Liberal Arts Essentials Course Assessment Report

Course: Bio 107-2, Spring 2009

Writing Unit: No

Instructor: Shelley Amstutz-Szalay

Methods: Pre/Post Test,

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 (13%)</td>
<td>10 (43%)</td>
<td>10 (43%)</td>
</tr>
<tr>
<td>2nd Stream of Evidence (final exam)</td>
<td>8 (33%)</td>
<td>16 (67%)</td>
<td>0 (0%)</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 conceived 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 pre-test on the first day of the course and post-test on the last day of the course. This assessment evaluated 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 by the final exam. The final exam consisted of 50 multiple choice questions covering the scientific content of each of the laboratories completed during the term.

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 number of points earned out of 11 possible points. Students were considered to have exceeded expectations by scoring a 10-11 or above, have met expectations by scoring 7-9, and having not met expectations by scoring 6 or below.

For the final exam, students who scored between 90-100% exceeded expectations, between 70-89% met expectations, and below 70% did not meet expectations.

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. This laboratory course was based primarily on observational, not experimental, activities. Some of the terminology used in the questions was likely also unfamiliar to students.

For the final examination used to assess content, all students met or exceeded expectations. Students completed both pre-laboratory and post-laboratory questions on each experiment, as well as completing a written lab report for most experiments. Having been required to answer questions on each experiment multiple times, as well as having to write a lab report that included background information, methods, results, and conclusions likely helped them understand and retain information.

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. It may be better to design individual exams that reflect the design of the individual sections. Re-writing questions to make the language more accessible to first-year students, particularly non-majors, would also be helpful.
Muskingum College Biology Department

LAE Pre-Post Assessment Exam
Biology 105, 107, 111, 112, 121, 122

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

   c. Control

   d. Replication
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.

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 synesthesia 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
1. These are found on the revolving nosepiece of the microscope:
   a. objectives
   b. oculars
   c. stage

2. This is used to refocus the specimen when changing to higher magnifications:
   a. fine adjustment knob
   b. ocular
   c. coarse adjustment knob

3. At increasing magnifications, the field of view:
   a. gets smaller
   b. gets larger
   c. doesn’t change

4. The bog bodies found in Florida (the Windover bodies) were individuals who:
   a. were Native Americans
   b. lived during the Iron Age
   c. appear to have killed by violent means
   d. all of the above
   e. none of the above

5. The part of the compound light microscope labeled “A” in Figure 1 is:
   a. the coarse adjustment knob
   b. the fine adjustment knob
   c. the objective
   d. the stage

6. VNTRs:
   a. can be amplified by PCR, then separated and visualized by gel electrophoresis
   b. will show two bands if the individual is homozygous
   c. can be used to definitively identify a suspect
   d. all of the above

7. The part of the compound light microscope labeled “C” in Figure 1 is:
   a. the condenser
   b. the nosepiece
   c. the illuminator
   d. the base
8. The height of a person can be estimated from their remains by:
   a. measuring the arm span
   b. entering the length of the limb bones into a regression formula
   c. both a and b

9. The integumentary system:
   a. functions mainly in protection
   b. includes the skin
   c. includes the sweat glands, hair, and nails
   d. all of the above

10. Skin:
    a. comprises 50% of the total weight of an adult
    b. contains only one layer, the epidermis
    c. protects the interior of the body from injury, bacteria, water, and heat loss

11. The epidermis:
    a. consists of epithelial tissue
    b. does not have a blood supply
    c. has ridges that increase friction and enhance gripping ability
    d. none of the above
    e. all of the above

12. Bog bodies have been found in:
    a. Northern Ireland
    b. Denmark
    c. the United States
    d. all of the above

13. Prints that require development with powder or chemicals to be visible are called:
    a. patent
    b. latent
    c. inked
    d. plastic

14. The chemical ninhydrin reacts with what substance in a fingerprint:
    a. amino acids
    b. salt
    c. water
    d. oil

15. DNA replication:
    a. involves unwinding of the DNA strands
    b. requires DNA polymerase to catalyze the formation of new bonds
    c. adds new nucleotides to the growing strand by “matching” nucleotides with their complements (A with T, etc.)
    d. all of the above
16. During a chromatographic analysis, a substance moved 4.0 cm, and the solvent front moved 8.0 cm. The \( R_f \) value equals:
   a. 0.5
   b. 2
   c. 0

17. What ridge characteristic is identified in Figure 2, letter B:
   a. bifurcation (fork)
   b. bridge
   c. island

18. What fingerprint pattern is identified in Figure 2, letter C:
   a. double loop
   b. tented arch
   c. whorl

19. What ridge characteristic is identified by Figure 2, letter D:
   a. bridge
   b. island ridge (short ridge)
   c. double bifurcation
   d. trifurcation

20. During chromatography:
   a. a substance that has a higher affinity for the stationary phase will move farther than one with a high affinity for the mobile phase
   b. a substance that has a higher affinity for the mobile phase will move farther than one with a high affinity for the stationary phase
   c. a substance with a \( R_f \) value of 1.00 did not travel up the plate

21. The central-most part of the hair shaft is the:
   a. cortex
   b. medulla
   c. cuticle

22. The cuticle:
   a. has scales that point toward the scalp
   b. can be used to identify individual humans
   c. of a human being usually has a spinous pattern
   d. none of the above
   e. all of the above

23. The cuticle shown in the Figure 3:
   a. has a imbricate scale pattern
   b. has an coronal scale pattern
   c. is very unlikely to be seen in human hair
24. Thin layer chromatography:
   a. uses a liquid mobile phase
   b. uses a solid stationary phase
   c. both a and b

25. The medulla shown in Figure 5 is:
   a. continuous
   b. fragmented
   c. absent

26. The diameter of a hair is 60 μm, and the diameter of the medulla is 40 μm. Therefore:
   a. the medullary index of the hair is 1.5
   b. the medullar index of the hair is 0.66
   c. the hair is probably from a human
   d. both b and c

27. Which of the following are useful in determining whether a hair is from a human or nonhuman animal:
   a. presence of a root
   b. scale pattern
   c. presence of a medulla

28. A Schedule III drug:
   a. has a higher potential for abuse than a Schedule II drug
   b. include most over-the-counter mediations
   c. have no acceptable medical use
   d. none of the above

29. The three steps of a PCR reaction include:
   a. hybridization (annealing)
   b. denaturation
   c. DNA synthesis (elongation)
   d. all of the above

30. Characteristics of hair that vary among ethnic groups:
   a. cross-section
   b. pigment granules
   c. diameter
   d. all of the above

31. Saliva:
   a. is produced by the gastric glands
   b. contains an enzyme called amylase that digests proteins
   c. contains epithelial cells that contain DNA
   d. all of the above
32. Hallucinogens:
   a. cause alterations in perceptions and moods
   b. may be identified only by reaction with hydrochloric acid
   c. include alcohol
   d. all of the above

33. Chemicals that can be used to identify a substance as blood include:
   a. precipitin
   b. luminol
   c. phenolphthalein
   d. both b and c

34. In the luminol test, the catalyst for the reaction is:
   a. hemoglobin
   b. phenolphthalein
   c. luminol
   d. hydrogen peroxide

35. A person that is blood type O-:
   a. has Rh antigens on their red blood cells
   b. has anti-A and anti-B antibodies in their plasma
   c. has B antigens on their red blood cells
   d. is a universal recipient

36. Narcotics:
   a. heighten the activity of the sympathetic nervous system
   b. reduce the activity of the central nervous system
   c. are a class of drugs that include morphine

37. If the luminol test is positive, the investigator:
   a. can positively identify the substance as blood
   b. can positively identify the subject without further testing
   c. should follow up this test with another test to confirm the presence of blood

38. If a person has B antigens on their red blood cells:
   a. they can donate blood to type B individuals
   b. they can donate blood to type AB individuals
   c. they have anti-A antibodies in their plasma
   d. all of the above

39. If a person has both A and Rh antigens on their red blood cells:
   a. their blood type is A-
   b. their blood type is A+
   c. their blood type is B+
40. The instrument used to cycle between the three temperatures required for PCR is:
   a. an electrophoresis chamber
   b. a thermocycler
   c. a centrifuge
   d. a chromatography chamber

41. The axial skeleton consists of:
   a. the skull
   b. the limb bones
   c. the pectoral and pelvic girdles
   d. all of the above

42. DNA:
   a. is found in the nucleus of a cell
   b. is composed of nucleotides linked by chemical bonds
   c. has a two-stranded structure called a double helix
   d. all of the above
   e. none of the above

43. The stage of suture closure seen in Figure 10 is best described as:
   a. significant
   b. obliterated
   c. open

44. Taq polymerase:
   a. is isolated from a microorganisms that lives in hot temperatures
   b. functions well at high temperatures
   c. catalyzes the formation of bonds between nucleotides in a growing DNA strand
   d. all of the above

45. The bone shown in Figure 8:
   a. is a sternum
   b. is human
   c. is a scapula
   d. both b and c

46. The bone shown in Figure 9:
   a. is a femur
   b. is a pelvis
   c. is nonhuman
   d. both b and c

47. Cranial vault sutures were scored for a skull, and the composite score was 4. This individual was most likely (Use table and chart on last page):
   a. 22-45 years of age
   b. 32-60 years of age
   c. over 60 years of age
48. During gel electrophoresis:
   a. DNA migrates toward the negatively charged electrode
   b. larger pieces of DNA move more quickly through the gel
   c. DNA should be loaded in wells positioned closest to the black electrode
   d. none of the above
   e. all of the above

49. Limb bones were determined to be from a Caucasian female. The measurement of the femur was 45 cm. The height of the individual was approximately (use Table 1):
   a. 5' 0"
   b. 5' 5"
   c. 6' 0"

50. A skull has round eye orbits, a rounded dental arch and shovel-shaped incisors. The individual was probably:
   a. Caucasian
   b. Asian
   c. African

Figures

Figure 1. Microscope
Figure 2

Figure 3
Figure 10

Figure 11
Composite Scores of Vault and Lateral-Anterior Sutures

<table>
<thead>
<tr>
<th>Composite Score (vault)</th>
<th>Stage</th>
<th>Composite Score (lateral-anterior)</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>S1</td>
<td>1</td>
<td>S1</td>
</tr>
<tr>
<td>3-6</td>
<td>S2</td>
<td>2</td>
<td>S2</td>
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<tr>
<td>7-11</td>
<td>S3</td>
<td>3-5</td>
<td>S3</td>
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<tr>
<td>12-15</td>
<td>S4</td>
<td>6</td>
<td>S4</td>
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<tr>
<td>16-18</td>
<td>S5</td>
<td>7-8</td>
<td>S5</td>
</tr>
<tr>
<td>19-20</td>
<td>S6</td>
<td>9-10</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>11-14</td>
<td>S7</td>
</tr>
</tbody>
</table>

![Composite scores](chart.png)

**FIGURE 9.28** Chart showing relationship between closure scores and age.

**Table 1. Regression formulas to determine approximate height**

<table>
<thead>
<tr>
<th>Bone measured</th>
<th>Caucasian</th>
<th>Africoid</th>
<th>Mongoloid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humerus (H)</td>
<td>3.08H + 70.45</td>
<td>3.26H + 62.10</td>
<td>2.68H + 83.19</td>
</tr>
<tr>
<td>Radius (R)</td>
<td>3.78R + 79.01</td>
<td>3.42R + 81.65</td>
<td>3.54R + 82.00</td>
</tr>
<tr>
<td>Ulna (U)</td>
<td>3.70U + 74.05</td>
<td>3.26U + 79.29</td>
<td>3.48U + 77.45</td>
</tr>
<tr>
<td>Femur (F)</td>
<td>2.38F + 61.41</td>
<td>2.11F + 79.29</td>
<td>2.15F + 72.57</td>
</tr>
<tr>
<td>Tibia (T)</td>
<td>2.52T + 71.78</td>
<td>2.19T + 86.02</td>
<td>2.39T + 81.45</td>
</tr>
<tr>
<td>Fibula (Fib)</td>
<td>2.68Fib + 71.78</td>
<td>2.19Fib + 85.65</td>
<td>2.40Fib + 70.37</td>
</tr>
<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humerus (H)</td>
<td>3.36H + 57.97</td>
<td>3.08H + 64.67</td>
<td>N/A</td>
</tr>
<tr>
<td>Radius (R)</td>
<td>4.74R + 54.93</td>
<td>2.75R + 94.51</td>
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</tr>
<tr>
<td>Ulna (U)</td>
<td>4.27U + 74.05</td>
<td>3.31U + 75.38</td>
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<tr>
<td>Femur (F)</td>
<td>2.47F + 54.74</td>
<td>2.28F + 59.52</td>
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<tr>
<td>Tibia (T)</td>
<td>2.90T + 59.24</td>
<td>2.45T + 72.01</td>
<td>N/A</td>
</tr>
<tr>
<td>Fibula (Fib)</td>
<td>2.93Fib + 59.61</td>
<td>2.49Fib + 70.90</td>
<td>N/A</td>
</tr>
</tbody>
</table>

1 inch = 2.54 cm