Academic Affairs Assessment of Student Learning
Report for Academic Year _2017- 2018

Department/Program __Biology_____
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1. **Which learning outcomes did you measure this past year?** Learning Outcomes assessed:

PLO #1: Demonstrate Field Knowledge

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

Data collection schedule
1. Spring semesters: Biology 120, 121, 250, 270, 385
2. Spring and fall semesters: Biology 411 Major Field Test

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

PLO #1: Biology 121, Biology 250, Biology 270, Biology 385, Biology 411
PLO #2: Biology 120 and Biology 385

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?

Table 1. Number of students participating in PLO assessment for courses listed

Course	PLO Assessed	Number of Students
Biology 120	2	41
Biology 121	1	35
Biology 250	1	17
Biology 270	1	13
Biology 385	1,2	8, 8
Biology 411*	1	17

***Combined cohort fall 2017 and spring 2018

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 121: all students taking the final exam in spring sections were assessed
Biology 250: all students taking the final exam in spring sections were assessed
Biology 270: all students taking the final exam in the spring section were assessed
Biology 385: all students taking the final exam in the spring section were assessed
Biology 411: all students taking senior seminar in fall and spring were assessed.

PLO #2: Biology 120: all students enrolled in spring sections of Biology 120 were assessed
Biology 385: all students enrolled in the spring section of Biology 385 were assessed.

6. **In general, describe how each assessment tool (measure) was constructed**

PLO #1 is assessed with the Biology Major Field Test, and faculty developed questions embedded in the final exam
PLO #2 is assessed with a faculty-developed rubric designed to assess various aspects of 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.* Please see Appendix I for results.

PLO #1

Students participating in the assessment of PLO #1 in Biology 121 in the 2018 spring semester did not show improvement in their ability to use Phylogenetic trees when compared to students participating in the same assessment as measured by the same tool in spring semesters of 2015, 2016 and 2017 (see Biology Program Review Follow-up,

2017). Faculty teaching the course developed a laboratory exercise that allowed students to practice interpreting and creating/using phylogenetic trees, but this did not improve the scores as was hoped.

Scores in Biology 270 program assessment tool (see Table 3) showed that students improved their performance on the subject of productivity, but this subject is still the one in which students perform the lowest. In 2015 only 13% if students were able to answer the question on productivity correctly. Scores were little better in 2016 and 2017 (16% and 10% respectively). Faculty teaching this course set a goal of 50% of students answering this question correctly for 2018. Although this goal was not met, improvement was seen: 35% of students answered this question correctly.

Students continue to perform best in the subject of Molecular Genetics. Table 5 shows that 62% of students participating in the assessment scored as "proficient." This is consistent with data collected in spring 2016 that showed 50% of students scored at this level or above. Upon review of earlier assessment data, the department thought no corrective action needed to be taken.

Upon reviewing assessment data from the 2017 Department of Biology Program Review Follow-up, faculty set a goal of improving students' ability to compare and contrast (a higher-order thinking skill) the structure and function of subcellular organelles. This is assessed in Cell Biology. The goal set was for 75% of student scores to be in the proficient/excellent category by spring of 2019. The scores in this subject area improved from 12% of students scoring in the Proficient/Excellent range to 63% of students scoring in this range.

Major Field Test assessment data show that WVSU students have a scaled average score of 151 (see Table 10). Sub scores showed 2017 – 2018 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 generally defined as a series of steps that scientists use to answer a question. This process is essential to biology and other scientific disciplines.[1] Since it is so important to the discipline, proper and meaningful use of the scientific method was identified by the faculty as an 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

[1] https://www.khanacademy.org/science/biology/intro-to-biology/science-of-biology/a/the-science-of-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.

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. The results from Biology 120 and Cell Biology were compared to determine if students improved from the beginning of the program to the end in their ability to use the scientific method. Students were scored as follows advanced = 4, proficient = 3, satisfactory = 2, poor = 1 in the categories specified above.

Comparison of scores between Biology 120 students and Cell Biology students shows improvement in 5 of the six components of the scientific method assessed. No improvement was seen in the component of "apply model." However, the goal set in the 2017 Department of Biology Program Review Follow-up of a minimum average score of 3 in all components for upper level students was achieved (see Table 11).

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?)

   This year (2017 – 2018) is the fourth year of the current assessment program. 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 developed the assessment outcomes, rubrics and in-house final exam embedded questions ourselves with little experience or knowledge of assessment. While I am not confident of the validity of our in-house attempts at assessment tools and data, I am happy that we now have a better culture of assessment in our department. This will improve development of our future assessment PLOs, data collection and program improvement in the coming assessment cycles.

   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).** Please see Appendices II and III.

APPENDIX I

Results

Table 1. PLO #1 Demonstrate Field Knowledge: Faculty – Developed final exam – embedded questions; Number of students scoring in subject area indicated. Spring 2018 Biology 121; N = 35

Subject	Number of students scoring in indicated subject			
	Poor	Fair	Proficient	Excellent
	0% - 49%	50% - 69%	70% - 89%	90% - 100%
Land Plants: Taxon Identification	23	8	2	2
Plant Phylogeny	30	3	2	0
Animals: Taxon Identification	20	11	2	2
Animal Phylogeny	27	2	3	3

Table 2. PLO #1 Demonstrate Field Knowledge: Faculty – Developed final exam – embedded questions. Percent of students scoring in category indicated. Spring 2018 Biology 121; N = 35

Subject	Percent of students scoring in the ranking indicated			
	Poor	Fair	Proficient	Excellent
	0% - 49%	50% - 69%	70% - 89%	90% - 100%
Land Plants: Taxon Identification	66	23	6	6
Plant Phylogeny	86	9	6	0
Animals: Taxon Identification	57	31	6	6
Animal Phylogeny	77	6	9	9

Data displayed in Tables 1 and 2 suggest that students score either poor or fair in their ability to use phylogenetic trees to assess organismal relatedness.

Table 3. PLO #1 Demonstrate Field Knowledge: Faculty – Developed final exam – embedded questions. Spring 2018 Biology 250; N = 17

Subject	Percent of students answering correctly	Number of students answering correctly
Succession	59	10
Productivity	35	6
Conservation	82	14

Students performed best on the assessment question on conservation.

Table 4. PLO #1 Demonstrate Field Knowledge: Faculty – Developed final exam – embedded questions. Spring 2018 Biology 270; number of students scoring in subject area indicated. N = 13

Subject	Number of students scoring in indicated subject			
	Poor	Fair	Proficient	Excellent
	0 % - 49%*	50% - 69%	70% - 89%	90% - 100%
Mendelian Genetics	0	2	1	2
Molecular Genetics	0	5	8	0
Quantitative Genetics	2	4	2	3
Population Genetics	2	0	0	6

Table 5. PLO #1 Demonstrate Field Knowledge: Faculty – Developed final exam – embedded questions. Spring 2018 Biology 270; Percent of students scoring in category indicated. N = 13

Subject	Percent of students scoring in ranking indicated			
	Poor	Fair	Proficient	Excellent
	0 % - 49%*	50% - 69%	70% - 89%	90% - 100%
Mendelian Genetics	0	15	8	15
Molecular Genetics	0	38	62	0
Quantitative Genetics	15	31	15	23
Population Genetics	15	0	0	46

Most students scored proficient in the area of subject of Molecular Genetics.

Table 6. PLO #1 Demonstrate Field Knowledge: Faculty – Developed final exam – embedded questions. Spring 2018 Biology 385; number of students scoring in subject area indicated. N = 8

Subject	Poor	Fair	Proficient	Excellent
	0% - 49%	50% - 69%	70% - 89%	90% - 100%
Structure/chemistry of biological molecules	3	3	2	0
Structure/function/chemistry organelles	2	1	2	3
Enzyme Kinetics	4	0	4	0

Table 7. PLO #1 Demonstrate Field Knowledge: Faculty – Developed final exam – embedded questions. Spring 2018 Biology 385; Percent of students scoring in category indicated. N = 8

	% students scoring in ranking indicated			
Subject	Poor	Fair	Proficient	Excellent
	0% - 49%	50% - 69%	70% - 89%	90% - 100%
Structure/chemistry of biological molecules	38	38	25	0
Structure/function/chemistry organelles	25	13	25	38
Enzyme Kinetics	50	0	50	0

Students did not score well in all three subject areas tested. Lowest scores were seen in enzyme kinetics and structure/chemistry of biological molecules.

Table 8. PLO #1 Demonstrate Field Knowledge: Biology Major Field Test. Combined Cohort Fall 2017 and Spring 2018. Total Test Results N=17

TOTAL TEST		
Scaled Score Range	**Number in Range**	**Percent Below**
200	0	100
195-199	0	100
190-194	0	100
185-189	0	100
180-184	0	100
175-179	0	100
170-174	1	94
165-169	2	82
160-164	2	71
155-159	2	59
150-154	2	47
145-149	1	41
140-144	4	18
135-139	3	0
130-134	0	0
125-129	0	0
120-124	0	0

National scaled average = 153.

Table 9. PLO #1 Demonstrate Field Knowledge: Biology Major Field Test. Combined Cohort Fall 2017 and Spring 2018. Sub score Results N=17

Data show that students did best in the subcategory of Population Biology, Evolution, and Ecology.

Table 10. PLO #1 Demonstrate Field Knowledge: Biology Major Field Test. WVSU averages fall 2017 and spring 2018 N = 17

	Mean	Standard Deviation
Total Test Scaled Score	151	12
Subscore 1	49	12
Subscore 2	50	13
Subscore 3	49	12
Subscore 4	55	13

Table 11. PLO #2 Apply the scientific method to answer a biologically relevant question: Comparison of scores Biology 120 and Biology 385

	Average scores	
	Biology 120	Biology 385
Components Assessed	N = 41	N = 8
Identify Problem	2.4	3.7
Measure Observations	2.4	4
Organize Data	2.8	3.7
Analyze Observations	2.9	3.2
Apply Model	3.1	3.1
Communicate Results	2.9	3.6

Comparison of scores between Biology 120 students and Cell Biology students shows improvement in 5 of the six components of the scientific method assessed. No improvement was seen in the component of "apply model."

APPENDIX II

Sample Assessment tool; Faculty – Developed final exam-embedded assessment of PLO#1: Demonstrate Field Knowledge

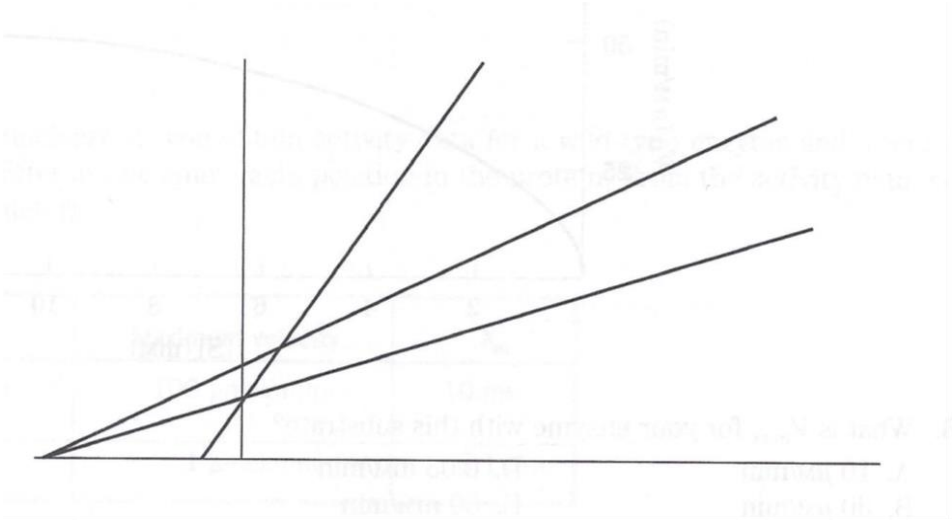
Part III.

1. (8) Draw the structure of glucose as it normally exists in cells.

a) Show the carbon atom involved in oxidation/reduction reactions that make us classify glucose as a reducing sugar.
b) Glucose is central to intermediary metabolism. Show how it is "activated" to undergo oxidation during glycolysis.

2. (21) Enzyme mechanisms and regulation can often be studied using kinetic analyses and plots of [substrate] and enzyme activity (reaction rates). Label the double reciprocal plot below with the letters corresponding to items (a)-(g).

a. A typical Michaelis-Menton enzyme in the absence of inhibitors
b. Enzyme activity in the presence of a noncompetitive inhibitor
c. Enzyme activity in the presence of a competitive inhibitor
d. 1/[S]
e. $1/V_o$
f. $-1/K_m$
g. $1/V_{max}$



3. (20) The chloroplast and the mitochondrion both have electron transport chains and carbon-based metabolic reactions that function to produce reductants and ATP. Compare and contrast how these two organelles accomplish similar goals in quite different processes.

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 Sci Method Assessment Rubric Year ____ Term ____ Class _____ Project _____ Student _____ Evaluator _____

	SCORING					
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**	**Comments**
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. • 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	• Selects or applies an appropriate method for analysis of observations,	• Selects or applies a method for analysis of observations.	• Needs to select or apply a method for analysis of observations.		

	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 drawn between outcome & theoretical or conceptual understandings in the field.	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.	• 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 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, and visually describing results of investigation of system/problem/observation.	Conveys specific information, orally and in writing, describing results of investigation of system/problem/observation.	Conveys general information describing results of investigation in system/problem/observation	Needs to describe results of investigation.		