

**Student Learning Assessment Report  
BIOLOGY DEPARTMENT**

**Learning and misconceptions in the General Biology II course**

**Biol 3052**

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**SECTION I: Mission and Student Learning Outcomes**

**The Biology Department Mission** The Biology Department will develop in each professor and student, critical thinking, enthusiasm, initiative and the necessary skills to become lifelong students of Biology. Emphasis will be placed on basic concepts and research, in an environment that promotes the development of professionals with social, cultural and humanistic sensibility as well as profound ethical values. In this way, the Department will contribute to the enrichment of science and society through the creation and dissemination of new knowledge through scientific research.

**Biology Student Learning Outcomes**

The Biology Department Programs aim to develop graduates with the following skills and values, as well as with proficiency in the following scientific concepts:

**Skills and Values**

- Critical thinking and problem solving skills through the scientific method
- Team working skills
- Communication skills in Spanish and English
- Computer literacy and its scientific applications
- Knowledge of up-to-date scientific tools and techniques
- Awareness of contemporary scientific issues
- Awareness of ethical implications in science
- Ability to learn by him/herself (lifelong learners)

**Scientific concepts**

- Cell structure and physiology
- Organismal biology (zoology, botany and microbiology) with emphasis in tropical environments.
- Genetics: classical, population and molecular
- Chemical, physical and mathematical applications to biology
- Ecology: Interrelationship among organisms and its environment, population, ecology, biodiversity and conservation biology
- Evolution as a unifying science

**SECTION II: Biology Student Learning Assessment Project –BIOL 3052**

<b>Sub-section</b>		<b>Content</b>
<b>Focus of Assessment Project</b>		Assess the learning of basic biology concepts and identify misconceptions in the second part of the General Biology (BIOL 3052) course
<b>Justification</b>		<ul style="list-style-type: none"> <li>This course is taken by all freshman biology majors and introduces important concepts necessary for advanced courses.</li> </ul>
<b>POPULATION Student Faculty</b>		<ul style="list-style-type: none"> <li>Three faculty members</li> <li>Pretest- 429 students</li> <li>Post test -346 students</li> <li>Course enrolls about 400 students per year</li> </ul>
<b>Assessment</b>	<b>Pre-intervention</b>	<ul style="list-style-type: none"> <li>A diagnostic pretest on content was offered on the first day of class.</li> </ul>
	<b>Intervention</b>	<ul style="list-style-type: none"> <li>Conventional lectures, laboratory exercises, diagnostic test group discussion</li> </ul>
	<b>Post-intervention</b>	<ul style="list-style-type: none"> <li>Post activity: Same test was offered near end of the semester (before semester ended to allow for taking proper action)</li> </ul>
<b>Results and discussion</b>		<ul style="list-style-type: none"> <li>Students improved performance thus the interventions helped clarify the chosen content Average score increased from 51.25% in pretest to 78.70% in posttest (Figure 1).</li> <li>Incoming and persisting misconceptions were identified and clarified before semester ended</li> </ul>
<b>Dissemination of Results</b>		<ul style="list-style-type: none"> <li>Failed questions and the misconceptions were discussed with course faculty.</li> <li>Project was summarized at department meeting</li> <li>Project was presented at A&amp;S final presentation activity to department coordinators and College officials (May 06)</li> </ul>
<b>Course of Action</b>		<ul style="list-style-type: none"> <li>Faculty was asked to re-teach the misconceptions and difficult concepts</li> <li>This information will also be sent to the new faculty teaching the course</li> <li>Will recommend group discussion of diagnostic test as teaching tool</li> <li>Faculty will review course content and prepare a new diagnostic test with other important concepts</li> <li>Important concepts will be clarified to students and laboratory teaching assistants</li> </ul>
<b>Next learning assessment closing the loop project</b>		<ul style="list-style-type: none"> <li>Conduct a similar study in the General Biology I (BIOL 3051) course to identify misconceptions and difficult concepts</li> </ul>

**Focus of Assessment Project**

The main focus of this study was to assess the learning of basic concepts and identify the misconceptions associated with these concepts in the General Biology II course (BIOL 3052).

**Justification**

The General Biology II course is taken by all freshman biology majors in their second semester. This course is a prerequisite to all other biology courses and teaches the fundamental scientific concepts and skills needed in advanced courses. Furthermore, concepts and skills included in the General Biology II course are comprised within the Department expected student learning outcomes (e.g. cell physiology, organismal biology, mathematical applications to biology, ecology and evolution).

**Impacted Population**

The General Biology course enrolls about 400 students per year, mostly freshman biology majors, and is taught by different faculty members. In this study the data was collected from three faculty members. The pre test was taken by 429 students and the post test by 346 students. The results were then shared with all the faculty that teaches the course.

**Learning Assessment Loop*****Pre-intervention Activity***

For the pre-intervention activity, a diagnostic pretest on content developed by the faculty that teaches the course was offered on the first day of class. The test consisted of 21 multiple choice questions from the following fundamental concepts discussed in the course: Evolution, Classification, Kingdoms, Plant tissues and processes and animal tissues and physiology.

***B. Intervention***

The intervention used to teach these concepts consisted of the conventional lectures, the laboratory exercises and group discussion of the diagnostic test. Thus, the diagnostic test was also used as a teaching/ learning tool to improve student understanding of major concepts.

***C. Post-intervention***

For the post intervention activity, the same pretest was offered as a post-test before the semester ended to allow for taking proper action. Some students first took the post-test individually and then discussed it in small groups and the concepts were again discussed to entire class.

**Results and Discussion**

The pre and post test scores were used not only to assess how much the lectures and laboratory assisted students in learning the concepts but to identify misconceptions. The incoming misconceptions (brought from high school) were identified in the pre-test as

those questions were 40% of the students that failed them choose the same wrong answer. Misconceptions that persisted throughout the semester were identified in the post-test again as those questions that 40% of the students that failed them choose the same wrong answer. Those questions were then again discussed in groups and to the entire class before the final exam.

**PRE-TEST:** In the pre-test, the test score average was 51.25. The data was analyzed individually for each faculty member as well as globally (Figure 1 and 2). Pre test data was used to identify those concepts that students had some knowledge on, those they did not know, as well as the misconceptions brought from high school. The data herein reported is from the global data. Entering students had some knowledge in evolution, species, polinization, and antibodies. Thirteen of the 21 questions of the pre-test were failed by over 50% of students (Figure 3). Misconceptions identified in the pretest (answered incorrect by more than 50% of students and same incorrect answer was chosen by more than 40% of those who failed them) include identifying smooth and striated muscle instead of only striated muscle as that which causes arm and leg movement, not identifying blood as a connective tissue, not associating the blood with defense mechanisms and identifying all chordates as vertebrates.

**POSTTEST:** The test score average increased from 51.25% in the pretest to 78.70% in the post-test (Figure 1). Post-test data showed increase in 20 questions for all groups and faculty members thus indicating that learning took place through lectures and laboratory for most students. There was improvement in knowledge in all but one question in immunology which had a misleading terminology. Fourteen of the 21 questions were answered correctly by at least 70% of the students (Figure 4). Questions still failed in the post-test (by more than 25% of the students) include 8 of the 21 questions and dealt with classification, the protist kingdom, muscular tissue, blood relation to the immunological system, menstrual cycle hormones, differences among plants and animals and classification of viruses. These are all department students who will built on the basic concepts in the advanced courses thus it is important all major concepts are clarified. As for misconceptions, most students clarified incoming misconceptions. In some students the misconceptions persisted thus traditional teaching was not sufficient to correct them. Misconceptions in posttest were those answered incorrectly by more than 20% of students and same incorrect answer was chosen by more than 40% of those who failed it. Four misconceptions were identified in the posttest. Three of these questions were identified as misconceptions in the pretest and were again failed in the posttest by some students. These included identifying smooth and striated muscle as the muscle that moves legs and arms, thinking blood cells are produced in the blood and that blood is not associated with defense mechanisms, relating movement only with animals and not using heterotrophs and autotrophs as distinguishing traits for plants and animals, identifying the vertebral column and not the notochord as present in all vertebrates.

**Innovations in this study** Giving the posttest before the semester ended allowed for taking action before students left the course. Offering the diagnostic test individually and then in groups allowed for students to clarify concepts as well as review for the final

exam. Thus, the diagnostic test was used as teaching/ learning tools – to improve student understanding.

**Dissemination of results:** Those questions failed by many students as well as the misconceptions were sent to the faculty teaching the course for them to take proper action. This study was also summarized and presented in a department meeting and to Arts and Sciences assessment coordinators and officials.

### **Course of Action**

The individual and global results were returned to the faculty before the semester ended and they were asked to further discuss the difficult questions and misconceptions in group or to the group as a whole and even include in final to measure effectiveness. Faculty received their own results and global results thus can compare their individual results throughout next semesters to evaluate their efforts in clarifying misconceptions.

Among the strategies used by some faculty is that where the diagnostic test was again discussed in small groups. For this activity the students answered the pretest in groups of 5 right after individually taking the pretest. The group post-test was taken by 18 groups (89 students). In this group activity 80% of the groups (14/18) got a perfect score thus misleading concepts were clarified in groups. Two groups failed one question, 1 group failed 2 questions and 1 group failed 3 questions. Thus, students clarified most of their doubts among themselves through the group discussion. Still those questions that were failed in the groups were again discussed and clarified to the entire group. Some were again asked in the final exam of two faculty members that had re-discussed them and the results showed an increase.

Thus, faculty is also becoming aware of group discussion techniques to re-teach concepts. In a meeting with the faculty that teaches the courses failed questions and misconceptions were analyzed and strategies were discussed. Also it was accepted that this information would be given to the new course faculty. Faculty also decided to review course content and modify the diagnostic test. They agreed to conduct a similar study in the General Biology I course (BIOL 3051). Teaching assistants will also be aware of these misconceptions so that can help clarify them in the laboratory.

### **Next learning assessment closing the loop project**

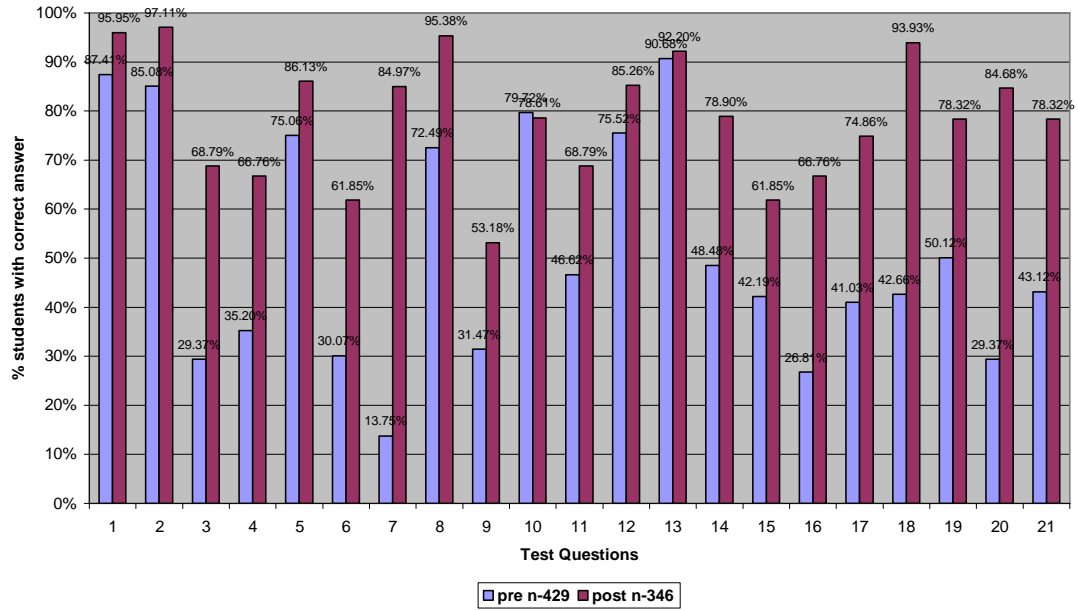
Conduct a similar study in the General Biology I course (BIOL 3051)

### **Appendix**

Pre and post-test-available upon request

Figure 1

Results of Pre and Post test  
GEN BIOL II  
Global



**Figure 2**  
**Faculty and test average**

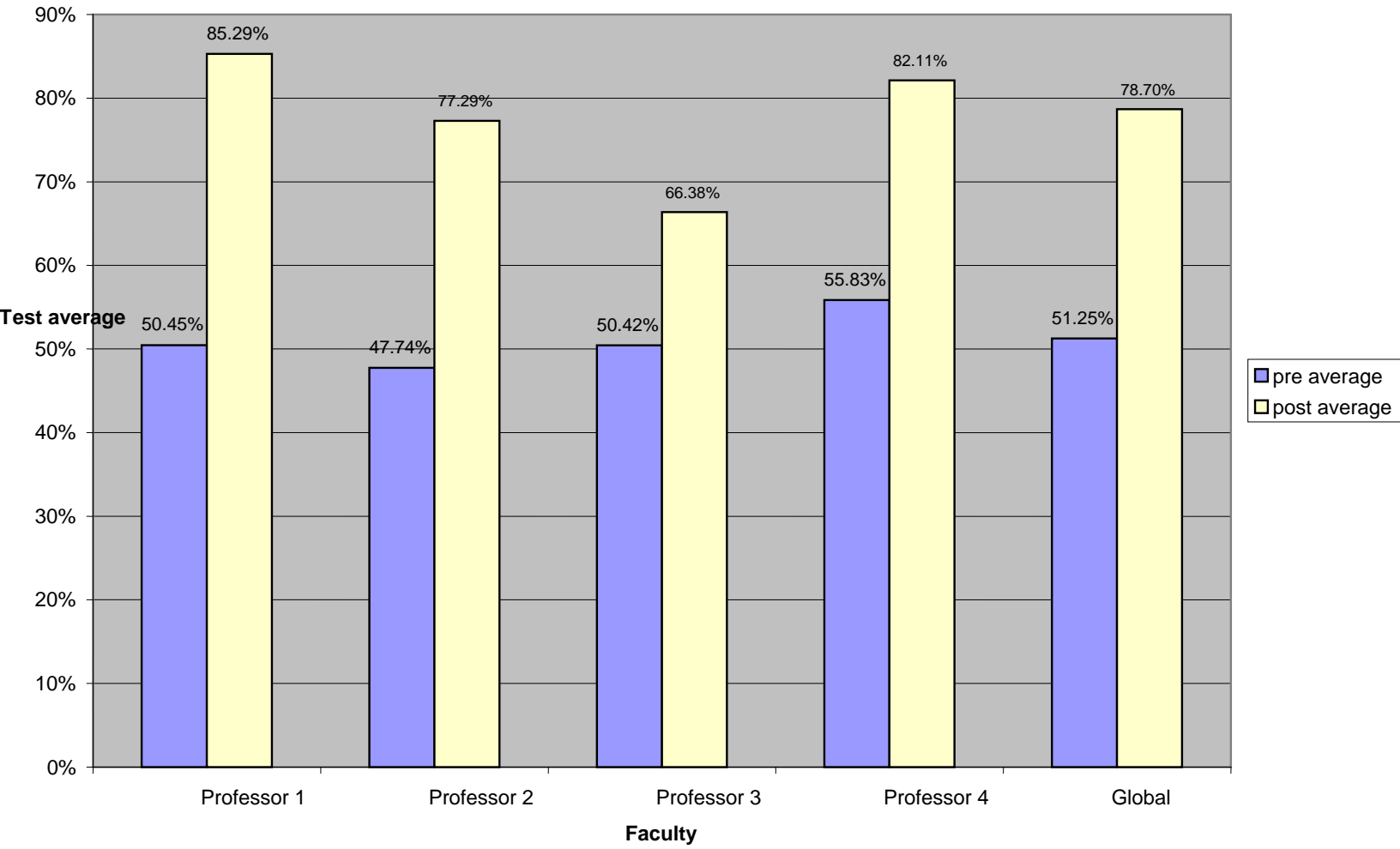
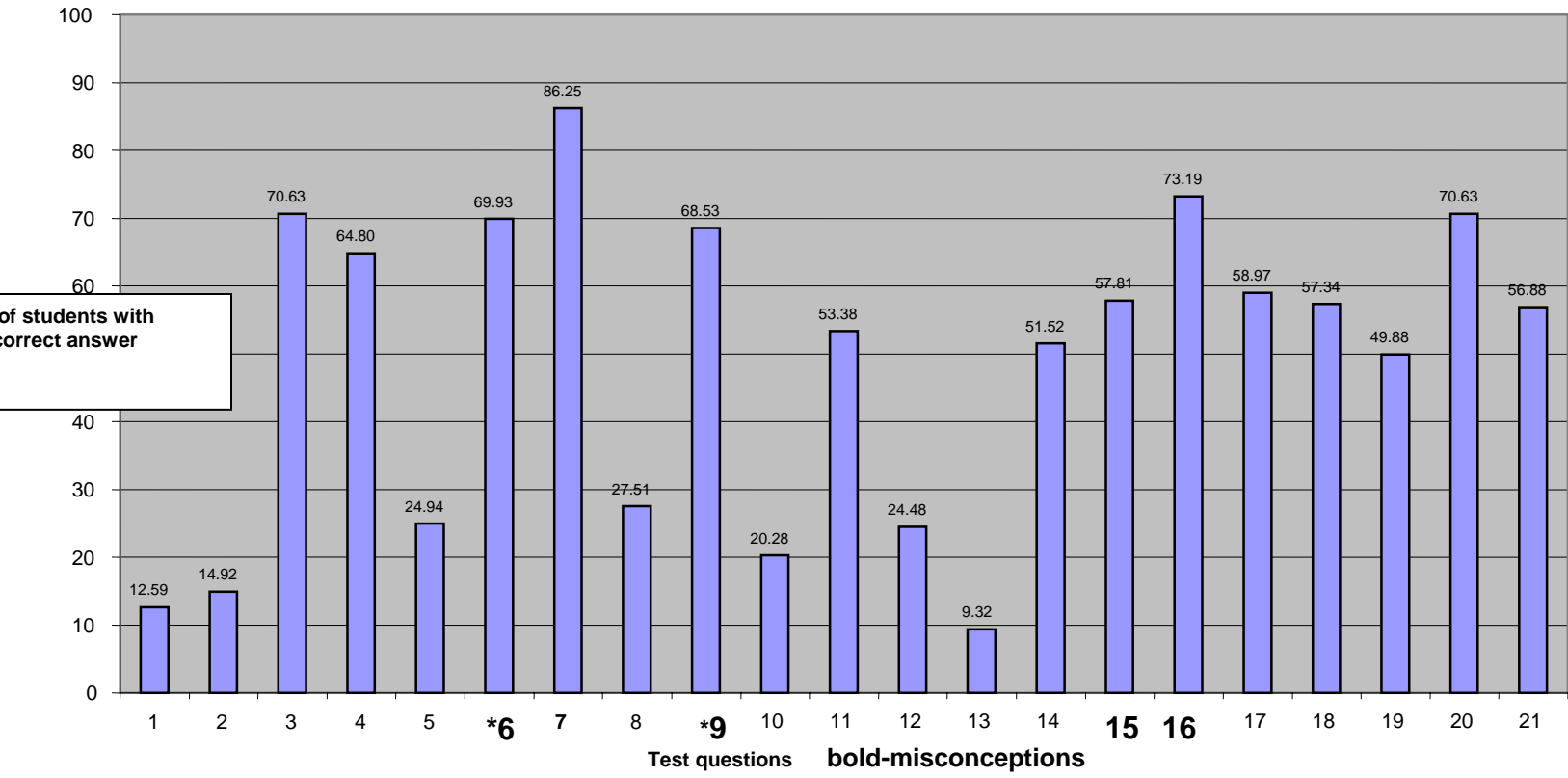


Figure 3  
Incorrect answers in pretest



**Figure 4**  
**Incorrect answers in posttest**

