

General Education Category 3 Assessment Report

Assessment Objective

General Education Category 3 exposes students to the Natural Sciences. The goal of this category as published in the *Undergraduate Bulletin* is “to improve students’ understanding of natural science principles and of the methods of scientific inquiry, ie., the ways in which scientists investigate natural science phenomenon.” This report describes the assessment of student performance in meeting the outcomes set by the Minnesota Transfer Curriculum for courses in this category. Samples of student work were collected during Fall 2007 and these samples were assessed during Spring 2008. Finally the results of this assessment are presented, discussed and compared with the results of the first assessment in 2002.

Assessment Process

The GECCIG members, or the assessment committee, were Steven Kipp (Astronomy), William Bessler (Biology), Patricia Rambo (Chemistry), Forrest Wilkerson (Geography), Steven Losh (Geology) and Thomas Brown (Physics). The Department of Anthropology offers courses in Category 3; however, none of those courses were offered during Fall 2007. Due to the very short time that was available for organizing the GECCIG and acquiring samples of student work, the Departments of Family and Consumer Science and the Department of Electrical and Computer Engineering and Technology, which also offers courses in this category, were not represented.

The assessment committee had a challenging assignment. They had less than 15 weeks to organize the assessment process, discuss the assessment in their departments, develop appropriate assessment tools and collect samples of student work. The GECCIG members met early in the Fall of 2007 to organize the assessment process and define the rubrics for scoring samples of student work addressing the specific outcomes. The outcomes assigned to Category 3 and the rubrics used for each outcome are given in following tables.

Student Outcome 1	Students will be able to develop understanding of scientific theories.
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Rubric for Outcome 1

Level 1	Student demonstrates an understanding of basic, scientific terminology, principles or theories.
Level 2	Student can apply appropriate terminology, principles or theories to solve scientific problems.
Level 3	Student can utilize scientific principles to evaluate hypotheses and theories.

Student Outcome 2	Students will be able to formulate and test hypotheses in laboratory, simulation or field experiences.
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Rubric for Outcome 2

Level 1	Student can make accurate observations or measurements.
Level 2	Student can interpret observations or measurements.
Level 3	Student can formulate a testable hypothesis, conduct a simple experiment to test the hypothesis and evaluate the hypothesis based upon the experimental outcome.
Level 4	Student can formulate a testable hypothesis and design a simple experiment to test the hypothesis.

Student Outcome 3	Students will be able to communicate his/her experimental findings and interpretations both orally and in writing.
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Rubric for Outcome 3

Level 1	Student can effectively communicate the application of the scientific method to the experiment.
Level 2	Student can effectively communicate the experimental results.
Level 3	Student can effectively communicate experimental results and the interpretation of those results.
Level 4	Student can effectively communicate an assessment of the validity of an experiment or the data obtained.

Student Outcome 4	Students will be able to apply the natural science perspective to society issues.
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Rubric for Outcome 4

Level 1	Student can identify a relationship between the natural sciences and a social issue.
Level 2	Student can identify and describe a relationship between the natural sciences and a social issue.
Level 3	Student can analyze a relationship between the natural sciences and a social issue.

After defining the rubrics, the GECCIG members organized the assessment process in their departments and the collection of data began. Samples of student work were obtained from the following courses.

Astronomy 101, 102 and 115
Biology 100
Chemistry 104, 111, 191 and 201
Geography 101
Geology 100 and 121
Physics 101 and 211

A critical step in this assessment procedure was the design of activities that gave the students opportunities to demonstrate their proficiency with the outcomes. A variety of tools were used including multiple choice test questions, problems, essays and laboratory reports. Many instructors found it necessary to design separate activities for each level of the rubric for each outcome. The sampling process varied in the different courses. While some courses selected a random sample of student work based on the tech id numbers, other courses used all students in the assessment.

Results and Discussion of the Category 3 Assessment

The following tables summarize student performance in achieving the four outcomes. The fact that some departments assessed work from all students while other departments assessed only a sample of the student work tended to skew the results toward the disciplines that sampled all students. To reduce this bias, the tables give a summary of student achievement for each discipline in addition to combining the results of student performance in all the courses. In these tables, n represents the number of samples of student work that were assessed for each rubric level for the outcome. The table gives the percent of these samples that satisfied the rubric at the specified level.

Student Outcome 1	Students will be able to develop understanding of scientific theories.			
Discipline	Rubric Level 1	Rubric Level 2	Rubric Level 3	Rubric Level 4
Astronomy	68.8 % (n = 128)	**	**	*
Biology	75.9 % (n = 230)	74.3 % (n = 230)	89.3 % (n = 48)	*
Chemistry	68 % (n = 50)	52.5 % (n = 40)	80 % (n = 30)	*
Geography	99.7 % (n = 364)	96.7 % (n = 364)	96.7 % (n = 364)	*
Geology	77.1 % (n = 144)	81.0 % (n = 63)	74.8 % (n = 115)	*
Physics	83.5 % (n = 327)	77.4 % (n = 327)	90.8 % (n = 327)	*
Combined	85.0 % (n = 1243)	82.8 % (n = 1024)	90.7 % (n = 884)	*

- The rubric for this outcome did not include a level 4.
- ** The discipline did not have an assessment for this level of the rubric.

The results of the assessment for Outcome 1 are encouraging. Not only are the majority of students demonstrating an ability to understand scientific theories, they are performing at high levels on the rubric. At least 82.8 % of the combined samples of student work satisfied Outcome 1 at all levels of the rubric. Students were least successful in the Chemistry courses. In this discipline, only 68 % of the samples satisfied the rubric at level 1 while 52.5 % met level 2. However, 80 % of the chemistry samples achieved level 3 on the rubric. In all the disciplines, at least 74.8 % of the samples satisfied the rubric at level 3.

Student Outcome 2	Students will be able to formulate and test hypotheses in laboratory, simulation or field experiences.			
Discipline	Rubric Level 1	Rubric Level 2	Rubric Level 3	Rubric Level 4
Astronomy	**	**	77.3 % (n = 128)	**
Biology	82.7 % (n = 230)	72.1 % (n = 230)	72.0 % (n = 230)	87.4 % (n = 48)
Chemistry	**	100 % (n = 30)	70.0 % (n = 30)	**
Geography	99.2 % (n = 364)	89.6 % (n = 364)	89.6 % (n = 364)	**
Geology	84.5 % (n = 71)	86.3 % (n = 146)	78.9 % (n = 71)	72.4 % (n = 58)
Physics	**	**	**	**
Combined	91.8 % (n = 665)	84.1 % (n = 770)	81.4 % (n = 752)	79.2 % (n = 106)

** The discipline did not have an assessment for this level of the rubric.

For Outcome 2, 81.4 % of the combined samples of student work satisfied through level 3 on the rubric. Only two classes assessed student performance at level 4, and 79.2 % of those students were able to perform at that level. Opportunities to “formulate a testable hypothesis and design a simple experiment to test the hypothesis,” as required for rubric level 4, are typically reserved for upper level classes. The logistics of giving large general education classes an opportunity to perform at this level are difficult. However, if they are given the opportunity, the students can succeed.

Student Outcome 3	Students will be able to communicate his/her experimental findings and interpretations both orally and in writing.			
Discipline	Rubric Level 1	Rubric Level 2	Rubric Level 3	Rubric Level 4
Astronomy	**	**	**	**
Biology	91.0 % (n = 48)	89.3 % (n = 48)	80.7 % (n = 48)	**
Chemistry	**	**	**	**
Geography	79.7 % (n = 364)	96.4 % (n = 364)	96.4 % (n = 364)	**
Geology	82.5 % (n = 63)	93.1 % (n = 72)	90.3 % (n = 72)	80.4 % (n = 51)
Physics	100 % (n = 30)	100 % (n = 30)	100 % (n = 30)	**
Combined	82.4 % (n = 505)	95.5 % (n = 514)	94.4 % (n = 514)	80.4 % (n = 51)

** The discipline did not have an assessment for this level of the rubric.

For Outcome 3, 80.4 % of the combined student samples achieved all four levels of the rubric. Again, they were given an opportunity to achieve at level 4 in only one class. In the disciplines that assessed this outcome, at least 80.7 % of the samples satisfied Outcome 3 at some level on the rubric. The students are demonstrating an ability to communicate experimental results.

Student Outcome 4	Students will be able to apply the natural science perspective to society issues.			
Discipline	Rubric Level 1	Rubric Level 2	Rubric Level 3	Rubric Level 4
Astronomy	93.0 % (n = 128)	**	93.0 % (n = 128)	*
Biology	77.7 % (n = 230)	77.5 % (n = 230)	87.5 % (n = 48)	*
Chemistry	100 % (n = 19)	31.6 % (n = 19)	10.5 % (n = 19)	*
Geography	99.7 % (n = 364)	99.2 % (n = 364)	98.9 % (n = 364)	*
Geology	75.2 % (n = 133)	68.1 % (n = 72)	76.2 % (n = 63)	*
Physics	**	**	**	*
Combined	89.2 % (n = 874)	86.7 % (n = 688)	91.8 % (n = 622)	*

- The rubric for this outcome did not include a level 4.
- ** The discipline did not have an assessment for this level of the rubric.

Over 86% of the combined student samples demonstrated an ability to relate the Natural Sciences to society issues at all three levels of the rubric for Outcome 4. Although students were least successful in meeting this outcome at higher levels in the chemistry courses, 100 % of the samples from chemistry classes satisfied the rubric at level 1. At least 75.2 % of the sampled work successfully related Natural Sciences to society issues at level 1 on the rubric.

In summary, the results of the assessment of student performance in Category 3 General Education courses demonstrate that a large fraction of the students are meeting the outcomes for this category. Moreover, a large majority of the students are satisfying the outcomes at high levels on the rubrics.

Comparison to First Category 3 Assessment

One of the goals of the assessment process is to track student performance over time. The Natural Science Category was last assessed in 2002. A stated purpose of that assessment was to establish a set of baseline data that could serve as reference point for subsequent assessments. The following tables summarize the results of that assessment. It should be noted that a direct comparison between the results of the current assessment and the previous assessment is not completely valid. While the rubrics used for the both assessment are very similar, they differ slightly.

In the following tables, the data in the top line in each row represent results from the 2002 assessment while the data in the bottom line (and in parentheses) in each row represent results from the 2008 assessment.

Student Outcome 1	Students will be able to develop understanding of scientific theories.			
	Rubric Level 1	Rubric Level 2	Rubric Level 3	Rubric Level 4
Discipline				
Anthropology	**	**	>70% n = ?	*
Astronomy	49% n = 80 (68.8 %)	38% n = 80	47% n = 80	*
Biology	65.9 % n=780 (75.9%)	65.9 % n=780 (74.3%)	65.9% n=780 (89.3%)	*
Chemistry	** (68 %)	** (52.5 %)	** (80 %)	*
ECET	75 % n = ?	**	**	*
FACS	94 % n = ?	**	91 % n = ?	*
Geography	100 % n = ? (99.7%)	100 % n = ? (96.7%)	70 % n = ? (96.7%)	*
Geology	** (77.1%)	** (81.0%)	** (74.8%)	*
Physics	77 % n = ? (83.5%)	47.5 % n = ? (77.4 %)	** (90.8 %)	*

- The rubric for this outcome did not include a level 4 in 2002.
- ** The discipline did not have an assessment for this level of the rubric in 2002.

Student Outcome 2	Students will be able to formulate and test hypotheses in laboratory, simulation or field experiences.			
Discipline	Rubric Level 1	Rubric Level 2	Rubric Level 3	Rubric Level 4
Anthropology	**	**	**	**
Astronomy	**	**	** (77.3 %)	**
Biology	67.1 % n=150 (82.7%)	67.1 % n=150 (72.1%)	67.1 % n=150 (72.0%)	67.1 % n=150 (87.4%)
Chemistry	**	** (100%)	** (70.0%)	**
ECET	**	**	**	**
FACS	**	**	**	**
Geography	100 % n=? (99.2 %)	75 % n=? (89.6 %)	45 % n=? (89.6 %)	25 % n=?
Geology	** (84.5%)	** (86.3%)	** (78.9%)	** (72.4%)
Physics	**	**	**	90% n=?

- The rubric for this outcome did not include a level 4 in 2002.
- ** The discipline did not have an assessment for this level of the rubric in 2002.

Student Outcome 3	Students will be able to communicate his/her experimental findings and interpretations both orally and in writing.			
Discipline	Rubric Level 1	Rubric Level 2	Rubric Level 3	Rubric Level 4
Anthropology	**	**	**	*
Astronomy	**	**	**	*
Biology	63.0 % n=150 (91.0%)	63.0 % n=150 (89.3%)	63.0 % n=150 (80.7%)	*
Chemistry	**	**	**	**
ECET	**	**	**	*
FACS	**	**	**	*
Geography	100 % n = ? (79.7 %)	75 % n = ? (96.4 %)	45 % n = ? (96.4 %)	*
Geology	** (82.5%)	** (93.1%)	** (90.3%)	* (80.4%)
Physics	** (100 %)	** (100 %)	90% n = ? (100 %)	*

- The rubric for this outcome did not include a level 4 in 2002.
- ** The discipline did not have an assessment for this level of the rubric in 2002.

Student Outcome 4	Students will be able to apply the natural science perspective to society issues.			
Discipline	Rubric Level 1	Rubric Level 2	Rubric Level 3	Rubric Level 4
Anthropology	**	**	**	*
Astronomy	** (93.0%)	**	** (93.0%)	*
Biology	79.8 % n=780 (77.7%)	64.3 % n=780 (77.5%)	66.8% n=780 (87.5%)	*
Chemistry	** (100 %)	** (31.6%)	** (10.5%)	*
ECET	**	**	**	*
FACS	**	**	**	*
Geography	100 % n = ? (99.7 %)	100 % n = ? (99.2 %)	50 % n = ? (98.9 %)	*
Geology	** (77.1%)	** (81.0 %)	** (74.8%)	*
Physics	**	**	**	*

- The rubric for this outcome did not include a level 4 in 2002.
- ** The discipline did not have an assessment for this level of the rubric in 2002.

The comparison of the current assessment results with the 2002 assessment reveals that the instructors were more thorough at assessing all 4 outcomes for this category and for assessing at higher levels on the rubric. Furthermore, it appears that the students were significantly more successful at satisfying the outcomes for Category 3. A problem observed in the first assessment related to providing students activities that allowed them address all four outcomes and to work at high levels on the rubrics. The current assessment demonstrates that if the instructors take the time to give the students opportunities to perform at higher levels in all the outcomes, the students will excel.