BIOLOGY: Assessment Report Format (Academic Programs)

Academic Year 2007-2008

I. Brief Summary of Assessment Plan

The goal(s), student learning outcome(s), associated components of the outcome(s) (if applicable), and the performance characteristics or criteria. For 2007 – 2008 the faculty agreed to assess goals 1) Content and 2) Methodology

Table 1. Brief summary of the 2007-2008 assessment plan for the biology majors.

	BIOL-L 105	MICR-M 315	PHSL-P 416	PHSL-P 416	PLSC-B 203
Goals	Methodology	Methodology	Methodology	Content	Content
Outcomes	Apply the methods biologists use to explore living organisms & evaluate the outcomes of scientific experiments	Apply the methods biologists use to explore living organisms	Evaluate the outcomes of scientific experiments	Describe the phylogenetic interrelationships between living organisms	Describe the phylogenetic interrelationships between living organisms
Component(s)	- Observation -Hypothesis development -Measurement -Data collection -Experimentation -Evaluation of evidence -Mathematical analysis	- Data collection - Experimentation - Evaluation of evidence	-Interpretation (of findings from experiment/study)	- Comparison	Comparison, interpretation
Activity (ies)	Write a detailed lab report for the "Mitochondrial DNA" exercise	Perform a microbial diversity group project over the course of the semester and oral presentation of the results.	Perform a literature research on the influence of size on some aspect of comparative animal physiology of their choosing and write a term paper.	Exam question that testing the understanding of similarities and differences in the circulatory systems of fish and crustaceans, which have superficially very similar designs to their circulatory systems.	Exam questions, including critical thinking exercise, from pretest & posttest covering the range of material taught in the course.
Performance Characteristics	-Clear/unclear -Relevant/irrelevant -Correct/incorrect -Complete/incomplete -Concise/verbose -Simple/more fully developed -Correct/incorrect	-Complete/incomplete -Clear/unclear -Detailed/superficial	-Complete / Incomplete (of coverage) -Simple/more fully developed (depth of presentation and expansion of the topic beyond basic concepts covered in lecture)	-Correct/incorrect	-Complete/incomplete, -Fully developed/simple
Benchmark	70%	70%	70%	60%	60%
Faculty assessor	Ms. Carrie Kinsey	Dr. Christian Chauret	Dr. Michael Finkler	Dr. Michael Finkler	Dr. Gary Dolph

II. Assessment Methods

In BIOL-L 105 Introduction to Biology, the classroom activity being assessed was the laboratory report for the "Mitochondrial DNA" exercise. This exercise is performed in weeks 13 & 14 of the semester. The "Mitochondrial DNA" exercise is the last in a series of five exercises for the "Experimental DNA Module" portion which occurs during the final third of the semester. The lab report format as assigned to the student is as follows:

> **Key Principles**
>
> Use the background material, or introduction, to the exercise. Use your own words!
>
> **Materials**
>
> Explain what solutions, etc, were used as well as what equipment was used.
>
> **Procedure**
>
> Explain the procedure in your own words.
>
> **Observations**
>
> Tell what you saw. There is no right or wrong answer. Give an accurate description of your findings.
>
> **Discussion of findings**
>
> Explain your findings in relation to the key principles. Was it what you expected to happen? What variables might have been involved in making it turn out differently?

In PLSC-B 203 Survey of the Plant Kingdom, a pretest-posttest covering the range of material taught in the course was given. Using a paired comparisons t-test, the average score of the pretest was compared to the average score of the posttest for each student completing the course. If the results of the test are significant, the class as a whole will have shown increased content mastery. Increase in student critical thinking was also measured by the difference between their pretest and posttest scores.

The critical thinking exercise was the following:

> The investigator who first described a part of this plant was Susanne Leclercq in 1924. She observed cross sections of petrifaction fossils containing very small axes (E) with a conspicuous exarch actinostele having 5 to 10 radiating protoxylem points. This, plus the fact that the cells of the cortex were thick-walled, suggested to Dr. Leclercq that this was the stem of an ancient fern. Similar material was described by Darrah. In 1954, Fry published a comprehensive study of the fernlike stems of this plant. During his investigation he discovered new characteristics of the stems that convinced him that these axes were ancient arborescent lycopods and not ferns at all. He found delicate linear microphylls spirally arranged on the stem. Twelve years later, in 1966, Phillips & Leisman found the stems attached to a root-bearing rhizophore (C). Examination of the petrified rhizophores showed a protostele surrounded by secondary xylem, the product of a vascular cambium. The radial alignment of cells in the outer cortex of the rhizophore suggested that it was the product of cambial activity. Aerial branches were found attached to the upper end of the rhizophore bearing spirally arranged leaves. The roots borne on the rhizophore were spirally arranged, a rather unusual root arrangement. Instead of a vascular system that is a bilaterally or radially symmetrical protostele, Phillips & Leisman found a monarch collateral bundle centrally placed in each root (D). this is a very un-rootlike structure similar to that found in coal swamp plants. Still working with permineralized specimens (coal balls) from the Middle

Pennsylvanian, Schlanker and Leisman were able to demonstrate a connection between a heterosporous cone (F) and the stem and rhizophore. At this time, the plant was classified in the _____. The elapsed time from Leclercq's initial paper in 1924 to Schlanker & Leisman's 1966 paper is 42 years.

1. Place this plant in the correct order (remember that they end in "-ales") or be more specific if you have the courage.
2. Give three reasons for choosing this order.
3. Give at least one reason for rejecting each similar order.

In PHSL-P 416 Comparative Animal Physiology, Each student performed independent literature research on the influence of size on some aspect of comparative animal physiology of their choosing. They wrote a term paper on the subject (with initial and revised submissions), provide an oral presentation of the paper to the class, and conducting a peer-review of a fellow student's paper. Assessment was conducted on the initial submission of the term paper. The term paper was structured after review articles published in refereed scientific journals. Students were provided with many examples of these types of papers during the course of the semester, and additional suggestions for writing the paper were posted online for the students. Criteria for the paper were as follow:

- The paper had to include a descriptive title, the paper body, and a literature cited section.
- The body of the paper (not including title page and literature cited section) was a *minimum* of six double-spaced pages in length with standard font sizes and margins. The body had to include an introduction to the topic, including a thesis statement, support for this idea in a logical order and fashion (citing references as appropriate), and a conclusion which summarized the topics touched upon in the paper and how they supported the thesis
- Each paper had to cover a minimum of six ***primary research papers*** from at least three different journals, although review papers and chapters from books could be used to supplement this material. Appropriate in-text citations of references and a complete literature cited section were required.

On the second exam for PHSL-P 416, Dr. Finkler asked a question that tested a student's understanding of similarities and differences in the circulatory systems of fish (non-tetrapod vertebrates) and crustaceans, which have superficially very similar designs to their circulatory systems.

Question #5. Which of the following statements regarding a comparison between the circulatory systems of crustaceans and those of fish is/are true?

a) crustacean hearts pump circulatory fluid from the gills to the tissues; fish hearts pump from the tissues to the gills
b) both crustaceans and fish have closed circulatory systems
c) crustaceans use a single passage heart whereas fish have a double-passage heart
d) all of the above are true

e) none of the above are true

The correct answer is a) crusteaceans have a partly open circulatory system (hemolymph is not contained solely to blood vessels) and both fish and crustaceans have single-passage hearts. The question requires comparisons of three attributes of circulation: the overall direction of blood flow in the circulatory system of each taxon, the basic design of the circulatory system in terms of fluid containment, and the number of flow circuits within the design of each taxon's circulatory system

In MICR-M 315 Microbiology Laboratory, each pair of students had to perform a microbial diversity project over the course of the semester. The purpose of the project was to better understand microbial diversity and population transition in the environment. The project consisted of preparing a simulated pond ecosystem, which was incubated at room temperature with sunlight for 6 to 8 weeks. The students had to perform weekly observations and evaluate the microbial populations using various microbiological techniques. At the end of the semester, each group gave a power point oral presentation on their project and wrote a research paper. The assessment was performed using the components and criteria listed in Table 1, which included data collection (effort to collect and quality of data), experimentation (experimental design and clarity), and evaluation of evidence (quantitative and qualitative analyses, summary, conclusions).

III. Description of Assessment Results

Assessment in BIOL-L 105 was performed in both the fall and spring semesters. There were two sections of 24 students during the fall semester and one lab section of 24 students in the spring semester. While this is a majors Biology, course a number of the students were not Biology majors. By the time this exercise was performed in the fall the class size had dropped to 30 students overall in the two sections. Of those 30, 15 were Biology majors or Biological and Physical Science majors. In the spring there were 19 students remaining by the time this exercise was performed, of those, 6 were Biology or Biology and Physical Science majors. Assessment was done using data from the "majors" students only (Table 2).

Table 2. Assessment results in BIOL-L 105.

Components	Results		
	Fall 2007	Spring 2008	Total
Observation	46% clear	34% clear	43% correct
Hypothesis Development	59% relevant	68% relevant	60% relevant
Measurement	46% correct	67% correct	52% correct
Data Collection	46% complete	50% complete	50% complete
Experimentation	67% concise	50% concise	62% concise
Evaluation of Evidence	30% with developed evaluation; 67% with simple evaluation	16% with developed evaluation; 50% with simple evaluation	19% with developed evaluation; 62% with simple evaluation
Employment of Mathematical Analysis	67% correct	50% correct	62% correct

The lab exercise being assessed for this academic year is different from the one that has been assessed in the past. The key principles, protocol and analysis are all more complicated as it is the last exercise done in the unit. Since it is the last exercise performed in the unit students are expected to write the lab report without help or coaching. In previous years we have assessed the lab reports for the first exercise in this unit. The class did not reach the desired 70% benchmark in any of the components for this exercise in either the fall or spring semesters.
In previous years all students were included in the assessment. This year only the "majors" students were included. Course grades were included in the data tables to indicate the overall performance in the class for each student.

In PHSL-P 416, all but one student turned in a paper that provided satisfactory completeness in the summaries of the studies discussed (Table 3). In addition, all but one of the students appropriately covered their topics in an appropriate level of depth and expanded beyond the course content**.** Although the benchmark was reached for both components examined, there was a great deal of variation in the clarity of presentation.

Table 3. Assessment results in PHSL-P 416 (methodology).

Student	COMPLETENESS	DEVELOPMENT
1	Complete	More fully developed
2	Complete	More fully developed
3	Complete	More fully developed
4	Complete	More fully developed
5	Complete	More fully developed
6	Complete	More fully developed
7	Incomplete	Simple
Overall	14/15 (93%)	10/15 (67%)

In the second part of the assessment in PHSL-P 416, Dr. Finkler assessed content by examining the ability of the students to compare the two circulatory systems in questions (see question in section II). Five of eight students (62.5%) enrolled in the course correctly answered the question. Thus the benchmark of 60% was surpassed. Although the benchmark may appear to have been set low, recall that the question entails comparison of three different aspects of the circulatory system.

In PLSC-B 203, a pretest-posttest covering the range of material taught in the course was given. Using a paired comparisons t-test, the average score of the pretest was compared to the average score of the posttest for each student completing the course. If the results of the test are significant, the class as a whole will have shown increased content mastery. The average score on the pretest was 34.14 and on the posttest, 62.71. The value of t with 13 degrees of freedom was -7.661, a result significant at $p > 0.0001$. The gain in knowledge was highly significant. Overall content mastery for each student was also assessed based on their final average (Table 4).

Table 4. Assessment results in PLSC-B 203 (part 1).

Outcome	Proficiency Level 1 Ave ≤ 65.0	Proficiency Level 2 Ave. = 65.1 to 85.0	Proficiency Level 3 Ave. ≥ 85.1
Average Content Mastery	1	9	4

Only one student did not show average proficiency or higher. Increase in student critical thinking was also measured by the difference between their pretest and posttest scores (Table 5).

Table 5. Assessment results in PLSC-B 203 (part 2).

Outcome	Proficiency Level 1 Increase ≤ 10 points	Proficiency Level 2 Increase = 11 - 30 points	Proficiency Level 3 Increase ≥ 31 points
Critical Thinking	1	7	6

Content mastery was also compared to critical thinking. Dr. Dolph assumed that most of the students would fall along the composite diagonal.

Table 6. Assessment results in PLSC-B 203 (part 3).

	Proficiency Level 1 Ave ≤ 65.0	Proficiency Level 2 Ave. = 65.1 to 85.0	Proficiency Level 3 Ave. ≥ 85.1
Proficiency Level 1 Increase ≤ 10 points	0	1	0
Proficiency Level 2 Increase = 11 - 30 points	1	6	0
Proficiency Level 3 Increase ≥ 31 points	0	2	4

All the students except one performed at or above the expected level (Table 6). A subset of the students was required to answer the critical thinking exercise (see above in section II) which will be required next year. As this question was not graded and represented a test of what would be done next year, the answers were graded as not close, close, and correct (Table 7).

Table 7. Assessment results in PLSC-B 203 (part 4).

Outcome	Proficiency Level 1 Not Close	Proficiency Level 2 Close	Proficiency Level 3 Correct
Critical Thinking	2	3	2

Since Dr. Dolph had never given this type of question before, the results were considered to be quite good. Most of the students were close (placed the species in the right sub-division (lycopods) but the not correct order (Selaginellales)), and Dr. Dolph thinks that the results were very reasonable.

In MICR-M 315, all nine students achieved the objectives for the three components that were tested. As a result of the previous assessment of this exercise in 2007, Dr. Chauret spent a fair amount of time throughout the semester to emphasize the importance of proper data collection, evaluation, and clear experimental protocols. This seems to have been useful since the students met the objectives. The students were also juniors and seniors, and many of them had had Dr. Chauret in previous classes and might have been familiar with his expectations for this type of exercise. However, although the benchmark was reached for all three components, there was a still some variations in data collection and evaluation, with some students performing at what could be considered a "superior" level than others.

Table 8. Assessment results in MICR-M 315.

Components	Results
	Total
Data Collection	(9/9) 100% complete
Experimentation	(9/9) 100% clear
Evaluation of Evidence	(9/9) 100% detailed

IV. Use of assessment for program improvement.

In BIOL-L 105, more teaching emphasis is indicated in all areas. These freshmen appear to be unprepared for college-level work in a biology laboratory. In PHSL-P 416, Dr. Finkler will expand the number of phylogenetically-based questions. Most of the questions set forth on these exams deal with concepts and functions that are ubiquitous among animals. However, the "comparative" aspect of the course should be more strongly emphasized to examine how different lineages of organisms have developed different approaches to these common functions. Dr. Finkler also plans to spend more time on writing exercises. For example, he may take papers from previous semesters that had problems with presentation and ask students to proof-read them, write a paper indicating what the paper would need to be improved, and have them do a re-write of the paper. This hopefully will help students develop the skills needed to start to critically review their own writings, which is a key step in developing their own writing. In PLSC-B 203, all students will be required to answer the critical thinking exercise next year. Finally, in MICR-M 315, we will continue to emphasize thorough data collection and evaluation. These are deficiencies identified in previous assessments exercises and we must continue to adequately address them with each new group of students.

V. Dissemination of results.

A web page linked to the NIMS main webpage is used to post the various assessment reports online.

http://www.iuk.edu/~konims/Assessment.shtml