**Liberal Arts Essentials Course Assessment Report**

**Course:** Bio 107-5, Spring 2010  
**Writing Unit:** No  
**Instructor:** Danny Ingold  
**Methods:** Departmental Pre/Post Test & Basic Botany Pre/Post Test (Ingold)  
**LAE Category:** Scientific Understanding  

**Goal:** Muskingum students will develop the ability to analyze questions related to major concepts in a field of study.  

**Learning Objective:** A Muskingum College student will be able to define a meaningful issue (or problem) related to an academic area of study, formulate a position (or solution or argument) on that issue, and communicate his or her position effectively to a professional audience.  

**Departmental Perspective (if applicable):** Students will develop the ability to analyze questions related to major concepts covered in a field of study.

### A. Student Outcomes

<table>
<thead>
<tr>
<th>Learning Objective or Departmental Perspective</th>
<th>Number and percentage of students exceeding expectations</th>
<th>Number and percentage of students meeting expectations</th>
<th>Number and percentage of students failing to meet expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Stream of Evidence (pre/post test)</td>
<td>3/17 (18%)</td>
<td>5/17 (29%)</td>
<td>9/17 (53%)</td>
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<tr>
<td>2nd Stream of Evidence (botany pre/post test)</td>
<td>9/16 (56 %)</td>
<td>6/16 (38%)</td>
<td>1/16 (6%)</td>
</tr>
</tbody>
</table>

### B. Student work examined

**Summarize the tasks used to measure the objective (e.g., exams, research project/paper assignments, presentation, or class assignment) and attach a copy of each (from Departmental assessment instrument or other source).**

Science can be thought of as a form of human inquiry focused on questions about the natural world that can be addressed through the evaluation of objective information. As such, students need to understand current content information in any particular field in order to appreciate the context for ongoing lines of research as well as the process of scientific inquiry itself. We use separate modes of assessment to address both of these important areas.

Student understanding of scientific inquiry was assessed by administering a general biology pre-test on the first day of the course and post-test on the last day of the course. This assessment attempted to evaluate the extent to which students have changed in their appreciation for how science works as a mode of human inquiry.

Student understanding of the scientific content of the course was assessed with a pre-post botany quiz. This quiz consisted of 8 questions (10 pts) and was designed to test the basic conceptual/factual knowledge of students in botany both before and after they completed this laboratory.
C. Scoring Criteria

Explain the criteria used to evaluate student performance in relation to the learning objective (i.e., what constitutes advanced, proficient, partially proficient, not proficient, etc.) Attach copies of measurement instrument or rubric (Departmental assessment instrument or other source).

Questions on our pre- and post-course scientific inquiry understanding assessment will be marked as correct or incorrect. Differences in assessment scores (Post - Pre) will be evaluated from both the standpoint of a class average as well as changes in individual performance. For the pre/post test, exams were scored as a total percentage of points earned out of 11 possible points. Students were considered to have exceeded expectations by scoring a 85-100% on either the pre- or post-exam, have met expectations by scoring 70-84% on either the pre- or post-exam, and having not met expectations by scoring below 70% on both the pre- and post-exams.

For the botany pre-post exam (10 pt quiz) I included only those students who missed at least 5 of the 10 points on the pre-exam. From this subset, students who improved their score by five points or more exceeded expectations, students who improved their score by 3-4 points met expectations and students who failed to improve their score by at least three points, did not meet expectations.

Results of Department Assessment Exam

![Results of Biology Dept. LAE Pre-Post Exam for Bio. 107 (Ingold)](image)
Pre-Scores (darker bars) vs. Post-Scores (lighter bars) of individual students in Bio. 107 Lab Assessment
Results of IngoId General Botany Assessment Exam

Results of Pre-Post Test
Plant Lab Exam (107)
IngoId - Assessment
Fall 2009
Pre-Scores (purple bars) vs. Post-Scores (blue bars) of individual students in Bio. 107 Lab Assessment

T value = 10.96  
P value = 0.00000001  
D.F. = 15  
Significant Difference
D. **Analysis/Reflections on the student learning outcomes**

**Why do you think students performed as they did in this class? What might be done to improve their performance?**

The pre/post test designed to measure student understanding of scientific inquiry focused mainly on issues related to experimental design. Although this plant lab is focused mainly on observation and basic plant anatomy and natural history, we did conduct two experimental labs in which the students had to develop and test a few hypotheses and compare their outcome to a control. During these two labs (cellular respiration and photosynthesis) we went over experimental hypotheses, controls, replications etc… and I believe that the slight but significant improvement in student scores ($t = 2.12, P < 0.049, df = 16$) on the post test resulted largely from these experiences. However, in spite of a statistically significant difference in pre- vs. post- test outcomes, only 18% of students exceeded expectations and only 29% met expectations on the exam. The fact that 53% of students failed to meet expectations likely reflects the observational and natural history inclination of the course. Only two of eight labs placed the focus on scientific inquiry and experimentation. As a department we might need to reassess if we are using the proper tool (in this case a scientific inquiry/experimental design exam) to really get at whether our biology 107 labs are meeting our general LAE expectations.

For the botany pre-post exam, it is not surprising that most incoming first-year students lack an understanding of basic botanical concepts and facts such as what photosynthesis is. This is likely the result of their lack of exposure to botanical principles in high school and/or their general lack of interest in the subject overall. I was pleased and pleasantly surprised to find 56% of students exceeded expectations and 38% met expectations on the pre-post botany test. Because of the nature of the exam (botany content), invariably there had to be improvement. Nonetheless, the number of students who had a grasp on basic botanical concepts such as photosynthesis, functions of plant cells, mitosis etc. improved markedly (see last figure).

E. **Reflections on the assessment process**

**How might the course-embedded assessment process be improved? Ideas for possible revisions of listed learning objective(s) related to the goal are especially welcome.**

The biology department originally intended for the pre/post test to be used for all Bio 107 labs. In my view, after having gone through the process (along with Shelley Szalay), it would probably be more useful for the biology faculty to design individual exams that reflect the design of the individual 107 sections. Re-writing questions to make the language more accessible to first-year students, particularly non-majors, would also be helpful.
Name: ______________________________

Year (Fr, So, Jr, Sr): ________________________________

Major: ________________________________

Students:

This is not a test for which you will be graded. However, this assessment document will provide us with some very important information that will be used to gauge how successful our LAE courses are in educating our students. Therefore, it is critical that you take this exercise seriously and do your very best to provide us with thoughtful, reflective answers to the questions – to the best extent you can. Thank you for your help and cooperation with this effort.

1. Let’s suppose that over the course of the next couple of weeks as you meet new people in your dorm and around campus, one person were to say to you, “So you’re taking a science course? So tell me .. what is science?” How would you respond to this question?

2. Briefly describe how the following terms relate to scientific inquiry.

   a. Hypothesis

   b. Theory
3. A touch therapist claimed that therapeutic touch can reduce the frequency of headaches and as evidence published a testimonial from a client claiming reduced headache frequency after one treatment. Critique this evidence and suggest a better scientific test of this claim.

d. Replication

c. Control

4. A man diagnosed with Parkinsonism suspected that pollution at his workplace (a mill) may be to blame. Which of the following statements would lend greatest support to his suspicion?
   a. A survey of workers at the mill reveals many cases of illness.
   b. A survey of workers at the mill and at other similar mills reveals many cases of illness.
   c. The incidence of illness is higher among the mill workers than among age-matched workers in non-polluted workplaces.
   d. The national average incidence of Parkinsonism is lower than that among workers at the mill.

5. George claimed that a tropical animal protein was effective in lowering blood pressure, and he was planning to invest in the product. As evidence of his claim, George, who had hypertension, said that he felt much better after the treatment and had much more energy. In comparison to a credible scientific investigation, how is George's inference flawed?
   a. Lack of an appropriate outcome measure.
   b. Lack of appropriate controls and lack of an appropriate outcome measure.
   c. Lack of randomization, lack of replication, and lack of an appropriate outcome measure.
   d. Lack of replication and lack of appropriate controls.
   e. Lack of appropriate outcome measure, replication, randomization, and controls.
6. People with a rare condition called synesthesia interpret one kind of stimulus as another. For example, they might feel the shapes of certain objects when tasting certain kinds of food. The cause of synthesis is unknown. Suppose a person saw a series of bright lights in the air when a telephone rang and an undulating chain of light when a kitten purred. Which of the following hypotheses would you choose to test as the most likely explanation for this person’s synesthesia?

- a. The person has light sensing cells in their eyes that are connected to auditory centers in the brain.
- b. The person’s auditory neurons cannot produce action potentials.
- c. The person has some sensory neurons connected to the wrong brain centers
- d. None of the above

7. A physiologist monitored the effects of a novel drug intended to enhance kidney function in the elderly. In designing the study, a cohort of 400 college freshman were divided randomly into a control and placebo group. Which of the following is a potential problem with how the study was designed?

- a. Lack of replication
- b. Lack of controls
- c. Sample group make-up
- d. No flaw

8. Two eukaryotic liver cells were isolated and cultured in optimal growth conditions. After two generations of replication have passed how many total cells would exist? You may assume exponential growth.

- a. 2
- b. 6
- c. 14
- d. 32
#1. What is photosynthesis?

#2. Name three types of cells found specifically in plants:

- ______________________
- ______________________
- ______________________

#3. In what plant cell organelle does cellular respiration occur: (a) ribosome, (b) nucleus, (c) chloroplast, (d) mitochondrion, or (e) endoplasmic reticulum? __________

#4. List one of the gases given off during cellular respiration: ______________________

#5. What plant tissue carries the water: (a) xylem, (b) collenchyma, (c) phloem, or (d) sclerenchyma? __________

#6. The fruit of a plant develops from a mature: (a) ovary, (b) seed, (c) stigma, or (d) anther? __________

#7. What Kingdom are plants in: ________________________________________

#8. What Kingdom are algae such as spirogyra in: ____________________________