

Environmental Science

Bachelor of Science

Program Overview

Environmental Science allows students to investigate and seek out natural solutions to environmental problems, learning to preserve, restore, manage, and support both the living and nonliving components of our fragile ecosystems in order to ensure a healthy environment. Students have the opportunity to specialize in the following areas: Ecosystem Restoration, Environmental Molecular Science, Environmental Science Education, Soil Resources and Environmental Sustainability, and Water Science.

In the Ecosystem Restoration specialization, students will study how ecosystems (both land and water) function at the physical, biological, and chemical level. This specialization is aimed at giving students the knowledge needed to preserve, create and restore our fragile ecosystems. Students will take classes in ecosystem science and restoration as well as methods.

The Environmental Molecular Science specialization looks for answers to environmental challenges by studying their smallest components, analyzing chemical and biological processes on the scale of a single atom, molecule, and cell. It is particularly suited for students wishing to pursue an advanced degree from graduate school in the fields of environmental microbiology, geobiology, or biogeochemistry.

The Environmental Science Education specialization couples scientific coursework with interpretation and communication skills. It is particularly suited for those who want to pursue a Master of Education to become an environmental science teacher. Students will take classes in science education, ecosystem science, and methods for ecosystem restoration.

In the Soil Resources and Environmental Sustainability specialization, students focus on sustaining and improving soil quality to ensure a healthy environment. Students will take classes in biology, microbial ecology, chemistry, earth sciences, ecology, hydrology, mineralogy, mathematics, and physics.

In the Water Science specialization, students address the role that freshwater plays in our human and natural systems, competing and growing demands for water, and the influences of changes in climate and land-use on our water resources. Students will take courses in ecology, geology, physics, hydrology, water resources, wetland ecology, civil engineering, aquatic plants, soil chemistry, climatology, limnology, and environmental microbiology.

Program Learning Goals & Outcomes

Goal 1.0

Have the ability to think critically in solving problems addressed by environmental science

Outcome 1.1

Describe what critical thinking is, how evidence is used to develop an argument, and how to avoid errors in critical thinking

Outcome 1.2

Evaluate the extent to which critical thinking is employed in a group research project related to environmental science, forestry/fisheries/wildlife science and management, natural resource management, environmental policy and decision making, or similar fields related to environmental sustainability

Outcome 1.3

Apply critical thinking to a real-world environmental issue in which the role of the soil is central, such as food security, land degradation, carbon cycle/global change, downstream water quality

Outcome 1.4

Critically analyze a current environmental or natural resources issue at a local, regional, state level, how a broad range of stakeholders are engaged in the issue, how concepts and issue-solving skills learned to-date can be applied to the issue, how possible means to address the issue may be received by stakeholders from environmental, social, and economic perspectives, and how to evaluate and communicate supportable and realistic solutions through a team effort

Outcome 1.5

Demonstrate critical thinking in solving environmental problems

Goal 2.0

Know how to apply theoretical concepts of environmental science to address contemporary environmental issues

Outcome 2.1

Relate concepts from social science theories to describe human dimensions of real-world environmental challenges

Outcome 2.2

Relate concepts from environmental science and environmental policy and management to address contemporary environmental issues

Outcome 2.3

Apply theory to professional practice in solving environmental problems

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THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES

Assessment Findings

Reporting Synopsis

Data from identified methods (measures) were collected and reported as evidence of achievement of program learning goals via supporting outcomes (objectives) for the 2012-2016 assessment reporting cycles. Collectively in periodic meetings (review colloquy) the CFAES Office for Teaching, Learning, and Assessment and the assessment contact for the Environmental Science program elaborated upon the process by which the program was going to review and use evidence (findings/results). They also discussed the procedure which was going to be followed for taking future actions and examined the approach for future planning for the program. One of the primary topics of discussion at these meetings was exploring how the information gathered about student learning was to be shared with the division's faculty, instructional staff, and leadership, and how to use it for improvement of learning outcomes.

This document, the *Assessment Executive Summary* which is a collaborative report compiled from the information submitted by the academic unit's assessment contact(s) to the Office for Teaching, Learning, and Assessment, is to serve as a mechanism for sharing the status of the program's assessment activities and results with the program faculty and instructional staff, unit and college leadership, stakeholders, the unit's Committee on Academic Affairs, the college's Assessment Committee and CFAES Committee on Academic Affairs.

This summary covers 18 of the 29 identified methods for the 28 supporting outcomes of the 8 program learning goals of this program learning outcomes assessment plan were reviewed during the 2012-2016 assessment reporting cycle.

Use of Assessment Findings

Use and Actions Taken

Any changes and/or modifications to this program and/or its learning outcomes assessment plan resulting from these assessment results were explored while reflecting upon collected and reported assessment data during the annual Autumn semester review colloquy. Resulting desired adjustments were then enacted during the following assessment reporting cycle.

The program's coordinator, assessment contact, the CFAES Office for Teaching, Learning, and Assessment, and other faculty and instructional staff has examined the program, its supporting course work, and the related assessment findings on an ongoing basis to formulate recommendations for incremental change.

Areas for which assessment data has and will be used include:

- Analyzing and discussing trends with the unit's faculty
- Analyzing and reporting to college/school
- Making improvements in curricular requirements
- Making improvements in course content
- Making improvements in course delivery and learning activities within courses
- Making improvements in learning facilities, laboratories, and/or equipment
- Periodically confirming that current curriculum and courses are facilitating student attainment of program goals



Program Learning Goals & Outcomes (Continued)

Goal 3.0

Communicate effectively in oral and written forms

Outcome 3.1

Demonstrate a basic level of sufficiency in written communication

Outcome 3.2

Demonstrate a basic level of sufficiency in oral communication

Outcome 3.3

Communicate technical information with correct spelling and grammar, logically organized, and with technical style and format that is appropriate to the discipline for oral and written forms of communication

Outcome 3.4

Communicate effectively in written and oral forms in professional settings following graduation

Goal 4.0

Understand natural systems with breadth across biotic and abiotic components

Outcome 4.1

Apply theoretical concepts in environmental science to understand how Earth's biotic and abiotic systems function, how humans affect the environment, and how to achieve global sustainability

Outcome 4.2

Demonstrate an understanding of abiotic components of natural systems, such as illustrating elements of the hydrologic cycle, and integration of the abiotic and biotic systems, such as illustrating elements of the carbon and nitrogen cycles

Outcome 4.3

Demonstrate a comprehension of the structure and dynamics of populations and communities in relation to sustaining resource production and biological diversity

Outcome 4.4

Apply understanding of natural systems with breadth across biotic and abiotic components in professional settings

Goal 5.0

Understand human systems with breadth across individual, community, and polity levels of organization

Outcome 5.1

Identify concepts, theories and examples relevant to understanding human systems across individual, community, and polity levels of organization

Outcome 5.2

Appraise the nature and values of organizations and polities and their importance in social problem solving and policy making related to environmental and natural resource issues

Outcome 5.3

Apply understanding of human systems with breadth across individual, community, and polity levels of organization in professional settings

Goal 6.0

Understand coupled systems, human and natural, and their relevance to problems addressed by environmental science

Outcome 6.1

Integrate information related to natural and human dimensions of contemporary environmental issues and formulate professionally appropriate recommendations to address those issues

Outcome 6.2

Illustrate the integration of information related to natural and human dimensions of contemporary environmental issues while making professionally appropriate recommendations to address those issues

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Assessment Fundamentals

What is assessment?

While there are certainly many answers to this question, in the context of the CFAES academic community, assessment is the practice of evaluating the manner or degree to which students in academic programs in our College are learning. Academic units and programs within CFAES have developed student learning outcomes, which are statements of the key indicators of student learning in specific programs. Assessment is designed to compare actual student performance to these predetermined student learning outcomes.

Assessment is used to respond to at least two concerns:

1) Are students learning what they are supposed to be learning? and 2) How can educators document that students are learning what they are supposed to be learning? While these two concerns are intertwined, they also fulfill separate functions. Concern one is primarily a question of academics: Are our teaching methods effective? Are our students learning what they should and as well as they should? What can we do to improve student learning? Concern two is aligned with continued improvement of teaching and learning. Concern two is aligned more with the issue of accountability. Education is increasingly being asked and even required to document that students know and can do what we say they can do and simple completion of course, program, and graduation requirements is not enough. Accountability requires that educators show that students can actually demonstrate what they know and can do and merely one grade on a test, a paper, or in a course is not sufficient. Accountability should flow naturally from the focus on teaching and learning.

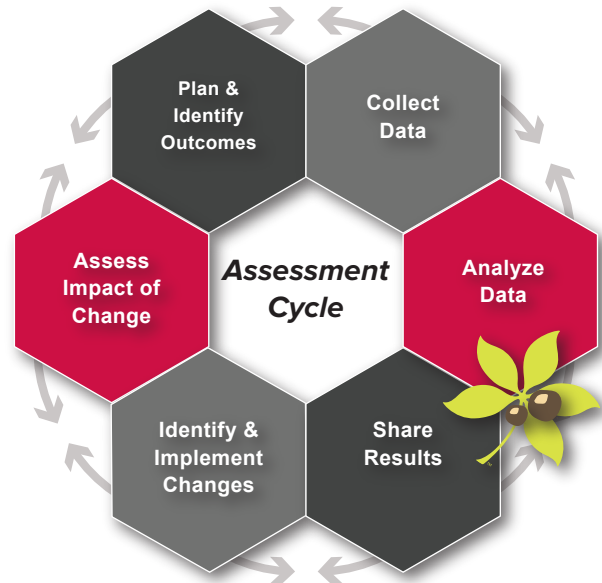
Why do assessment?

Assessment needs to take place for at least two reasons:

- 1) Assessment is designed to function as continued improvement for teaching and learning.
 - ♦ Assessment helps educators improve the manner and degree to which students learn what they are supposed to be learning.
 - ♦ Assessment provides information that allows educators to make good decisions based on quality information about student learning.
 - ♦ Assessment encourages educators to look at what they do in the classroom, how their classroom practices affect student learning, and what changes could be made in teaching methods or materials to enhance student learning.
- 2) We need to do assessment to remain accountable to the publics we serve.
 - ♦ Students and their families should be able to see what we do in teaching and learning, and what we expect of students;
 - ♦ Accrediting agencies need to know that we are effective in our teaching and learning;
 - ♦ Legislative and executive governmental bodies provide funding and need to know that these funds are accomplishing their intended purposes.

Assessment Cycle

The assessment cycle considers collection and review of data on an ongoing basis to formulate recommendations for incremental programmatic change. Accumulative findings for all program goals based on the contributing outcomes are used as the cornerstones for programmatic review. Assessment provides essential information for making strategic adjustments to the academic program, which assures continuous quality improvement with the intent of improving teaching and learning.



The language of assessment . . .

Goals: Student Learning Goals are stated in terms of achievement resulting from student learning. Goals provide a broad description identifying the foundations, concepts, theories, abstractions, principles, knowledge base, and/or skills, which are the products of what students are to be able to do, know, and care about upon the completion of the program. Learning goals are frequently stated using the verbiage of: understand; appreciate; know about; become familiar with; learn about; or become aware of. Reoccurring learning goal concepts/themes for CFAES programs are Critical Thinking, Communications, Academic and Professional Integrity, Diversity, and Knowledge.

The stated learning goals of the programs within CFAES have the inferred prefix of, “*Students will . . .*”


Outcomes: Student Learning Outcomes (SLO’s) {also commonly referred to as Expected Learning Outcomes (ELO’s) or “objectives”} are statements indicating changes in knowledge, skills, behaviors, attitudes, or values relative to a desired goal as a result of a specific activity, such as completion or participation in a program, activity, course, or project. Cognitive learning outcomes can most effectively be stated using verbs aligned with one of the six domains of the Bloom’s Taxonomy of Educational Objectives (Remembering, Understanding, Applying, Analyzing, Evaluating, or Creating). Appropriately structured outcomes serve as the supportive methods/means of measuring student attainment of the associated learning goal.

The stated expected learning outcomes of the programs within CFAES have the inferred prefix of, “*Students will have the ability to . . .*”




Assessment & Curriculum Connection

Assessment results are used in concurrence with the program curricular map to form the underpinning for informing curricular decisions and to further enhance student learning. Curricular mapping demonstrates the opportunities for students to be introduced to knowledge (beginning), opportunities for reinforcement of knowledge (intermediate), and opportunities for students to demonstrate mastery of knowledge (advanced) relative to the stated programmatic learning goals.

		Program Learning Goals B=Beginning, I=Intermediate, A=Advanced						
Courses		Have the ability to think critically in solving problems addressed by environmental science	Know how to apply theoretical concepts of environmental science to address contemporary environmental issues	Communicate effectively in oral and written forms	Understand natural systems with breadth across biotic and abiotic components	Understand human systems with breadth across individual, community, and polity levels of organization	Understand coupled systems, human and natural, and their relevance to problems addressed by environmental science	Manifest professional competency for career-track employment or graduate work in environmental science
ENR 2100 <i>Introduction to Environmental Science</i>					4.1 Apply theoretical concepts in environmental science to understand how Earth's biotic and abiotic systems function, how humans affect the environment, and how to achieve global sustainability			
ENR 2300 <i>Society and Natural Resources</i>			2.1 Relate concepts from social science theories to describe human dimensions of real-world environmental challenges			B 5.1 Identify concepts, theories and examples relevant to understanding human systems across individual, community, and polity levels of organization		
ENR 2367 <i>Communicating Environmental and Natural Resources Information</i>	1.1 Describe what critical thinking is, how evidence is used to develop an argument, and how to avoid errors in critical thinking 1.2 Evaluate the extent to which critical thinking is employed in a group research project related to environmental science, forestry/fisheries/wildlife science and management, natural resource management, environmental policy and decision making, or similar fields related to environmental sustainability			3.1 Demonstrate a basic level of sufficiency in written communication 3.2 Demonstrate a basic level of sufficiency in oral communication				

Program Learning Goals

B=Beginning, I=Intermediate, A=Advanced

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ENR 3000 <i>Soil Science</i>	/ 1.3 Apply critical thinking to a real-world environmental issue in which the role of the soil is central, such as food security, land degradation, carbon cycle/global change, downstream water quality			/ 4.2 Demonstrate an understanding of abiotic components of natural systems, such as illustrating elements of the hydrologic cycle, and integration of the abiotic and biotic systems, such as illustrating elements of the carbon and nitrogen cycles			
ENR 3300 <i>Introduction to Forest, Fisheries, and Wildlife</i>				/ 4.3 Demonstrate a comprehension of the structure and dynamics of populations and communities in relation to sustaining resource production and biological diversity			
ENR 3700 <i>Introduction to Spatial Information for Environment and Natural Resources</i>							/ 7.1 Demonstrate basic knowledge of the role of spatial information and information systems in addressing environmental and natural resource issues 7.2 Analyze spatial information relevant to natural resource and ecosystem management and resource planning by utilizing digital vertical image interpretation and geographic information systems
ENR 4000 <i>Environmental and Natural Resources Policy</i>					/ 5.2 Appraise the nature and values of organizations and their polities and their importance in social problem solving and policy making related to environmental and natural resource issues		

Program Learning Goals B=Beginning, I=Intermediate, A=Advanced						
Courses	Have the ability to think critically in solving problems addressed by environmental science	Know how to apply theoretical concepts of environmental science to address contemporary environmental issues	Communicate effectively in oral and written forms	Understand natural systems with breadth across biotic and abiotic components	Understand human systems with breadth across individual, community, and polity levels of organization	Understand coupled systems, human and natural, and their relevance to problems addressed by environmental science
	1.4 Critically analyze a current environmental or natural resources issue at a local, regional, state level, how a broad range of stakeholders are engaged in the issue, how concepts and issue-solving skills learned to-date can be applied to the issue, how possible means to address the issue may be received by stakeholders from environmental, social, and economic perspectives, and how to evaluate and communicate supportable and realistic solutions through a team effort	2.2 B Relate concepts from environmental science and environmental policy and management to address contemporary environmental issues	3.3 B Communicate technical information with correct spelling and grammar, logically organized, and with technical style and format that is appropriate to the discipline for oral and written forms of communication	Understand natural systems with breadth across biotic and abiotic components	Understand human systems with breadth across individual, community, and polity levels of organization	Understand coupled systems, human and natural, and their relevance to problems addressed by environmental science
ENR 4900.01 <i>Environment and Natural Resources Management</i>					6.1 A Integrate information related to natural and human dimensions of contemporary environmental issues and formulate professionally appropriate recommendations to address those issues	



Assessment Methods

Achievement of program learning goals are assessed systematically utilizing the identified means for the aligned learning outcomes via direct and indirect measures that serve as authentic assessment methods.

Direct

Direct assessment methods are means of assessment that measure students' performance directly, are authentic, and minimize mitigating or intervening factors. In general, direct assessment methods are assessment tools that measure student learning by having students create or perform directly based on their learning. Direct methods are the direct evaluation of aggregate student achievement on specific learning outcomes.

Indirect

Indirect assessment methods are means of assessment that are steps removed from direct methods and are based upon perception of student learning from various constituents. In general indirect assessment methods infer whether learning has taken place by asking for perception of learning, typically from students, but also from those with whom they have worked. Indirect methods are tools that enable us to infer actual student achievement, very often from student self-reports of their perception of their learning.

Within the Environmental Science program's assessment plan, the following methods have been identified as means of assessing student attainment of state learning outcomes:

Direct
Embedded Testing Student work in designated courses is collected and assessed in relation to the program learning outcomes, not just for the course grade. The assessment may be conducted at specific points in a program and the products of student work need to be considered in light of the multiple dimensions of the learning outcomes.
Writing Assignment Written display of comprehension of course topic(s). This can be done through a research report, essay, journal entry, creative writing piece, or another suitable writing method.
Capstone Course A method of summative evaluation. Student is given an opportunity to demonstrate integrated knowledge and growth in the major. May assess a student's cognitive, affective, and psychomotor learning in the major and also the overall collegiate learning experience.
Oral Presentation A classroom presentation or showcasing of the results of a particular project that has been conducted by an individual student or by a group of students in fulfilling a course assignment. The presentation might take place in a classroom or over the web and would typically present the results of a course-based assignment.
Other Direct Measure Specific course assignments also serve as assessment methods for appraising students' ability to evaluate situations while collecting accurate information to make sound decisions and solve problems.

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Scaffolding to Support Learning Outcomes Assessment

The primary purpose of program learning outcomes assessment is to assure that all students have the opportunity to learn what is truly valued by the program. It is not enough to simply collect data for the programmatic learning outcome assessment; these data must be used to reflect and examine whether learning expectations are being obtained and when weaknesses are discovered, needed changes are determined. Educators must remember that the foremost purpose of learning outcomes assessment is for programs to continually be improving the quality of the teaching and learning experiences that enable significant learning.

To assure that all students have the opportunity to learn what is truly valued by the program, the program must engage all faculty and instructional staff at some level of the assessment process. To be successful a program must also have leadership and a supportive scaffolding structure in place to facilitate its assessment efforts.

Overview

The 2012 *Environmental Science - BS* program assessment plan was crafted under the leadership of the unit assessment contact(s) for Environmental Science located on the Ohio State Columbus campus. The CFAES Office for Teaching, Learning, and Assessment coached the program's learning outcomes assessment plan development team through the process by: 1) Elucidating program learning goals and developing measurable contributing outcomes; 2) Identifying the means and methods by which the embedded assessment of learning outcomes will be achieved; 3) Defining programmatic criteria for student achievement of each identified outcome; and 4) Planning for the use and implementation in the process of generating the comprehensive program learning outcomes assessment plan.

Commitment

Development, implementation, documentation and reporting associated with the 2012 *Environmental Science - BS program learning outcomes assessment plan* are coordinated through academic unit's assessment contact(s) with adherence oversight and support provided by the CFAES Office for Teaching, Learning, and Assessment. Data collection is a collaborative endeavor between the unit's assessment contact(s), course instructors and academic advisors, and students. The assessment contact(s) partners with the CFAES Office for Teaching, Learning, and Assessment to collect, report, and review results on the basis of the Ohio State's annual assessment reporting cycle. The assessment contact(s), Environmental Science program, the School of Environment and Natural Resources, and course instructors are to review the program, its supporting coursework, and the related assessment results annually, on an ongoing basis, to formulate recommendations for incremental programmatic change to the unit's Academic Affairs Committee. With the goal of improving learning, instruction, and curriculum, indicators from a summary report of the findings are to be used to plan the incorporation of needed modifications. Accumulative findings for all program goals based on the contributing outcomes will be used as the cornerstone in the programmatic review cycle, providing essential information for making strategic adjustments to this academic program, assuring continuous quality improvement.



Program Learning Goals & Outcomes (Continued)

Goal 7.0

Outcome 7.1

Demonstrate basic knowledge of the role of spatial information and information systems in addressing environmental and natural resource issues

Outcome 7.1

Analyze spatial information relevant to natural resource and ecosystem management and resource planning by utilizing digital vertical image interpretation and geographic information systems

Outcome 7.3

Demonstrate professional competency through job placement and success in professional certification exams (soil, water, forestry, fisheries, wildlife, other)

Outcome 7.4

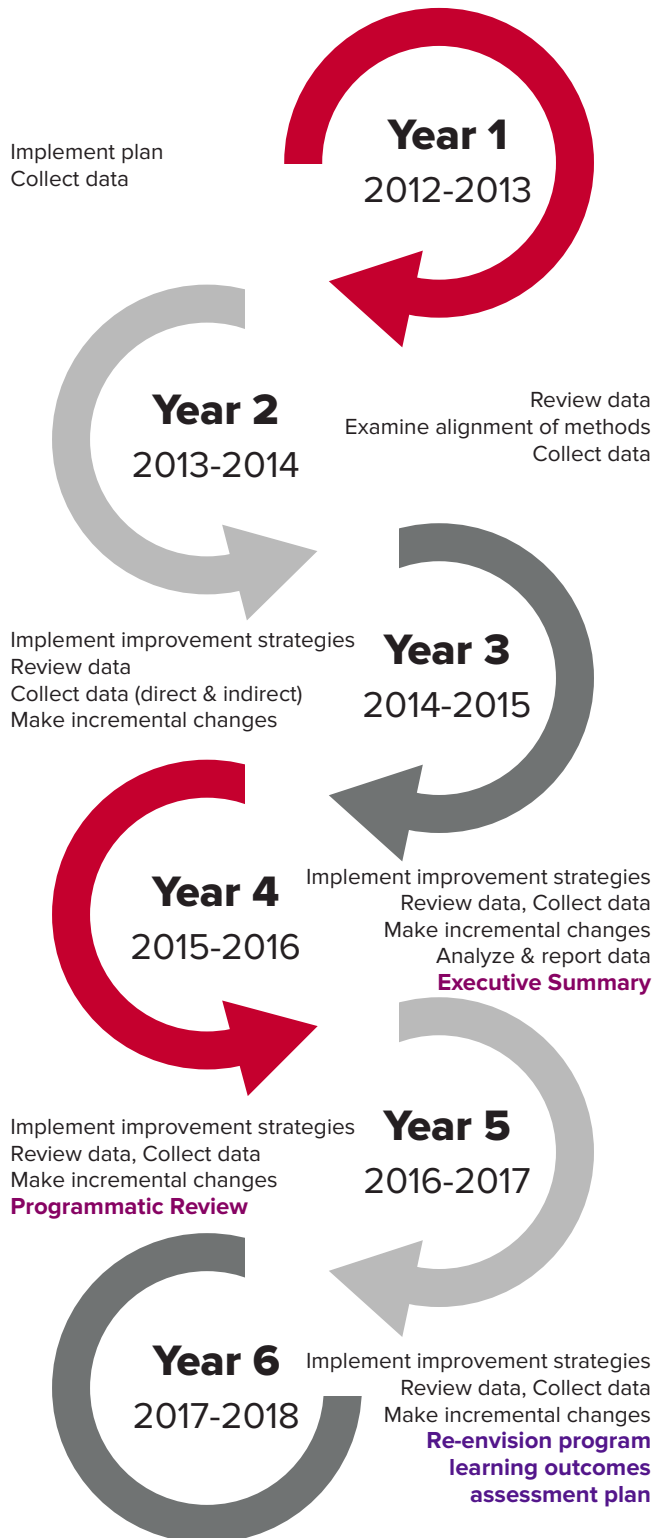
Demonstrate professional competencies

Continued Assessment Methods Table . . .

Direct
Laboratory Report A report generated after the student completes designated experiment, process, research, or other laboratory procedure. The report should outline steps taken, materials used, methods, and results. This shows a student's comprehension of laboratory procedures and methods and ability to implement learned methods.
Other Culminating Project Identified course projects serve as assessment tools in appraising students' ability to evaluate situations by collecting accurate information and using sound logic in decision making and problem solving.
Indirect
Survey (Employer) Surveying of student internship and/or alumni student employers provides insights regarding students' workforce preparedness, professionalism, work ethic, and being cooperative team members. Can be accomplished through mail and/or telephone surveys, focus groups, and interviews.
Survey (Alumni) Surveying of program/college alumni allows insight into the perspective that students have on their education after time away from school. Allows for external look at strengths/weaknesses of a program. Can be accomplished through mail and/or telephone surveys, focus groups, and interviews.
Other Indirect Measure Other course assignments/ experiences serve as assessment methods for appraising students' ability to collect and apply accurate information to make sound decisions and solve problems. Examples include a research forum presentation, annual report or a report from a certification agency.



Implementation – Six-Year Schedule



The data collection for the identified direct methods of the supporting learning outcomes is conducted annually (or each semester the affiliated course(s) or activities are conducted) starting Au2012. In adherence to the CFAES Academic Program Assessment Plan Revision Cycle (presented and adopted at the December 01, 2011 meeting of the CFAES Committee on Academic Affairs) this program will go through a comprehensive outcomes assessment review every six years.

During the first year of implementation of a new (or re-envisioned) program assessment plan, focused attention will be given to refining the measures used for assessing achievement to assure alignment of identified assignments with outcomes. During the initial year of the plan, the program will collect and report supporting data for half of the documented learning goals.

In year two, focused efforts will explore and reexamine alignment of methods with specific program learning outcomes along with data collection and reporting on the remainder of the program learning goals (those not addressed previously).

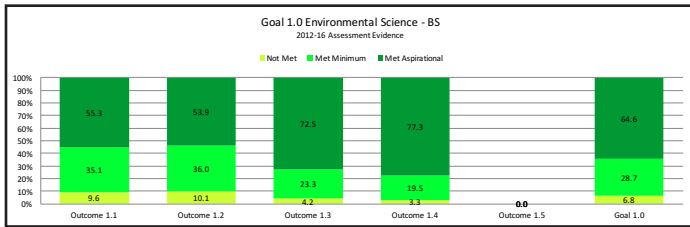
During the third year, in addition to collecting and reporting data for all program learning goals, the program will explore conducting faculty facilitated student, alumni, and/or stakeholder focus groups and/or surveys to aid in assessing success of learning outcomes.

For year four of the cycle, supporting data will continue to be collected and reported for all program learning goals. Upon conclusion of the academic year, the academic unit, with the assistance of the CFAES Office for Teaching, Learning, and Assessment, will craft and submit to the College's Academic Affairs Committee. An executive summary of findings for the programs based on the four years of Program Assessment Plan data collected.

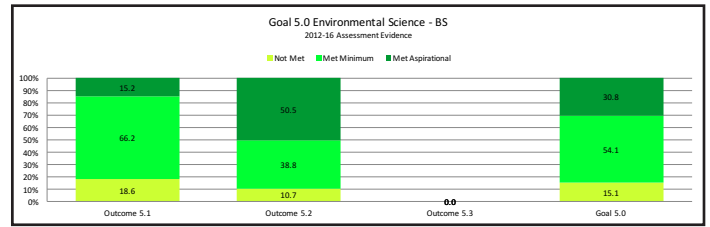
In the fifth year of the cycle the program will continue collecting and reporting data for all program learning goals and the program coordinator will review the stated set of program learning goals to determine if modifications should be made in the forthcoming rendition of the program assessment plan.

During year six, data collection and reporting for all program learning goals will continue. In addition, the unit, upon notification from the CFAES Office for Teaching, Learning, and Assessment will work with the academic unit's assessment contact(s) to assemble and convene a formal programmatic assessment review team, comprised of faculty, staff, students, alumni, and stakeholders, to do the following program evaluation: 1) Review the accumulated findings from the assessment review cycle; 2) Appraise the achievement and success of the program; 3) Examine alignment of program learning goals and outcomes; and 4) Produce a summary of recommendations for program modifications and enhancement. The efforts of the team's comprehensive review of the individual Program Assessment Plan in "year six" will produce a "re-envisioned" plan.

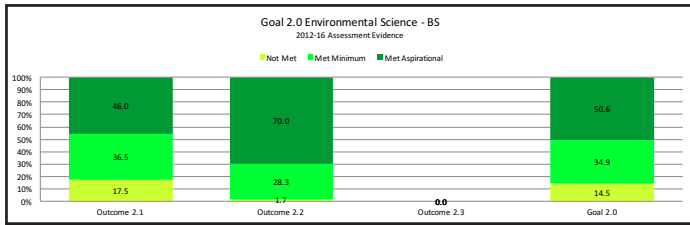




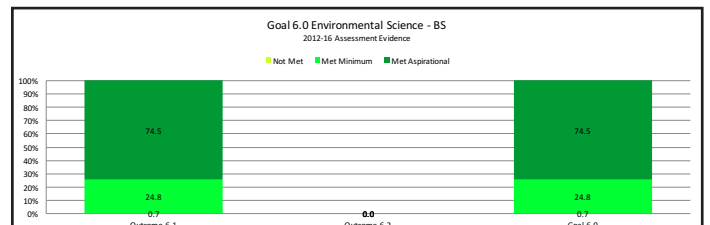
Learning Goal 1.0 has five identified unique contributing/supporting *Learning Outcomes* for which attainment is appraised via the use of six assessment methods (student n = 278 for reported assessment methods data)



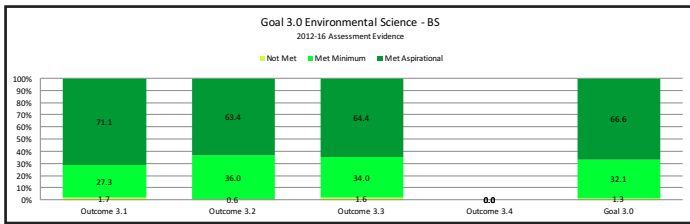
Learning Goal 5.0 has three established contributing/supporting *Learning Outcomes* for which student accomplishment is rated by using three assessment measures (student n = 503 for reported assessment methods data)



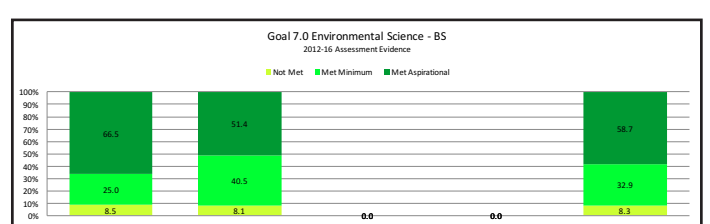
Learning Goal 2.0 has three discerned contributing/supporting *Learning Outcomes* for which student achievement is gauged by the use of four assessment methods (student n = 379 for reported assessment methods data)



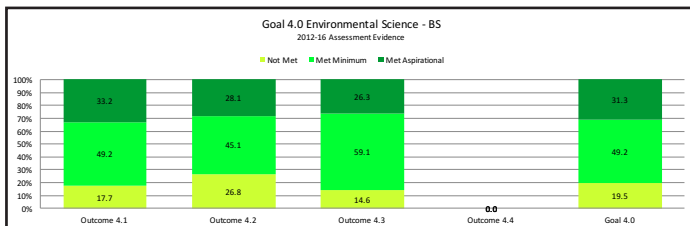
Learning Goal 6.0 has two established contributing/supporting *Learning Outcomes* for which student accomplishment is rated by using three assessment measures (student n = 84 for reported assessment methods data)



Learning Goal 3.0 has four defined contributing/supporting *Learning Outcome* for which student performance is assessed by using six assessment methods (student n = 326 for reported assessment methods data)



Learning Goal 7.0 has four established contributing/supporting *Learning Outcomes* for which student accomplishment is rated by using five assessment measures (student n = 398 for reported assessment methods data)



Learning Goal 4.0 has four established contributing/supporting *Learning Outcomes* for which student accomplishment is rated by using six assessment measures (student n = 2354 for reported assessment methods data)

