



General Education Natural Sciences Assessment (Fall 2014)

History of the Assessment Program

Assessment of student learning outcomes is a national expectation in higher education, and the expectation calls for increased accountability. Section 2.7.3 of the Southern Association of Colleges and Schools' (SACS) accreditation standards requires in each undergraduate program the successful completion of a general education component that:

- 1) is a substantial component of each undergraduate degree,
- 2) ensures breadth of knowledge, and
- 3) is based on a coherent rationale.

Section 3.5.1 of the SACS accreditation standards also requires that “the institution identifies college-level competencies within the general education core and provides evidence that graduates have attained those competencies.”

Based on these standards, in 2005, the Provost charged the General Education Curriculum Committee (GECC) with developing and implementing an assessment program. To accomplish this directive, the committee developed and modified rubrics to measure student performance in the competencies stated in the preamble of the general education plan: “The General Education Program at the University of Louisville fosters active learning by asking students to:

- 1) think critically,
- 2) to communicate effectively,
- 3) and understand and appreciate cultural diversity.”

The GECC initiated the first general education assessment in fall of 2005. The university adopted LiveText© as the platform for electronic assessment of general education artifacts in the Fall of 2010. The assessment is currently in the third cycle, which is scheduled to be complete in Spring of 2016. This report summarizes the process, results, and findings for the assessment of student performance in general education Natural Science (NS) courses for the fall 2014 semester.

Assessment Administration

The General Education Program at the University of Louisville addresses the three over-arching competencies of critical thinking, effective communication, and understanding of cultural diversity. In addition, the university has defined competencies and learning outcomes for the Arts and Humanities, Mathematics, Natural Sciences, Oral Communication, and Social and Behavioral Sciences. The University of Louisville content area competencies and outcomes are

closely aligned with the Statewide General Education Student-Learning Outcomes. A crosswalk of the outcomes and assessment measures is provided in Appendix A.

University of Louisville Natural Science Competency and Learning Outcomes

The Natural Sciences are concerned with understanding the physical world through the scientific method. Students who satisfy this requirement will demonstrate that they are able to do all of the following:

1. Relate everyday observations of the world to physical principles;
2. Apply scientific principles to construct explanations of natural phenomena; and
3. Communicate an understanding of scientific explanations of natural phenomena.

Statewide Natural Science Student-Learning Outcomes

1. Demonstrate an understanding of the methods of science inquiry.
2. Explain basic concepts and principles in one or more of the sciences.
3. Apply scientific principles to interpret and make predictions in one or more of the sciences.
4. Explain how scientific principles relate to issues of personal and/or public importance.

University of Louisville General Education Natural Science Assessment Rubric Measures

The measures for the Natural Science Critical Thinking Rubric are as follows:

- (NS1) Demonstrate an Understanding of Methods of Science
- (NS2) Construct Scientific Understanding of Natural Phenomena
- (NS3) Apply Scientific Principles to Everyday and Lab-based Phenomena
- (NS4) Communicate an Understanding of Vocabulary, Materials, and Technique Used

The University of Louisville Natural Science Critical Thinking Rubric uses a four-point scale, with 4 indicating performance of the measure as “clearly evident,” 3 indicating performance as “usually evident,” 2 indicating “minimally evident,” and 1 indicating performance as “not evident.” In addition, a score of “not requested” could be assigned for assignments that did not provide an opportunity for the student to demonstrate the criterion within the rubric measure.

Assessment Process

For the fall 2014 assessment of Natural Sciences (NS), the General Education Assessment Coordinator notified department chairs of the upcoming assessment and met with them to disseminate all pertinent information. These meetings provide an overview of the project, the outcomes to be assessed, and sampling process. A formal memo outlining the project and process was then provided to each of the NS department chairs to ensure a mutual understanding of project expectations.

After the semester drop deadline passed, the Assessment Coordinator requested the class rosters for all general education NS courses from the Office of the Register and systematically selected

every fifth student for assessment from the roster. Instructors of all general education courses in the Natural Sciences were sent assessment rosters along with detailed instructions requesting that a copy of one assignment with the ungraded responses for the selected students be sent to the Assessment Coordinator.

Student artifacts were collected and stored in an electronic repository and uploaded into the LiveText© assessment management system. A panel of 14 tenured and tenure-track faculty assessed student artifacts using the Natural Science Critical Thinking Rubric. One week prior to the assessment reading, assessors were brought together for a four-hour training session coordinated by the Office of General Education Assessment and assisted by College of Education and Human Development (CEHD) faculty. In the training session, the Office of General Education Assessment presented the context and process for the assessment, faculty engaged in dissection and discussion of the rubric criteria, and faculty assessors then individually reviewed and scored three benchmark sample assignments. The results from the scoring of benchmark samples were displayed to highlight the reliability in scoring. Assessors then engaged in discussion about the assessment scores that were selected to support the conclusions for why particular scores were selected. The results of the benchmark sample assessments are provided in Table 1, Figure 1, and Figure 2.

Table 1

Results of Benchmark Sample Assessments

	Clearly Evident	Usually Evident	Minimally Evident	Not Evident	<i>Not Requested</i>
Biology					
Benchmark					
Sample					
NS1	28.6%	50.0%	21.4%	0.0%	0
NS2	7.1%	64.3%	28.6%	0.0%	0
NS3	0.0%	38.5%	30.8%	30.8%	0
NS4	7.1%	50.0%	42.9%	0.0%	0
Physics					
Benchmark					
Sample					
NS1	58.33%	33.33%	8.33%	0.00%	1
NS2	57.14%	42.86%	0.00%	0.00%	0
NS3	0.00%	33.33%	33.33%	33.33%	10
NS4	83.33%	16.67%	0.00%	0.00%	7

Figure 1

Biology Benchmark Sample

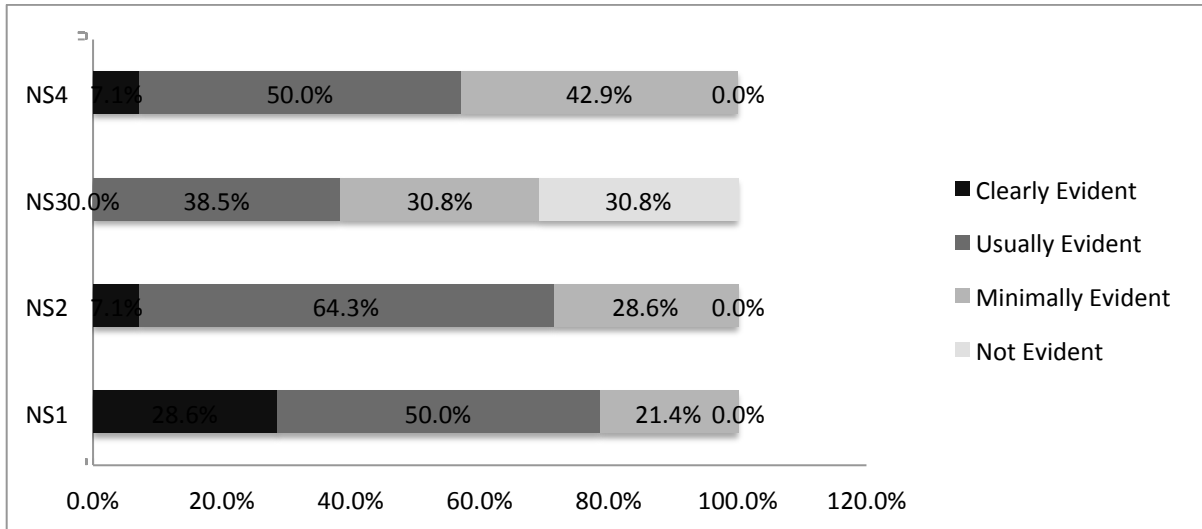
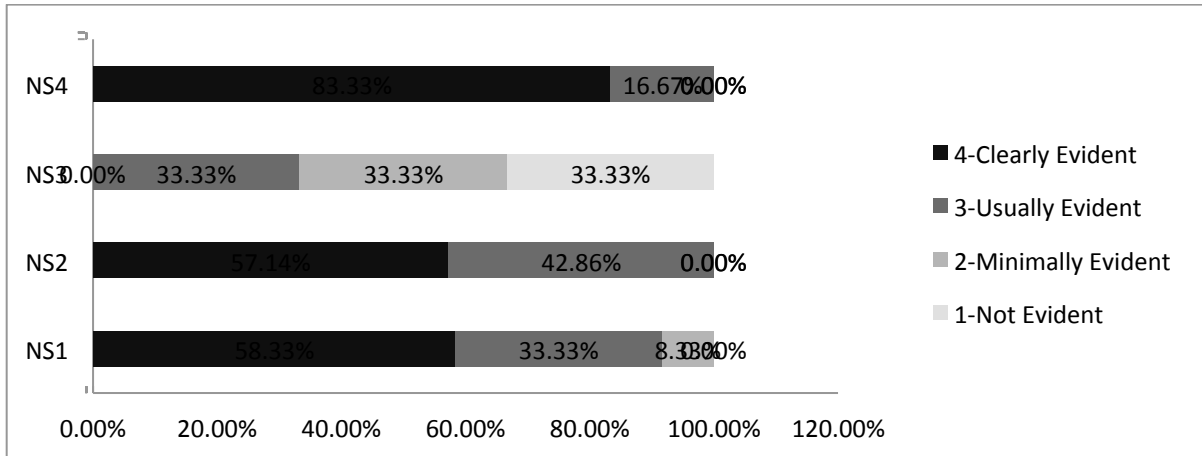


Figure 2

Physics Benchmark Sample



Faculty assessors received training on LiveText© assessment management system the morning of the assessment reading. Each faculty assessor was assigned a username and password for one of three LiveText© accounts and a list of courses and artifacts to assess. Each artifact was assessed by three faculty assessors so that scores could be compared across assessors for reliability purposes.

Data Collection Overview

As of the final withdrawal date for the fall semester, 8374 students were enrolled in 243 sections of general education NS courses. 296 student artifacts were received and eligible for review. Table 2 presents the number of admissible artifacts received from each of the NS departments and courses.

Table 2

Sample for Natural Sciences Assessment

Course	Course Title	Number of Student Artifacts	Sub-total
Biology 104	Lab Intro Biol Systems	36	
Biology 240	Unity of Life	48	
Biology 244	Prin Biology Lab	29	
Biology 258	Intro Microbiology	23	
			136
Chemistry 201	General Chemistry I	11	
			11
Geography & Geosciences 200	The Global Environment	4	
			4
Health & Sport Science 387	Biomechanics	11	
			11
Physics 107	Elementary Astronomy	27	
Physics 108	Elem Astronomy Lab	29	
Physics 111	Elements of Physics	30	
Physics 221	Fund of Physics I	15	
Physics 222	Fundamentals of Physics II	8	
Physics 223	Fundamentals of Physics Lab I	6	
Physics 298	Intro Mech, Heat, & Sound	17	
Physics 299	Intro Elec, Mag & Light	2	
			134

Summary of Assessment Data

For the assessment of NS outcomes, 296 student artifacts were assessed by faculty from the College of Arts & Sciences (Natural Sciences), Speed School of Engineering, and the College of Education & Human Development using the Natural Science Critical Thinking Rubric. Summary of results from the NS assessment are provided in Table 3 and Figure 3. The criterion for Critical Thinking rubrics was set by the General Education Assessment Coordinator and the General Education Curriculum Committee Assessment Subcommittee at 60% of artifacts to score at a 3 or 4, indicating that at least 60% would perform at either the “usually evident” or “clearly evident” level. The criterion for was met for all NS measures.

General Education Natural Sciences Assessment Report – Fall 2014

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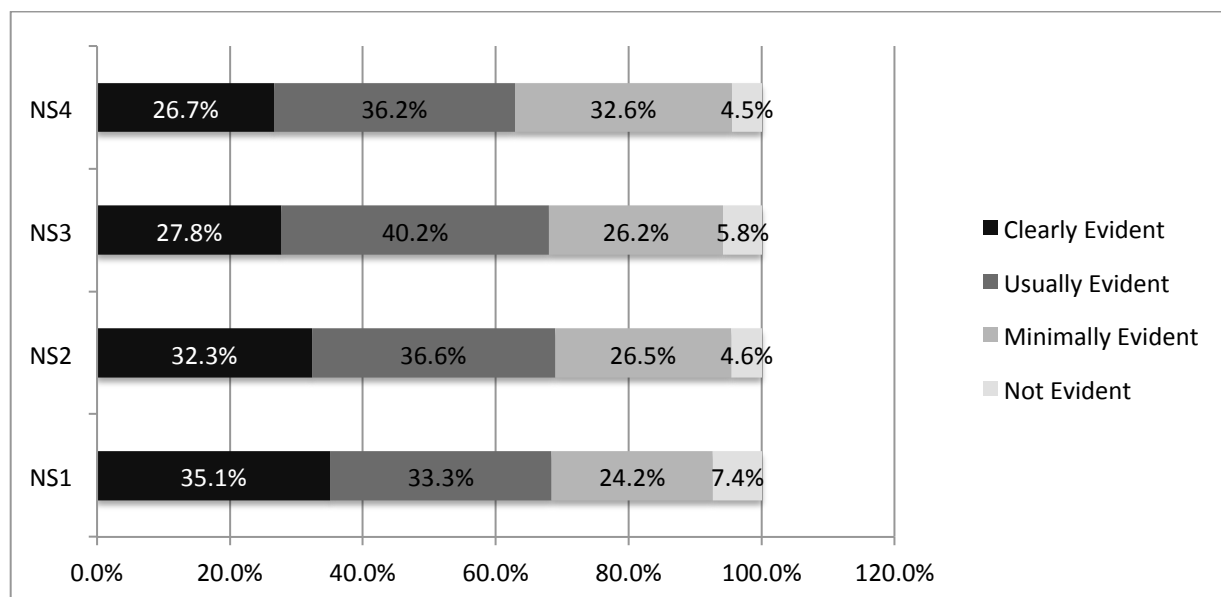
Table 3

Summary Results for NS Assessment

	Clearly Evident	Usually Evident	Minimally Evident	Not Evident	<i>Not Requested</i>	% Above (3 or 4)
NS1	35.1% (285)	33.3% (271)	24.2% (197)	7.4% (60)	75	68.4%
NS2	32.3% (272)	36.6% (308)	26.5% (223)	4.6% (39)	46	68.9%
NS3	27.8% (234)	40.2% (339)	26.2% (221)	5.8% (49)	45	68.0%
NS4	26.7% (218)	36.2% (296)	32.6% (267)	4.5% (37)	70	62.8%

Figure 3

Summary Results for NS Assessment



The “not requested” scores were not included in calculation of mean scores (Table 4) or the percentage of overall ratings (Table 3). A count of “not requested” is provided in Table 3. The majority of the “not requested” scores were assigned to artifacts from the Physics department with 76% of the 75 “not requested” scores for NS1, 76.1% of 46 for NS2, 77.8% of 45 for NS3, and 70.0% of 70 for NS4. The remaining “not requested” scores were assigned to artifacts from Biology and Chemistry.

The mean score for each NS measure is broken out by content in Table 4 and Figure 4. Physics had the highest mean score for NS1. Physics and Health & Sport Sciences had the highest mean score for NS2 (3.03). Health & Sport Sciences had the highest mean score for NS3 (3.15) and NS4 (3.09).

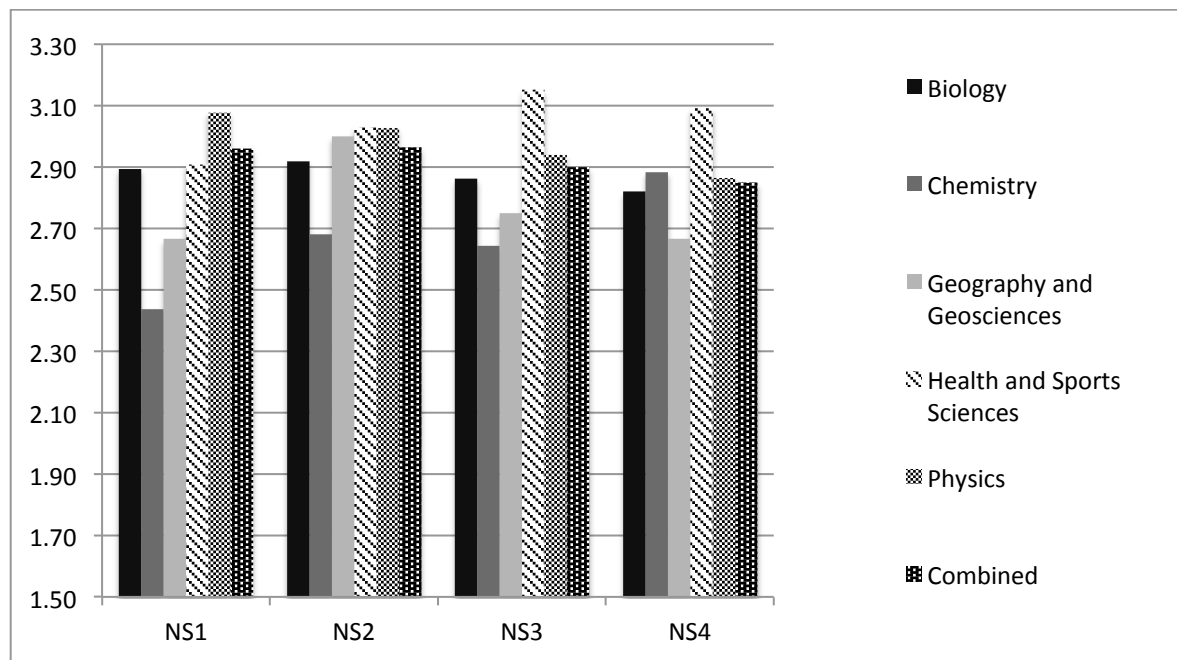
Table 4

Mean Score by NS Content

	NS1	NS2	NS3	NS4
Biology	2.89	2.92	2.86	2.82
Chemistry	2.44	2.68	2.64	2.88
Geography & Geosciences	2.67	3.00	2.75	2.67
Health & Sport Sciences	2.91	3.03	3.15	3.09
Physics	3.08	3.03	2.94	2.86
All NS Artifacts	2.96	2.97	2.90	2.85

Figure 4

Mean Score by Content



Each student artifact was assessed by three readers. Table 5 displays the mean score for three separate readings of all artifacts.

Table 5

Inter-rater Summary for Natural Sciences

	GEAssessor1	GEAssessor2	GEAssessor3	SD
NS1	2.99	2.82	3.08	0.13
NS2	3.03	2.88	3.00	0.08
NS3	3.04	2.80	2.87	0.13
NS4	2.87	2.72	2.96	0.12

Supporting Documentation for General Education Natural Sciences Assessment

The Department of Anthropology was not represented in the results of the Natural Sciences General Education Outcomes. Anthropology utilizes multiple choice exams to measure student learning within their courses. Multiple choice exams have not been admissible for the General Education Assessment.

While Anthropology was not included in the NS assessment Anthropology faculty have worked with representatives from Ideas 2 Action (i2a) to incorporate critical thinking into the general education Anthropology courses, including the NS course (Anthropology 202: Introduction to Biological Anthropology).

Faculty members for the Department of Anthropology conducted a review of 39 predominantly multiple-choice exams in 2013 (Burnet, Hoefler, McGrath, & Short, 2013). In summary, the exam questions were evaluated using Bloom’s Taxonomy as the criteria for assessing the criticality of individual questions. Twelve exams (655 questions) from Anthropology 202 courses were scored. Five of 12 exams were rated as having greater than 10% critical questions and 9.5% of all questions were rated as critical.

Lessons Learned

The assessment process was designed with an emphasis on coordination with department chairs. Faculty are notified of the assessment after the Assessment Coordinator has met with the department chair to discuss the notification and artifact collection processes. The pre-assessment notification procedure was followed with one exception for the assessment of the Natural Sciences. The meeting with the department chair was delayed in the Chemistry department due to transitioning department chairs. The faculty in this department were notified of the assessment after the semester started, rather than before the semester started. As a result of this delay, faculty in the Chemistry department were notified of the assessment after the some lab courses had ended and artifacts had been returned to students. While artifacts were still captured from 11 Chemistry courses, the inclusion of the lab courses could have provided for a more representative sample. Semester length will be taken into consideration for future assessments to ensure that faculty are given adequate notice to collect artifacts.

Work Cited

Burnet, J., Hoefer, D., McGrath, B., and Short, N. (2013). Fostering Critical Thinking in Anthropology General Education Courses.

Appendix A: Natural Sciences Outcomes and Assessment Measures Crosswalk

