topic is introduced, specific questions will be part of the lecture or laboratory exams. All students will be taking this exam. Data will be collected from the total number of students enrolled in each course by the instructors of the course during the Fall Semester. All data for this semester must be collected and compiled and turned in to the Department Chair by February of the Spring Semester.

The criteria for measurement of results will be the student's score on the specific embedded questions.

- 80% and above means exceeds standard
- 70% to 79% means meets standard
- 60% to 69% means approaches standard
- 59% and below means not meeting standard
31115 Environmental Conservation, 31120 Field Natural History and 31123 Diversity of Life will be evaluated as described below. All students enrolled in these courses will be assessed. The assessment will be implemented by the course instructor. The assessment of these courses will be as follows:

I. Field Biology (31120)

Each student will complete an independent field study under the instructor's supervision which will consist of: making observations of outdoor, natural history phenomena, asking a scientific question based on those observations, formulating a hypothesis, garnering background information on the hypothesis from published sources, designing a scientific study to test the hypothesis, collecting data as dictated by the study's design, analyzing the data using elementary statistical methods, and interpreting the study's findings in evaluating the initial hypothesis. The specific topic of the study will be chosen by the student with guidance from the instructor. Class sessions throughout the semester will provide students with the necessary background and training in conducting the steps outlined above. The student's attainment of these learning outcomes will be assessed by evaluating a written paper prepared by the student of the study she or he conducted. The format of this paper will follow that of a scientific research paper (i.e., segregated into Introduction, Methods, Results, and Discussion sections, with citations of

II. Environmental Conservation (31115)

The course will include a few laboratory sessions in which students will learn the scientific method, and complete written, group exercises applying their understanding of the scientific method. For example, student groups will generate testable hypotheses from actual questions posed by environmental science, and design hypothetical studies that would adequately test these hypotheses. Also, student groups will learn how to conduct elementary statistical analyses and interpret data in evaluating hypotheses. The student's attainment of these learning outcomes will be assessed by evaluating written assignments students will complete independently that will be based on the in-class exercises. In addition, questions testing the student's understanding of the scientific method will appear on exams. An example of such a question is the following: "These data were collected to test the hypothesis that urban portions of a stream contain more nitrates than rural portions of the same stream. Results of an unpaired t-test performed on these data are:

\[ t=3.51, P=0.03. \] What conclusion can one draw from these data?"

III. Diversity of Life (31123)

Assessment will be accomplished in two ways. First, each student will complete an organism project (hereafter referred to as "organism assignment"). This project will consist of the following phases: (1) Upon choosing an organism from an instructor-prepared list, the student will garner information about that organism from secondary sources at the library. From this background information, the student will then generate a few scientific questions they find interesting about her or his organism. (2) The student will then garner additional information from the primary literature pertaining to one of their questions and formulate a testable
hypothesis from this question. (3) The student will outline a scientific study to test her or his hypothesis. (Prior to this assignment, portions of laboratory periods will be spent discussing how to formulate testable hypotheses and how to design scientific studies to test hypotheses.) All three elements of the project will be submitted as an assignment that will be graded according to a rubric. The rubric itself, as well as the instructor's grading of submitted assignments, will be evaluated independently by another instructor.

Second, students will conduct an in-lab, group exercise that will compare morphological variability among two "populations" of mollusk shells (hereafter referred to as "adaptation assignment"). Each group will measure shell size, shape, and pattern, compute and graph the mean and standard error of each set, and write a summary paragraph that will discuss the results, pose a hypothesis explaining the results, and include the scientific rationale for the hypothesis. This assignment will be submitted at the end of the laboratory period and graded according to a rubric. The rubric itself, as well as the instructor's grading of randomly selected 20% of submitted assignments, will be evaluated independently by another instructor.

The criteria for determining the degree to which a student has achieved the specified learning outcomes for courses 31120, 31115 and 31123 is based on the average of that student's grade percentage on the specific assignment designed to test the learning outcomes for that course.

<table>
<thead>
<tr>
<th>Avg. Grade</th>
<th>Degree of Achievement</th>
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<tbody>
<tr>
<td>80% and above</td>
<td>means exceeds standard</td>
</tr>
<tr>
<td>70% to 79%</td>
<td>means meets standard</td>
</tr>
<tr>
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</tr>
<tr>
<td>59% and below</td>
<td>means not meeting standard</td>
</tr>
</tbody>
</table>

**Analyzing and Improving Student Learning Outcomes**

The course coordinator of a multi-section course, or a sole instructor of a course will summarize and interpret all data for that course. This data will be presented at the Spring Semester curriculum and assessment department meeting for discussion by all faculty. As a result of that meeting, recommendations to curriculum and instruction will be made. It will be the responsibility of the course coordinator and sole instructor to implement these changes in the curriculum and insure all full-time and adjunct faculty have incorporated the changes. The assessment process will be open and continuous.

The date relative to student performance and learning outcomes will be summarized and forwarded to the Vice President for Academic Affairs and the General Education Committee.
BIOLOGY DEPARTMENT TIME LINE FOR GENERAL EDUCATION ASSESSMENT

Discussion and identification of measurable learning objectives in relation to knowledge and skills of Natural Sciences competencies - Fall 2001

Submission of plan to College General Education Committee - January 2002

Create a menu of measuring tools for learning objectives - Spring 2002

Resubmission of plan to College General Education Committee - Dec. 2002

Launch Pilot Assessment Program for General Biology I, Introduction to Biology and Diversity of Life during Fall 2002

Department implementation of General Education Assessment - Fall 2003 for General Biology I, Introduction to Biology and Diversity of Life
GENERAL EDUCATION ASSESSMENT

ORGANIZATION

The Department of Science and Engineering will function as a "Committee of the Whole" with regard to General Education Assessment. This committee will be chaired by John Wolbeck. The committee will be charged with all aspects of implementation of the plan; that is, choosing the course evaluation schedule, preparing (and/or revising) the assessment tool for the given semester, analyzing student learning outcomes, making recommendation and fine tuning the plan in the light of ongoing experience.

Target Courses

It is assumed that the general education requirement will be met by a student who takes the gateway course for a sequence. Consequently, subsequent courses in a sequence will be removed from the general education list. The following courses will be subject to the continuing General Education Assessment Plan:

34103        Applied Chemistry I
34105        General Chemistry I
36110        Physical Geology
37110        Elements of Chemistry and Physics
37120        Astronomy
37125        Physical Science/Physical World
37140        Physical Science/Environment
35101        General Physics I
35103        Physics for Science & Engineering I
35105        General Physics I with Calculus
35108        Acoustics
35111        Applied Physics I
Assessment

Every course to be assessed in the Department of Science and Engineering will be a laboratory based course. Each course will be assessed once every three years. Thus, on average there will be four course assessments each year. The experience of the students taken from both the lecture and the laboratory will form the basis for the assessment.

1. Each course will have a listing of selected laboratory experiences and the corresponding Knowledge and Skill Areas specified for the Learning Outcomes in the Task Force Report Learning Outcomes document. This information will be presented in a standard matrix form for the entire department. A check will be placed on this form wherever a learning outcome is represented in the laboratory work. The department will gain a clear idea of the extent to which the learning outcomes are present in our laboratory work. A copy of this format is attached to this plan.

2. The Department Committee of the Whole, under the direction of the committee chair will generate a General Education Assessment Test section which will be included with the instructor's final examination for those courses which are to be assessed. It will be up to the instructor to determine the weight (if any) this section will have on a student's final grade. This section will be designed to test the outcomes listed on the departmental laboratory matrix.

Assessment Plan

Students must demonstrate competence in the following learning outcomes.

1. Scientific Method:
   - Observation
   - Hypothesis
   - Measurement and data collection
   - Experimentation
   - Mathematical Analysis

2. Applications:
   - Scientific data
   - Concepts
   - Modeling

The assessment of these learning outcomes shall be accomplished via a multiple choice exam that will be administered at the end of any course being evaluated. The
exam will be administered in all of the listed General Education courses which have been chosen for evaluation for that year. The exam will contain two sections pertaining to the student learning outcomes for the Natural Sciences Knowledge and Skill Areas as follows:

1. **Scientific Method:** Seven representative multiple choice questions.
2. **Applications:** Three representative multiple choice questions.

**Evaluation:**

Scientific Method:

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE</th>
<th>NUMBER OF CORRECT ANSWERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceeding Standard</td>
<td>6-7</td>
</tr>
<tr>
<td>Meeting Standard</td>
<td>4-5</td>
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<tr>
<td>Approaching Standard</td>
<td>2-3</td>
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<tr>
<td>Not Meeting Standard</td>
<td>0-1</td>
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Applications:

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE</th>
<th>NUMBER OF CORRECT ANSWERS</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>Meeting Standard</td>
<td>2</td>
</tr>
<tr>
<td>Approaching Standard</td>
<td>1</td>
</tr>
<tr>
<td>Not Meeting Standard</td>
<td>0</td>
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</tbody>
</table>

**Analyzing the Outcomes**

All outcomes assessment will be done at the end of the academic year in question. Firstly, the laboratory matrix will be reviewed by the department and perhaps adjusted. Secondly, the department will be divided into two person teams to evaluate the administered assessment questions. The results of the assessment will be forwarded to the VPAA and to the General Education Committee.

**Utilizing the Outcomes Assessment Results**

The results of the previous assessment will form the basis for departmental discussions during the subsequent academic year. Weaknesses in either an individual course or in the exam itself will be addressed and recommended action taken. Such action might include adjusting course outlines, acquiring additional, laboratory equipment, changing texts, etc.
Updating and Monitoring the Plan

The departmental General Education Assessment Plan should be approved by a majority of the department's full time faculty, although an achievable goal is the department's unanimous consent. The plan may be modified based on perceived effectiveness or on suggestions from the VPAA and the General Education Committee of the college. All changes need departmental review and approval.

Time line

Spring '02: The department will develop an assessment vehicle which is consonant with the idiosyncrasies of the individual courses. Laboratory work will be reviewed by individual instructors, with the aim of pointing out and enhancing the already existing objectives in current syllabi. These results will be discussed on a regular basis at department meetings. Adjustments will be made where appropriate. To begin the process the first circuit of general education course evaluations will be accomplished in two years -- Spring '03 and Spring '04. After this time the circuit will be accomplished in three years as shown below for Spring '05, Spring '06 and Spring '07.

Spring '03: These courses will be assessed -- 34105, 37120, 35101, 35103, 34103, 36110

Spring '04: These courses will be assessed -- 37140, 35108, 37110, 37125, 35105, 35111

Spring '05: These courses will be assessed -- 34105, 37120, 35101, 35103

Spring '06: These courses will be assessed -- 34103, 36110, 37140, 35108

Spring '07: These courses will be assessed -- 37110, 37125, 35105, 35111

The assessment will then toggle around in the same fashion on the three year '05, '06, '07" schedule. The assignment of actual courses in the above rotating schedule might be adjusted with experience.