WEST VIRGINIA STATE UNIVERSITY
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Academic Affairs Assessment of Student Learning
Report for Academic Year: 2021-2022

Department/Program: Biology
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1. **Which learning outcomes did you measure this past year?** [Please indicate whether any of these measures were conducted as follow-up to a previous year's issues or in response to Program Review. Be specific.]

   PLO #1: Demonstrate field knowledge (of Biology)

   PLO #2: Apply the scientific method to answer a biologically-relevant question

2. **In which course(s) were assessments conducted?**

   PLO #1: Biology 250, 411

   PLO #2: Biology 120

3. **How did you assess the selected program learning outcomes?** (i.e., what did you assess – group project, skills demonstration, presentation, performance, debate, lab experiment, online discussion, etc. *and*- what tool (measure) did you use - rubric, nationally or state-normed exam, item analysis, pre-posttest design, skills inventory, survey, etc.)

   PLO #1:
   ETS Biology Major Field Test (nationally normed exam)
   Department of Biology Faculty-developed questions embedded in the final exam.

   PLO #2:
   Departmental faculty-developed rubric designed to assess various aspects of the scientific method

4. **How many students were included in the assessment(s) of each PLO in a course?**

Course	PLO Assessed	Number of Students
Biology 120	**2**	**39**
Biology 250	**1**	**10**
Biology 411	**1**	**11**

5. **How were students selected to participate in the assessment of each outcome (**Helpful details might include- whether this assessment represents all students, a sample of students in a class, or a sample of students across sections)?

PLO #1:
Biology 250: all students taking the final exam in spring sections were assessed
Biology 411: all students taking senior seminar in fall and spring were assessed.

PLO #2:
Biology 120: a subset students enrolled in spring sections of Biology 120 were assessed

6. **In general, describe how each assessment tool (measure) was constructed** (i.e. in-house, national, adapted).

PLO #1 is assessed with faculty developed questions embedded in the final exam the Biology Major Field Test

PLO #2 is assessed with a faculty-developed rubric designed using the framework of our General Education assessment rubric to assess student's knowledge and ability to utilize the scientific method

7. **Who analyzed results and how were they analyzed?**

ETS analyzes the Major Field test and the data are downloaded from their website. The Assessment Coordinator uses a statistical analysis to analyze the other data collected.

8. **Provide a summary of the results/conclusions from the assessment of each measured Program Learning Outcome.** *Report scores for this assessment, as well as students' strengths and weaknesses relative to this learning outcome.*

PLO #1
Scores in Biology 250 program assessment tool (see Table 3) showed that students improved their performance on all the subjects (productivity, succession and conservation) compared to the

prior year's final exam which was online and open book. For comparison, in 2015 only 13% if students were able to answer the question on productivity correctly. Scores were slightly better in 2016 and 2017 (16% and 10% respectively).

Major Field Test assessment data show that WVSU students have a scaled average score of 150 (see Table 10). Sub scores (only available for Spring 2022) students did best in the subcategory of Population Biology, Evolution, and Ecology followed by Molecular Biology and Genetics. This is consistent with our faculty – developed assessment results showing acceptable student performance in Molecular Genetics (Biology 270) and improvement in Ecology (Biology 250).

PLO #2

The Scientific Method is defined as a series of steps that scientists use to answer a question based on an observation. This process is essential to biology and other scientific disciplines. Since it is so important to the discipline, proper and meaningful use of the scientific method was identified by the faculty as an appropriate outcome for assessment.

This Program Learning Outcome is assessed at the beginning of the BS Biology program in Biology 120, the first core course of the major and near the end of the program in Cell Biology. Although WVSU Catalog Suggested Course Sequence for the BS Biology program indicates Cell Biology be taken in the junior year, many students wait to take the course in the first or second semester of the senior year. Unfortunately, because the former instructor for Biology 385 retired, the new instructor did not assess the scientific method for academic year 2021-2022. Our assessment outcomes for Biology 385 will be changed with the new assessment procedure we will be following beginning in Fall 2023.

By using either a survey tool or standard experimental approach, groups of students in Biology 120 are given the assignment of designing, and implementing an activity and analyzing the results. Student groups are then required to present the findings in class. In Cell Biology, the activity is more refined, less open-ended. After receiving some basic information and techniques about enzymes and enzyme assays, groups of students are asked to design, implement, analyze and present findings on some aspect of enzyme kinetics. A rubric designed by the Departmental Assessment Committee is used to evaluate group achievement in the following assessment areas: ability to clearly identify a problem, measure observations, organize data, analyze the observations (data), apply a model and communicate the results. Students were scored as follows advanced = 4, proficient = 3, satisfactory = 2, poor = 1 in the categories specified above.

9. **What are next steps?** (e.g., will you measure this same learning outcome again? Will you change some feature of the classroom experience and measure its impact? Will you try a new tool? Are you satisfied?)

Because of the COVID-19 pandemic, the manner in which classes were delivered was changed significantly. These changes carried over for the next academic year such that this year (2021 – 2022) is the first year that we have been able to return to normal instruction and incorporate our assessment program once again. Although we had intended to collect another year of data on the current two PLOs, this is the final year of collecting data on the PLOs indicated above. We are developing new assessment outcomes, rubrics and in-house final exam embedded questions to be implemented beginning in Fall 2023. One of the issues that has concerned me with regard to assessment is that we don't know our students' level of Biology understanding when they enter our department. One of the changes to our new assessment procedure will be to determine a baseline of our new majors' level of understanding and assess their knowledge based on those assessments and test them again in each of the core courses, then the Major Field Test can assess their understanding of Biology against students from other universities. In addition, we plan to develop new learning outcomes that specifically address scientific writing and oral communication.

10. **Please attach an example of the assessment tool used to measure your PLO(s).** These can be added as an appendix, a link to the assessment, or sent separately in email with your report.
    Those assessment tools are included in Appendices II and III.

APPENDIX I

Table 1. PLO #1 Demonstrate Field Knowledge (Ecology):

Faculty – Developed final exam – embedded questions. Spring 2022 Biology 250; N = 10

Subject	% of students answering correctly	Number of students answering correctly
Succession	80	8
Productivity	90	9
Conservation	90	9

Students performed best on the assessment questions on conservation and productivity. However, it is worth noting that students performed well on all embedded questions. For comparison, a different cohort of students were given these same questions on the Spring 2020 final exam that was proctored virtually because of COVID-19 restrictions and thus was open book. On that exam (N=12), 58% of students answered the succession question correctly, 83% answered the productivity question correctly and 83% answered the conservation question correctly. The Fall 2021 Final exam included 2 of the 3 embedded questions (conservation and productivity) and 71.4% and 85.7% of students answered those questions correctly, respectively.

Table 2. PLO #1 Demonstrate Field Knowledge: Biology Major Field Test. Total Test Results from Fall 2021 and Spring 2022, N=11

Fall 2021

Student	Total Biology
1	158
2	153
3	145
4	158
WVSU Mean	153.5 (+/- 6.1)
Nat'l Mean	153

Spring 2022

Student	Total Biology	Cell Biology	Mol. Biol. Gen.	Org. Biology	Pop. Eco. Evo.
1	149	38	47	50	56
2	128	35	27	35	28
3	164	57	60	60	71
4	146	35	55	39	54
5	141	35	47	42	43
6	143	42	47	46	41
7	165	65	60	67	61
WVSU Mean	148 (+/- 13.1)	44 (=/- 12.2)	50 (=/- 11.4)	48 (=/- 11.5)	51(=/- 14.3)
Nat'l. Mean	152	53	54	53	52

For the academic year 2021-2022, Biology majors scored a mean of 150 on the Major Field Test in Biology (composite). The Fall 2021 (N=4) cohort had a scaled mean of 153.5 (s.d.= 6.1) and the Spring 2022 cohort (N=7) had a scaled mean of 148 (s.d.= 13.1).

For comparison, here are some mean composite scores from other institutions (and WVSU):

UT-Chattanooga 2020-2021: 146.8
Wiley College 2020-2021: 134
WVSU 2020-2021: 148.2

Our students' performance on the Major Field Test in Biology indicates that our students' mastery of Biology is comparable to that of students from other universities. On the subject-specific areas, our students performed best in the Population Biology, Ecology and Evolution section but performed least well on the Cell Biology section. Comparison data for those subject areas was not readily available.

Table 3. PLO #2 Apply the scientific method to answer a biologically relevant question: Mean scores from Biology 120 .

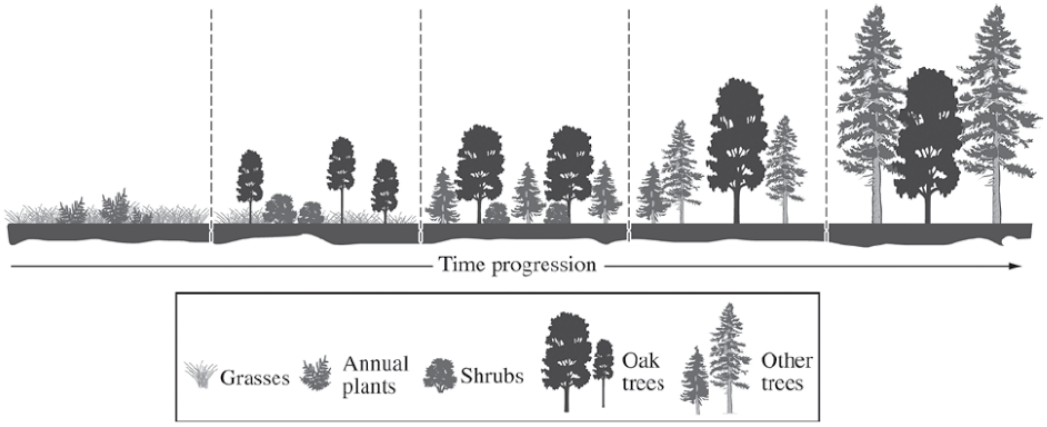
Components assessed	N=39
Identify problem	2.6
Measure observations	2.9
Organize data	3.1
Analyze observations	2.7
Apply model	2.5
Communicate results	2.6

From our rubric (Appendix III), the students in Biology 120 all scored at least Satisfactory on the Scientific Method exercise and scored Proficient for their organization of data. They scored least well on their ability to apply the model to their observations.

APPENDIX II

Sample Assessment Tool: Faculty – Developed final exam-embedded assessment of PLO#1: Demonstrate Field Knowledge (Ecology)

The diagram below shows the progression of ecological events after a fire in a particular ecosystem. *Based on the diagram*, which of the following best explains why oak trees are later replaced by other tree species?



A- Eventually other trees grow taller than the oak trees, forming a dense canopy shading the understory
B- Oak trees alter the pH of the soil, making the forest better suited for shrubs and other trees
C- Roots of shrubs proliferate in the soil of the forest and prevent the oak trees from obtaining water
D- Oak trees succumb to environmental pollutants more readily than do either shrubs or other trees

In an Asian rice paddy, carp eat decaying material from around the base of rice plants while a snail scrapes algae from the leaves, stems, and roots of the same plant. They can survive at the same time in the same rice paddy because they

A- Belong to different phyla.
B- Occupy the same habitat but different niches
C- Occupy different habitats and different niches
D- Occupy the same habitat and the same niche

Tigers are an endangered species, with fewer than 7,500 individuals left in the wild. Tigers are solitary and secretive, and each tiger needs at least 10 square miles of habitat. Female tigers mature at 3 years of age, usually produce 2 cubs per year, and may live up to 20 years. Which of the following is the best conservation measure for these animals?

A- Introduce exotic prey for tigers to eat.
B- Use a captive breeding program to reduce genetic diversity
C- Increase carrying capacity by protecting large tracts of high-quality habitat.
D- Promote hunting to remove the sick and old from the population

APPENDIX III

Sample Assessment tool; faculty – developed rubric for assessment of PLO#2: Apply the scientific method to answer a biologically relevant question

Biology Program Scientific Method Assessment Rubric

Year ___ Term ___ Class _____ Project _____ Student _____ Evaluator _____

Scientific method components	4 = Advanced (excellent, next level)	3 = Proficient (good)	2 = Satisfactory/Basic (OK but weak)	1 = Not satisfactory / Below basic (significant problems)	Score	Comm.
Identify relevant properties of the system / problem / observation	Identifies the role of specific parts of relevant concepts and how they interact to create the outcome of the system / problem / observation.	Identifies what specific parts of relevant concepts contribute to the outcome of the system/ problem/ observation, but doesn't distinguish the role of their contributions or how they interact.	Identifies relevant concepts, which contribute to outcome of system /problem / observation.	Needs to identify concepts of system / problem / observation, which contribute to outcome.		
Measure/Assess quantified observations in a reproducible manner in standard units of measurement	Objective-quantified observations are made through reproducible measurements of the relevant quantities contributing to the system, while minimizing error and using standard units of measurement	Objective-quantified observations are made through reproducible measurements of the relevant quantities contributing to the system, using standard units of measurement	Objective-quantified observations are made of the relevant quantities contributing to the system, using standard units of measurement.	Observations are made of the relevant quantities contributing to the system but are neither quantified nor objective.		
Organize collected observations	Selects and applies an appropriate method for organizing quantitative or qualitative data, including, when applicable: a database, graphs, tables or images. Data are ranked, grouped or tabulated in a manner for clear interpretation. Appropriate units are included.	Selects or applies an appropriate method for organizing quantitative or qualitative data, including, when applicable: a database, graphs, tables or images. Data need to be ranked, grouped or tabulated in a manner for clear interpretation. Units are included.	Quantitative or qualitative data is collected, but is not arranged in an organized manner. Data need to be ranked, ordered or grouped according to variables of interest. Units need to be included.	Neither quantitative nor qualitative data was collected or organized.		

Analyze collected observations	Correctly selects and applies an appropriate method for analysis of observations, including, when applicable: pattern recognition, measures of central tendency (mean, median, and mode), standard deviation, and other statistical analysis (Chi-Squared, student T- test), and error analysis appropriate for the course, discipline and/or question. Discusses the factors that contributed to the outcome, & any sources of error. Strong, valid connections are drawn between outcome & theoretical or conceptual understandings in the field	Selects or applies an appropriate method for analysis of observations, such as, including, when applicable: pattern recognition, measures of central tendency (mean, median, and mode), standard deviation, and other statistical analysis (Chi-Squared, student T-test), error analysis as is expected for the course, discipline and/or question. Discusses the factors OR sources of error which have contributed to the outcome. Connects the outcome to theoretical or conceptual understandings in the field.	Selects or applies a method for analysis of observations. Needs to discuss factors that may have contributed to the outcome. Needs to connect the outcome to theoretical or conceptual understandings in the field	Needs to select or apply a method for analysis of observations Needs to discuss factors that may have contributed to the outcome. Needs to connect the outcome to theoretical or conceptual understandings in the field.		
Apply model based on results to predict future outcomes/explain /interpret the initial system/ problem/ observation	Summarizes and explains results. Draws inferences that are consistent with the data and scientific reasoning Explains expected results & offers explanations/ suggestions for further research of unexpected results Distinguishes between raw data & inferences, avoids overgeneralization, and accepts/rejects hypothesis (if appropriate)	Summarizes and explains the results. Draws inferences that are consistent with the data and scientific reasoning. Explains expected results but needs to acknowledge unexpected results. Distinguishes between raw data and inferences.	Results summarized, but not interpreted or explained.	Results need to be summarized.		
Communicate & defend results	Conveys detailed, specific information, orally, in writing,	Conveys specific information, orally and in	Conveys general information describing	Needs to describe results of investigation		

	and visually describing results of investigation of system/problem/observation	writing, describing results of investigation of system /problem/observation.	results of investigation in system/problem/observation			