SUNY College at Brockport

General Education Natural Science Assessment (Outcome #1)

Instructions: Please provide the information requested in the form below and return to P. Michael Fox, Vice Provost for Academic Affairs, 618 Allen Administration Building. Fall assessments should be submitted in January 2015; Spring assessments in May 2015.

Department: Chemistry and Biochemistry  Course Reporting Data: NAS 273 Investigating Physical Science

There are two General Education student learning outcomes for the Natural Sciences. Assessment data for the two outcomes are to be submitted on separate report forms.

Natural Science Student Learning Outcome #1:

Students are able to demonstrate their knowledge of the methods scientists use to explore natural phenomena, including observation, hypothesis development, measurement and data collection, experimentation, evaluation of evidence, and employment of mathematical analysis.

Sources of Assessment Data on Outcome #1:

Data can be test scores from exams testing a specific understanding of the scientific method; data can also be scores on laboratory reports that evaluate students’ understanding of scientific method; or other sources as specified below.

Semester(s) in which reported assessment data were collected: Fall 2014  □  Spring 2015 X  Both □

Below briefly describe how you collected these assessment data. What specific assessment methods—exams, assignments, or instruments did you use to acquire the data reported. Use of a rubric is recommended for less-quantitative assessments.

- **Identifying Control, Dependent and Independent Variables based on provided experimental procedures (from Lab Reports #3 and 4)**

- **Design an Experiment Assignments** — students were given a basic 5-step model of the Scientific Method and asked to use online simulations to predict the influence of a given independent variable on a dependent variable, design an experiment using the simulation, report and analyze the data, and draw a conclusion based on that data. The first involved choosing an independent variable from a pendulum simulation to see how it influenced time of a swing and the second involved first varying mass and then speed to see the effects on kinetic energy of a moving object.

- **Short Answer Exam Questions from Exam #3**
  - **Required to identify the definition of a solid, liquid or gas in terms of definite/indefinite volume and shape and provide the experimental evidence to justify.**
  - **Required to identify one gas law relationship as direct or inverse and provide the experimental evidence to justify.**
  - **Required to utilize data given to determine the volume of an object using water displacement, and given mass calculate the density and use a chart of known densities to determine the identity of the material.**

- **Short Answer Exam Questions from Exam #4** (best of two was chosen as there were options to choose other problems as well). Students either needed to describe an experiment to show the difference between chemical and physical changes or given an “unknown” solid, describe two tests they would run to determine the difference between an ionic or covalent compound.

- **Laboratory Conclusions** — two specific conclusions were graded separate from the remainder of the lab report. For complete credit in each, students differentiated between physical and chemical changes from a series of experiments performed in the lab. For full credit they needed to identify one chemical change they witnessed and how they recognized it as such, including a full description of starting materials and products, and then the same idea for a physical change.

Enter the total number of students from whom you collected the assessment data.  \( N = 48 \)

CHECK: Data are totals from a multi-section course?  \( \square \)  Data are only from one course/section?  \( X \)
In the spaces provided below, enter the number of students (and percent of total) who scored in each of the achievement levels indicated:

<table>
<thead>
<tr>
<th>Achievement Level</th>
<th>Number of students who reached this level</th>
<th>Percent of total students assessed who reached this level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceeded Criterion (A/B) 80-100 %</td>
<td>3</td>
<td>64.6%</td>
</tr>
<tr>
<td>Met Criterion (C) 70-79.99%</td>
<td>13</td>
<td>27.1%</td>
</tr>
<tr>
<td>Approached Criterion (D) 60-69.99%</td>
<td>3</td>
<td>6.2%</td>
</tr>
<tr>
<td>Did Not Meet Criterion (E) &lt;59.99%</td>
<td>1</td>
<td>2.1%</td>
</tr>
</tbody>
</table>

**Closing the Loop Recommendations:** After examining these assessment results, do you find any weaknesses in student performance on this specific student learning outcome that you plan to address by changes in course content, curricular emphasis, instructional approaches? If so, please describe the need for improvement and what you will do. Also, even if you have reached your desired criterion, you should have a plan to go beyond this level in the performance expectations on this outcome.

**This was the first time I taught the scientific method as a specific subject and attempted to have students design experiments with a basic outline covering the five basic steps.** Previously, they had been asked to analyze experiments that were already designed and that they performed, and occasionally asked to design experiments, but without this specific assessment in mind. What I found is that as a whole, they have the general idea of solving a scientific question methodically and based on data or observations, but they are sadly lacking in the details that go into designing a good scientific experiment. When asked to describe the actual experiment they intended to perform, they gave only the bare minimum information. If a person unfamiliar with the simulations or tasks were to read them, it would be very confusing.

I have always asked short answer questions similar to those that were assessed here, but have not usually isolated them out for such an assessment. From experience though, I know that detail has always been an issue here as well. Some of the responses to these questions is simply recall from what they did in lab or saw in a lecture demonstration, but I felt they were appropriate for this assessment because if they truly understood the experimental observations and could tie it back to a logical conclusion then they are demonstrating some understanding of and appreciation for the scientific method.

This lack of detail was also a problem for most of the semester in lab report conclusions. Because they were told specifically that detailed observations were critical to the conclusions regarding physical and chemical changes and they had gotten feedback on nine previous reports, they did a lot better on that particular assignment.

I will repeat some of what I did with the scientific method, but it is clear that I need to give them more good examples and feedback to get them to appreciate the details that are so important to scientific experimentation and reporting. As for designing their own experiment assignments utilizing the scientific method, I may have sprung that on them too fast or without enough guidance, so I will try to ease into that and emphasize it more consistently throughout the semester.