

## General Education Outcomes Assessment Brief [Science – Revised 11/30/08]

### Part I. Executive Summary: (1 to 2 page summary)

- A. State the general education outcome being assessed.
- B. Provide brief background - few sentences that may include those from the background and justification written for the introduction.
- C. List major findings (2 to 4 pts) in bullet points. May use small graph or table to highlight major findings. Be selective in the graphs or tables used.
- D. Identify conclusions based upon the major findings. Major conclusions highlight suggestions for improvement or briefly identify example of best practice. The major conclusions consist of bullets of key points.

### Part II. Assessment Brief

#### A. Introduction: (One to two paragraphs.)

##### 1. Background.

To fulfill its mission to “embrace the liberal arts,” the University is steadfastly committed to the proposition that a thorough, broad-based foundation in the arts and sciences is a necessary condition for the development of the whole person. To prepare students to live and work in today’s society, a basic understanding of the concepts, methods, and reasoning processes used in the natural sciences is necessary.

##### 2. General Education Outcomes Statement.

The learning outcomes for General Education include the following: “students are able to demonstrate effective scientific reasoning appropriate at the bachelor degree level and to any academic discipline.” This outcome is grounded in one of the new objectives for General Education that reads:

“Students will demonstrate foundational knowledge of the important ideas and methods of different ways of knowing as follows:

b) in the sciences students will engage in the scientific method, laboratory study, appropriate technology, and mathematics to investigate, evaluate, and apply scientific concepts and theories.

The CAAP Science test is a general assessment of scientific reasoning. Success on this test requires competency on the very skills enumerated in the stated objective. It was given to a sample of students nearing graduation who had completed their Gen Ed science requirements so as to best assess the attainment of this objective.

##### 3. Justification.

To satisfy General Education requirements, students must take at least two courses in the natural sciences (BIOL, CHEM, ESCI, PHYS) and at least one of these must be a laboratory course. This requirement is designed to engage students in applying the

scientific method using technology and mathematics as appropriate for the discipline and level of class. Because this requirement is aligned with the relevant Gen Ed objective and the CAAP Science test seems to be aligned with both of them, it is believed that results from this test will provide a fair assessment of the objective and of Millersville's approach to science education for its Gen Ed students.

**B. Information Source:** Describe the source(s) of information used. (one or two paragraphs and table, if appropriate)

The CAAP Science Test is a 45-item, 40 minute multiple choice test that “emphasizes scientific knowledge and reasoning skills” (p. 11). A series of eight passages fall into one of three formats: Data Representation (.33), Research Summaries (.54), or Conflicting Viewpoints (.13). The items test three elements: understanding, analyzing, and generalizing. (pp. 11-12). [Source: CAAP Technical Handbook 2006-2007, ACT, Inc.]

We identified a stratified random sample of approximately 300 - 500 students who meet the stipulations of being a junior or senior and having completed the minimum Gen Ed science requirement at Millersville. Stratification was planned to avoid over sampling science and others majors who may have disproportionately completed their G2 Block requirements but was found to be unnecessary. Sampled students were contacted by email and postal mail to solicit their participation. Non-responders to the mailing were phoned to solicit participation and to assign a testing session. If a student's schedule prevented testing during any of the group testing sessions, efforts will be made to schedule the student for individual testing by the Graduate Assistant. Tests were administered in MU classrooms by faculty or Graduate Assistants trained in accordance with ACT guidelines.

A total of 47 students eventually completed the testing (62% female; 91% white/Caucasian). Of those reporting their majors, 15 were in education, 8 were in social sciences, and 5 were in biology.

**C. Major Findings:**

1. Data Summary for Major Finding

- MU students had a mean test score of 63.2 (SD=3.9) which exceeded the national norm of 61.4 (SD=4.5).
- Of the 47 students taking the test at Millersville, 34 scored at or above the national mean, thereby earning a Certificate of Achievement.

2. Interpretation/ Discussion

- MU faculty who had viewed the test had expected MU students to have difficulty with the test, but in fact, MU students exceeded the national norms. National norms, however, are derived from testing of college sophomores across the nation over the previous three years. Our sample was largely juniors and seniors, and they were specifically chosen because they had

completed their Gen Ed science requirements. Hence, it is hard to judge whether the national norm provides a valid reference point.

### 3. Conclusion

- The original design of the Science Reasoning assessment also called for a sample of entering students to be tested first as first years and then retested later in their college careers to provide a value added assessment. Given ambiguity in how to interpret our results for our junior/senior sample, the value added assessment may provide more useful data.

## Part III. Appendices

### A. CAAP Science Test Review – Summary (2/27/07)

#### CAAP Science Test Review – Summary (2/27/07)

The Academic Outcomes Assessment Committee (AOAC) has proposed the use of the CAAP Science test to assess a sample of juniors later this spring and a sample of incoming first year students next fall to assess Gen Ed objectives related to scientific reasoning. Prior to committing to this plan, science faculty who are especially familiar with teaching Gen Ed science courses and members of AOAC were asked to review the test to assure us that it is an appropriate tool for assessment. A faculty member from each of the four physical and life sciences and three members of AOAC participated in this review.

Each of the science faculty members strongly recommended the use of the CAAP Science test with one individual suggesting that students take only a subset of the test. They felt it was an appropriate test of scientific understanding and reasoning. All thought the test would be difficult for our students and that students at MU would “not do well” or would, at a minimum, be “challenged.” Most of the reviewers felt that good performance would be at least partly dependent upon content familiarity which would not be possessed by many of our students. Students who could read well for comprehension and were good thinkers generally were also seen as having an advantage on this test. They did agree, however, that students with comparable reading and general critical reasoning skills but who differed in exposure to our Gen Ed science curriculum would indeed perform differently, although the size of the difference might not be very large. All AOAC reviewers either “recommended” or “strongly recommended” the test.

**Test Description:** [Source: CAAP Technical Handbook 2006-2007, ACT, Inc.]

The CAAP Science Test is a 45-item, 40 minute multiple choice test that “emphasizes scientific knowledge and reasoning skills” (p. 11). A series of eight passages fall into one of three formats: Data Representation (.33), Research Summaries (.54), or Conflicting Viewpoints (.13). The items test three elements: understanding, analyzing, and generalizing. (pp. 11-12). The test has good internal consistency reliability (KR-20 = .86). Completion rates are above 90% and the average item difficulties (proportion getting item correct) fall mostly between .4 and .7 (means = .55, .58).

## **Current Objectives:**

Objective 9. Science and Math.

At completion of their general education requirements, MU students will be able to articulate connections between mathematical and scientific principles, technologies, and events affecting our everyday lives.

Objective 10. Science and Math.

At completion of their general education requirements, MU students will be able to explain how we know and why we believe key concepts in the natural sciences, and be able to use:

- a. scientific reasoning;
- b. laboratory methods;
- c. mathematics to solve scientific problems; and
- d. appropriate technology

## **Proposed New Objective:**

### **Critical Thinking across the Liberal Arts**

2. Students will demonstrate foundational knowledge of the important ideas and methods of different ways of knowing as follows:

b) in the sciences students will engage in the scientific method, laboratory study, appropriate technology, and mathematics to investigate, evaluate, and apply scientific concepts and theories.