Student Learning in Natural Science with a Laboratory Experience Courses
Self-Study Report
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Based on the NSLE assessment report of August, 2015

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Jeff Hughes, Professor, Department of Biology

I. Executive Summary

The departments of Biology, Chemistry, and Physics have developed the following learning goals for courses students take to satisfy the MPSL Natural Science with Lab Experience (NSLE) non-sequential requirement:

1. Develop an understanding of how to use logic and the scientific method to analyze the natural world and solve problems.

2. Learn about issues in science that are important both personally and globally.

3. Utilize technology in laboratory and field environments in order to connect theories and descriptions found in lectures and textbooks with real-world phenomena.

Accomplishing the NSLE goals will simultaneously address the core goals expressed in the mission statement of Millikin University. The first and third NSLE goals will help students achieve *professional success* through their practice of the scientific method as a mode of critical inquiry demanded by many careers. All three goals will contribute to Millikin graduates' working knowledge of issues, processes, and advances in science and technology around the globe, thus helping them contribute as *democratic citizens in a global environment*. By acquainting students with the nature of scientific investigation, how advances impact daily life, and the potential for future advances and changes, the NSLE second and third goals help *prepare students for a personal life of meaning and value*.

The courses that students take to satisfy these learning goals come from the three departments in the natural sciences and are taught by nearly the entire faculty in each department. Prior to 2011, the evaluations were limited to one course per department. From 2011-13, the assessments included evaluations of several courses per department, and assessments were based upon syllabi, assignments and rubrics, and student artifacts. Assessment reports since then reflect a broken assessment system and have relied on the assumption that conclusions reached on previous years remain valid in the absence of any significant changes in the staffing, courses, or goals of the program.

From 2011-13 our status on all three learning goals was awarded a "**green light**" (acceptable) according to results seen in assessment rubrics. An unanswered call for a new faculty assessor in 2013-14 prevented review of the learning goals and artifacts, but minimal changes to the courses and faculty who taught in science MPSL courses for AY 2013-14 supported a conclusion that the efforts to meet NSLE goals remained at a "**green light**" status. Because no new faculty assessor was named until early May, 2015 learning goals were not actively assessed nor were artifacts collected again in 2014-15. The stability in the faculty and courses over that time again prompt an assumption that the program is at a "**green light**" level. Late requests and poor follow-through by the current assessor produced a somewhat updated but still incomplete report for the past year, but again lack of change or concerns suggests an at least acceptable program. Clearly the assessment mechanism needs to be rejuvenated to justify this conclusion much longer, and some efforts were made this past year to supplement and expand the NSLE assessment program. So, while the NSLE learning goals are being met, the assessment mechanism itself has been weak and is only now being revamped, and it might be said that a major assessment goal for 2016-17 is to complete and implement suggestions in this report to recover from a "**red light**" performance in assessment itself over the previous three years.

II. Goals

The faculty in the Departments of Biology, Chemistry, and Physics design courses that satisfy the MPSL NSLE requirement to leave students with the ability to:

1. use logic and the scientific method to analyze the natural world and solve problems,

2. analyze issues in science which are important both personally and globally, and

3. connect theories and descriptions found in lectures and textbooks with real-world phenomena utilizing appropriate technology in laboratory and field environments.

Students who achieve these goals will simultaneously satisfy the core goals expressed in the mission statement of Millikin University. Specifically, a Millikin education aims to help students

1. *achieve professional success*, a goal helped by learning how the nature, application, and practice of the scientific method as a mode of inquiry is valuable as a way to approach questions found in any career,

2. *become a democratic citizen in a global environment*, a goal facilitated by learning about, contributing to, and forming opinions on issues that challenge people either in particular regions or across the globe, and

3. *prepare students for a personal life of meaning and value*, a goal supported by helping student connect the theory in texts to the practical applications of science in their lives will help the students be life-long learners and continue to integrate future developments in science into their understanding of and participation in world events.

With a new faculty assessor now in place and suggestions made to improve the program provided in this report, these goals will be reviewed in detail during and at the conclusion of the 2016-17 academic year.

III. Snapshot

The departments of Biology, Chemistry, and Physics at Millikin University were staffed in 2015-16 by 16 tenured/tenure-track faculty, one full-time instructor, seven part-time adjunct faculty, and 1.5 academic staff support personnel. A tenured biologist, C. Handler, teaches half-time and also directs the Pre-Professional Program. Similarly, the instructor, R. O'Conner, divides her duties between teaching and lab support (lab set-ups, inventory, ordering, etc.) in the biology department. The science departments are housed in the Leighty-Tabor Science Center (LTSC). Opened in 2002, it meets all teaching and research needs. Full-time faculty teach a variety of courses designed for non-majors, service courses required by non-science programs (e.g., Nursing and Exercise Science), and entry- and upper-level courses for science majors. Adjunct instructors usually lead laboratory sections in introductory courses or in courses for non-majors. Course sizes vary from as few as eight students—typically upper-level classes limited to no more than 20 students—to 60 or more students in a single lecture section divided into multiple smaller lab sections of up to 20 students each. The few larger classes typically serve non-majors and include BI206/207 (*Human Anatomy and Physiology I/II*), CH203/205 (*Essentials of Organic and Biochemistry*), and PY100/104 (*The Planets*) and PY101/105 (*Stars and Galaxies*). Labs are capped at 12-24 students.

This review covers NSLE courses offered in AY 2015-16 focusing either on topics of interest to non-science majors, service courses required by non-science majors, or introductory science courses for science majors. They include courses offered for PACE students, all of whom must satisfy the NSLE requirement. Note that only two full-time science faculty members are not on this list.

Table 1. "Natural Science with Laboratory Experience" courses with enrollments

Course Number	Course Title or Section Name	# Sect. '15-'16	Sem(s) Offered	Seats	Enrolled	Instructor(s)
BI102	*Biochem. of Food**	4	F,S,P	90	80	Galewsky
	Biology of Birds	2	F,S	40	42	Horn
	Biology of Disease	1	F	20	20	Zimmerman
	Biology Inf. Disease	1	F	20	17	Hughes
	Curr. Issues in Biol.	1	S	20	20	O'Conner
	Human Biology	2	F,P	44	45	Schroeder
	Useful Microbes	2	F,S	40	36	Smith
BI105/155	*Ecology & Evolution*	3/7	F	75	68	Parrish, Robertson, Horn, Wilcoxen, Smith, O'Conner
BI108/158	*Diversity of Life*	2/3	S	44	46	Schroeder, Parrish, Smith
BI125	*Local Flora*	1	S	16	18	Parrish
BI130	*Environ. Biology*	1	F	19	17	O'Conner
BI204	*Ess. of Anat. & Phys.*	2	F,S	40	38	Handler
BI206	*Human Anat./Phys. I*	2	F,S	95	101	Zimmerman
BI207	*Human Anat./Phys. II*	2	F,S	90	74	Wilcoxen
BI230	*Princ. of Microbiology*	2	F,S	60	53	Hughes
CH121/151	*Gen. Chemistry* (all)	6/10	F,S	192	177	Higgins, Guasco, Barnes, Knust, Stensrud, Madler
IN204	*Biology of Spiders*	2	S	40	23	Robertson
PY100/104	*The Planets*	1/3	S	48	51	Watson
PY101/105	*Stars and Galaxies*	2/3	F,P	68	58	Watson
PY111/171[#]	*College Physics I*	1	F	36	31	Martell
PY112/172[#]	*College Physics II*	1	S	36	29	Martell
PY151/171[#]	*University Physics I*	1	F	36	21	Martell
PY152/172[#]	*University Physics II*	1	S	24	11	Martell

TOTALS: 17 courses, 43 sections, 1193 available seats, 1076 students enrolled (90.2% of capacity).
F = Fall, S = Spring, P = PACE (fall or spring)
Courses listed as a single number have labs integrated with lectures, courses listed as ###/### have the lecture course listed before the obligatory laboratory course. Every course carries four credit hours.
**Biochemistry of Food* is listed under CH102 for PACE sections.
[#]PY171/172 enroll students from College and University Physics; there were two sections of each lab.

IV. Learning Story

Students taking science courses typically fall into three groups: 1) science majors who take many science courses; 2) students who need service courses to supplement their major (e.g., Nursing and Exercise Science), and 3) students who often take only one science course, usually to fulfill the NSLE requirement. Courses for science majors have additional learning goals specified by the major, courses for the third group must meet NSLE learning goals, and courses serving the second group often serve the needs of more than one group and must be designed with objectives aimed at satisfying professional needs defined by their major while also satisfying the NSLE learning goals. The combination of these three groups produces a highly diverse clientele for science courses, as noted in Table 2.

The many NSLE courses forbid any story that describes a "typical" experience. Instructors use content delivery and inquiry-based pedagogical methods and integrate lectures and labs to emphasize critical thinking, application, and problem solving skills that reflect current understanding of effective teaching.

Table 2. Distribution of NSLE course enrollments by major

Major	'11-'12	'12-'13	'13-'14	'14-'15	'15-'16	Major	'11-'12	'12-'13	'13-'14	'14-'15	'15-'16
Accounting	21	12	12	NR	10	Intern'l Business	3	1	0	NR	2
Art	2	2	4	NR	0	Intern'l Studies	2	0	2	NR	0
Art Education	1	1	0	NR	0	Management	0	0	0	NR	8
Art Therapy	7	2	2	NR	4	Marketing	6	9	7	NR	2
Athletic Training	26	27	47	NR	56	Math/Applied Math	4	9	4	NR	7
Biology (all tracks))	123	173	253	NR	217	Math, Sec. Teach	5	2	3	NR	7
Biology, Sec. Teach.	10	4	9	NR	9	Math, Act. Sci.	3	3	0	NR	3
Bus. Mgt & Undec.	18	15	11	NR	9	Music	4	13	2	NR	3
Chemistry	27	0	75	NR	31	Music Business	8	14	10	NR	10
Chem., Sec. Teach.	3	39	0	NR	5	Music Ed Inst.	2	6	3	NR	1
Commercial Art	1	13	0	NR	0	Music Ed Vocal	11	12	10	NR	8
Commercial Music	18	49	7	NR	13	Music Perf. Inst.	3	6	5	NR	1
Communication	25	15	43	NR	41	Music Perf. Vocal	11	2	4	NR	4
Digital Media Mktg.	NA	NA	NA	NR	1	Musical Theatre	11	4	6	NR	8
Early Childhood Ed.	19	25	16	NR	7	Non-Deg./No Major	2	0	6	NR	3
Elementary Ed	25	1	29	NR	14	Nursing/Pre-Nursing	49	81	182	NR	142
English - Literature	1	4	1	NR	2	Philosophy	4	5	5	NR	4
English, Sec. Teach.	6	11	5	NR	4	Phys Ed (K-12)	27	25	13	NR	8
English - Writing	7	6	4	NR	2	Physics	10	16	32	NR	11
Entrepreneurship	2	36	1	NR	5	Political Science	0	4	6	NR	3
Exploratory Studies	23	6	39	NR	41	Psychology	20	35	42	NR	26
Finance	3	28	7	NR	0	Soc Sci. Sec. Tch	0	3	13	NR	3
Graphic Design	1	20	2	NR	3	Sociology	13	16	5	NR	11
Health/Fit/Rec (& F/S)	57	1	37	NR	31	Spanish	3	1	0	NR	5
History	5	8	1	NR	0	Sport Managem't	1	22	22	NR	34
Human Services	23	26	33	NR	24	Studio Art	6	9	5	NR	3
Information Systems	3	1	11	NR	3	Theatre	29	23	14	NR	34
Information Tech.	0	0	0	NR	1	**SUM**	**701**	**848**	**1050**	NR	**889**
Interdepartmental	6	2	0	NR	3	**NA = not applicable, NR = 2014-15 not received**					

Includes BI102, BI105/155, BI108/158, BI125, BI130, BI204, BI206, BI207, BI230, BI280, CH121/151, CH131, IN204, PY100/104, PY101/105, PY111/171, PY112/172, PY151/171, PY152/172. PACE classes were included in 2014-16.

V. Assessment Methods

Prior to 2011, one faculty member was selected from each of the Biology, Chemistry, and Physics departments to represent the diversity of NSLE courses. These instructors assessed one of their own courses, and their individual evaluations were combined to produce the overall NSLE assessment.

This method underrepresented the breadth of NSLE courses and minimized faculty input. As listed in Table 1, 23 courses (seven as BI102) meet the NSLE requirement and many are offered more than once each year; evaluating a single course from three instructors seemed insufficient. Also, a rigorous and impartial assessment cannot be conducted only by instructors of their own courses; an impartial evaluator seemed necessary.

To ensure a more in-depth assessment, a larger subset of courses was assessed annually for **AY 2011-13**, with the goal of having 60-70% faculty contribute course assessments from biology and chemistry and 100% participation from physics. Table 3 lists the results of these three assessment years, where the "score" represents success in meeting the goal of increased faculty participation.

Table 3. Evaluation results of faculty participation in NSLE assessment activities, 2011-13. Data summarize results presented in the 2014-15 NSLE assessment report.

Acad. Year	Biology NSLE Courses			Chemistry NSLE Courses			Physics NSLE Courses		
	Courses Assessed	Faculty Particip'n	Score	Courses Assessed	Faculty Particip'n	Score	Courses Assessed	Faculty Particip'n	Score
11-12	7/21=33%	5/11=46%	**red**	4/8=50%	3/5=60%	**yellow**	4/6=67%	2/2=100%	**green**
12-13	14/26=54%	6/12=50%	**yellow**	5/8=63%	3/6=50%	**green**	2/9=22%	1/2=50%	**red**
13-14	11/31=36%	5/12=54%	**green**	5/12=42%	4/9=44%	**yellow**	4/9=44%	2/2=100%	**green**

SIR scores, a syllabus audit, and rubric-guided evaluation of faculty and student artifacts were used to determine success in meeting the NSLE assessment goals as described in 2011-13 NSLE assessment reports. The SIR data were not specific to NSLE courses and instead rated all courses taught in the three departments, and while illustrating the satisfaction of students with science classes in general, they didn't speak to NSLE goals, are of questionable relevance, and have been omitted in subsequent reports. Faculty syllabi for NSLE courses contained information explicitly required by the University but were very weak in expressing NSLE goals. Rubric-guided evaluations of artifacts submitted by faculty (e.g., tests, assignments) and students (e.g., papers, worksheets) showed improvement in faculty efforts to evaluate success in reaching NSLE goals and in student work directed to the goals. The evaluation process was time-consuming and did not involve all NSLE faculty or courses, but did document success in meeting the goals of expanding faculty participation and including a larger variety of NSLE courses.

The NSLE assessment system broke down in **2013-15**. Dr. Schroeder resigned as NSLE assessment coordinator before AY 2013-14, but no successor was appointed and no data were collected. She performed a meta-analysis in the 2013-14 report and concluded that, with little change in classes and faculty that year, NSLE courses merited "**green light**" status in meeting all three NSLE goals. Failure to secure an NSLE assessment coordinator until May 2015 meant that again no data were requested or collected during AY 2014-15. There was too little time to obtain course enrollment data, NSLE-specific SIR data evaluations, artifacts, and audit syllabi for NSLE goals statements. Example: requests for SIR and enrollment information at the end of the spring semester were not answered. Again, analysis of available data and lack of substantial change to the NSLE program warranted a "**green light**" conclusion regarding program goals and suggestions for improving assessment in the coming year.

While new procedures were discussed during 2015-16, frankly, little was done to put them into action. All syllabi for NSLE courses were directed to include specific language including the learning goals statement, Information Technology has provided more reliable enrollment figures for Table 1, and an informal survey of faculty affirmed broad satisfaction with the NSLE requirement. Requests for NSLE-focused SIR data were again unanswered this past summer, and no student artifacts were gathered or even requested for direct evidence of student learning or appreciation for the role of science and scientific investigation in society.

VI. Trends and Improvement Plans

Changes in the NSLE assessment effort at the beginning of AY 2011-12 improved faculty participation and expanded the diversity of courses included in the final NSLE assessment report. An appreciation of the stability in faculty and curriculum and lack of audible calls for change during 2013-16 support the conclusion that these goals have been well met during the absence of an active assessment effort. What's needed is a more thorough evaluation to back up and understand this conclusion.

Current State and Future Prospects. The NSLE element of the MPSL has not been significantly altered in recent history primarily because, given the University faculty's decision to restriction science education to a minimum of a single course, students and teachers appear to be happy with what's being offered. There have been no calls to change the program, most likely because it allows each department to contribute as it sees fit and permits faculty to design courses for non-majors with topics that capture the expertise and enthusiasm of the instructor. Given the overall satisfaction and success of NSLE offerings and barring a significant revision of the MPSL program, there is little reason or need to change our approach to meeting the NSLE requirement.

That is not to say that programs goals are being met, so the assessment mechanism must be modified to promote broader faculty participation, reliable yearly assessments, and most especially evidence of student learning. This need was addressed at the end of the 2014-15 NSLE assessment report and included suggestions to increase involvement of NSLE instructors in assessment with the goal of 100% participation, develop an assessment-focused assignment in each NSLE class (e.g., a quantifiable pre/post survey or skills-based activity) that might also serve as artifacts, re-evaluate NSLE learning goals, and include student course evaluations in assessments. Discussions of options have only begun.

Changes must also ease all faculty into the assessment process by building it into day-to-day class operations. Many faculty balk at contributing hours to filling out novel rubrics or to volunteering for committee work that appears to have ill-defined, apparently endless and unrewarded time requirements. This may be done by better providing guidance in meeting current expectations and simple evaluation tools with easily analyzed objective data that can be completed during the course of each class may minimize "assessment phobia", especially among prospective assessment coordinators.

Assessment during AY2016-17 must include two elements. First, we need a measure of student satisfaction with NSLE courses that would be best obtained through evaluation of SIR scores for all NSLE classes. A semester-by-semester list of NSLE classes with corresponding CRNs was provided to Information Technology in early June but a long list of other requests delayed the programming needed to provide information for which the administrative system is not yet to use routinely. The other need is to gauge student learning. This would require artifacts that encourage students to reflect on the NSLE goals and provide a written response to a question or questions at the beginning and end of their class. It must be short and contain objective questions focused on the NSLE goals and also ask a question that would allow reflection on the specific subject of the class. If made a requirement of all NSLE classes and scored by the instructors for each class, this tool would provide before/after data, NSLE-specific information on student learning and understanding, and a durable artifact with a burden shared by all of the science division faculty.

VII. Conclusion

Based on the assumption that little change in faculty or curriculum since the completed 2012-13 NSLE report means it seems reasonable once again to award the same assessment scores to efforts to meet NSLE goals; i.e., all three goals merit a "**green light**" score. This is admittedly getting old, and obtaining SIR data and developing and using a tool to solicit student input on their appreciation of the NSLE goals will be essential to resuscitate NSLE assessment.

Respectfully submitted by Jeff Hughes, Professor, Department of Biology, on 8/15/16.