WSU Five-Year Program Review
Self-Study

Cover Page

Department/Program: Botany

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Brief Introductory Statement
(Reference: Annual Report – description of contribution to the university as a whole)

The Botany Department provides education and training to 65 majors (five year average, based on Fall semester third week enrollments) in four emphasis areas (tracks). Of particular note is that students who complete the field emphasis are in demand by state and federal agencies as well as NGOs because of their hands-on training in field survey techniques and knowledge of the flora of the Intermountain West. The department contributes to WSU's general education program, with 81% of SCHs coming from general education offerings, primarily BTNY LS 1403, Environment Appreciation, which is required by all programs in the Goddard School of Business and Economics and several programs in the College of Engineering, Applied Science and Technology. From 2012-2017, enrollments in this class averaged 685 per year. BTNY LS 1203, Plant Biology, is used as a support course by several COS majors and some pre-professional programs. Three faculty have taught general education courses in the Honors Program in the last two years. One faculty member worked with statistics faculty in the Department of Mathematics to design and now co-teach MATH 3450, Advanced Statistical Methods, an applied statistics class for field scientists. Upper division Botany courses are used as electives by Biology Teaching Composite, Geosciences, Microbiology, Zoology, and Biochemistry majors. The department provides the faculty member who designed and teaches the College of Science (COS) Laboratory Safety class. This class, which is taken by about 120 students each year, is cross-listed in five COS departments, but only the SCHs taken under the BTNY prefix (about 20% of the total) are credited to the department. The department houses and curates the Mary Carver Hall Herbarium, a collection of over 25,000 specimens with an emphasis on the Utah flora. Also under the care of the Botany Department is a greenhouse facility with a collection of living plants maintained in three climate zones: tropical, temperate, and desert. Our main outreach activity is greenhouse tours for K-12 field trips. The department participates in the Green Department Program and offers 11 courses that are listed as sustainability related.

As part of the successful application by the College of Science for an interdisciplinary position in Environmental Science, the college made the following argument:
The outdoor opportunities and environment of our region are vital to its economy, because of the role that landscape and the environment play in attracting and retaining new businesses, entrepreneurs, and a highly-educated and healthy workforce. Understanding our environment and teaching our students the best means of protecting and conserving it is critical to the continued health of our region.
Botany is an essential part of the mission in education about the environment and training of scientists who study the environment from a variety of perspectives. In our 2012 program review, then chair Barb Wachocki noted:

The Botany Department at Weber State University is ***the last remaining undergraduate Botany department in Utah****, and one of the few left nation-wide. Trends to downsize, consolidate, or eliminate Botany programs have been occurring for over 20 years. The impact this is having and will have, is well documented in the 2010 report*, Assessing botanical capacity to address grand challenges in the United States*, issued by the Chicago Botanic Garden and Botanic Gardens Conservation International U.S. (http://www.bgci.org/usa/bcap). The report is based on a survey of over 1,500 respondents and 30 workshop members. It states that since 1988, "undergraduate degrees earned in botany are down 50% and advanced degrees earned in botany are down 41%." In addition, "courses eliminated tend to be from among those required for the 0430 (botanist) federal job code."*

The situation has not improved in the past six years, with continued periodic reports about the loss of field botanists with survey skills and knowledge of plant identification, including recent articles in The Wall Street Journal and U.S. News and World Report. With growing concerns about the environmental impacts of climate change, there is a need for historical records of plant distributions, such as those in the department's Mary Carver Hall Herbarium, and people trained in surveying and analysis of flora and their growing conditions, such as our graduates. The Botany Department offers the courses that are listed in the 0430 job code, and our graduates have the minimum 24 botany credits needed for these jobs. We have ongoing examination of our course offerings to make sure that the training we provide meets the critical need for field botantists, as well as their laboratory counterparts who do the analytic work of soil analysis, plant physiology, cell biology, anatomy, and DNA analysis that supports field studies.

Standard A - Mission Statement

Botany Department Mission Statement

The mission of the Botany Department at Weber State University is to provide students with the necessary knowledge and skills to pursue diverse educational and career goals. To this end, the Botany Department offers a diversity of high quality courses that provide classroom, laboratory, and field experience in the major subdisciplines of plant biology. Our botany graduates find employment as researchers in academic, industrial, or government labs; as field botanists for state and federal agencies, including state and national parks; and as employees of educational and environmental organizations. The undergraduate botany department at WSU is the only of its kind remaining in Utah and one of the few left in the U.S. As such, we aim to increase the visibility of botany as a vitally important discipline. Accordingly, the Department provides general education courses and support courses that enhance student appreciation for plants and their physically and functionally keystone place in the world.

Actions to Realize the Mission of the Botany Department:

- Contribute to the growth of STEM literacy at WSU by providing general education courses, support courses for other degrees across campus, and a diversity of courses relevant for careers in botany and related fields.
- Recruit and retain undergraduate students in STEM fields with interests in plant biology
- Involve students in active research and community service.
- Through research and service, contribute new knowledge within the major subdisciplines of botany and related fields.

The Botany Department mission meshes with the university Access Theme:

The Botany Department offers a Bachelor of Science degree in four areas to fit a variety of career goals: laboratory emphasis, pre-natural medicine, field emphasis, and general Botany. Pre-professional preparation is available for individuals interested in pursuing degrees in forestry, range management, agriculture, and horticulture. The department also offers a minor and a Bachelor of Integrated Studies emphasis area in Botany. Several courses are offered which meet the WSU life science general education criteria. All general education and some introductory courses for majors are also offered in more accessible formats to accommodate non-traditional and early college students, including on-line, interactive video conferencing, at night, and at various WSU campuses and centers.

The Botany Department mission meshes with the university Learning Theme:

Botany majors are required to develop a portfolio, which includes the documentation of a capstone experience and an assessment of expected outcomes for Botany majors. These include a thorough knowledge and comprehension of the core concepts in Plant Biology and mastery of fundamental skills which are needed to function effectively as professionals in field or laboratory work.

Educational experiences for Botany students involve small classes which emphasize opportunities for hands-on activities in the field or laboratory. Individualized learning is available through individual research and an undergraduate thesis option. The student-led Botany Club provides extracurricular activities, including field trips and service projects.

The Botany Department mission meshes with the university Community Theme:
The Botany Department contributes to the community through the training of pre-service and post-service K-12 teachers. Students, faculty, and staff participate in a variety of outreach programs, notably those which target a K-12 audience. In addition, Botany faculty, staff, and students participate in community education and service through sponsored workshops, presentations, and community events. Through internal interdisciplinary grants, the Botany Department has helped establish and maintain the WSU Community Garden on the main campus and the Davis campus greenhouse and community garden. The Department has been involved with planning additional community gardens within the city, including at local schools.

Standard B - Curriculum

Curriculum Map for courses in the Botany major
In response to a recommendation from our last program review to align department learning goals and outcomes with those articulated by the AAAS Vision and Change initiative, we recently completed a revision of the curriculum map and learning outcomes for the Botany major. The first semester that will be assessed with the new map and outcomes is Fall 2018. A copy of the new map and outcomes can be found in Appendix H. Courses presented in this 2018-19 program review were assessed with the old map shown below and the old outcomes provided in Standard C.

Botany Major - B.S. degree

The Botany major is currently available in four tracks. All share a common core curriculum of required Botany courses and then specialize based on additional required Botany courses and support courses. Curriculum details for each track can be found in the university catalog.

Track A, Option 1: Laboratory Emphasis - enriched with quantitative science and intense laboratory hands- on experiences with embedded Chemistry minor, designed to prepare students for graduate school and careers in laboratory research.

Track A, Option 2: Pre-Natural Medicine- enriched with quantitative science and intense laboratory hands- on experiences with embedded Chemistry minor, designed to prepare students for admission to Natural Medicine schools.

Track B: Field Botany Emphasis- enriched with field-oriented course opportunities, is designed to best prepare students for field-related careers/graduate school in areas such as ecology, environmental science, and natural resource management.

Track C: General Botany Emphasis- with a slightly reduced number of required courses but with more elective courses, is designed to meet the needs of students who wish to obtain a General Botany degree, with flexibility for transfer students to minimize the time to graduation.

Curriculum Map

Core Courses in Department/ Program	Department/Program Learning Outcomes														
	Knowledge and Comprehension			Skills								Affective Domain			
BTNY Courses	Plant/other	Plants are unique	Plant products	Field/lab research	Critical thinking	Problem solving	Communication	Computer	Information seeking	Cooperation and social	Self-assessment	Appreciation of diversity	Ethics	Liberal Arts	Aesthetic appreciation
2104 (Plant Form & Func)	L	H	L	H	H	H	H	M	H	M	L	L	L	L	L
2114 (Evol Survey of Plants)	H	H	L	M	M	M	L	L	O	M	O	H	L	M	H
2121 (Career Plan for Bot)	O	O	O	O	L	L	L	L	M	L	M	L	L	L	L
2203 (Home & Garden)	M	H	M	H	M	L	M	M	L	L	L	L	L	M	H
2303 (Ethnobotany)	M	H	H	L	L	L	L	L	L	L	L	H	H	H	H
2413 (Nat Resource Mgt)	O	M	O	O	H	M	M	L	L	M	L	H	H	M	H
2600 (Lab Safety)	O	O	O	M	M	H	L	L	L	O	L	O	L	O	O
3105 (Plant Anatomy)	M	H	L	H	M	M	M	O	L	M	M	M	O	L	L
3153 (Bio of the Plant Cell)	M	H	O	L	H	H	M	L	H	L	L	L	L	L	L
3204 (Plant Physiology)	L	M	O	H	H	H	H	M	H	M	M	M	L	O	O
3214 (Soils)	O	M	O	H	M	M	M	L	M	L	M	L	M	M	M
3303 (Plant Genetics)	M	M	M	M	H	H	M	M	L	M	M	L	M	L	O
3403 (Env Apprec Upp Div)	O	O	O	O	L	L	H	M	H	L	M	L	L	L	L
3454 (Plant Ecol)	M	H	O	H	M	H	H	M	M	H	M	L	L	L	M
3473 (Plant Geog)	M	H	O	M	M	L	L	L	M	L	L	H	L	M	H
3504 (Mycology)	M	H	M	H	M	L	M	L	L	M	M	L	O	O	L
3583 (Medicinal Plants)	L	H	H	H	M	M	L	L	H	L	M	H	H	H	H
3624 (Taxon of Vasc Plants)	L	L	O	H	M	M	L	L	L	L	M	L	O	M	H
3643 (Intermtn Flora)	L	L	L	M	M	M	L	L	L	L	M	L	L	O	H
4252 (Cell Culture)	M	M	L	H	M	M	M	M	L	M	L	O	L	L	L
4750 (Topics in Bot)	V	V	V	V	V	V	H	V	V	V	M	V	V	H	V
4800 (Indiv Research)	V	V	V	V	H	V	H	V	V	V	M	V	V	V	V
4830 (Readings in Bot)	V	V	V	V	H	V	H	V	V	V	M	V	V	V	V
4840 (Thesis Readings)	V	V	V	V	H	H	H	V	H	V	H	V	V	V	V
4850 (Thesis Research)	V	V	V	H	H	H	H	M	V	V	H	V	V	V	V
4890 (Co-op Work Exper)	V	V	V	M	M	M	H	M	V	H	H	V	V	V	V
4920 (Workshops, etc.)	V	V	V	V	V	V	V	V	V	V	H	V	V	V	V
4950 (Advanced Field Bot)	L	H	L	H	L	L	L	L	O	H	H	O	H	L	H
4970 (Botany Thesis)	V	V	V	H	H	H	H	H	V	V	H	V	V	V	V
4980 (Portfolio Sum Assess)	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
4990 (Seminar in Botany)	V	V	V	V	H	H	H	H	V	V	H	V	V	V	V

H = high emphasis, M = moderate emphasis, L += low emphasis, V = variable emphasis, depending on topic and instructor. O = outcome not emphasized.

Schedule for offering Botany courses

Course	Sum Odd	Fall Odd	Spr Even	Sum Even	Fall Even	Spr Odd	Notes
LS1203 (Plant Biology)	X	X	X	X	X	X	1
LS1303 (Plants in Human Affairs)	X	X	X	X	X	X	1
LS1403 (Environment Appreciation)	X	X	X	X	X	X	1, 10
2104 (Plant Form & Function)		X	X		X	X	2
2114 (Evolutionary Survey of Plants)		X	X		X	X	2
2121 (Career Planning)		X	X		X	X	
2203 (Home & Garden)			X			X	
2303 (Ethnobotany)			X			X	
2413 (Natural Resource Management)		X					3
2600 (Lab Safety)		X	X		X	X	4
3105 (Anatomy of Vascular Plants)					X		
3153 (Biology of the Plant Cell)			X				
3204 (Plant Physiology)		X					
3214 (Soils)			X			X	
3303 (Plant Genetics)						X	
3403 (Environment Appreciation)		X	X		X	X	
3454 (Plant Ecology)					X		3
3473 (Plant Geography)						X	9
3504 (Mycology)		X					3
3583 (Medicinal Plants)					X		
3624 (Taxonomy of Vascular Plants)	X			X			11
3643 (Intermountain Flora)		X			X		9
4750 (Topics in Botany)		X	X		X	X	5
4950 (Advanced Field Botany)			X			X	6
4800 (Individual Research)	X	X	X	X	X	X	7
4830 (Readings in Botany)	X	X	X	X	X	X	7
4840 (Thesis Readings)	X	X	X	X	X	X	7
4850 (Thesis Research)	X	X	X	X	X	X	7
4890 (Co-Op Work Experience)	X	X	X	X	X	X	
4970 (Botany Thesis)		X	X		X	X	
4980 (Portfolio Summative Assessment)		X	X		X	X	
4990 (Seminar in Botany)		X	X		X	X	
Math 4950 (Advanced Statistical Methods)			X			X	8

Notes

1. General education courses are offered in a variety of formats to accommodate student schedules: online, day and night sections at the Ogden and Davis campuses, and interactive video conferencing from the Ogden campus to WSU centers in Farmington, Davis, Morgan, and West (Roy). This meshes with the university mission of access.

2. These Botany core courses are offered at both the Ogden and Davis campuses. This meshes with the university mission of access.
3. With a growing number of students interested in field botany, we are considering offering this course yearly instead of alternate years.
4. This class is offered under five department prefixes each semester. It was designed and is taught by a member of the Botany faculty. Approximately 60 students in various science majors and Criminal Justice majors who have a concentration in Crime Scene Investigation (College of Social & Behavioral Sciences) take the class each semester.
5. We try to offer a 2 credit section each semester. Not only does this provide variety in electives for majors and minors, it also helps students who are 1 or 2 credit hours short of the minimum graduation requirement for 40 upper division credit hours.
6. We just changed this to a yearly offering to meet demand for students interested in field botany. We will change it to a Fall offering beginning Fall 2019.
7. These are individualized instruction classes. Sections are opened for specific faculty as needed to accommodate individual students doing special projects.
8. This class is team-taught by Mathematics and Botany. It counts as a Botany elective for majors and minors/BIS.
9. After this academic year, frequency and semester of course offering will change with the retirement of the department's plant taxonomist and herbarium curator.
10. We offer an optional 4th credit hour for this class to meet the needs of students in Construction Management (College of Engineering, Applied Science & Technology) and other students who want a 4th credit hour.
11. The keys used to identify plants are heavily based on flower structure. Several years ago, we started offering Plant Taxonomy in the first block of the summer session so that students could work with fresh flowers instead of the frozen flowers that Dr. Clark would collect throughout the late spring and early summer. Changing the schedule has greatly improved the quality of the course as it is now taught during the time of year when much of the local flora is in bloom.

We have a number of courses, including some that are required in some of the major Tracks, that are offered alternate years. This was done in response to having reduced faculty numbers and based on student demand. Now that the faculty numbers are up, we are moving to offer the highest demand classes yearly again. There will be some shifting with regard to which semester courses are offered as well. The department now has a formal curriculum committee made up of the junior faculty (Dr. Root, Dr. Schramm, and Dr. Hilbig), chaired by Dr. Hilbig. They have identified courses for elimination (the above table does not show classes we stopped offering as faculty retired and their expertise was not replaced) and new courses to take advantage of expertise in the current faculty composition, support our field botany emphasis, and address weaknesses in the current curriculum with regard to molecular biology. Based on their work, we are planning to eliminate the tracks and set up a core curriculum based on the biology content areas outlined in Vision and Change (see Appendix H). This will impact future scheduling and possibly shorten time to degree for our majors because there will be course options rather than a specific course needed to meet a content area.

Last year, we changed requirements for the Botany minor and BIS emphasis. We deleted one of the required lower division classes and moved those credit hours to elective hours, providing an additional opportunity for students to choose an upper division class among the electives. We also spelled out which BTNY classes can be used as electives to address various other issues.

General Education and Service Courses provided by the Program

The Botany Department offers three General Education courses, Botany LS1203 *Plant Biology*, Botany LS1303 *Plants in Human Affairs*, and Botany LS1403 *Environment Appreciation.* Additional service courses include Botany 2104 *Plant Form and Function* and Botany 2114 *Evolutionary Survey of Plants*. As noted above, we offer these courses in a variety of formats and venues.

Botany LS1203, Botany 2104, and Botany 2114 serve as a pool from which Microbiology, Zoology, Geosciences, and Biology Composite Teaching majors select one or more as required courses. In addition, Geosciences recommends the Botany 3214 (*Soils*) course for their Applied Environmental Geosciences major and Botany 3214 (*Soils*), Botany 3303 (*Plant Genetics*), or Botany 3473 (*Plant Geography*) for their Earth Science Teaching major.

Botany LS1403 *(Environment Appreciation*) **is a service course** required of all majors in the John B. Goddard School of Business and Economics and the Automotive Technology program and Construction Management program in the College of Engineering, Applied Science, and Technology. We offer a 4 credit version of this class in response to requirements in Construction Management.

The Botany Department also provides the primary instructor for the cross-listed course 2600 (Laboratory Safety). This course is cross-listed in five departments within the College of Science and is a required course in the in Criminal Justice Crime Scene Investigation Concentration (Department of Criminal Justice) in the College of Social and Behavioral Sciences.

Standard C - Student Learning Outcomes and Assessment
(These are the learning outcomes that were in place for the review period. The new outcomes that begin in Fall 2018 can be found in Appendix H.)

Measurable Learning Outcomes

Upon graduation, Botany majors should:

1. have a thorough **knowledge and comprehension** of the **core concepts** in the discipline of Plant Biology. These include the fact that :

   a. Plants are *like* other organisms in regard to: basic metabolism, sexual reproduction, clonal reproduction, hormonally regulated development, ability to respond to the environment, diversity and evolution.

   b. Plants are *unique* organisms in: their varied life histories - especially a sporic one with alternation of generations; their role as primary producers in food webs, serving as the interface organisms between the organic and inorganic worlds *via* mineral assimilation and photosynthesis; and the oxygenation of the atmosphere.

   c. Plants serve as an important source of products: food, fiber, flavorings, feed, fuel, pharmaceuticals, etc.

2. have mastered a set of fundamental **skills** which would be useful to function effectively as professionals and to their continued development and learning within the field of Plant Biology. These skills include the following:

   a. *Communication Skills*: Botany graduates will be required to demonstrate competence in communication, both written and oral, and present the results of their research in senior theses, senior capstone courses, and in all upper-division courses where such communication is expected and evaluated by both their peers and the instructor.
      i. *Writing Skills* - This component shall also demonstrate *critical thinking, reasoning, and effective argument skills*.
      ii. *Speaking Skills* - any oral presentation(s) given in courses or extracurricular events.
   b. *Computer Skills*
   c. *Field and Laboratory Research Skills*
   d. *Problem-Solving Skills*
   e. *Self-Assessment Skills*
   f. *Cooperation/Social Responsibility Skills*
   g. *Information Seeking Skills*

3. demonstrate significant value-added progress in developing the following **values (affective domain)**:
   a. *Appreciation* of the *diversity* of cultures and intellectual points of view.
   b. *Understanding* of *ethical issues* and responsibilities
   c. *Commitment* to *non-discrimination*
   d. *Appreciation* that Botany follows the *Liberal Arts* tradition
   e. *Appreciation* of the *aesthetic* attributes of nature

Five-year Assessment Summary

The course assessment process has evolved over time. Initially, a threshold was considered to be met if the class average for a particular measure of a learning outcome (exam, etc.) was above a certain percentage. Later, the university adopted the meaning of a threshold as a certain percentage of the students being assessed achieving a specified percentage on a particular measure (exam, etc.). The threshold percentages varied from year to year as well as between the types of courses (Gen Ed, etc.). To confuse matters further, new thresholds were often decided upon after the department had received feedback on the prior year's assessments, which was after Summer and Fall assessments had been completed for the next year. Hence, there may be some discrepancy between classes & instructors within a given semester.

As of Fall 2016, the Botany Department has adopted thresholds that have been consistently implemented since Fall 2017. These are university "aspirational" thresholds and are as follow:

General Education courses: 80% of students achieve at least 70%

- These courses serve mostly non-science students, usually freshmen, sophomores and Early College students

2000-Level Courses: 80% of students achieve at least 70%

- These courses serve as introductory courses for Botany majors and support courses for College of Science majors

Upper Division Botany courses: 90% of students achieve at least 80%

- These courses serve Botany majors and minors, but some also attract other College of Science majors

Previous assessment thresholds for Learning Outcomes are listed below.

2013-2014

Threshold for Evidence of Student Learning is 65% out of 100%.

2014-2015

Assessment Threshold for Gen Ed LS courses is 65%.
Assessment Threshold Core lab courses for Botany majors and minors is 67%.
Assessment Threshold for upper division courses within the major is 70%.

2015-2016

Assessment Threshold for Gen Ed LS courses is 60% or more of students scoring at least 65%.
Assessment Threshold Core for 2000-level courses is 60% or more of students scoring at least 70%.
Assessment Threshold for upper division courses is 70% or more of students scoring at least 70%.

2016-2017

Assessment thresholds were the same as for 2017-2018, but some course assessments were done before we received feedback on the thresholds used in the 2015-2016 report. Those assessments used different thresholds that are included with the respective assessment grids.

Tables in Appendix G show assessment results from Summer 2013 through Spring 2018 for Botany 2000-Level, Upper Division, and General Education courses. For each course, the percentage of sections assessed that met the threshold (whatever it was at the time) for each learning outcome is shown. The weighted average of all sections assessed for each learning outcome appears in parentheses.

The results are further categorized showing relative student achievement on exams (closed book), quizzes (often open book and/or more than one attempt possible), and other assignments (essays, class projects, lab notebooks, etc.). Not all sections assessed student Learning Outcomes for all measures (exams, quizzes, other assignments), hence only sections with data for a particular category were used. If more than one measure was used for a particular learning outcome in a section of a course (e.g. essay and class project for "other assignments"), the average of those measures was calculated for that course section. Weighted averages were calculated by multiplying a section's percentage for a measure by the number of students in that section, adding all sections' products of that course together and then dividing by the total number of students assessed in that category (e.g. other assignments) for that particular course from Summer 2013-Spring 2018.

Not all sections of each course were assessed every semester. Some classes are offered every semester, some once per year, and others are only offered every other year. The total number of sections assessed for each course from Summer 2013 through Spring 2018, as well as the total number of students assessed are also presented in the tables.

General Education Courses

Student Learning Outcomes for Life Science (LS) General Education courses are university wide and include four Natural Science (NS) Learning Outcomes that all Life Science and Physical Science courses must meet in addition to four LS-specific Learning Outcomes. These are as follow:

Foundations of the Natural Sciences Learning Outcomes

1. **Nature of science**. Scientific knowledge is based on evidence that is repeatedly examined, and can change with new information. Scientific explanations differ fundamentally from those that are not scientific.

2. **Integration of science**. All natural phenomena are interrelated and share basic organizational principles. Scientific explanations obtained from different disciplines should be cohesive and integrated.

3. **Science and society**. The study of science provides explanations that have significant impact on society, including technological advancements, improvement of human life, and better understanding of human and other influences on the earth's environment.

4. **Problem solving and data analysis.** Science relies on empirical data, and such data must be analyzed, interpreted, and generalized in a rigorous manner.

The Life Sciences Learning Outcomes

1. **Levels of organization:** All life shares an organization that is based on molecules and cells and extends to organisms and ecosystems.

2. **Metabolism and homeostasis**: Living things obtain and use energy, and maintain homeostasis via organized chemical reactions known as metabolism.

3. **Genetics and evolution:** Shared genetic processes and evolution by natural selection are universal features of all life.

4. **Ecological interactions:** All organisms, including humans, interact with their environment and other living organisms.

Student Learning Outcomes for 2000-Level and Upper Division Botany courses have changed over time. We now use two major Botany Learning Outcomes, 1) Knowledge and Comprehension, and 2) Skills. Each instructor employs different measures, depending on the course. Many of these courses have lecture and lab components. The assessment results are presented in a similar fashion as with the LS General Education courses, except that the Learning Outcomes assessed are the two listed above adopted by the Botany Department.

Summary of course assessment findings.

LS General Education Courses

At this point, all of our LS General Education courses are a lecture-only format. In all of the General Education courses, students do well on quizzes (many open book and/or multiple attempts) and usually perform well on written assignments, projects, etc. Exam scores are often lower. Overall, Learning Outcomes that involve chemistry (NS2, LS1 and LS2) are more difficult for students to understand, probably because many non-science majors lack a basic chemistry background. Problem solving and data analysis (NS4) are also challenging, as many of our students struggle with math and often need to take developmental math courses. Genetics and Evolution (LS3) are also sometimes a challenge for non-science majors, even on a basic level. Over the last few years, we have incorporated more hands-on group activities in the lecture classes that have helped promote student understanding in these challenging areas.

One thing that seems obvious is that multiple measures of student learning are needed to give a better picture of student success. The Botany Department has realized that many students, especially non-majors, are not good test takers in the scientific realm. Hence, other measures have been employed in all classes and in many sections. Class projects and writing assignments seem to indicate that students understand the concepts and can better express their understanding in these ways, rather than on exams.

BTNY LS 1203 (Plant Biology):

Many of the NS and LS Learning Outcomes are more difficult to grasp without hands-on labs. However, with the incorporation of group and problem-solving activities into lecture periods, there has been an overall improvement in student learning over time. Exam scores have improved. Students seem to do well on quizzes and writing assignments in the sections where these are given.

BTNY LS 1303 (Plants in Human Affairs):

Students who take this course seem to struggle with the material more than those in the other General Education courses. Although hands-on activities have been incorporated into the course, student exam performance has not improved markedly. The few instances where written assignments were used as a second measure for a Learning Outcome, student understanding seemed better than on the exams. The use of quizzes should be implemented to help students review the material. Interest in this course as a face-to-face model has waned in favor of an on-line version. There is discussion within the department of converting this course to an interdisciplinary WSU (LS/SS) General Education course, most likely with the Sociology & Anthropology Department. This would undoubtedly attract more students from a broader audience and would benefit both of the small departments involved.

BTNY LS 1403 (Environment Appreciation):

This course is required in several majors, including a variety of Business majors as well as Construction Management. Being well aware that this is a crucial course for our department, the Botany faculty who teach this course have invested a great deal of thought and time into developing group activities, projects, quizzes, and supplemental assignments (readings, videos, etc.) to help students understand the concepts being taught. Assessment data show that students perform better on quizzes and other assignments, however exam scores have also improved over time. Next year, the department will implement an optional one credit hour lab to accompany this course to further the hands-on learning for those who choose to take it.

2000-Level Courses

BTNY 2104 and BTNY 2114 are lab-based courses required for all Botany majors. Botany 2121 and Botany 2600 are skills-related courses required of all Botany majors. The other 2000-level courses are required for some tracks within the major.

BTNY 2104 (Plant Form and Function):

This is a lab-intensive course with an incorporated lecture component. The same course material is used for all sections and there is great uniformity among sections. Students have several exams with both lecture and lab material covered (lab practical). There is a great deal of material, including challenging topics such as biomolecules, photosynthesis and respiration, genetics, plant anatomy, and plant function. Students are required to complete numerous lab worksheets, many with graphing and data analysis. Students tend to do well on lab worksheets, but struggle a bit with some of the more complex concepts on exams. Hands-on activities have been added to help students better understand genetic concepts. This course has been modified several times over the years and continues to be changed to meet student needs. Quizzes are implemented in some sections, but have not been included in assessment data, however henceforth, quizzes will probably be used as an assessment tool.

BTNY 2114 (Evolutionary Survey of Plants):

Like BTNY 2104, this is a lab-intensive course with an incorporated lecture component. Students have several exams with both lecture and lab material covered (lab practical). This course is in the process of becoming more standardized among sections. The nature of the material covered (prepared slides, prepared and live specimens) lends itself to more independent work by students, although there are also some group activities. Overall, students have done very well on exams, quizzes and oral presentations. In some sections, student lab notebooks are required and graded, rather than just testing students on what they have learned. Some form of graded lab write-ups/ drawings/ notebooks will be implemented henceforth in all sections. Since this course mostly involves comparing evolutionary features of different groups of plants, (rather than conducting experiments), drawings and understanding evolutionary relatedness is crucial.

BTNY 2121 (Career Planning for Botanists):

This course introduces students to different aspects of Botany through guest speakers from various fields within the discipline. Job seeking skills are also taught. This course has recently been modified to delete the draft of the essay that was required for the major's portfolio in BTNY 4980 (Portfolio Summative Assessment). This portion of the portfolio is no longer required since many students do research projects, independently or as part of courses they take.

BTNY 2600 (Laboratory Safety):

This course is cross-listed in five departments and is required for all Botany majors and minors, several other programs within the College of Science (COS), some programs in Criminal Justice (College of Social and Behavior Sciences). Data presented are only for the students registered in Botany sections of the course. This course focusses on laboratory and field safety and therefore, only the Skills Learning Outcome is assessed. Six different measures are used to assess student learning, including closed book exams, open book quizzes, two hands-on activities (conducting a lab audit and using a fire extinguisher to put out a small fire), and two written assignments. Students met the threshold for five of the six measures. The only measure that students struggle with is developing a chemical storage scheme for several lab chemicals, based on Safety Data Sheets. A tour of a well-run

prep room in one of the COS departments will be included in the course henceforth to help students see how chemicals should be stored.

BTNY 2303 (Ethnobotany) and BTNY 2413 (Natural Resource Management):
Both of these courses are required in certain tracks within the majors. Both courses use exams and other assignments (case studies, oral reports, group presentations, etc.) as assessment tools and students do very well in all areas. These courses attract students who are very interested in the topics, which undoubtedly help them learn the material.

Upper Division Courses
Some upper division courses are offered every year, some every other year, and some less frequently depending on enrollment. The only assessed upper division courses offered every semester are BTNY 4980 (Portfolio Summative Assessment) and BTNY 4990 (Seminar in Botany) which are for graduating seniors. Numbers in these courses vary, depending on how many students are graduating in a given semester. Almost all upper division courses include a lab component and many incorporate student research projects (individual or group). Consequently, Botany students engage in undergraduate research, even if they do not choose to do a formal research project (thesis, etc.).

Due to the infrequency of offerings and the recent high faculty turnover, there are many courses assessed only once during this period, often with small numbers of students. Hence, in many of the courses, either 0% or 100% of students met the threshold of learning. The threshold for upper division courses is also quite high (90% of students achieve at least 80%). Overall, in courses where there were more than seven students assessed, students met the learning threshold with the exception of BTNY 4980 (Portfolio Summative Assessment). Students did not meet the threshold, primarily for an extensive essay that was required. The Botany Department has decided that the essay will no longer be required. Recently, the department also decided to restructure BTNY 4980 and BTNY 2121 (Career Planning). (A draft of the essay was also problematic in BTNY 2121). The focus of BTNY 2121 is now preparing students for careers and/or graduate school. BTNY 4980 will require a more limited portfolio and will focus on student capstone projects.

Assessment of Graduating Students
Graduating students complete a capstone class (BTNY 4990 Senior Seminar or BTNY 4970 Botany Thesis) and BTNY 4980 Portfolio Summative Assessment in their last semester. The capstone class requires a public presentation of a student's capstone experience (thesis, individual research, study abroad project, internship project) which is assessed by a department rubric. The various elements of a student's portfolio (Appendix I) are also assessed.

During the review period, ten students completed a botany thesis, eight did an independent research project, and fifteen reported on a co-operative work experience project (out of 28 who enrolled for BTNY 4890, Co-operative Work Experience, credit).

Since our last program review, the following Botany graduates have received the Botanical Society of America Young Botanist Award, a national undergraduate award that recognizes the accomplishments of outstanding graduating seniors in the plant sciences.

2014:
Julia Hull
Taylor Nelson
Molly Sutton

2017:
Makenna Hill
Nicholas Shaw

Standard D - Academic Advising

Advising Strategy and Process

Students who are interested in science who have not declared a major are advised by advisors in the College of Science Academic Advisement Office. When a student indicates an interest in botany or a related area, the science advisors direct that student to the appropriate department.

Initial advising of potential Botany majors and minors begins with a meeting with the department chair. Career interests, graduate school, and future plans are explored to see which of the tracks within the major best meets the needs of the student. Possible electives and complementary minors (Geospatial Analysis, Anthropology, Chemistry, etc.) are also discussed. At this meeting, the student is given a printout of Botany degree requirements and a copy of the GradMap for his/her track. Additionally he or she is shown the CatTracks degree evaluation/planning tool and is informed about general graduation requirements, general education requirements, the portfolio, and capstone experience options. The student is encouraged to explore independent research, thesis projects, paid and volunteer internships, and co-op work experiences.

For ongoing advising, botany majors are assigned to faculty advisors based on their major track. All faculty advisors in botany have been trained on CatTracks, which tracks student degree progress in all degree requirements: major, minor, general education, total credit hours, and upper division credit hours. Each time a student meets with an advisor, the advisor makes a note in CatTracks so that there is a record. Students who are in botany programs other than the major (minors, BIS emphasis) have ongoing advising with the department chair. Students also need to meet with the department chair in order to enroll for co-operative work experience credit or to get permission for course substitutions. Students are reminded to meet with their advisor regularly.

Once students become majors, they take BTNY 2121 (*Career Planning for Botanists*). Here, they are introduced to the student portfolio and begin drafts of certain components of the portfolio. Guest lecturers include the Science Counselor from Career Services, individuals (often alumni) employed locally with various state and federal agencies and botany-oriented businesses, alumni with graduate school experience, Botany faculty, and current majors with internship experience. This gives students many perspectives within Botany.

Informal advising about academics, graduate school, and careers also takes place in classes (especially during down times in lab and field sessions), in conversations with the lab manager, and while students doing projects meet with their mentors.

Most Botany majors join the Botany Club, a WSU registered student organization. This support network is invaluable as students navigate coursework, apply for jobs, form study groups, and establish social ties with like-minded people. Each department in the College of Science has a room in the Tracy Hall Science Center that is set aside for students. Botany students use their room to study, eat, converse, and hold biweekly club meetings.

In order to help students start to build their résumés while in their sophomore to senior years, the faculty and lab manager forward job announcements, especially summer internships, to the Botany Club president who sends them to all members via the club's electronic newsletter and posts the announcements in the majors' room. Students are encouraged to apply for undergraduate research grants through the university's Office of Undergraduate Research and have been hired as student assistants on a variety of grants as well as the 50/50 program through the Provost's office. Majors in their graduating year are encouraged to apply for the CLM Internship through the Chicago Botanic Garden to help transition them into permanent jobs at federal or state agencies.

Effectiveness of Advising

Botany graduates are asked about advising during their graduation exit interview. Students are very satisfied with the formal and informal advising that they have received from the college Advisement Center and faculty (contract and adjunct) and staff in the department.
Indirect evidence of effectiveness includes:

- The majority of botany graduates have done independent research or an undergraduate thesis, have credit for co-operative work experience, or have done a paid internship.
- Students are choosing minors that complement their career goals. This is particularly evident among the Track B graduates who have at least some training if not a minor or certificate in geospatial analysis.

Past Changes and Future Recommendations

All formal advising used to be done by the department chair. One of the recommendations from the last program review was to spread advising among the faculty. Because of the turnover in Botany faculty at that time, this could not be done until new faculty were in place. After the most recent hire completed her first year on the faculty in 2016-17, majors were distributed to the faculty for ongoing advising based on their major track. Although the division was based on the number of majors in each track, faculty with Track B majors seem to have more advising appointments than faculty with majors in the other tracks. We are currently revising the major curriculum with a view toward eliminating the tracks. The method for assignment of advisees will be revised when the new curriculum is in place to make advising loads more equitable.

Standard E - Faculty

Programmatic/Departmental Teaching Standards

The departmental teaching standards are essentially those of the university, as set down in PPM 8-11 (Evaluation of Faculty Members), PPM 9-5 (Faculty Responsibilities to Students), and the College of Science Tenure Document . Opportunities to foster awareness of and adherence to these standards come in various ways. There is constant dialogue, both between individual faculty and in the department as a whole, on how to improve teaching and learning in our courses. All classes taught by

Botany faculty, both contract and adjunct, are required by the department to have syllabi that list the course outline, assignments, grading policies, and other pertinent information. We review all departmental syllabi to check for completeness, offer suggestions to one another, and make sure that various sections of the same course cover similar material. While professors are free to choose content for their courses, the department has broad control over what is taught to ensure that course titles and catalog descriptions match content. We were pleased to discover a high amount of similarity among course sections, and good quality syllabi present for all courses. Furthermore, faculty use a variety of active learning/ high impact practices in their instruction, from think-pair-share to case studies to CUREs (Course-based undergraduate research experience).

All faculty are expected to do the best job possible in their teaching. In hiring decisions, candidates are required to teach one period of a general education class in addition to giving a research seminar. This gives the department a feel for the candidates' teaching style and ability to connect with undergraduate students. Previously demonstrated teaching ability and interactions with WSU students during the interview process are also weighted heavily. In the exit interview with our graduating seniors, many of the questions we ask deal with curriculum issues such as possible improvements or problems in the curriculum, student satisfaction, breadth of training they feel they have received in their major, etc. We feel that this is an excellent way to get feedback on our program and ensure that we are meeting our students' needs. The department advisory board which we established in Fall 2017 has been helpful in confirming and identifying skills that our graduates need.

New hires are told when they interview that the department is teaching-centered, and the bulk of their time will be spent interacting with students in and out of class. We also try to hire like-minded individuals whose primary interest lies in teaching.

All faculty are informed of the university's Policies and Procedures Manual and its importance to guiding the operation of all aspects of the university. In addition, faculty are informed of the College of Science Tenure Document as well as their expectations relative to the teaching standards embedded in the annual review of faculty process.

In summary, the model teacher in the Department of Botany is: knowledgeable and current about the subject matter; enthusiastic about botany, teaching, and students; organized during class; constantly challenging students to apply knowledge in problem solving; one who requires students to go beyond bare facts to consider implications; approachable in and outside of class; innovative; and supportive of students and their activities.

Faculty Qualifications

Name	Rank	PhD Institution, year	Postdoctoral Experience	Pre-WSU Teaching Experience Beyond Graduate School TA
Stephen Clark	Professor	Brigham Young University, Provo, UT, 1980		
Sue Harley (Chair)	Professor	University of California, Santa Cruz, 1983	University of Warwick, Coventry, UK, 1 yr; University of California, Los Angeles, 1 yr; University of Oklahoma, 2 yrs	Visiting Assistant Professor, University of Oklahoma, 2 yrs
Bridget Hilbig	Assistant Professor	University of California, Riverside, 2015	Center for Conservation Biology University of California, Riverside 1 yr	Associate Faculty, Mt. San Jacinto College, 1 semester Adjunct Professor, California State University, San Bernardino, 1 semester
Heather Root	Assistant Professor	Oregon State University, 2011	Oregon State University, 1.5 years	Oregon State University, post-doctoral teaching, 1 semester
Katharina Schramm	Assistant Professor	Friedrich Schiller University, Jena, Germany, 2011	Max Planck Institute for Chemical Ecology, Jena, Germany, 2 yrs; University of Utah, Salt Lake City, Utah, 2 yrs	
Barbara Wachocki	Professor	Wayne State University, Detroit, MI, 1992		

Name	Areas of Expertise	Courses currently taught
Stephen Clark	Plant taxonomy, ethnobotany	Plant Taxonomy, Intermountain Flora, Plant Geography,
Sue Harley (Chair)	Plant physiology, biochemistry, and cell biology	Plant Form and Function, Plant Genetics, Biology of the Plant Cell
Bridget Hilbig	Plant-soil interactions; mycorrhizal fungi; fungal pathogens; invasion ecology	Environment Appreciation, Evolutionary Survey of Plants, Mycology, Soils, Plant Anatomy
Heather Root	Plant ecology, lichenology, disturbance ecology	Environment Appreciation, Natural Resource Management, Plant Ecology, Advanced Statistical Methods, Advanced Field Botany, Career Planning for Botanists
Katharina Schramm	Chemical ecology, plant-insect interactions, phytochemistry, ecology, biochemistry	Plant Biology, Plants in Human Affairs, Ethnobotany, Plant Physiology, Medicinal Plants
Barbara Wachocki	Plant ecology, plant cell culture, plant-microbe interactions	Environment Appreciation, Plant Form and Function, Evolutionary Survey of Plants, Laboratory Safety, Career Planning for Botanists, Cell Culture

Faculty Scholarship

Botany Faculty Scholarship

Publications, 2014-2018

Schmalz JM, **Wachocki B**, Wright M, Zeveloff SI, Skopec MM. 2014. Habitat selection by the pygmy rabbit (*Brachylagus idahoensis*) in northeastern Utah. Western North American Naturalist 74: 456–466.

Root HT, McCune B, Jovan S. 2014. Lichen communities and species indicate climate thresholds in southeast and south-central Alaska, USA. Bryologist 117: 241-252.

Dodson EK, **Root HT**. 2014. Native and exotic plant cover vary inversely along a climate gradient 11 years following stand-replacing wildfire in a dry coniferous forest, Oregon, USA. Global Change Biology

Root HT, Geiser LH, Jovan S, Neitlich P. 2015. Epiphytic macrolichen indication of air quality and climate in interior forested mountains of the Pacific Northwest, USA. Ecological Indicators 53: 95-105.

Root HT, Betts MG. 2015. Managing Moist Temperate Forests for Bioenergy and Biodiversity. Journal of Forestry.

McCune B, **Root HT**. 2015. Origin of the dust bunny distribution in ecological community data. Plant Ecology 5: 645-656.

Skopec MM, Kohl KD, **Schramm K**, Halpert JR, Dearing MD. 2015. Using the specialization framework to determine degree of dietary specialization in an herbivorous woodrat. Journal of Chemical Ecology 41: 1059-68.

Root HT, Dodson EK. 2016. Pssst… pass the algae: succession in lichen soil crusts. Frontiers in Ecology and the Environment 14(8): 451-452.

Hilbig BE, McDonald C, Swanson A, Valliere J. 2016. Hold the Mustard – Field guide to the Mustards of the Mojave Desert. University of California ANR 2016.

Valliere J, **Hilbig BE**, and Allen EB. 2016. Santa Rosa Plateau Habitat Studies and Restoration Program: Working to restore California grasslands through research and education. Grasslands 26(3): 7-10.

Root HT, Verschuyl J, Stokely T, Hammond P, Scherr MA, Betts MG. 2017. Plant diversity enhances moth diversity in an intensive forest management experiment. Ecological Applications 27(1): 134-142.

Miller JE, Villella J, Carey G, Carlberg T, **Root HT**. 2017. Canopy distribution and survey detectability of a rare old-growth forest lichen. Forest Ecology and Management 392: 195-201.

Root HT, Brinda JC, Dodson EK. 2017. Recovery of biological soil crust richness and cover 12–16 years after wildfires in Idaho, USA. Biogeosciences 14(17): 3957-3969.

Jeschke V, Kearney EE, **Schramm K,** Kunert G, Shekhov A, Gershenzon J, Vassão GD. 2017. How Glucosinolates Affect Generalist Lepidopteran Larvae: Growth, Development and Glucosinolate Metabolism. Frontiers in Plant Science 8: 1995.

Zalucki MP, Zalucki JM, Perkins LE, **Schramm K,** Vassão GD, Gershenzon J, Heckel DG. 2017. A Generalist Herbivore Copes with Specialized Plant Defence: the Effects of Induction and Feeding by *Helicoverpa armigera* (Lepidoptera: Noctuidae) Larvae on Intact *Arabidopsis thaliana* (Brassicales) Plants. Journal of Chemical Ecology 43(6): 608-616.

Kitanovic S, Orr T, Spalink D, Cocke G, **Schramm K**, Wilderman R, Halpert J, Dearing MD. 2017. Role of Cytochrome P450 2B Sequence Variation and Gene Copy Number in Facilitating Dietary Specialization in Mammalian Herbivores. Molecular Ecology 27(3): 723-736.

Root HT, Brinda JC, Dodson EK. 2018. Biotic soil crust community composition 12–16 years after wildfires in Idaho, USA. The Bryologist 121(3): 286-296.

Miller JE, **Root HT**, Safford HD. 2018. Altered fire regimes cause long-term lichen diversity losses. Global Change Biology 24(10): 4909-4918.

JM Valliere, Balch S, Bell C, Contreras C, and **Hilbig BE.** 2018. Repeated mowing to restore perennial grasslands invaded by nonnative annual grasses: Upsides and downsides above and below ground. Restoration Ecology https://doi.org/10.1111/rec.12873

Presentations, 2014-2018

Harley SM. 2014. Forgotten Applications of Common Techniques. A poster presented at Botany 2014, the annual meeting of the Botanical Society of America; Boise, ID; July 26 - 30.

Root HT. 2014. Epiphytic macrolichen indication of air quality and climate in interior forested mountains of the Pacific Northwest, USA. A talk presented at Botany 2014, the annual meeting of the Botanical Society of America; Boise, ID; July 26 - 30.

Harley SM. 2015. Introducing the primary research literature via trade books in an introductory botany class. A poster presented at Botany 2015, the annual meeting of the Botanical Society of America; Edmonton, Alberta; July 25 - 29.

Wachocki B, Sondossi M. 2015. Extent of fungal symbiosis *in Halogeton glomeratus*. A poster presented at Botany 2015, the annual meeting of the Botanical Society of America; Edmonton, Alberta; July 25 - 29.

Schramm K, Skopec MM, Cox J, Halpert JR, Dearing MD. 2015. Metabolomics of Juniper detoxification in a generalist and specialist mammalian herbivore. Presented at the Phytochemical Society of North America Annual Meeting 2015, University of Illinois; Urbana-Champaign, IL; August 8- 12.

Geiser L, Jovan S, **Root HT**. 2015. National scale lichen critical loads for nitrogen and sulfur deposition. National Atmospheric Deposition Program Critical Loads of Atmospheric Deposition (NADP), oral seminar; Rochester, NY; October 19.

Clark SL. 2015. Old, New, or In Between: The Indigenous Dilemma. An invited presentation to the IEEE conference on Technologies for Sustainability held at Weber State University; Ogden, UT.

Clark SL. 2015. Taxonomic Studies in *Penstemon leonardii* and **Penstemon** *platyphyllus*. Presented at a meeting of the Weber State University chapter of Sigma Xi; Ogden, UT.

Clark SL. 2015. Mechanics of Plant Evolution: The Origin of a New Species in the Wasatch Mountains. Presented at the International Darwin Day Celebration, Weber State University; Ogden, UT.

Clark SL. 2016. Present research on *Scirpus* at the Utah Academy of Sciences, Arts and Letters Conference Annual Conference held at Westminster College; Salt Lake City, UT; March 10.

Clark SL. 2016. From the Sacred to the Mundane, Governors Native American Summit, UVU; Orem, Utah.

Clark SL. 2016. Keynote speaker for the Weber State University Chapter of the National Society of Collegiate Scholars; Ogden, UT.

Schramm K, Orr T, Skopec MM, Kitanovic S, Wilderman PR, Halpert JR, Dearing MD. 2017. Juniper specialists excel a enzymatic α-pinene metabolism compared to generalist woodrats. A poster presented at Gordon Research Conference on Plant-Herbivore Interactions 2017; Ventura Beach, CA; Feb 12 - 17.

Harley SM, Domek M, Trask B. 2017. When Three Departments Try to Design a Class . . . A poster presented at NW-PULSE @ Northwest Biology Instructors Conference 2017; Tacoma, WA; May 4-6.

Hilbig BE. 2017. Enhancing arbuscular mycorrhizal fungi communities to improve drought tolerance in rooftop gardens. Oral presentation at the iUTAH Annual Symposium & Summer All-Hands Meeting; Logan, Utah; July 13-14.

Hilbig BE. 2017. Enhancing arbuscular mycorrhizal fungi communities to improve drought tolerance in rooftop gardens. Poster presentation at the International Conference on Mycorrhizas; Prague Czech Republic; July 30-Aug 4.

Root HT. 2018. Post-fire recovery in western ecosystems. Invited Oral Presentation at Utah State University's Department of Wildland Resources seminar series; Logan, UT; March 28.

Hilbig BE. 2018. Exploring soil biological complexity across different urban agroecosystems on the Wasatch Front. Poster presentation at the Ecology of Soil Microorganisms; Helsinki Finland, June 17-21.

Mentoring Activities

Weber State University students, Thesis and Individual Research Projects, 2014-2018

Shannon Call. 2014. Edge effect on mycorrhizal infection occurrence in *Gutierrezia sarothrae* (Asteraceae). Botany Thesis. (Barb Wachocki)

Julia Hull. 2014. Co-occurrence of fungal endophytes and gall-forming aphids on hybrid cottonwood trees. Botany Thesis, funded by OUR. (Ron Deckert)

Vanesa Martinez. 2014. Antimicrobial properties of *Penstemon cyananthus*. Individual Research, funded by OUR. (Sue Harley)

Taylor Nelson. 2014. Taxonomic Elucidation of *Arnica* via PCR. Individual Research, funded by OUR. (Sue Harley)

Molly Sutton. 2014. Tamarisk removal in the Grand Canyon: a follow-up biological opinion survey. Botany Thesis. (Barb Wachocki)

Ronnamay Walker. 2014. Native ground covers to manage invasive weed growth during river restorations. Botany Thesis. (Barb Wachocki)

Ryan Wall. 2014. Analysis of high-affinity potassium transporters subfamily 1 involved in salinity tolerance in halophytes native to the Great Salt Lake ecosystem. Individual Research, funded by OUR. (Sue Harley)

Jacob Bernhard. 2015. Antimicrobial effects of slippery elm. Individual Research, funded by OUR. (Sue Harley)

Heather Gardner. 2015. Ecology of the rare plant *Astragalus kelseyae*. Botany Thesis. (Heather Root)

Matthew Haithcock. 2016. Lichen bioindication of air quality in Ogden. Botany Thesis. (Heather Root)

Jared Higgs. 2016. Comparison of different populations of *Ferocactus* in central and southern Utah. Individual Research. (Sue Harley)

Karl Lye. 2015. Correlation between deciduous trees changing leaf color and aphid colonization. Individual Research, funded by OUR. (Sue Harley)

Nicholas Shaw. 2016. Kin relationships with ectomycorrhizal fungi. Individual Research, funded by OUR. (Heather Root)

Arusa Ashfaq. 2018. Antimicrobial Effects of *Ephedra viridis* as a Herbal Tea. Individual Research, funded by OUR. (Kat Schramm)

Jake Eiting. 2018. *Solanum lycopersicum* L. Response to Herbivory Under Three Different Mycorrhizal Associations. Honors Thesis, funded by OUR. (Bridget Hilbig)

Spencer Owen. 2018. Inhibition of pumpkin ATPases via general and natural anesthetics. Botany Thesis, funded by OUR. (Sue Harley)

Kristian Valles. 2018. Digitization and imaging of bryophyte collection at Weber State University. Botany Thesis, funded by OUR. (Sue Harley)

Kaliegh Walther. 2018. Effects of *Betula* and *Tortula* on Soil Microbial Communities. Botany Thesis, funded by OUR. (Bridget Hilbig)

Middle school and high school students, 2014-2018

Mount Ogden Middle School. 2014. Science fair project. (Sue Harley)

Ogden High School. 2015. International Baccalaureate project. (Sue Harley)

Mount Ogden Middle School. 2015. Science fair project. (Sue Harley)

Ogden High School. 2016. Science fair project. (Sue Harley)

West Point Jr. High. 2017. STEM fair project. (Sonya Welsh)

Ogden High School. 2018. Biology class project. (Sonya Welsh)

St. Joseph's Grade School. 2018. Science fair project. (Sue Harley)

Ogden Preparatory Academy. 2018. Science fair project. (Sonya Welsh)

Diversity of Faculty

Of the six contract faculty, five are women. Faculty come from California, Michigan, Pennsylvania, Utah, Vermont, and Germany. Ethnically, one is part Native American, and one is part Hispanic.

Ongoing Review and Professional Development

a. Ongoing Review

Contract Faculty

1. Contract faculty are evaluated annually by the Botany Department Chair with regards to teaching, scholarship and service. The evaluation is then reviewed by the Dean in order to assist the faculty in the improvement of teaching, scholarly activities, service, and in the determination of merit pay (when available). The annual reviews are also used for the post-tenure review process (below). Tenure-track faculty undergo an assessment of progress toward tenure by the department chair in their second year. They undergo a full interim review (peer review of teaching, department rank and tenure committee, college rank and tenure committee, and dean) in their third year and a final review for tenure and promotion to associate professor in the sixth year. Associate professors are eligible to request review for promotion to Professor after five years. A post-tenure review process which uses the collected annual reports occurs every five years for faculty who have achieved tenure. Review for promotion to full professor can substitute for the first post-tenure review cycle.
2. The department chair visits classes taught by tenure-track faculty during their probationary period to provide feedback on implementation of instructional strategies.
3. Tenured faculty are required to have at least two written student evaluations conducted per academic year. The faculty member chooses student evaluations from two courses per year to be included with his/her annual review. Non-tenured, tenure-track faculty must provide written student evaluations for each course taught each semester. Summaries are made by the faculty of these evaluations and are used for tenure and promotion decisions.
4. Graduating seniors are surveyed and asked to point out the strengths and weaknesses they perceive in the department. These are discussed by the departmental faculty and evaluated in terms of improving the department.

Adjunct Faculty

1. Student evaluations from every course taught are reviewed by the department chair who discusses the results with the faculty.
2. The department chair visits classes taught by adjunct faculty to provide feedback on implementation of instructional strategies.
3. Adjunct faculty are encouraged to self-assess their pedagogical methods and discuss these with other faculty.
4. Adjunct faculty are encouraged to attend campus workshops (Teaching and Learning and Forum, etc.) and courses/training (Training Tracker).

5. Adjunct faculty are encouraged to attend workshops designed for adjuncts offered throughout the academic year that are aimed to improve instruction and communication with various campus entities.

b. Professional Development

The Botany faculty are actively involved in professional development activities including laboratory and/or field research, grant writing, teaching improvements, conferences/workshops, professional presentations, consulting, etc., which are supported through departmental, institutional, and external funding sources.

Contract Faculty

1. Faculty are encouraged to attend seminars/workshops that are available on teaching strategies, presentation technologies, assessment, etc. offered through a variety of sources on campus (e.g. Teaching and Learning Forum, etc.).

2. Faculty are encouraged to attend and participate in professional meetings/conferences related to professional development in teaching or their area of expertise in order to remain current.

3. Funding (at least partial) for travel and registration fees for professional meetings/conferences is available through the department, other university sources, or grants.

Adjunct Faculty

1. Adjunct Faculty are encouraged to attend seminars/workshops that are available on teaching strategies, presentation technologies, assessment, etc. offered through a variety of sources on campus (e.g. Teaching and Learning Forum, etc.).

Evidence of Effective Instruction

Until Spring 2018, classes taught by all faculty (contract and adjunct) were assessed by students with the following instrument:

1. How do you rate the agreement between course objectives and topic coverage?
2. How do you rate the organization and use of class periods?
3. Were the teaching methods and techniques effective for you?
4. Does the instructor stimulate and challenge you to think and to question?
5. How interested is the instructor in helping you to understand the subject being taught?
6. How receptive is the instructor to questions and/or discussion during class?
7. How would you rate the fairness and effectiveness of the grading policies and procedures?
8. How would you rate the interest of the instructor in the teaching of this course?
9. Considering all the above items, what is your overall rating of this instructor?
10. How would you rate this instructor in comparison with all others you have had at the university?
11. Overall, what is your evaluation of this course?
12. Has this course influenced you to take another botany course?

13. Has this course changed the way you view the natural world?
Question 14. Please write comment below.
From Fall 2014-Fall 2017, the average student response to all questions across all classes was 5.57 on a 1-7 scale, with 1 defined as "extremely poor" and 7 defined as "excellent." Only question 12 had an average response below 5 (4.74). The highest average response was to question 8 (6.06). On average, 257 students filled out the evaluation survey in ChiTester each semester. Overall, students find that their courses taught well by the Botany faculty.

In Spring 2018, we changed the evaluation instrument to give students direction with the open ended comment question at the end of the survey and focus on questions that give useful feedback to faculty. The new survey instrument is:
1. The instructor made explanations clear and emphasized key points.
2. The instructor related course material to current scientific knowledge and societal issues.
3. The instructor provided opportunities to ask questions in class.
4. The instructor was approachable and accessible to help me with my questions.
5. Grading criteria were explained and followed.
6. The course content was presented in an engaging manner that encouraged class participation and discussion.
7. The instructor stimulated and challenged you to think and to question.
8. Which learning materials were the most useful in understanding course concepts? (textbook and/or other materials such as homework, videos, and activities)
9. If the course had an associated lab that you took at the same time, how did the lab help or hinder your understanding of the material? Which specific lab would you change and how?
10. What was effective about this course?
11. How could this course be improved?
12. What grade do you anticipate receiving in this course?
The average student response to all questions across all classes for Spring 2018 was 1.69 on a 1-6 scale, with 1 defined as "strongly agree" and 6 defined as "strongly disagree." The scores ranged from 1.41 (question 2) to 1.82 (questions 6). That semester, 275 students filled out the evaluation survey in ChiTester. The student satisfaction shown in the new survey is equivalent to what we saw with the old one.

Botany faculty, whether contract or adjunct, incorporate a variety of high-impact learning practices in their classes. Examples include:

- Two faculty piloted Signature Assignments in Environment Appreciation (BTNY LS 1403), a general education class required by the Goddard School and several programs in EAST
- Case studies are used regularly in classes such as Environment Appreciation (BTNY LS 1403), Plant Form and Function (BTNY 2104, the introductory course for majors), Evolutionary Survey of Plants (BTNY 2114), Introduction to Natural Resource Management (BTNY 2413), and Plant Ecology (BTNY 3454).
- The face-to-face section of Plants in Human Affairs (BTNY LS 1303) is a CEL class.
- Students in Ethnobotany (BTNY 2303) plan a research expedition to learn about local uses of plants from indigenous peoples and present their plans to the class.
- Soils (BTNY 3214) and Plant Ecology (BTNY 3454) have experiences in which students apply techniques learned in the classroom and laboratory in the context of a field research project.
- Advanced Field Botany (BTNY 4950) requires each student to do an individual research project plus a report addressing a local field botany problem as well as contribute to a class research

project in partnership with the USGS at the Canyonlands Research Center, at the end of which the class turns its data over to the USGS.

- Course-based undergraduate research experience (CURE): Students in Mycology (BTNY 3504) participated in scientific discussions of the primary research literature and then designed and carried out their own laboratory research projects on mycoremediation.
- A variable title topics class on plant-soil feedbacks (BTNY 4750) had students take turns being discussion leaders (four times each) as they explored the primary research literature on the topic.

From the comments on the open ended questions on the course evaluation instruments, students appreciate the active learning activities.

At various times, all faculty have mentored undergraduate research projects, many of which received funding from the WSU Office of Undergraduate Research (see mentoring activities listed above) . From Fall 2014-Fall 2018, 34 students have received credit for co-operative work experience. Experiences that involved interaction with the community are in Standard G and Appendix E.

Interdisciplinary activities included three faculty teaching in the Honors Program in 2016-18. Mycology and Soils attract students from Microbiology and Geosciences, respectively. The department offers 11 courses that are related to sustainability.

Instructional effectiveness is assessed yearly for all general education courses and the two 2000-level introductory foundational courses for the major. Upper division courses are assessed on a rotating sequence. The details of assessment of instructional effectiveness are in Standard B.

i. Regular Faculty

The main tool we use to determine the quality of teaching is through faculty self-reports of teaching practices and training (course innovations, workshops, etc.), peer evaluation of faculty during tenure and promotion reviews which includes classroom visits, and the student course evaluations described above. The department chair tries to visit at least one class meeting of all classes taught by junior faculty. While tenured faculty are required by the university to be evaluated in a minimum of two courses per year, most have students evaluate them in every course they teach, which is the requirement for non-tenured, tenure-track faculty. The department chair and the individual faculty member review the evaluations, and discuss them in the annual review of the faculty. We get some information about the quality of our teaching from our graduating seniors during their exit survey. Each faculty member is evaluated during the tenure and promotion process, and a teaching portfolio documenting the quality of instruction is part of the peer review process. The University Policies and Procedures Manual specifies that teaching is the primary responsibility of WSU faculty and gives guidelines on how evaluations of teaching quality are to be made by the department chair, dean of the college, etc.

ii. Adjunct Faculty

Student evaluations from every course taught are reviewed by the department chair who discusses the results with the faculty member. Most of our adjuncts have taught for the department for a number of years and have high teaching evaluations from students. The department chair visits random class meetings of classes taught by adjuncts and reviews selected course materials (syllabus, active learning practices, quizzes, etc.).

Standard F – Program Support
Support Staff, Administration, Facilities, Equipment, and Library

Adequacy of Staff
Currently, the department has one full-time Exempt Staff (Laboratory Manager) and one half-time Non-exempt Staff (Administrative Assistant). Both, because of their competence, training, and experience, have been indispensable to the operation of our program. With the department chair, the staff form the department Green Team.

Our Lab Manager was hired in Summer 2011. She graduated in 2008 from our department with a B.S in Botany and minors in Chemistry and Geosciences. She then received her M.S. at Utah State University in the Department of Watershed Sciences with a focus on ecogeomorhphology and ecology; she is also experienced in GIS. She is extremely proficient in all aspects of the job and has a pesticide applicator's license. Her organizational skills were on full display when she coordinated the orderly move of our laboratories and greenhouse from the Science Lab Building to the Tracy Hall Science Center in the summer of 2016. She is an invaluable resource to both faculty and students. In addition to her many duties as Laboratory Manager she is very familiar with our program and provides students with current information on job openings, graduate schools, and a sympathetic ear when needed. She also trains and oversees the work-study students who assist in the laboratory and greenhouse. She assists our Botany Club in its activities and fund-raisers (such as plant propagation and sales, programming for the biannual plant sale) and has taken an active role in recruitment activities (Career Day, Major Fest, Science Saturday, etc.). Her position and personality provide an important liaison between the students and faculty. A very important aspect of her position is that, with the exception of office supplies, she does all of the purchasing for the department She works with our Administrative Assistant to track expenditures from a variety of funding sources, including E&G money, course fees, and faculty grants.

Our Administrative Assistant was hired in Fall 2013. The Administrative Assistant's role has become more complex over time and includes mastering changing centralized computing systems and complex budget tracking. In conjunction with the budget, as noted above, she works with our laboratory manager to track spending and ensures that reallocations are completed. Furthermore, she is the reconciler for anyone in the department (except the department chair) with a P-card as well as reconciling the card for an administrative specialist in another COS department. Course scheduling is a large project each semester and includes inputting the schedule, coordinating with other departments as well as Continuing Education, room scheduling during times of competing needs (which has become more complicated with the loss of our assigned 80 seat classroom in Lind Lecture), and ordering books for all courses. She has learned and implemented a new computer program that automates professor and room scheduling within the department, reducing the need for handwritten documents and greatly reducing the possibility of error. Providing faculty support, administrative report preparation, student registration problem-solving, and inputting major and minor declarations are other duties. Communications with various public entities is ongoing and includes writing and sending out the department newsletter. She is the captain of the department Green Team and led the team to becoming a green certified department in just seven months, to date the fastest department on campus to achieve this certification. In addition, the need to maintain

assessment records, track majors and minors, address recruitment and retention of students, and efforts to maintain contact with alumni has intensified.

Other staff:
The department hires 2-3 work study students each semester to assist with laboratory course support and greenhouse work. A 50-50 student is hired as an herbarium assistant. Some students are hired through the 50-50 program for research assistant jobs that are available through faculty grants. On occasion we hire undergraduate teaching assistants (through the 50-50 program) for certain courses like Advanced Field Botany and Mycology.

The department shares an hourly lab manager/greenhouse and garden manager with the Department of Athletic Training and Nutrition to support courses offered at the Davis campus.

The Dean's office has recently made a "floater" office assistant available to the departments. We have not yet had the need to take advantage of this extra pair of hands, but we are relieved to know that additional office help is available given the half-time status of the administrative assistant.

A dedicated computing support person for the college faculty and staff is provided by the College of Science.

Ongoing Staff Development

Exempt Staff (Laboratory Manager):
Initial orientation and training includes:

- tours of the campus, Tracy Hall Science Center, the Botany laboratories, and the greenhouse facility
- basic instruction on laboratory safety, chemical and waste storage, etc. within the department
- Training Tracker courses on university systems and procedures the lab manager needs to be familiar with in order to do the job
- information on university support services

Ongoing staff development includes:

- discussions of greenhouse matters with the faculty
- asking questions of the faculty and staff and receiving feedback on general or specific job-related issues
- updated pesticide applicator training and licensure provided through the local ATC
- a comprehensive *"job description"* which outlines the duties of the laboratory manager. She is encouraged to ask questions as they arise. She is instructed to keep a list of duties not included in the *"job description"* that develop to be included in the next iteration of the job description.
- relevant Trainer Tracker courses for new or updated systems and procedures
- development opportunities and plans drawn up as part of the annual Performance Review and Enrichment Program (PREP). These involve goal setting and strategies for achieving those goals that include resources.

Non-exempt Staff (Administrative Assistant):

Initial orientation and training includes:

- tours of the campus, Tracy Hall Science Center, and the Botany laboratories and greenhouse
- introduction to other staff in the college
- Training Tracker courses on university systems and procedures the administrative assistant needs to be familiar with in order to do the job
- information on university support services

Ongoing staff development includes:

- relevant Trainer Tracker courses for new or updated systems and procedures
- external workshops, etc.
- development opportunities and plans drawn up as part of the annual Performance Review and Enrichment Program (PREP). These involve goal setting and strategies for achieving those goals that include resources.

Adequacy of Administrative Support

Except for times when budget cuts are incurred due to university enrollment shortfalls and various external economic factors that affect state funding, the budget for the department had been adequate. The principal source of support is legislative appropriations and its E & G budget allocation. Tuition and state appropriations, grants (both internal and external), donations, and laboratory fees are currently sufficient to cover the cost of operation. We were approved for an average 25% increase in course fees when our fees were reviewed in Fall 2018, the first fee increase since at least 2010. Overall, moneys available to the department are generally deemed adequate since occasional special funding through either grants, special legislative appropriations for technology enhancement, or private donations have been made available for equipment purchases outside the capability of the current expense budget. Of particular note is the money we received from donations to the college during the campaign for the Tracy Hall Science Center to purchase new equipment when we moved. We have hired three tenure-track faculty, and each received two years of start-up funds from the college.

Adequacy of Facilities and Equipment

Tracy Hall Science Center

The College of Science moved into the Tracy Hall Science Center (TY) in Summer 2016. The Botany Department lost one teaching lab room but gained several facilities that we had not had before.

TY 351 and TY 354

TY 351 and TY 354 are the two rooms that most majors classes are held in, with lower division classes using TY 354 and upper division in TY 351. Both have moveable benches that are configured for 24 students and state of the art AV/computing equipment (computer, projector, document camera, Blu-Ray player, etc.) that is maintained by university computing support. There is storage available in each room to hold the equipment and supplies that are needed for the scheduled classes. The prep lab is conveniently located between the two lab classrooms and easily accessed through connecting doors. Large equipment in TY351 includes a 6-ft wide laminar flow hood, benchtop growth chamber,

drying oven, and muffle oven. Large equipment in TY 354 includes an incubator and benchtop growth chamber. Both rooms have snorkels to vent chemical fumes. With the Tracy Hall funds, we were able to purchase new microscopes, and each room has sufficient compound light microscopes and dissecting microscopes so that students do not have to share. In addition to the student microscopes, there are a few teaching microscopes that are equipped with digital cameras that can be connected to the classroom AV system via HDMI. There are also six phase contrast microscopes in TY 351 that were purchased in 2008. The prep room has a 3-ft wide fume hood and proper storage cabinets for flammables and corrosives. There is adequate work space for prepping labs and storing equipment and supplies needed to do the prep work and clean up.

TY 350
TY 350 is a teaching lab for the classes that need a chemistry-type lab setup. There are three 6-ft fume hoods. The room has equipment for various electrophoresis and chromatography techniques, a microplate reader, spectrophotometers, microcentrifuges, and a rotary evaporator.

Faculty Research Labs
There are two faculty research labs, TY 349 and TY 347. TY 349 is set up for cell and molecular biology-related investigations. Equipment includes a 6-ft fume hood, a 6-ft laminar flow hood, a thermocycler, UV-Vis spectrophotomer, and a refrigerated centrifuge. The room connects to TY 350 for access to equipment that is shared between teaching and research activities, such as a nanodrop reader. TY 347 is for field-related research. It has storage space for plant presses. Two of the faculty using the room focus on microscopic organisms, so there are camera-equipped microscopes purchased with either grant money or their start-up funds. There is also a 3-ft laminar flow hood and a storage cabinet for flammable chemicals.

Controlled Environment Chambers
TY 139 was designed to house controlled environment chambers. There are four there now. One was moved from the Science Lab Building; the other three were purchased from the new equipment funds that were raised for TY.

Other Equipment
The college has an environmental scanning electron microscope. It has been used by people in the Botany Department for some student research projects and by students in Plant Anatomy. The college recently purchased (Summer 2018) a confocal microscope. While it has not yet been used for research projects in the department, the Fall 2018 Plant Anatomy class used it for their CURE project on fire damage to tracheary elements of forest trees. A common equipment room on the fourth floor of TY has high speed refrigerated centrifuges and an ultracentrifuge that have been used for faculty and student research. A UPLC housed in the Chemistry Department is shared with Botany.

The College of Science has made a commitment to replacing faculty computers on a four-year cycle. Faculty are offered a choice between a desktop and a laptop computer. Other computers in the department are replaced on an as needed basis from E&G funds.

Greenhouse
The greenhouse facility has three glasshouses set to tropical, temperate, and xeric growing conditions. The headhouse is a marked improvement over the space we had in Science Lab. It is much larger, there is more storage space, and we finally have a work table – and it is huge.

Mary Carver Hall Herbarium
The herbarium houses over 25,000 specimens, mostly representing the flora of Northern Utah and collections dealing with the ethnobotany of the Great Basin. We expect the collection to increase with the hire of a new plant taxonomist and herbarium curator after the retirement of Stephen Clark in June 2019. We purchased three additional herbarium cabinets when we moved to TY, but we are concerned about having sufficient storage space in the future. Installation of compacter units would give us additional space for more cabinets. There are grants that we can apply for that provide funds to small herbaria. In addition to the collection of vascular plants, there are about 2,000 moss species that were donated in the 1970s. The collection represents every moss known in Utah at the time the collection was made in the 1950s. A thesis student is currently curating this collection and putting it online as an herbarium digitization pilot project. This will give the herbarium an online presence when we begin advertising for the taxonomist/curator position.

Lind Lecture Hall
Because there are only two large classrooms (~65 seats) in TY, the COS departments have continued to use their allocated lecture halls in Lind Lecture Hall, adjacent to the Science Lab Building. When NUAMES (Northern Utah Academy for Math, Engineering, and Science; a charter high school associated with the WSU Davis campus) opened its second campus in Ogden in Fall 2018, Botany was one of three departments to lose a total of four large lecture rooms (80-160 seats each) in Lind. The two 65-seat rooms in TY are assigned among the departments after semester scheduling is completed. Consequently, departments need to have spaces for high enrollment classes in advance of requesting rooms in TY. With the loss of four rooms in Lind, three departments (Botany, Chemistry, and Microbiology) are now in a scheduling bind and scrambling for time slots available in Lind rooms assigned to other COS departments after those departments complete their schedules. Botany has occasionally used room 120 in the Kimball Arts Building, which was designed for large public events, because the layout of the room can be arranged for active learning strategies in our general education classes. The fate of Lind after NUAMES moves to a yet to be designed building is unknown. In any case, it is difficult to bring demonstration materials to and from classes in buildings that are some distance from TY.

Adequacy of Library Resources
Library resources are sufficient for our purposes. The COS has a library representative who is exceptionally helpful and efficient. She holds library assistance hours in TY to reach students where they are and is available to come to classes to give instruction on information seeking and evaluation skills. She notifies us when there is money available and facilitates the purchases of books, digital materials, etc. Electronic journals and databases are easily available via the internet. The interlibrary loan system is fast and efficient.

Standard G - Relationships with External Communities

Description of Role in External Communities
The Botany Department faculty, staff, and students are involved with the local community through K-12 outreach, science fairs, working with government agencies and local organizations, and internships/cooperative work experience. For mentoring of junior and senior high school students, see **Standard E - Faculty.**

External Community	Faculty and Staff Role	Dates
US Army Corps of Engineers	Stephen Clark, consultant	2013-16
Utah State Division of Wildlife Resources	Stephen Clark, consultant	2013-16
Trapper Trails Council, Boy Scouts of America	Stephen Clark. Executive Committee member and badge counselor	2013-2015
Ritchey Science & Engineering Fair	Sue Harley, Sonya Welsh & Barb Wachocki. Judges, category captains	2013 – ongoing
Ritchey Science Fair Committee & Advisory Board	Barb Wachocki, member	2013 - ongoing
Mount Ogden Junior High Science Fair	Barb Wachocki, judge	2013-2015
Weber Pathways	Heather Root, Hike Leader. Sonya Welsh, Science Hike coordinator	2014-2016
Ritchey ISEF (International Science and Engineering Fair) Committee	Barb Wachocki, member. Travels to ISEF with winners of Ritchey S&EF as chaperone and mentor	2015-ongoing
ISEF (International Science and Engineering Fair)	Barb Wachocki, Plant Sciences Category Judge in Los Angeles and Phoenix	2016-2017
Barker Park: Garden Projects, North Ogden	Kat Schramm, consultant	2016
Ritchey Science Fair Acting Director	Barb Wachocki	Spring 2017
Summit Land Conservancy, Park City	Bridget Hilbig, consultant	2018-ongoing
DaVinci Academy Curriculum Board, Ogden	Sonya Welsh, member	2018-2019
Ogden City Urban Forestry Advisory Committee	Heather Root, board member	2014-2018

Student interactions with external communities

BTNY 3214, Soils
Since 2015, Dr. Root has had a community service requirement in the soils class. The service projects to date have been:
Borski Farm, Dr. Root & the Soils class, service projects 2015-2018
Boy Scouts of America, students in the Soils class, service projects 2015-2018
Ogden Nature Center, students in Soils class, service project 2016
Weber County Pathways, students in Soils class, service project 2017
Hogle Zoo, students in Soils class, service project 2017
Girl Scouts, students in the Soils class, service projects, 2017-2018
Weber Children's School preschool, students in Soils class, service projects 2017-2018
Polk Elementary School 6th grade, students in the Soils class, service projects 2018
Green Team Farm, students in Soils class, service projects 2018
Davis Elementary 4th grade, students in Soils class, service projects 2018

BTNY 4950, Advanced Field Botany
During their extended field trip to the Canyonlands Research Center, the students do a class research project in partnership with the USGS, at the end of which the class turns its data over to the USGS.

BTNY 4890, Co-operative Work Experience

Tani Hatch	Cactus and Tropicals. Experience with propagation and care of succulents and tropical plants. Interaction with the public on how best to care for their plants.	Fall 2015
Kayleb Boyko	Arborist training with WSU landscaping crew	Spring 2016
Gage Watts	Applied knowledge of local flora and fauna and GIS in work with the state Division of Wildlife Resources	Fall 2016
Arica Scheetz	Learned new survey methods and applied knowledge of GIS in survey work in the Upper Columbia River Basin for the US Forest Service	Fall 2016
Makenna Hill	Applied her new found knowledge of tropical flora (obtained from Round River experience in Costa Rica) to her work at Cactus and Tropicals in Salt Lake City	Fall 2016
Kris Valles	Utah Natural Heritage Program. Experience working with state and federal regulations regarding endemic, rare, and endangered plant species in Utah.	Fall 2016
Jared Higgs	Propagated and prepared individualized care instructions for the various cacti and succulents in the Botany Dept greenhouse. Propagated and prepared individualized care instructions for arums in the Botany Dept greenhouse.	Summer2017
Dorian Libby	US Forest Service Ogden Ranger District. Experience applying taxonomic skills and GIS mapping while doing vegetation surveys in the Uinta Wasatch Cache National Forest.	Summer 2017

Grayson Hodge	Borski Farms. Learning and practicing techniques associated with sustainable agriculture.	Summer 2017
Taylor Warren	Red Butte Garden. Learning and practicing techniques for identification, propagation, and care of succulents and woody plants.	Summer 2017
Gage Watts	Field work with the Utah Division of Wildlife. Learned various field methods and how a government agency works.	Fall 2017
Morgan Brown	Borski Farms. Learning and practicing techniques associated with sustainable agriculture.	Summer 2018
Alexis Sullivan	Learned and applied techniques about sustainable urban farming at Green Urban Lunchbox.	Summer 2018
Alexis Sullivan	Learned and applied techniques for studying arbuscular mycorrhizal fungi with Dr. Bridget Hilbig.	Summer 2018
Monica Connors	Created a garden and worked with students on nutrition at Waypoint Academy.	Summer 2018
Evelyn Linford	Designed scavenger hunts for grades K-5 and grades 6-12 field trip groups that visit the WSU herbarium.	Fall 2018

Summary of External Advisory Committee Minutes

Botany Advisory Board Meeting Summary, Friday, December 1, 2017
The advisory board met for the first time. The department chair, Sue Harley, explained the purpose of the board. Faculty and board members introduced themselves. Dr. Harley went over the Botany program and current challenges. The board charter was approved and the board officers were elected.

Botany Advisory Board Meeting Summary, Friday, April 13, 2018
After the welcome and approval of minutes from the December 2017 meeting three botany majors discussed their experiences in botany as an active member of botany club, a student conducting OUR funded research and the Round River scholarship awardee. We discussed and listed the hard and soft skills our graduates should have for entry level jobs in various fields of botany. A plan was made for providing supporting documentation to our dean to illustrate the importance of filling the vacancy of a plant taxonomist that will result when Dr. Clark retires in spring 2019. The board explored the issue of a general biology class, an A.S. Biology degree, and various certificates that could be offered. The Department of Botany will undergo a program review spring 2019. A self-study will be conducted and written fall 2018.

Botany Advisory Board Meeting Summary, Friday, December 2, 2018
After the welcome and approval of minutes from the April 2018 meeting, Kris Valles gave a report on the pilot herbarium digitization project, the mosses collected by LeRoy Behling in the 1950s. Jeff Colbert, representing the students in the Plant Anatomy class, gave a report on their class project on fire damage to wood anatomy that used the college's new confocal microscope. The new Botany major learning outcomes and curriculum map were also presented to the board. The board discussed a possible certificate program in Field Botany and possible department name change to Botany and Plant Ecology. The composition of the Botany Program Review Team was announced.

Community and Graduate Success

A number of Botany graduates are known to currently work or have worked in northern Utah at the following organizations:
Red Butte Garden (University of Utah) – 6
Residency at the University of Utah Hospital - 1
Weber State University – 4
Utah State Division of Wildlife Resources - 1
Utah State Division of Natural Resources - 1
Antelope Island State Park – 1
Teaching K-12 – 11
Local non-profit conservation organizations – 3
Local natural products industry – 7
Local analytical and molecular biology labs – 4
Weber Basin Water District - 1
US Forest Service – 1
US Geological Survey – 1
Independent contract work doing floristic surveys – 4
Owner and operator of a local business in a botany-related field - 3

Four alumni are adjunct instructors at WSU, and three others have taught adjunct in the past. Three alumni teach community education classes through WSU and two through the University of Utah.

Standard H – Program Summary

Results of Previous Program Reviews

Recommendations from the 2012-2013 Program Review

At the time of the last review, we were down to four contract faculty due to retirements and a university hiring freeze during the recession. When the hiring freeze was lifted, we hired a plant ecologist with an extensive background in statistics in 2014 and a natural products chemist/chemical ecologist in 2015. Following the unexpected medical retirement of our mycologist and plant anatomist, we had a third hire in 2016. With the 2016 hire of a new mycologist, we are now at six full time contract faculty, which is the minimum staffing that was recommended for us in the 2012-13 review as well as in 2007-2008. However, due to the 50% turnover in faculty since our last review along with the time needed for the new faculty to settle into their positions, it is only in the last year and a half or so that we have been really able to address the recommendations from the 2012-13 review.

1. Standard A. Mission Statement.

--The Department is meeting guidelines, but we recommend they develop a strategic plan which will aid in guiding new faculty hires and restructuring the curriculum.

We made the three hires based on maintaining our strength in field and organismal botany and expanding expertise in phytochemistry to support the Pre-Natural Medicine program. Our taxonomist and herbarium curator, Dr. Clark, will retire at the end of the 2018-19 academic year. It is critical that we be able to replace him so that we continue our strength in training field botanists with knowledge of the flora of the Intermountain West and maintain an important regional herbarium.

We put together a strategic three year plan in conjunction with our annual review in May 2018. The plan addresses seven areas of concern in Academic Affairs that have been articulated by the Provost:
A. Identify new opportunities the program might pursue
B. Agree on emerging areas it might develop
C. Explore interdisciplinary work it might might engage in
D. Decide on courses or degrees that can be eliminated, pruned, or revised to allow pursuit of other endeavors and keep workloads reasonable
E. Collaborate with non-academic partners
F. Come to consensus on the challenges and/or limitations that the program confronts and ways of addressing them.
G. Improve student success, program productivity, and/or student efficiency

With the new faculty gaining better familiarity with the curriculum, both from teaching it and advising students about it, we are now in a position to address curriculum issues (see below).

2. Standard B. Curriculum.

--The Department should carefully reassess the curriculum in terms of serving both botany majors and general education .

-***Majors.***

--Additional research should be done to insure that the proposed pre-natural medicine Track A option meets the specific requirements and expectations of existing programs in natural medicine.

--- The core curriculum for the major should be standardized for each track with necessary changes to additional botany course requirements.

--The contribution of existing upper division electives should be evaluated in terms of existing faculty and the desired expertise of future hires.

There is a core curriculum common to all tracks. We are, however, in the process of designing a curriculum that eliminates the tracks. The department now has a formal curriculum committee made up of the junior faculty (Dr. Root, Dr. Schramm, and Dr. Hilbig) and chaired by Dr. Hilbig. The core classes taken by all majors remain, and all majors then take a minimum number of credit hours in three content areas based on *Vision and Change*: Genetics, Cell, and Molecular; Physiology and Organismal; and Evolution, Ecology, and Environmental. Students then select electives based on career goals and interests. Courses in the three content areas and the electives are being reviewed to identify any that need to be changed, eliminated, or added based on current faculty expertise and expertise needed in new hires. (We are starting a second round of retirements.) It is hoped that this plan will give students more flexibility in completing their degrees and perhaps shorten time to degree completion. To maintain the visibility of our popular Field Botany program, we are planning to change two non-degree two-year pre-professional programs (Pre-Agriculture and Pre-Horticulture; Pre-Forestry and Pre-Range Management) to a certificate in Field Botany.

--The Department should pursue additional interdepartmental cooperation in common areas:

--An introductory biology course, or sequence, as recommended in "Vision and Change" and including cell/molecular biology, genetics, evolution, and ecology.

--The biology composite teaching major.

The department chairs of Botany, Microbiology, and Zoology met regularly for a year or so to explore a joint introductory biology class, including content knowledge, laboratory skills, general education requirements, and course logistics. Logistics were the stumbling block as the life science departments do not have the facilities and personnel to offer multiple lab sections of a large enrollment introductory biology class. We also realized that a large enrollment class (> 200 students based on the total enrollment in our respective introductory majors' classes) would not serve the WSU student body (non-traditional, first generation, etc.) well. As we thought about the needs of the student body, we started to think about an Associate of Science degree in Biology. We have completed design of the degree, and it has been approved by the faculty of all three departments. It is now going through the university curriculum approval process with the following rationale:

The purpose of the Associate of Science degree in Biology is to provide direction at WSU for students who are interested in biology. In Utah many students start taking college credits in high school through concurrent enrollment or early college courses, but they often choose courses that will not lead to a BS in COS. Having an AS in biology would bring students to COS for course work (and advisement) sooner and would help give them the right path to their goal of a BS degree. The AS degree also brings students into contact with COS student clubs and other COS retention activities prior to starting a major. The AS puts a Biology Program in the WSU catalog and online materials. It will assist with recruitment and ultimately retention of 2 yr students as, having completed critical foundational coursework, they stay at WSU to pursue degrees in one of the life sciences or a related program. Furthermore, the AS was designed with advising in mind as students choose general education courses, science electives, and CHEM, PHYS, and MATH options:

- works as a 2+2 program with all majors in Botany, Microbiology, and Zoology as well as the Biology Composite Teaching major
- provides options for completion of CHEM, PHYS, and MATH depending on the specific 4yr degree a student plans to pursue
- science elective courses apply toward one or more of the life science BS degrees
- other electives accommodate students who need to take prep classes such as ENGL 1010, MATH 1010, and CHEM 1200
- includes a list of recommended general education courses, such as those required or recommended for professional schools and jobs commonly sought by life science graduates

- ***General Education.***

  - *The Department should consider pursuing additional interdepartmental cooperation in offering general education courses.*

We are considering offering WSU courses with other departments. (WSU courses carry general education credit in two areas.) Possibilities include a Natural History of Utah course with the Department of Geosciences (life science and physical science) and Plants and People (life science and social science) with the Department of Sociology and Anthropology.

3. Standard C. Student Learning and Assessment.

- *The Department should consider adapting existing assessment instruments, validated content inventories and inventories of general science literacy skills, in all classes*
- *The Department should consider developing a curriculum assessment rubric utilizing information from student portfolios.*

The curriculum revision for the major goes hand in hand with a revised curriculum map of learning outcome in the major (see Appendix H). The next step is to make assessment instruments that align with the new curriculum map.

-*The Department should pursue additional means of sending students to professional meetings.*
The university Office of Undergraduate Research (OUR) now provides some funding for sending students to professional meetings. Also, the department has been renting out laboratory space to the American Herbal Products Association for workshops. These workshops are very popular in the natural products industry. Not only has this given us some connections in this area, it also provides a pot of money that the department has decided to earmark to support student projects, including matching funds for OUR grant proposals, extra costs associated with CUREs, and student travel to conferences.

-*The Department should pursue cooperating with other science departments to establish a local Beta Beta Beta chapter and Sigma Xi Chapter.*
The College of Science has had a Sigma Xi chapter for at least 30 years. Its activity level fluctuates. The department has a student chapter of the Botanical Society of America.

4. Standard D. Academic Advising.

-*We recommend that student advising be distributed among the faculty.*
As of 2017-18, botany majors are assigned to faculty advisors based on their major track. There are currently some inequities in advising loads. The method for assignment of advisees will be revised when the new curriculum is in place to attempt to make advising loads more equitable.

5. Standard E. Faculty.

-*Faculty development has been sacrificed to maintain the existing curriculum as faculty numbers declined. As new faculty are hired, existing faculty should reduce their teaching loads and re-focus on their own professional development, including: research in collaboration both with students and faculty colleagues; participation in workshops; and attendance at professional meetings.*
This is happening. Dr. Wachocki is on a one semester sabbatical this year and is working with Dr. Sondossi of the Microbiology Department.

-*New faculty hires should complement the current strengths of the Department and add to the Department's teaching and research capacity.*
This is happening. Two of the new faculty hires have grant money and all received start up funding. They have equipped their spaces in the botany research labs on the third floor of TY and have made use of COS common equipment. They are mentoring students doing independent projects as well as student research assistants who are paid out of their various funds.

6. Standard F. Support.

-*A half-time, 10-month Administrative Assistant is inadequate and places additional burden on an already overstretched faculty to do clerical work. We recommend that this be made a full-time position.*

Our administrative assistant continues to be a half-time position. This semester, the new dean of the college instituted a "floater" assistant who can help departments with office-related projects as needed. Also, due the nature of the campus purchasing system and the types of items that the department tends to purchase, purchasing is almost exclusively handled by the laboratory manager. This reduces some of the demand on the administrative assistant's time.

- *The Botany Club should be encouraged to develop innovative and engaging (interactive?) displays for the Natural History Museum focusing on plants.*

At this time, the fate of Natural History Museum is up in the air. We are, however, discussing ways to involve the Botany Club in designing "Science on Display" art and displays for Botany spaces in TY.

- *Both the herbarium and greenhouse are indispensable resources for botany teaching and research and should be included in plans for the new science facility.*

We have both. The greenhouse has three climate zones. Thanks to WSU botany alumni who work at Red Butte Garden, the state botanical garden at the University of Utah, we have been able to take advantage of the three climate zones and expand our living collection to represent a broader array of plant families. Our concern for the herbarium is being able to replace Dr. Clark when he retires so that the excellent curation of the herbarium can continue.

Standard G. Relationships with the external community.

- *The Department needs more marketing and recruiting assistance.*

The college hired a public relations and marketing person last year. The university overhauled the layout for department web pages about the time she came on, and she is now in charge of the web pages for the college as a whole and the individual departments, taking one job off of the department chair. She has also developed a number of publicity materials and marketing efforts. The life science departments will meet with her about publicity to announce the Biology AS degree once it is approved.

- *We encourage plans for forming a General Advisory Committee and an Employer Advisory Committee for the department.*

We have a department advisory board that meets twice a year. It met for the first time in Fall 2017. The board is composed of people who work in areas that employ our graduates (and in some cases are our alumni) as well as people from schools with graduate programs and a natural medicine physician.

- *We encourage further outreach to tribal communities and the local schools.*

With Dr. Clark's retirement, we are losing our connection to tribal communities. Faculty have some ideas for continuity. Outreach to schools is primarily through hosting field trips that visit the greenhouse and Botany Club members doing service projects.

Action Plan for Ongoing Assessment Based on Current Self Study Findings

Action Plan for Evidence of Learning Related Findings

Problem Identified	Action to Be Taken
Better delineated learning outcomes in the major that are aligned with the AAAS Vision and Change document	Current 5 Year Program Review: new curriculum map and learning outcomes
	Year 1 Action to Be Taken: prepare assessment grids for use with major classes and assess classes with the new plan
	Subsequent Years Action to Be Taken: continue to use the new map and learning outcomes and tweak as necessary
Need to adjust assessment of graduates due to changes to the curriculum map and learning outcomes for the major	Current 5 Year Program Review: waiting on the new curriculum map and learning outcomes
	Year 1 Action to Be Taken: revise the portfolio assessment rubric to align with the new learning outcomes and put in place
	Subsequent Years Action to Be Taken: continue to use the new rubric and tweak as necessary

Action Plan for Staff, Administration, or Budgetary Findings

Problem Identified	Action to Be Taken
Retirement of the department's plant taxonomist and herbarium curator after 53 years on the WSU faculty. Replacing this faculty line is critical for maintaining the department's reputation in the training of field botanists and the quality and value of the Mary Carver Hall Herbarium.	Enlisting the department advisory board in supporting the need to hire a new taxonomist/curator. We are in the process of raising the public profile of the herbarium to show its importance to the department, college, university, and region.

APPENDICES

Appendix A: Student and Faculty Statistical Summary

(*Note*: Data provided by Institutional Effectiveness. This is an extract from the Program Review Dashboard and shows what will be sent to the Boards of Trustees and Regents)

Botany	2013-14	2014-15	2015-16	2016-17	2017-18*	5 yr. average
Student Credit Hours Total	**4,528**	**4,299**	**4,338**	**4,333**	**4,368**	**4,373**
Student FTE Total	**150.93**	**143.30**	**144.60**	**144.43**	**145.6**	**145.77**
Student Majors	73	59	57	68	69	65
Program Graduates	12	12	4	6	3	7.4
Student Demographic Profile						
Female	39	27	24	37	32	
Male	34	32	33	31	37	
Faculty FTE Total	**7.8**	**7.13**	**7.99**	**7.63**	n/a	
Adjunct FTE	3.24	2.57	3.02	1.95	n/a	
Contract FTE	4.56	4.56	4.97	5.68	n/a	
Student/Faculty Ratio	**19.35**	**20.10**	**18.10**	**18.93**	n/a	

*Most recent academic year counts subject to final verification

Student Credit Hours Total represents the total department-related credit hours for all students per academic year. Includes only students reported in Banner system as registered for credit at the time of data downloads.

Student FTE Total is the Student Credit Hours Total divided by 30.

Student Majors is a snapshot taken from self-report data by students in their Banner profile as of the third week of the Fall term for the academic year. Only 1st majors count for official reporting.

Program Graduates includes only those students who completed all graduation requirements by end of Spring semester for the academic year of interest. Students who do not meet this requirement are included in the academic year in which all requirements are met. Summer is the first term in each academic year.

Student Demographic Profile is data retrieved from the Banner system.

Faculty FTE is the aggregate of contract and adjunct instructors during the fiscal year.

Contract FTE includes instructional-related services done by "salaried" employees as part of their contractual commitments.
Adjunct FTE includes instructional-related wages that are considered temporary or part-time basis. Adjunct wages include services provided at the Davis campus, along with on-line and Continuing Education courses.

Student/Faculty Ratio is the Student FTE Total divided by the Faculty FTE Total.

Appendix B:

Faculty (current academic year)

	Tenure and tenure-track	**Contract**	**Adjunct**
Number of faculty with Doctoral degrees	6		1
Number of faculty with Master's degrees			4
Number of faculty with Bachelor's degrees			1
Other Faculty			
Total	6	0	6

Contract/Adjunct Faculty Profile

Name	Rank	Tenure Status	Highest Degree	Years of Teaching	Areas of Expertise
Stephen Clark	Professor	Tenured	PhD	54	Plant Taxonomy, Ethnobotany
Sue Harley	Professor	Tenured	PhD	31	Plant Physiology, Plant Cell Biology
Bridget Hilbig	Assistant Professor	Tenure-Track	PhD	3	Plant-Soil Interactions; Mycorrhizal Fungi; Fungal Pathogens; Invasion Ecology
Heather Root	Assistant Professor	Tenure-Track	PhD	6	Plant Ecology, Lichenology, Disturbance Ecology
Katharina Schramm	Assistant Professor	Tenure-Track	PhD	4	Chemical Ecology, Plant-Insect Interactions, Phytochemistry, Ecology, Biochemistry
Barbara Wachocki	Professor	Tenured	PhD	28	Plant Ecology, Plant Cell Culture, Plant-Microbe Interactions
Mindy Mortensen	Adjunct	Non-TenureTrack	BS	0	Horticulture
Annita Peterson	Adjunct	Non-TenureTrack	PhD	10	Plant Physiology, Crop Science
Jason Stettler	Adjunct	Non-TenureTrack	MS	0	Plant Systematics
BlakeWellard	Adjunct	Non-TenureTrack	MS	1	Plant Taxonomy, Plant Geography

Sonya Welsh	Adjunct	Non-TenureTrack	MS	7	Watershed Science, Ecogeomorphology, GIS, Riparian Ecology
Susan Young	Adjunct	Non-TenureTrack	MA	29	Anthropology, Paleoethnobotany

Summary Information (as needed)

Appendix C: Staff Profile

Name	Job Title	Years of Employment	Areas of Expertise
Mary Owen	Administrative Assistant	5	Departmental budget oversight Proficient in all computer applications necessary Scheduling (classes, rooms, etc.) Faculty support (exam prep, etc.)
Sonya Welsh	Laboratory Manager	8	Chemical & media preps Greenhouse management Lab preparations Inventory mgt. Purchasing/Equipment acquisition Writing lab protocols Chemical & waste storage & mgt.

Appendix D: Financial Analysis Summary
(This information is provided by the Provost's Office)

Botany w/CE IW Support					
Funding	**13-14**	**14-15**	**15-16**	**16-17**	**17-18**
Appropriated Fund	532,326	583,413	567,690	935,662	724,085
Other:					
Special Legislative Appropriation					
Grants or Contracts					
Special Fees/Differential Tuition	6,148	10,008	7,831	4,462	2,863
CE - Instructional Wage Support	60,340	62,115	58,810	57,395	58,815
Total	598,814	655,536	634,331	997,519	785,763

FTE	150.93	143.30	144.60	144.43	145.60
Cost/FTE	$3,967	$4,575	$4,387	$6,906	$5,397

Appendix E: External Community Involvement Names and Organizations

Name	Organization
Stephen Clark	US Army Corps of Engineers
	Utah State Division of Wildlife Resources
	Trapper Trails Council, Boy Scouts of America
Sue Harley	Ritchey Science & Engineering Fair
	Review for Professional Journal: The American Biology Teacher
Bridget Hilbig	Point Blue Conservation Science (nonprofit conservation research organization)
	Summit Land Conservancy (nonprofit conservation organization)
	Reviewer for professional journals: Mycorrhiza, Oecologia, Restoration Ecology
Heather Root	Weber Pathways
	Ogden City Urban Forestry Advisory Committee
	Biodiversity Research Collective (nonprofit conservation research organization)
	Northwest Lichenologists (nonprofit conservation research organization)
	Reviewer for professional journals: Torrey Botanical Society; Bryologist; Journal of Vegetation Science; Lichenologist; Forest Ecology and Management; Global Change Biology; Forests; Biodiversity and Conservation; Arctic Biology; Ecological Indicators; Journal of Vegetation Science; New Phytologist; Environmental Pollution; Science of the Total Environment; Ecological Applications; Perspectives in Plant Ecology, Evolution and Systematics; The Journal of the Utah Academy of Sciences, Arts and Letters
Kat Schramm	Barker Park: Garden Projects
Barb Wachocki	Ritchey Science Fair Committee & Advisory Board
	Ritchey Science & Engineering Fair
	Ritchey Science Fair Acting Director
	Ritchey ISEF (International Science and Engineering Fair) Committee
	ISEF (International Science and Engineering Fair)
	Mount Ogden Junior High Science Fair
Sonya Welsh	Weber Pathways
	Ritchey Science & Engineering Fair
	DaVinci Academy Curriculum Board

Appendix F: Site Visit Team (both internal and external members)

Name	Position	Affiliation
Dr. Exequiel Ezcurra	Director of UCMexus/Professor of Ecology	University of California, Riverside
Dr. Marjukka Ollilainen	Professor of Sociology and Department Chair	WSU Dept of Sociology and Anthropology
Dr. Eric Ribbens	Professor of Biological Sciences	Western Illinois University

Appendix G: Evidence of Learning <u>Courses within the Major</u>

Table 1. Percentage of 2000 level Botany courses that were assessed between Summer 2013 and Spring 2018 that met the threshold for the Botany Learning Outcomes. (NOTE: Thresholds varied between years). Current Threshold = 80% of students get at least 70%.

COURSE	Total # Sections (Total # Students)	Assessment Measure	% Sections that met the Threshold for each Learning Outcome (Average % among assessed sections for each Learning Outcome is in parentheses)	
			Knowledge & Comprehension	Skills
BTNY 2104	10 sections (N=152)	Exam Questions	60% (75.24%)	
		Quiz Questions		
		Other Assignments	100% (84.5%)	100% (86.3%) (Labs) 100% (85%) (Other)
BTNY 2114	6 sections (N= 65)	Exam Questions	83.3% (81.7%)	
		Quiz Questions	100% (87.3%)	100% (70%) (1 section)*
		Other Assignments		50% (80.8%) (Labs/2 sections) 100% (98.4%) (Other)
BTNY 2121	5 sections (N=48)	Exam Questions		
		Quiz Questions		
		Other Assignments	75% (essay in 3 of 4 sections)	100% (96.9%)
BTNY 2303*	2 sections (N=30)	Exam Questions	100% (81%)	
		Quiz Questions		100% (67.5%)*
		Other Assignments	100% (79%)	100% (85.2%)
BTNY 2413	2 sections (N=42)	Exam Questions		
		Quiz Questions		
		Other Assignments	100% (79.6%)**	
BTNY 2600**	4 sections (N=59)	Exam Questions		100% (97.5%)**
		Quiz Questions		100% (93.7%)**
		Other Assignments		100% (91.8%)**

*Threshold was set at 67% average for this class vs. % of students meeting a threshold

**Cross-listed between Botany, Chemistry, Geosciences, Microbiology & Physics, but only results Botany students are reported here.

Table 2. Percentage of Upper Division Botany courses that were assessed between Summer 2013 and Spring 2018 that met the threshold for the Botany Learning Outcomes. (NOTE: Thresholds varied between years). Current Threshold = 90% of students get at least 80%.

COURSE	Total # Sections (Total # Students)	Assessment Measure	% Sections that met the Threshold for each Learning Outcome (Aver % among assessed sections for each Learning Outcome is in parentheses)	
			Knowledge & Comprehension	Skills
BTNY 3153*	1 section (N=5)	Exam Questions	0% (60%)*	
		Quiz Questions		
		Other Assignments		0% (80%)* [100% (Oral Presentation) & 60% Essay)]
BTNY 3204*	1 section (N=5)	Exam Questions	0% (80%)*	
		Quiz Questions	0% (20%)*	
		Other Assignments		0% (40%)* (Labs) 0% (40%)* (Other)
BTNY 3214	3sections (N=41)	Exam Questions	100% (100%) (1 of 3 sections)	
		Quiz Questions	100% (100%)	
		Other Assignments		100% (97.7%)
BTNY 3303**	1 section (N=10)	Exam Questions	100% (90%)	
		Quiz Questions	100% (100%)	100% (100%)
		Other Assignments		100% (100%) (Labs)
BTNY 3454	1 section (N=10)	Exam Questions		
		Quiz Questions	100% (100%)	
		Other Assignments		100% (95%) (Reports, notebooks) 100% (95%) (Projects)
BTNY 3473	1 section (N=11)	Exam Questions	100% (90%)	
		Quiz Questions		
		Other Assignments		100% (100%)
BTNY 3504*	1 section (N=16)	Exam Questions		
		Quiz Questions	100% (93.8%)	
		Other Assignments	0% (87.5%)	100% (93.8%) (Labs) 0% (75%)* (Projects) 100% (100%) (Other)

Table 2. (continued) Percentage of Upper Division Botany courses that were assessed between Summer 2013 and Spring 2018 that met the threshold for the Botany Learning Outcomes. (NOTE: Thresholds varied between years). Current Threshold = 90% of students get at least 80%.

COURSE	Total # Sections (Total # Students)	Assessment Measure	% Sections that met the Threshold for each Learning Outcome (Aver % among assessed sections for each Learning Outcome is in parentheses)	
			Knowledge & Comprehension	Skills
BTNY 3583**	1 section (N = 8)	Exam Questions	100% (75%)**	
		Quiz Questions		
		Other Assignments		100% (85%)**
BTNY 3624***	1 section (N= 16)	Exam Questions	100% (80.6%)***	
		Quiz Questions		100% (82.9%)***
		Other Assignments		100% (89.1%)***
BTNY 3643	1 section (N=7)	Exam Questions	0% (71.4%)	
		Quiz Questions		
		Other Assignments		
BTNY 4950	1 section (N=10)	Exam Questions		
		Quiz Questions		
		Other Assignments	100% (90%)	100% (95%)
BTNY 4980	7 sections (N = 22)	Exam Questions		
		Quiz Questions		
		Other Assignments	57% (79.8%)	100% (86.1%)
BTNY 4990	2 sections (N=5)	Exam Questions		
		Quiz Questions		
		Other Assignments	100% (91%)	

*One section; threshold = 90% of students get at least 80%.
**Threshold was set at 70% average for this class vs. % of students meeting a threshold
***Threshold was set at 67% average for this class vs. % of students meeting a threshold

Evidence of Learning: General Education Courses

Percentage of Botany General Education courses that were assessed between Summer 2013 and Spring 2018 that met the threshold in the four Natural Science (NS) and four Life Science (LS) Learning Outcomes. (NOTE: Thresholds varied between years). Current Threshold = 80% of students get at least 70%.

COURSE	Total # Sections (Total # Students)	Assessment Measure	% Sections that met the Threshold for each Learning Outcome (Average % among assessed sections for each Learning Outcome is in parentheses)							
			NS 1	NS 2	NS 3	NS 4	LS 1	LS 2	LS 3	LS 4
BTNY 1203	14 sections (N = 664)	Exam Questions	57% (70.1%)	64.3% (71.2%)	92.9% (81.8%)	28.6% (65.4%)	78.6% (72.5%)	50% (67.2%)	35.7% (64.5%)	92.9% (77.6%)
		Quiz Questions	100 (96.7%)	100% (90%)	100% (89.2%)	100% (89.2%)	100% (88.6%)	100% (88.4%)	100% (91.2%)	100% (93.8%)
		Written Assignments	100% (88.6%)	100% (87.6%)	100% (87.7%)	100% (87.7%)				100% (86.9%)
BTNT 1303	7 sections (N= 196)	Exam Questions	71.4% (71.8%)	28.6% (61.1%)	42.9% (63.2%)	57.1% (55.9%)	14.3% (57.1%)	28.6% (59.2%)	28.6% (56.8%)	42.9% (63.8%)
		Quiz Questions								
		Written Assignments		100% (85%)	50% (83.5%)					
BTNY 1403	12 sections (N = 594)	Exam Questions	100% (87.9%)	100% (82.8%)	83.3% (84.7%)	100% (83.3%)	75% (68.7%)	83.3% (74.9%)	83.3% (76.3%)	83.3% (80.1%)
		Quiz Questions	100% (99.1%)	100% (93.1%)	100% (93.7%)	100% (98.6%)	100% (95.7%)	100% (95.7%)	100% (95.2%)	100% (93.4%)
		Written Assignments		100% (87.6%)	100% (95.6%)	100% (87.6%)	100% (93.6%)	75% (93.6%)	100% (96.8%)	100% (92.4%)

Individual Course Grids for Evidence of Learning Assessments for 2017-2018.
Individual course assessments for prior years can be found at https://www.weber.edu/portfolio/botany.html.

Majors Courses

BTNY 2104-Plant Form and Function. Data based on 33 students in two sections (Fall 2017 and Spring 2018) who completed the class. This is a Core lab course for Botany majors and minors.

BTNY 2104, Plant Form and Function	Evidence of Learning: Courses within the Major				
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: Knowledge and comprehension	Measure 1: Four exams, including a cumulative final. The exams are a mixed format of multiple choice, short answer, essay, and lab practical	Measure 1: Threshold for Evidence of Student Learning is 80% or more of the students achieving 70% or higher.	Measure 1: 67.7% of students averaged 70% or higher on exams.	Measure 1: Most students successfully demonstrated knowledge and comprehension at level of 70% or higher.	Measure 1: Added quizzes in Canvas and review exercises in class to prep students for exams. Adding stop and summarize breaks to lectures.
Learning Outcome 2: Skills	Measure 1: Seventeen labs and assignments with minimal data analysis	Measure 1: Threshold for Evidence of Student Learning is 80% or more of the students achieving 70% or higher.	Measure 1: 96.8% of students averaged 70% or higher on lab exercises.	Measure 1: Students successfully demonstrated development of laboratory and problem solving skills	Measure 1: No curricular or pedagogical changes needed at this time
	Measure 2: Thirteen labs and assignments that required data analysis with statistics &/or graphing done in Excel or equivalent	Measure 2 Threshold for Evidence of Student Learning is 80% or more of the students achieving 70% or higher.	Measure 2: 84.8% of students averaged 70% or higher on lab exercises.	Measure 2: Students successfully demonstrated development of problem solving and computer skills	Measure 2: No curricular or pedagogical changes needed at this time

*Direct and indirect: at least one measure per objective must be a direct measure.

BTNY 2104 (Plant Form and Function) (Data based on 12 students in one section [Fall 2017- Davis Campus] who completed the class.) This is a Core lab course for Botany majors and minors.

BTNY 2104, Plant Form and Function		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: Knowledge and comprehension	Measure 1: Four exams, including a cumulative final. The exams are a mixed format of multiple choice, short answer, essay, and lab practical	Measure 1: Threshold for Evidence of Student Learning is 80% or more of the students achieving 70% or higher.	Measure 1: 83.3% of students averaged 70% or higher on exams.	Measure 1: Students successfully demonstrated knowledge and comprehension	Measure 1: No curricular or pedagogical changes needed at this time
Learning Outcome 2: Skills	Measure 1: Twelve lab exercises with minimal data analysis	Measure 1: Threshold for Evidence of Student Learning is 80% or more of the students achieving 70% or higher.	Measure 1: 100% of students averaged 70% or higher on lab exercises.	Measure 1: Students successfully demonstrated development of laboratory and problem solving skills	Measure 1: No curricular or pedagogical changes needed at this time
	Measure 2: Eight lab exercises requiring data analysis with statistics &/or graphing done in Excel or equivalent	Measure 2 Threshold for Evidence of Student Learning is 80% or more of the students achieving 70% or higher.	Measure 2: 75% of students averaged 70% or higher on lab exercises.	Measure 2: Students did not successfully demonstrate development of problem solving and computer skills	Measure 2: More practice with statistics and graphing are in order. However, it should be noted, that two of the three students who struggled with these labs were absent a great deal and missed a lot of information.

*Direct and indirect: at least one measure per objective must be a direct measure.

Course: BTNY 2114 Evolutionary Survey of Plants Fall 2017 & Spring 2018 (N= 16)
This is a Core lab course for Botany majors and minors.

Course [Subject/Number]		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: Knowledge and comprehension	Measure 1: 8 quizzes with questions that integrated multiple topics	Measure 1: 80% of students with a score of 70% or greater	Measure 1: 85% of the students had average quiz scores over 70%	Measure 1: Students meet the threshold	No curricular or pedagogical changes needed at this time
	Measure 2: 5 Exams	Measure 1: 80% of students with a score of 70% or greater	Measure 1: 95% of the students had average quiz scores over 70%	Measure 1: Students meet the threshold	No curricular or pedagogical changes needed at this time
Learning Outcome 2: Skills	Measure 1: Lab Notebook (new assignment Spring 2018 class)	Measure 1: 80% of students with a score of 70% or greater	Measure 1: 78% of the students had an average score of over 80%	Measure 1: Students successfully demonstrated skills and were very close to the threshold.	No curricular or pedagogical changes needed at this time See note below
Learning Outcome 3: Affective Domain	Measure 1: Oral Presentation	Measure 1: 80% of students with a score of 70% or greater	Measure 1: 95% of students had project of over 70%	Measure 1: Students successfully demonstrated skills	No curricular or pedagogical changes needed at this time

*Direct and indirect: at least one measure per objective must be a direct measure.
Threshold for Evidence of Student Learning is 80% or more of the students achieving 70% or higher.

Learning Outcome 2: One or two students did not do the assignment and receive a score of zero; this brought the averages down.

BTNY 2114 (Evolutionary Survey of Plants) (Data based on 6 students in one section [Spring 2018-Davis Campus] who completed the class.) This is a Core lab course for Botany majors and minors.

Course [BTNY 2114]	Evidence of Learning: Courses within the Major				
Measurable Learning Outcome	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: Knowledge and Comprehension	Measure 1: Four exams, including a cumulative final. The exams are a mixed format of multiple choice, short answer, essay, and lab practical.	Measure 1: Threshold for Evidence of Student Learning is 80% or more of the students achieving 70% or higher.	Measure 1: 100% of students averaged 80% or higher on exams.	Measure 1: Students did not successfully demonstrate knowledge and comprehension	Measure 1: The combined classes fell short of the threshold. More review for exams and practice exercises may improve performance.
	Measure 2: Nine quizzes of a mixed format, including multiple choice, short answer, and essay questions.	Measure 2: Threshold for Evidence of Student Learning is 80% or more of the students achieving 70% or higher.	Measure 2: 100% of students averaged 80% or higher on quizzes.	Measure 2: Students successfully demonstrated knowledge and comprehension	Measure 2: No curricular or pedagogical changes needed at this time
Learning Outcome 2: Skills	Measure 1: Oral presentation on a topic or plant group studied in class.	Measure 1: Threshold for Evidence of Student Learning is 80% or more of the students achieving 70% or higher.	Measure 1: 100% of students averaged 70% or higher on their oral presentation.	Measure 1: Students successfully demonstrated development of laboratory and problem solving skills	Measure 1: No curricular or pedagogical changes needed at this time

BTNY 2121 (Career Planning for Botanists) (Data based on 21 students in two sections [Fall 2017 and Spring 2018] who completed the class.) This is a Core course for Botany majors and minors.

Course BTNY 2121 Fall 2017 & Spring 2018		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: **Knowledge and Comprehension** Understanding of how plants are similar to other organisms, how plants are unique, and the products humans get from plants (= first draft for their final student portfolio)	Measure 1: A preliminary essay on how plants are similar to other organisms, how plants are unique, and the products humans get from plants (= first draft for their final student portfolio)	Measure 1: 80% of students will score at least 70% on the assignment	Measure 1: The threshold was met (Fall 2017: 90.9% of students achieved at least 70%) **NOTE:** This course was changed and this assignment was not required in Spring 2018)	Measure 1: Students did effectively demonstrate a basic knowledge of plants' similarity and differences as compared with other organisms, as well as the products that humans obtain from plants.	Measure 1: No curricular or pedagogical changes needed at this time
Learning Outcome 2: **Skills** Measure 1: written communication, information-seeking & critical thinking	Measure 1: An outline of a talk to the general public entitled, *Science as a Way of Knowing* (includes scientific method, specific examples from Botany and explanations of how science is used to shape public policy)	Measure 1: 80% of students will score at least 70% on the assignment	Measure 1: The threshold was met (89.5% of students achieved at least 80%) (Fall 2017: 88.9% & Spring 2018: 90%)	Measure 1: Students did effectively communicate in a written outline an understanding of how science is conducted and its relevance to public policy decisions.	Measure 1: No curricular or pedagogical changes needed at this time

Course BTNY 2121 Fall 2017 & Spring 2018		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 2: **Skills** Measure 2: oral communication & information-seeking skills	Measure 2: Oral presentation on a graduate/professional program of the student's choice	Measure 2: 80% of students will score at least 70% on the assignment	Measure 2: The threshold was met (100% of students achieved at least 80% in both semesters)	Measure 2: Students effectively presented information about a graduate/professional program to fellow classmates through an oral presentation	Measure 2: No curricular or pedagogical changes needed at this time
Learning Outcome 2: **Skills** Measure 3: self-assessment skills	Measure 3: Written self-assessment of strengths, weaknesses, plans for self-improvement, career interests, short- and long-term goals	Measure 3: 80% of students will score at least 70% on the assignment	Measure 3: The threshold was met (100% of students achieved at least 80% in both semesters)	Measure 3: Students effectively demonstrated an ability to critically assess themselves	Measure 3: No curricular or pedagogical changes needed at this time
Learning Outcome 2: **Skills** Measure 4: written communication skills	Measure 4: Written résumé	Measure 4: 80% of students will score at least 70% on the assignment	Measure 4: The threshold was met (100% of students achieved at least 80% in both semesters)	Measure 4: Students effectively demonstrated an ability to write a résumé	Measure 4: No curricular or pedagogical changes needed at this time

*Direct and indirect: at least one measure per objective must be a direct measure.

Course: BTNY 2413 Natural Resource Management (N= 23)

Course [Subject/Number]		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: Knowledge and comprehension	Measure 1: Case study reports	Measure 1: 80% of students scoring 80% or higher	Measure 1: 80% of the students had average case study scores of over 80%	Measure 1: Students successfully demonstrated knowledge and comprehension	No curricular or pedagogical changes needed at this time
Learning Outcome 2: Skills	Measure 1: Case study reports	Measure 1: 80% of students scoring 80% or higher	Measure 1: 80% of the students had average case study scores of over 80%	Measure 1: Students successfully demonstrated skills	No curricular or pedagogical changes needed at this time
Learning Outcome 3: Affective Domain	Measure 1: Reading reflections	Measure 1: 80% of students scoring 80% or higher	Measure 1: 89% of the students had average reflection scores over 80%	Measure 1: Students successfully demonstrated development the affective domain	No curricular or pedagogical changes needed at this time.

*Direct and indirect: at least one measure per objective must be a direct measure.

Additional narrative:
The students in this class were just at the threshold for learning outcomes. However, the students who turned in their work generally did quite well. Low average scores were generally caused by missing assignments. This course required a lot of reading and writing from the students, and their discussions were wide-ranging, which made it difficult to assess. Both the case study reports and reading reflections were very integrative across the learning outcomes.

BTNY 2600 (Laboratory Safety) (Data based on 37 students in two sections [Fall 2017 and Spring 2018] who completed the class.) This is a Core course for Botany majors and minors.

Course BTNY 2600 Fall 2017 & Spring 2018		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 2: **Skills** Measure 1: written communication, information-seeking & critical thinking	Measure 1: Written assignment in which students must find and interpret Safety Data Sheets (SDS) for 17 chemicals to determine how each must be properly stored and explain safety measures and precautions required in labs for chemical storage and personal safety.	Measure 1: 80% of students will score at least 70% on the assignment	Measure 1: The threshold was not met (66.4% of students achieved at least 70%) (Fall 2017: 63.6% & Spring 2018: 69.2%)	Measure 1: Students did not effectively interpret Safety Data Sheets to determine how each must be properly stored and explain safety measures and precautions required in labs for chemical storage and personal safety .	Measure 1: Additional information on SDS and chemical storage is required. This class changed from a face-to-face format to a mostly on-line fornmat, with a few face-to-face meetings. This has proved challenging for this homework assignment.
Learning Outcome 2: **Skills** Measure 2: : written communication, information-seeking & critical thinking	Measure 2: Written assignment identifying the five major risks each student will encounter in their career of choice and explaining how to minimize each risk.	Measure 2: 80% of students will score at least 70% on the assignment	Measure 2: The threshold was met (100% of students achieved at least 70% in both semesters)	Measure 2: Students effectively identified the five major risks they will encounter in their career of choice and an explained how to minimize each risk.	Measure 2: No curricular or pedagogical changes needed at this time
Learning Outcome 2: **Skills** Measure 3: ability to conduct a basic lab audit using a checklist	Measure 3: Hands-on, in-class exercise in which each student uses a checklist provided to conduct a safety audit of a College of Science classroom lab	Measure 3: 80% of students will score at least 70% on the assignment	Measure 3: The threshold was met (100% of students achieved at least 70% in both semesters)	Measure 3: Students effectively demonstrated an ability to conduct a basic lab audit using a checklist	Measure 3: No curricular or pedagogical changes needed at this time

Course BTNY 2600 Fall 2017 & Spring 2018		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 2: **Skills** Measure 4: ability to use a fire extinguisher properly to put out a fire	Measure 4: Hands-on, in-class exercise in which each student practices how to use a hand-held fire extinguisher to put out a fire	Measure 4: 80% of students will score at least 70% on the assignment	Measure 4: The threshold was met (100% of students achieved at least 70% in both semesters)	Measure 4: Students effectively demonstrated an ability use a fire extinguisher properly to put out a fire	Measure 4: No curricular or pedagogical changes needed at this time
Learning Outcome 2: **Skills** Measure 5: understanding topics including chemical safety, basic toxicology and risk assessment, biological hazards, fire safety, proper use of lab equipment, waste disposal, radiation and laser safety, safe and ethical treatment of research animals, overall lab safety, and field safety	Measure 5: Multiple choice, matching and essay questions on two closed-book exams	Measure 5: 80% of students will score at least 70% on the exams	Measure 5: The threshold was met (96% of students achieved at least 70% on the exams) (Fall 2017: 92% & Spring 2018: 100%)	Measure 5: Students successfully demonstrated an understanding of the lab and field safety topics covered	Measure 5: No curricular or pedagogical changes needed at this time
Learning Outcome 2: **Skills** Measure 6: understanding topics including chemical safety, basic toxicology and risk assessment, biological hazards,	Measure 6: Multiple choice, matching and essay questions on 10 open-book quizzes	Measure 6: 80% of students will score at least 70% on the quizzes	Measure 6: The threshold was met (90% of students achieved at least 70% on the quizzes) (Fall 2017: 80% & Spring 2018: 100%)	Measure 6: Students successfully demonstrated an understanding of the lab and field safety topics covered	Measure 6: No curricular or pedagogical changes needed at this time

Course BTNY 2600 Fall 2017 & Spring 2018		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
fire safety, proper use of lab equipment, waste disposal, radiation and laser safety, safe and ethical treatment of research animals, overall lab safety, and field safety					

*Direct and indirect: at least one measure per objective must be a direct measure.

Course: **BTNY 3153, Biology of the Plant Cell (n = 5) This course is required in the Track A, Option 2 Botany major and is an elective for Tracks A1, B, and C, the Botany minor, some majors in Microbiology, and the Biochemistry major in Chemistry. (Spring 2018)**

Course [BTNY 3153]		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: Knowledge and comprehension	Measure 1: three essay exams	Measure 1: 90% of students with a score of 80% or greater	Measure 1: 80% of the students had an average score of 80% or greater on exams	Measure 1: Most students successfully demonstrated knowledge and comprehension	Add stop and summarize breaks to lectures. Provide additional homework assignments with practice exam questions.
Learning Outcome 2: Skills	Measure 1: three essays on cell vs organismal theory, model organisms, and plant movements at the cellular level. Skills: critical thinking, information seeking, written communication Measure 2: Oral report on a specific plant cell. Skills: critical thinking, information seeking, oral communication	Measure 1: 90% of students with a score of 80% or greater Measure 2: 90% of students with a score of 80% or greater	Measure 1: 60% of the students had an average essay score of 80% or greater Measure 2: 100% of the students had an average essay score of 80% or greater	Measure 1: Most students successfully demonstrated skills at a level of 80% or higher. All averaged 70% or higher on their essays. Measure 2: All students successfully demonstrated skills at a level of 80% or higher.	Add in class practice on reading the scientific literature and searching for articles.

*Direct and indirect: at least one measure per objective must be a direct measure.

Course: 3204 Plant Physiology, N= 5

Course [BTN3204]		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: Knowledge & comprehension	Measure 1: 26 essay questions from three exams	Measure 1: Evidence of Student Learning is 90% or more of the students achieving 80% or higher	Measure 1: 80% of students met the 80% threshold	Measure 1: students successfully demonstrated knowledge and comprehension	Measure 1: No curricular or pedagogical changes needed at the time
	Measure 2: 5 lab reports	Measure 2: Evidence of Student Learning is 90% or more of the students achieving 80% or higher	Measure 2: 40% of students met the 80% threshold	Measure 2: students struggled with knowledge and comprehension	Measure 2: Students should be encouraged to ask more about lab procedures. Lab quizzes could help facilitate this.
	Measure 3: Weekly in class quizzes	Evidence of Student Learning is 90% or more of the students achieving 80% or higher	Measure 3: 20% of students met the 80% threshold	Measure 3: Students struggled with demonstrating knowledge in in-class quizzes	Measure 3: There should be study guides to reduce the learning load towards important facts
Learning Outcome 2: Skills	Measure 1: 5 lab reports	Measure 1: Evidence of Student Learning is 90% or more of the students achieving 80% or higher	Measure 1: 40% of students met the 80% threshold	Measure 1: students students struggled with skills	Measure 1: Students should receive more detailed instruction, rubrics and feedback for lab reports, as well be encouraged to resubmit improved reports.
	Measure 2: Plant defence presentation	Measure 2: Evidence of Student Learning is 90% or more of the students achieving 80% or higher	Measure 2: 40% of students met the 80% threshold	Measure 2: students struggled with presentation skills	Measure 2: Students should be encouraged to use the rubric
	Measure 3: Lab book	Evidence of Student Learning is 90% or more of the students achieving 80% or higher	Measure 3: 20% of students met the 80% threshold	Measure 3: Students struggled with keeping a good labbook.	Measure 3: A graded lab book needs to stay part of the grade with possibly higher weight to impart on students the

Course [BTN3204]		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
					necessity to proper and good record keeping.

*Direct and indirect: at least one measure per objective must be a direct measure.

Additional narrative:
Six students were signed up, one took an Incomplete. The class was flipped classroom with readings assigned prior to each lecture period. We also read a number of primary literature pieces with subsequent discussion in class.
Students received feedback on all submitted materials and were given ample opportunity to improve submitted materials for higher credit: such as improved lab reports, edited lab books, several drafts of their final presentation with feedback. These offers were largely ignored, except by a small number of students who, it needs to be pointed out, did remarkably better than their peers in these sectors. It appears that grades and credit were no a strong enough motivation for students to work on these items, so maybe they need to have more impact on the final grade.

Course: BTNY 3504 Mycology Fall 2017 (N= 16)

Course [Subject/Number]		Evidence of Learning: Courses within the Major			
Measurable Learning Outcome	Method of Measurement*	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: Knowledge and comprehension	Measure 1: 12 quizzes with questions that integrated multiple topics	Measure 1: 90% of students with a score of 80% or greater	Measure 1: 93.8% of the students had average quiz scores over 80%	Measure 1: Students meet the threshold	No curricular or pedagogical changes needed at this time
Learning Outcome 2: Skills	Measure 1: Lab assignments	Measure 1: 90% of students with a score of 80% or greater	Measure 1: 93.8% of the students had an average score of over 80%	Measure 1: Students successfully demonstrated skills	No curricular or pedagogical changes needed at this time
	Measure 2: Individual projects	Measure 2: 90% of students with a score of 80% or greater	Measure 2: 75% of students had project of over 80%	Measure 2: In independent projects, students struggled more with the results and discussion section	Independent projects did not meet the threshold, see notes below
	Measure 3: Oral Presentation	Measure 3: 90% of students with a score of 80% or greater	Measure 3: 100% of students had project of over 80%	Measure 1: Students successfully demonstrated skills	No curricular or pedagogical changes needed at this time
Learning Outcome 3: Affective Domain	Measure 1: Reading Assignments and Discussions	Measure 1: 90% of students with a score of 80% or greater	Measure 1: 87.5% of the students had average reading and discussion score over 80%	Measure 1: Students were very close to the threshold.	No curricular or pedagogical changes needed at this time, See note below

*Direct and indirect: at least one measure per objective must be a direct measure.

Upper Division Threshold for Evidence of Student Learning is 90% or more of the students achieving 80% or higher

Additional narrative:
Learning Outcome 2: Students did not meet the threshold on their independent project. Each portion of the project write up was completed and graded in a step wise manner to make the project manageable. On the introduction section, as well as the materials and methods section, 93.8% of the students meet the threshold; the portion that brought the overall score down was the results and discussion. The students had the skills to execute the project, but struggle presenting results and interpreting their findings correctly. Part is the students failing to incorporate feedback from peer reviews and myself. In the future I will stress further the importance of edits post peer review to strengthen this section.

Learning Outcome 3: With a class of only 16 students to reach 90% of students scoring 80% and above 15 out of 16 must meet the threshold. There were multiple reading and discussion days so if students miss class they receive a score of zero; this brought the averages down with only 3 students missing one day each.

General Education Courses

Botany 1203 Introduction to Plant Biology Fall 2017 (N=53)

Evidence of Learning: General Education Area NS/LS					
Measurable Learning Outcome Students will…	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: NS1- Nature of Science	Measure 1 15 multiple choice questions spread across 2 exams	Measure 1 80% or more of the students achieving 70% or higher	Measure 1: 67% of students met the 70% threshold	Measure 1: students understand the Nature of Science	Measure 1: No curricular or pedagogical changes needed at the time
Learning Outcome 2: NS2 - Integration of Science	Measure 1: 4 multiple choice questions spread across 1 exam Measure 2: creating and populating a fictional planet with botanical life	Measure 1: 80% or more of the students achieving 70% or higher Measure 2: 80% or more of the students achieving 70% or higher	Measure 1: 57% of students met the 70% threshold Measure 2: The average grade for this assignment cluster was 85% with a participation rate of above 90%	Measure 1: students struggle with understanding of the integration of Science Measure 2: students successfully integrated botanical and scientific facts into their fictional planets	Measure 1: Incorporate more practice and more examples into curriculum Measure 2: No curricular or pedagogical changes needed at time
Learning Outcome 3: NS3 - Science and Society	Measure 1: 16 questions (multiple choice, essay, matching etc) spread across 4 exams	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 22% of students met the 70% threshold	Measure 1: students struggle with understanding of Science & Society	Measure 1: Emphasize connection of Science and Society more
Learning outcome 4: NS4 – Problem Solving & Data Analysis	Measure 1: 20 questions (multiple choice, essay, matching etc) across 4 exams	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 63% of students met the 70% threshold	Measure 1: Students struggled with Data Analysis	Measure 1: Incorporate more practice and more examples into curriculum and expose students to wider variety of data analysis problems and questions
Learning outcome 1: LS1 – Levels of organization	Measure 1: 63 multiple choice questions across 4 exams	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 50% of students met the 70% threshold	Measure 1: Students struggle with understanding the levels of organization in Botany	Measure 1: Incorporate more examples to emphasize and diversify exposure to these principles

Evidence of Learning: General Education Area NS/LS					
Measurable Learning Outcome Students will…	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning outcome 2: LS2 – Metabolism & Homeostasis	Measure 1: 34 multiple choice and essay questions across 1 exam	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 50% of students met the 70% threshold	Measure 1: students struggle with understanding metabolism & homeostasis	Measure 1: Incorporate more examples to emphasize and diversify exposure to these principles
Learning outcome 3: LS3 – Genetics & Evolution	Measure 1: 5 multiple choice questions across 3 exams	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 42% of students met the 70% threshold	Measure 1: students struggle with understanding genetics & evolution	Measure 1: Incorporate more examples to emphasize and diversify exposure to these principles
Learning outcome 4: LS4 – Ecological Interactions	Measure 1: 30 multiple choice, essay and matching questions across 3 exams	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 57% of students met the 70% threshold	Measure 1: students struggle with understanding of ecological interactions	Measure 1: Incorporate more examples to emphasize and diversify exposure to these principles

*At least one measure per objective must be a direct measure; indirect measures may be used to supplement direct measure(s).

Botany 1303 Plants in Human Affairs Fall 2017 (N=15)

Evidence of Learning: General Education Area NS/LS					
Measurable Learning Outcome Students will…	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: NS1- Nature of Science	Measure 1 15 multiple choice questions spread across 2 exams	Measure 1 80% or more of the students achieving 70% or higher	Measure 1: 69% of students met the 70% threshold	Measure 1: students understand the Nature of Science	Measure 1: No curricular or pedagogical changes needed at the time
Learning Outcome 2: NS2 - Integration of Science	Measure 1: 3 multiple choice questions spread across 1 exam	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 50% of students met the 70% threshold	Measure 1: students struggle with understanding of the integration of Science	Measure 1: Incorporate more practice and more examples into curriculum
Learning Outcome 3: NS3 - Science and Society	Measure 1: 50 questions (multiple choice, essay, matching etc) spread across 4 exams Measure 2: Essay assignment where students interview a person working with plants and summarize what they have learned in terms of how plants affect people and society	Measure 1: 80% or more of the students achieving 70% or higher Measure 2: 80% or more of the students achieving 70% or higher	Measure 1: 60% of students met the 70% threshold Measure 2: The average score for this assignment was 86%. 20 % of students did not finish the assignment, even though it counts for 10% of the final grade	Measure 1: students struggle with understanding of Science & Society Measure 2: students successfully demonstrated an understanding and appreciation of Science & Society	Measure 1: Emphasize connection of Science and Society more Measure 2: No curricular or pedagogical changes needed at the time
Learning outcome 4: NS4 – Problem Solving & Data Analysis	Measure 1: 28 multiple choice questions across 4 exams	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 26% of students met the 70% threshold	Measure 1: Students struggled with Data Analysis	Measure 1: Incorporate more practice and more examples into curriculum and expose students to wider variety of data analysis problems and questions

Evidence of Learning: General Education Area NS/LS					
Measurable Learning Outcome Students will…	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning outcome 1: LS1 – Levels of organization	Measure 1: 35 multiple choice questions across 4 exams	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 31% of students met the 70% threshold	Measure 1: Students struggle with understanding the levels of organization in Botany	Measure 1: Incorporate more examples outside the book to emphasize and diversify exposure to these principles
Learning outcome 2: LS2 – Metabolism & Homeostasis	Measure 1: 20 multiple choice questions across 3 exams	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 54% of students met the 70% threshold	Measure 1: students struggle with understanding metabolism & homeostasis	Measure 1: Reduce level of detail and spend more time on what is being discussed for deeper understanding
Learning outcome 3: LS3 – Genetics & Evolution	Measure 1: 3 multiple choice questions across 4 exams	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 46% of students met the 70% threshold	Measure 1: students struggle with understanding genetics & evolution	Measure 1: Incorporate more examples into curriculum, reduce level of detail, take more time
Learning outcome 4: LS4 – Ecological Interactions	Measure 1: 20 multiple choice, matching questions across 3 exams	Measure 1: 80% or more of the students achieving 70% or higher	Measure 1: 55% of students met the 70% threshold	Measure 1: students struggle with an understanding of ecological interactions	Measure 1: Incorporate more examples into curriculum, reduce level of detail, take more time

*At least one measure per objective must be a direct measure; indirect measures may be used to supplement direct measure(s).

Additional narrative:

This semester I attempted to use a flipped classroom approach in 1303. I wanted students to read chapters of the book before class and then had in-class assignments, quizzes, case studies and small labs for the class work. It was a lot of work In preparation but was impossible to actually execute. Students didn't prepare for class- and without that flipped classroom doesn't work. I had to completely change everything in response to that- and in the evaluations, students complained about the change of teaching style because the result didn't comply with the syllabus.

Course: BOTANY LS 1403 (Environment Appreciation), Fall 2017 (N=105)

Evidence of Learning: General Education Area [LS]					
Measurable Learning Outcome Students will…	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
NS1: Nature of Science	Measure 1: 4 Multiple Choice Questions	Measure 1: 80% of the students correctly answered 70% or higher	Measure 1: 90% of the students correctly answered 70% or higher	Measure 1: Students were very successful for this learning outcome	Measure 1: No curricular or pedagogical changes needed at this time
NS2: Integration of Science	Measure 2: 5 Multiple Choice Questions	Measure 1: 80% of the students correctly answered 70% or higher	Measure 1: 85% of the students correctly answered 70% or higher	Measure 1: Students were very successful for this learning outcome	Measure 1: No curricular or pedagogical changes needed at this time
NS3: Science and Society	Measure 1: 5 Multiple Choice Questions	Measure 1: 80% of the students correctly answered 70% or higher	Measure 1: 85% of the students correctly answered 70% or higher	Measure 1: Students were very successful for this learning outcome	Measure 1: No curricular or pedagogical changes needed at this time
	Measure 2: Project 2, relating water, oil and agriculture	Measure 2: 80% of the students correctly answered 70% or higher	Measure 2: 100% of the groups scored 70% or higher	Measure 2: Students were very successful for this learning outcome	Measure 2: No curricular or pedagogical changes needed at this time
NS4: Problem Solving and Data Analysis	Measure 1: 5 Multiple Choice Questions	Measure 1: 80% of the students correctly answered 70% or higher	Measure 1: 86% of the students correctly answered 70% or higher	Measure 1: Students were very successful for this learning outcome	Measure 1: No curricular or pedagogical changes needed at this time
LS1: Levels of Organization	Measure 1: 5 Multiple Choice Questions	Measure 1: 80% of the students correctly answered 70% or higher	Measure 1: 86% of the students correctly answered 70% or higher	Measure 1: Students were successful for this learning outcome, but it was one of the more difficult for them	Measure 1: No curricular or pedagogical changes needed at this time
LS2: Metabolism and Homeostasis	Measure 1: 5 Multiple Choice Questions	Measure 1: 80% of the students correctly answered 70% or higher	Measure 1: 84% of the students correctly answered 70% or higher	Measure 1: Students were successful for this learning outcome, but it was one of the more difficult for them	Measure 1: No curricular or pedagogical changes needed at this time

Evidence of Learning: General Education Area [LS]					
Measurable Learning Outcome Students will…	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
LS3: Genetics and Evolution	Measure 1: 7 Multiple Choice Questions	Measure 1: 80% of the students correctly answered 70% or higher	Measure 1: 73% of the students correctly answered 70% or higher	Measure 1: Students were somewhat successful for this learning outcome	Measure 1: This area needs to be emphasized in future years.
	Measure 2: Project 1, describing a hypothetical speciation event	Measure 2: 80% of the students correctly answered 70% or higher	Measure 2: 100% of the groups scored 70% or higher	Measure 2: Students were very successful for this learning outcome	Measure 2: No curricular or pedagogical changes needed at this time
LS4: Ecological Interactions	Measure 1: 4 Multiple Choice Questions	Measure 1: 80% of the students correctly answered 70% or higher	Measure 1: 85% of the students correctly answered 70% or higher	Measure 1: Students were very successful for this learning outcome	Measure 1: No curricular or pedagogical changes needed at this time
	Measure 2: Final project, examining the value of oil and water	Measure 2: 80% of the students correctly answered 70% or higher	Measure 2: 95% of the students scored 70% or higher	Measure 2: Students were very successful for this learning outcome	Measure 2: No curricular or pedagogical changes needed at this time

*At least one measure per objective must be a direct measure; indirect measures may be used to supplement direct measure(s).

Additional narrative (optional – use as much space as needed):
The students were successful at meeting most of the learning outcomes, and struggled most with genetics and evolution. Because this was the first time teaching the course with a greater emphasis on projects, in preparation for the new gen-ed requirements, the students were somewhat less prepared for the exams. I plan to add quizzes or homework to help them prepare for this form of assessment in addition to their projects.

Botany LS 1403 (Environment Appreciation), Spring 2018 (86 students)

Evidence of Learning: General Education Area [LS]					
Measurable Learning Outcome Students will…	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 1: S1: Nature of Science	a) 4 multiple choice questions on 1 exam b) 1 multiple choice questions on final exam	a) 80% of students achieving 70 % or higher on multiple choice exam questions b) 80% of students achieving 70 % or higher on multiple choice exam questions	a) 85% of students achieved 70% or higher on questions b) 96% of students achieved 70% or higher on questions	Students successfully demonstrated an understanding of the nature of science.	None
Learning Outcome 2: S2: Integration of Science	a) 2 multiple choice questions on 1 exam	a) 80% of students achieving 70 % or higher on multiple choice exam questions	b) 92% of students achieved 70% or higher on questions	Students successfully demonstrated an understanding of the nature of science.	None
Learning Outcome 3: S3: Science and Society	a) 2 multiple choice questions on exam 1 b) 6 multiple choice questions on exam 2 c) 3 multiple choice questions on the final exam	a) 80% of students achieving 70 % or higher on multiple choice exam questions b) 80% of students achieving 70 % or higher on multiple choice exam questions c) 80% of students achieving 70 % or higher on multiple choice exam questions	a) 92% of students achieved 70% or higher on questions b) 74% of students achieved 70% or higher on questions c) 64% of students achieved 70% or higher on questions	Students successfully demonstrated an understanding of science and society.	None Collectively, across the three exams students met the threshold

Evidence of Learning: General Education Area [LS]					
Measurable Learning Outcome Students will…	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Learning Outcome 4: S4: Problem Solving and Data Analysis	a) 4 multiple choice questions on 1 exam b) 2 multiple choice questions on Final Exam	a) 80% of students achieving 70 % or higher on multiple choice exam questions b) 80% of students achieving 70 % or higher on multiple choice exam questions	a) 83% of students achieved 70% or higher on questions c) 80% of students achieved 70 % or higher on multiple choice exam questions	Students successfully demonstrated an understanding of problem solving and data analysis	None
Learning Outcome 5: LS1: Levels of Organization	a) 3 multiple choice questions on exam 1	a) 80% of students achieving 70 % or higher on multiple choice exam questions	a) 24% of students achieved 70% or higher on questions	Students did not successfully demonstrated an understanding of the levels of organization.	Ask more questions in this category on Exam 1. Many got 2/3 questions correct (>80%) but that puts them at a 67%.
Learning Outcome 6: LS2: Metabolism and Homeostasis	a) 3 multiple choice questions on exam 2 b) 1 multiple choice questions on Final Exam	a) 80% of students achieving 70 % or higher on multiple choice exam questions b) 80% of students achieving 70 % or higher on multiple choice exam questions	a) 45% of students achieved 70% or higher on questions b) 90% of students achieved 70% or higher on questions	Students successfully demonstrated an understanding of metabolism and homeostasis.	Ask more questions in this category on Exam 2. Many got 2/3 questions correct (~92%) but that puts them at a 67%. If you combine the questions from Exam 1 and 2 then you get over 80% (87%) at 75%
Learning Outcome 7: LS3:	a) 13 multiple choice questions on exam 1	a) 80% of students achieving 70 % or higher on multiple choice exam questions	a) 82% of students achieved 70% or higher on questions	Students successfully demonstrated an understanding of	None

Evidence of Learning: General Education Area [LS]					
Measurable Learning Outcome Students will…	Method of Measurement	Threshold for Evidence of Student Learning	Findings Linked to Learning Outcomes	Interpretation of Findings	Action Plan/Use of Results
Genetics and Evolution	b) 6 multiple choice questions on final exam	b) 80% of students achieving 70 % or higher on multiple choice exam questions	b) 73% of students achieved 70% or higher on questions	genetics and evolution.	
Learning Outcome 8: LS4: Ecological Interactions	a) 1 multiple choice question and 1 essay question on Exam 1 b) 9 multiple choice questions on the final exam	a) 80% of students achieving 70 % or higher on multiple choice exam questions b) 80% of students achieving 70 % or higher on multiple choice exam questions	a) 49% of students achieved 70% or higher on questions b) 65% of students achieved 70% or higher on questions	Students did not successfully demonstrated an understanding of ecological interactions	Ask more questions on exams in this category and send more time on the biodiversity and ecological services assignments and lectures.

Appendix H. New Botany curriculum map and learning outcomes

GOAL 1: Breadth across three major subdisciplines of Botany - 1) Molecular, Cellular, & Developmental; 2) Anatomy,Physiology & Organismal; and 3) Ecology & Evolution
Outcome: Students are able to describe and explain fundamental topics in three major subdisciplines of Botany

	Topic is not addressed
	Topic is introduced in the course
	Topic is emphasized in the course
	Topic is the principle focus of the course
	Variable

Courses	Cellular, Developmental, Genetics, & Molecular		Anatomy, Physiology, & Organismal	Ecology and Evolution	
	The chemical and molecular machinations operating within all biological processes	The centrality of genetic systems' governance of life's actions from the cellular to the phyletic	The coordinated regulation of integrated cellular systems and their effect on the physiological functioning of organisms	The dynamic interaction of living systems with each other and their environments	The transforming role of evolution in changing life forms and how evolution explains both the unity and diversity of life.
LS1203 (Plant Biology)					
LS1303 (Plants in Human Affairs)					
LS1403 (Environment Appreciation)					
2104 (Plant Form & Function)					
2114 (Evolutionary Survey of Plants)					
2121 (Career Planning)					
2203 (Home & Garden)					
2303 (Ethnobotany)					
2413 (Natural Resource Management)					
2600 (Lab Safety)			?		
3105 (Anatomy of Vascular Plants)					
3153 (Biology of the Plant Cell)					

Courses	Cellular, Developmental, Genetics, & Molecular		Anatomy, Physiology, & Organismal	Ecology and Evolution	
	The chemical and molecular machinations operating within all biological processes	The centrality of genetic systems' governance of life's actions from the cellular to the phyletic	The coordinated regulation of integrated cellular systems and their effect on the physiological functioning of organisms	The dynamic interaction of living systems with each other and their environments	The transforming role of evolution in changing life forms and how evolution explains both the unity and diversity of life.
3204 (Plant Physiology)					
3214 (Soils)					
3303 (Plant Genetics)					
3403 (Environment Appreciation)					
3454 (Plant Ecology)					
3473 (Plant Geography)					
3504 (Mycology)					
3583 (Medicinal Plants)					
3624 (Taxonomy of Vascular Plants)					
3643 (Intermountain Flora)					
4113 (Plant Evolution)					
4252 (Cell Culture)					
4750 (Topics in Botany)					
4950 (Advanced Field Botany)					
4800 (Individual Research)					
4840 (Thesis Readings)					
4850 (Thesis Research)					
4890 (Co-Op Work Experience)					
4970 (Botany Thesis)					
4980 (Portfolio Summative Assessment)					
4990 (Seminar in Botany)					
Math 4950 (Statistics for Sciences)					

GOAL 2: Biology Core Compentencies

	Topic is not addressed
	Topic is introduced in the course
	Topic is emphasized in the course
	Topic is the principle focus of the course
	Variable

Courses	**The Process of Science:** Students will use observational strategies to test hypotheses and critically evaluate experimental evidence.	**Quantitative Reasoning:** Students will represent diverse experimental data sets graphically and apply statistical methods to them.	**Communication:** Students will disseminate results of experiments in a variety of presentation formats to a wide variety of audiences	**Sustainability:** Students will use their knowledge of biology to address environmental issues and solutions.
LS1203 (Plant Biology)				
LS1303 (Plants in Human Affairs)				
LS1403 (Environment Appreciation)				
2104 (Plant Form & Function)				
2114 (Evolutionary Survey of Plants)				
2121 (Career Planning)				
2203 (Home & Garden)				
2303 (Ethnobotany)				
2413 (Natural Resource Management)				
2600 (Lab Safety)				
3105 (Anatomy of Vascular Plants)				
3153 (Biology of the Plant Cell)				
3204 (Plant Physiology)				
3214 (Soils)				

Courses	**The Process of Science:** Students will use observational strategies to test hypotheses and critically evaluate experimental evidence.	**Quantitative Reasoning:** Students will represent diverse experimental data sets graphically and apply statistical methods to them.	**Communication:** Students will disseminate results of experiments in a variety of presentation formats to a wide variety of audiences	**Sustainability:** Students will use their knowledge of biology to address environmental issues and solutions.
3303 (Plant Genetics)				
3403 (Environment Appreciation)				
3454 (Plant Ecology)				
3473 (Plant Geography)				
3504 (Mycology)				
3583 (Medicinal Plants)				
3624 (Taxonomy of Vasculaar Plants)				
3643 (Intermountain Flora)				
4113 (Plant Evolution)				
4252 (Cell Culture)				
4750 (Topics in Botany)				
4950 (Advanced Field Botany)				
4800 (Individual Research)				
4840 (Thesis Readings)				
4850 (Thesis Research)				
4890 (Co-Op Work Experience)				
4970 (Botany Thesis)				
4980 (Portfolio Summative Assessment)				
4990 (Seminar in Botany)				
Math 4950 (Statistics for Sciences)				

GOAL 3 : develop and refine skills in the 3 subdisciplines										
		Topic is not addressed								
		Topic is introduced in the course								
		Topic is reinforced in the course								
		Topic is the principle focus of the course								
		Variable								
	Lab				Field				Data Management	
Courses	Basic Lab Techniques	Molecular	Microscopy Techniques	Safety	Navigation	Plant Identification	Plant Community Sampling	Safety	Record Keeping	Software Applications
LS1203 (Plant Biology)										
LS1303 (Plants in Human Affairs)										
LS1403 (Environment Appreciation)										
2104 (Plant Form & Function)										
2114 (Evolutionary Survey of Plants)										
2121 (Career Planning)										
2203 (Home & Garden)										
2303 (Ethnobotany)										
2413 (Natural Resource Management)										
2600 (Lab Safety)										
3105 (Anatomy of Vascular Plants)										
3153 (Biology of the Plant Cell)										
3204 (Plant Physiology)										
3214 (Soils)										
3303 (Plant Genetics)										
3403 (Environment Appreciation)										
3454 (Plant Ecology)										
3473 (Plant Geography)										
3504 (Mycology)										
3583 (Medicinal Plants)										
3624 (Taxonomy of Vasculaar Plants)										
3643 (Intermountain Flora)										
4113 (Plant Evolution)										
4252 (Cell Culture)										
4750 (Topics in Botany)										
4950 (Advanced Field Botany)										
4800 (Individual Research)										
4840 (Thesis Readings)										
4850 (Thesis Research)										
4890 (Co-Op Work Experience)										
4970 (Botany Thesis)										
4980 (Portfolio Summative Assessment)										
4990 (Seminar in Botany)										
Math 4950 (Statistics for Sciences)										

Appendix I: Complete Botany Student Portfolio and Grading Rubrics

This is the portfolio description and rubric that was used for the 2013-2018 assessments.

What is a Student Portfolio?

A portfolio is a multidimensional collection of both student and faculty selected educational works. This collection contains both developmental as well as representational materials and is well-organized and readily revisable. The material represents knowledge literacy, skills mastery, and affective development. This collecting exercise empowers students while giving new dimensions to the purpose of their education. Portfolios are used for assessment purposes in addition to serving as an incentive to the student for developing good habits in assembling and organizing materials of relevance to themselves and others, such as personnel managers or graduate school selection committees. "Folder" topics of the Botany Portfolio are listed below but be mindful of the fact that some materials will be used in more than one folder, therefore, cross-reference such material rather than duplicate it.

(1) Knowledge and Comprehension

Upon graduation, Botany majors should have a thorough **knowledge and comprehension** of the **core concepts** in the discipline of Plant Biology. These include the fact that:

(a) Plants are *like* other organisms in regard to: basic metabolism, sexual reproduction, clonal reproduction, hormonally regulated development, ability to respond to the environment, diversity and evolution.

(b) Plants are *unique* organisms in: their varied life histories - especially a sporic one with alternation of generations; their role as primary producers in food webs, serving as the interface organisms between the organic and inorganic worlds *via* mineral assimilation and photosynthesis; and the oxygenation of the atmosphere.

(c) Plants serve as an important source of products: food, fiber, flavorings, feed, fuel, pharmaceuticals, etc.

- Course syllabi for all Botany and Support courses.
- Completed *"Advising Summary"* Sheet.
- Copy of the most recent *TRANSCRIPT*.
- Exit interview summary.
- Optional: If a GRE (or similar) exam is taken, a copy of the record received should be included in the portfolio.

(2) Skills Development

Upon graduation, Botany majors should have mastered a set of fundamental **skills** which would be useful to function effectively as professionals and to their continued development and learning within the field of Plant Biology. Evidence of mastery of each skill must be presented.
These skills include the following:

a. **Communication Skills:** Botany graduates will be required to demonstrate competence in communication, both written and oral, and present the results of their research in senior theses, senior capstone courses, and in all upper-division courses where such communication is expected and evaluated by both their peers and the instructor.

(i) ***Writing Skills*** - any graded written assignments, in Botany courses or other, such as poems or short stories in an English class. Included shall be date, course number and title, instructor, purpose of the assignment (if known), etc. Included here shall be an annotated reading list, with abstracts of papers, articles, or books that were both read and had a significant impact upon the student. We believe that such reflections causes us to identify with the *pivotal* impacts in our lives that changed our paradigm. This component shall also demonstrate ***critical thinking, reasoning, and effective argument skills***. CRITICAL THINKING as used here contains the following elements:

- Determining cause-and-effect relationships
- Differentiating between fact and opinion
- Recognizing and evaluating author bias and rhetoric
- Determining the accuracy and completeness of information presented
- Recognizing logical fallacies and faulty reasoning
- Comparing and contrasting information and points of view
- Developing inferential skills
- Making decisions and sound judgments by drawing logical conclusions using quantitative or statistically-based reasoning

Critical thinking does not exclude imaginative and speculative thinking as it applies to science in general and botany specifically. To the extent that critical thinking skills are discipline-specific, students should understand that science and its methodology is a way of knowing.

(ii) ***Speaking Skills*** - any oral presentation(s) given in courses or extracurricular events. Include title of talk, abstract, date, location of talk, & type of audience. Sample of evaluations using the *Oral Presentation Evaluation Form* as used by the Department of Botany should be included.

b. ***Computer Skills***- Botany graduates should be competent users of computer software including, but not limited to, wordprocessing, spreadsheet, graphing, and web-search programs. Such skills are also imperative for organizing their required portfolios. Evidence may include any courses taken or training (certificate) received. List of programs student can use, including version (WP 9.0 vs. 8.0, Mac vs. PC, etc.). Include hard copy of work.

c. ***Field and Laboratory Research Skills:*** Majors should be competent observers and experimentalists, whether such research takes place in the field or in the laboratory. They should be able to design & execute experiments, collect and analyze data, and interpret the results using logic.

d. ***Problem-Solving Skills:*** Botany majors should be competent problem-solvers. They should be able to assess the elements of a problem and develop and test a solution based on logic and the best possible information. Evidence of problem-solving skills development should appear in the capstone experience portion of the portfolio, however, draw specific attention to the evidence at this point in the portfolio.

e. ***Self-Assessment Skills:*** Graduates should be able to demonstrate progress in the development of their ability to make a realistic appraisal of growth in all three domains of learning (cognitive, conative, and affective). They should be able to identify, evaluate and explain major, if not pivotal, influences in their development as a botanist. Evidence of such skill development might be a statement of personal and professional goals, assessment of progress toward these goals, assessment of major accomplishments, individual strengths and weaknesses, etc. What experiences have you had that demonstrates strengths and weaknesses. Written evaluation of experiences should be made, for example: was a particular course or relevant experience useful, enjoyable, and why (include support courses as well as Botany courses.) What was science fair judging like and what did you learn from that experience? If you attended a conference and presented a paper, how did you do? How did the audience react and why? Giving this area considerable thought will pay enormous dividends.

f. ***Cooperation/Social Responsibility Skills:*** Graduates ought to understand and appreciate the value of cooperating and working effectively with peers and be able to demonstrate a commitment to the process of developing such skills. Included here also is valuing: democracy, equal opportunity, work ethic and ongoing personal growth and renewal. Students might consider as evidence such things as written recommendations from those with knowledge of such skills, assessments by supervisors on cooperative work experiences, employers who have placed students in a position to gain such skills on the job, etc.

g. ***Information Seeking Skills:*** For success in college and for lifelong learning, graduates must be able: to recognize when information is needed; to identify appropriate types of information; and to locate, evaluate, and use information effectively, ethically, and legally.

(3) Special Achievements

a. Letters/Certificates of commendation, recognition, special achievements, awards, etc.
b. Newspaper clippings of articles featuring the student.
c. Anything by the student that was published - newspaper article, book review, research paper, etc.
d. Letters of recommendations which are not confidential
e. Presentation at a conference. We encourage students to participate at regional conferences like the National Undergraduate Research Conference; the National Honors Conference; Utah Academy of Arts, Letters, and Sciences; Western Regional Honors Conference; Weber State Chapter of Tri-Beta Honor Society; Weber State Chapter of Sigma Xi; West Coast Biological Sciences Undergraduate Research Conference; etc.
f. Membership in professional societies (Most student rates for membership are so low there is no reason for an interested student not to belong. Examples include Sigma Xi and Tri-Beta). Botany students have an opportunity to hold office in the local chapter of Tri-Beta or other organizations on campus.

(4) Capstone Experiences

a. **Senior Project/Thesis:** To be written according to the guidelines in the *"Botany Senior Thesis"* section of the *"Botany Student Handbook".* This shall include an annotated list or summary of pertinent papers, books, notes, diaries, letters, etc., read in conjunction with the project. Laboratory notebook(s), field notebook(s), with objectives, plans, procedures adopted, observations, measurements, graphs, tables, conclusions, etc. connected with the

project should be included. Include title and abstract of oral presentation of senior project or thesis given at the senior seminar or formal presentation before your thesis advisory committee.

b. **Other Field and Laboratory Research:** As records of field and/or laboratory research as part of senior courses are kept, select ones should be used as evidence of research skills gained. Botany majors should be competent observers and experimentalists, whether such research takes place in the field or in the laboratory. They should be able to design and execute experiments, systematically collect and analyze data, identify sources of error, and interpret the results and reach logical conclusions. They should also have a basic understanding of laboratory and field safety issues and demonstrate that such understanding has been achieved.

(5) Creativity

This folder provides the student with an opportunity to demonstrate their creative talents and individuality using whatever medium the student selects. This could be related or unrelated to Botany. Considerable overlap with other folders could be expected. If the student feels that there is no possibility for meeting this requirement, at a minimum, the student shall write a paper wherein s/he demonstrates the ability to apply some mathematical skill or principle in solving a botanical problem. Any ***Unique Skills*** development should be included here such as special training or hobby development. Evidence of any workshop attended, including subject, date, location, presenter, and synopsis. Catalogs of collections of photographic slides or prints, microscope slides, herbarium specimens, etc. could be used. Include photographs of representative samples of such work since some projects are difficult to store in a folder, such as a display made for a museum cabinet, special laboratory apparatus, etc. A particularly well maintained laboratory and/or field notebook might qualify as well.

(6) Affective Domain Development

Upon graduation, Botany majors should demonstrate significant value-added progress in developing the following **values**:

(d) *Appreciation* of the *diversity* of cultures and intellectual points of view.

(e) *Understanding* of *ethical issues* and responsibilities such as the environmental costs of excessive consumerism, impacts of technology upon society, etc.

(f) *Commitment* to the development of cultural perspectives that do not disparage others solely on the basis of an individual's or group's ethnicity, gender, religion, sexual orientation, marital status, age or disability.

(g) *Appreciation* that Botany follows the *Liberal Arts* tradition which is based upon the notion that, in a world of ideas, a person is not free or liberated from the bonds of ignorance if s/he makes decisions based upon closed-minded habits, prejudices, or unconscious emotions that preclude critical thinking. Additionally, graduates will need to demonstrate growth in their social obligation to communicate with the public on scientific and technical issues.

(h) *Appreciation* of the *aesthetic* attributes of nature, whether their studies are primarily in the field where entire ecosystems or biomes are investigated or in the laboratory where the microscope and biochemical techniques are used as

tools for observing nature. Evidence of growth in the development of the affective domain is likely to be the most difficult to gather. Creativity and considerable thought will need to be exercised to meet this criterion. Experiences gained from such things as travel, either domestic or foreign; working with minority or disadvantaged groups of people; courses taken which address ethics or aesthetics, particularly as it relates to you as a Botanist; etc. upon reflection could be written up and become supporting evidence of such growth.

(7) Career Planning

a. ***Employment/Graduate School Assessment:*** Students shall provide evidence that they have researched the job market, have knowledge of careers for Botanists and professionals in allied plant sciences, or have researched graduate school programs and assessed their suitability for advanced degree studies relative to their own professional interests and strengths. This evidence may take various forms left to the discretion of the student.

b. ***Résumé:***

(i) Work experience - Any activity for which the student was paid, e.g. Botany tutor, Supplemental Instructor, Forest Service summer employment, museum curating, etc. Maintain a list of dates, places, duties/assignments, etc.

(ii) Volunteer service - Science fair judging, Expanding Your Horizons conference, Science Olympiad, Botany Laboratory, Center for Environmental Services Conference, etc. are examples. This should not simply be a list of activities, but include details of when and where it was done, and what the student actually did.

(iii) Extracurricular activities - Botany Club plant sale, Botany Club officer, ECOS officer, etc. (Including achievements and duties - e.g. arranged for the following speakers, chaired the following sub-committees, etc.)

c. ***Curriculum Vita:*** A current, updated and neatly printed vita, essentially representing a selection of materials from each of the other folders would be expected of the student. This would assist greatly in future employment searches or graduate school placement.

(8) Science as Process

All students who are exposed to Botany courses (majors, minors, support, and General Education students) should **understand and appreciate**, in addition to the core knowledge of Plant Biology, the nature of science, how science is applied to everyday problems, and significant botanical achievements. Teaching majors and minors should become aware of teaching strategies that accommodate multiple learning styles of their prospective students. For this folder of the portfolio a suggested means of providing evidence of understanding and appreciation of the nature of science as a process and a way of knowing, along with applications to everyday problems might be to prepare an ***outline of a lecture***, designed for a varied audience in terms of science background that would deal with these topics. The outline would address:

What is science? How is scientific inquiry carried out? How do we apply scientific methodology to solving everyday problems? What significant botanical achievements were made using these techniques? Those students who are contemplating teaching biology should, in addition, address current teaching strategies, through lesson plans, that not only deliver life science to students but demonstrates some understanding and sensitivity to the need for multiple learning styles of these prospective students.

Portfolio Scoring Rubric

Each folder will be scored on a 0-4 scale according to the attached rubric. Each raw score is then multiplied by that particular folder's weight factor. The weighted scores are added up to give a final score and grade which correspond to the WSU 0-4 grade point scale.

Folder	**Raw Score (0-4)**	**Weight Factor**	**Weighted Score**
1.A. Botany Student Essay		0.30	
1. B-E. Course Syllabi Most Recent Transcript, GRE (optional), etc.		0.05	
2. Skills Development a. Communication Skills (i) Writing Skills (ii) Speaking Skills b. Computer Skills c. Field and Laboratory Research Skills d. Problem-Solving Skills e. Self-Assessment Skills f. Cooperation/Social Responsibility Skills g. Information Seeking Skills		0.05	
3. Special Achievements		0.05	
4. Capstone Experience a. Senior Project/Thesis b. Other Field and Laboratory Research		0.15	
5. Creativity		0.10	
6. Affective Domain (a) *Appreciation* of the *diversity* of cultures, etc. (b) *Understanding* of *ethical issues* & responsibilities (c) *Commitment* to development of cultural perspectives (d) *Appreciation* that Botany follows the *Liberal Arts t*radition (e) *Appreciation* of the *aesthetic* attributes of nature		0.05	
7. Career Planning a. employment/graduate school assessment b. résumé		0.05	
8. Science as a Process ***outline of a lecture***, designed for a varied audience		0.15	
Overall Presentation of the Portfolio		0.05	
	Total Score		

Portfolio Essay Grading Rubric

	weight	raw score (0-4)	weighted score
Mechanics	0.10		
References	0.10		
Illustrations	0.05		
Introduction and Conclusion	0.10		
Body of the Essay level depth use of specific examples accuracy 13 topics @ 0.05 each Plants are like other organisms in regard to: a. basic metabolism b. sexual reproduction c. clonal reproduction d. hormonally regulated development e. ability to respond to the environment f. diversity g. evolution Plants are unique organisms in: a. their varied life histories - especially a sporic one with alternation of generations b. their role as primary producers in food webs c. their role as the interface organisms between the organic and inorganic worlds via: i. mineral assimilation ii. photosynthesis d. the oxygenation of the atmosphere Plants serve as an important source of products: food, fiber, flavorings, feed, fuel, pharmaceuticals, etc.	0.65		
		Total	

Mechanics
4 = essentially free of typos, spelling errors, format errors, grammar errors, etc.
3 = substantially free of typos, spelling errors, format errors, grammar errors, etc. Errors do not detract from the essay.
2 = mechanical errors detract from the essay, but the narrative of the essay can still be followed.
1 = mechanical errors detract from the essay to the point that the narrative of the essay is difficult to follow.
0 = Mechanical errors render the essay unreadable.

References
4 = over 20 references are cited; over 8 of the references are from the primary literature

3 = 15-20 references are cited; 5-8 of the references are from the primary literature
2 = minimum reference requirement met
1 = minimum reference requirement not met: less than five references from the primary literature; less than 15 references total
0 = no references from the primary literature

Illustrations (Figures and Tables)
4 = The illustrations enhance the essay and their reason for inclusion is clear. Illustrations are captioned and attributed.
3 = It is not clear why some of the illustrations were included. Captions and attributions are not always complete.
2 = It is not clear why some of the illustrations were included. It is apparent that additional illustrations could have been used. Captions and attributions are not always complete.
1 = Illustrations are included to avoid a score of zero.
0 = No illustrations.

Introduction and Conclusion
4 = All of the information asked for in the guidelines is present. The narrative flows easily, with smooth transitions between the subjects that need to be included.
3 = Some of the information is missing. Otherwise, as in 4.
2 = Some of the information is missing. The narrative is choppy and reads like a list. Transitions are not effective.
1 = Either the Introduction or the Conclusion is essentially missing.
0 = Both the Introduction and the Conclusion are essentially missing.

Body of the Essay
Scoring is per topic. A missing topic scores 0.
4 = The level of coverage is that which would be expected of a student who has mastered upper division course work. The student makes use of specific plants and appropriate illustrations to demonstrate the points being made about the topic. The information is accurate and referenced. The narrative flows well with smooth transitions.
3 = The level of coverage is that which would be expected of a student who has mastered upper division course work. For the most part, the student makes use of specific plants and appropriate illustrations to demonstrate the points being made about the topic. For the most part, the information is accurate and referenced. The narrative flows well with smooth transitions.
2 = The level of coverage is that which would be expected of a student who has mastered lower division course work. The student occasionally makes use of specific plants and appropriate illustrations to demonstrate the points being made about the topic. Inaccuracies detract from the essay. The information is poorly referenced. The narrative is choppy.
1 = The level of coverage is at or below that which would be expected of a student who has mastered lower division course work. The student rarely makes use of specific plants to demonstrate the points being made about the topic. Illustrations are rare. Inaccuracies detract from the essay. Information is not referenced. The narrative is choppy.
0 = The topic is either missing or very poorly covered. The level of coverage is below that which would be expected of a student who has mastered lower division course work