

**B.S. Academic Assessment Plan  
Department of Horticulture  
University of Arkansas  
June 2018**

**Contact Information:** Department of Horticulture, Dr. Wayne Mackay, Professor and Department Head

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**Departmental Mission:** The mission of the Department of Horticulture is to conduct applied and basic research to support and enhance the Arkansas horticultural industries; and to conduct high quality teaching and student research programs leading to B.S., M.S., and Ph.D. degrees.

**Program Goals:** The goal of the Department of Horticulture is to serve the people of Arkansas and assist the nation and the world through education, research, and service. Through dedicated teaching, pursuit of knowledge and interaction with society, we seek to improve our contributions to the general welfare. The Department of Horticulture has, as perhaps no other department, a goal to create quality of life for all citizens--economic, aesthetic and social well-being by educating students in horticultural and turfgrass sciences, conducting research that makes a difference, and to communicate those findings to industry and the public.

Student Learning Outcomes are defined into General and Discipline Specific Skills as follows.

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**1) General Skills:**

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- a) **Student Learning Outcome 1: Written Communication Skills** - The development and expression of ideas in writing. Written communication involves learning to work in many genres and styles. It can involve mixed-media including digital format. Written communication abilities develop through iterative experiences across the curriculum. See Tables 1 and 6.
- b) **Student Learning Outcome 2: Oral Communication Skills** - Oral communication is a prepared, purposeful presentation designed to increase knowledge, to foster understanding, or to promote change in the listeners' attitudes, values, beliefs, or behaviors. See Tables 2 and 6.
- c) **Student Learning Outcome 3: Critical Thinking Skills** - The comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion. See Tables 3 and 6.

**2) Discipline Specific Skills:**

**a) Student Learning Outcome 1: Acquire, integrate, and apply knowledge of plant science to managed systems.**

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- i) Goal 1: Develop working knowledge of multiple sources, including current and older literature, to find, evaluate, organize, and manage information related to horticultural systems.
- ii) Goal 2: Demonstrate competence with both laboratory and field-based technologies used in modern horticulture.
- iii) Goal 3: Apply concepts of plant biology, systematics, ecology, and genetics to manage and improve plants and their products.
- iv) Goal 4: Apply scientific methods to test hypothesis.

**b) Learning Outcome 2: Demonstrate interdisciplinary knowledge and competency in managing horticultural system.**

- i) Goal 1: Assess soils, soil health, plant fertility, water, and site limitations.
- ii) Goal 2: Assess potential and evaluate realized interactions with the abiotic and biotic environment in which plants are grown.
- iii) Goal 3: Recommend and use appropriate application methods, materials, and diagnostic skills for addressing soil constraints and irrigation, nutrient, stress, and pest management issues.
- iv) Goal 4: Apply principles of accounting, business law, labor, marketing and personnel management to a horticultural business and contribute to developing the various components of a business plan.

**c) Learning Outcome 3: Synthesize knowledge and use insight and creativity to better understand and improve plant systems.**

- i) Goal 1: Anticipate and recognize problems, identify causes of those problems, identify viable solutions to the problems and evaluate actions and consequences of treatments and interventions.
- ii) Goal 2: Develop, identify and employ best management practices that lead to sustainable solutions and outcomes.
- iii) Goal 3: Understand how global issues including climate change, energy use, water availability, and/or food safety impact on sustainability of horticultural systems locally, regionally and globally.

**d) Learning Outcome 4: Appreciate and communicate the diverse impacts of horticulture on people.**

- i) Goal 1: Describe the various ways plants impact human well-being (mental: psychological and restorative; and physiological).
  - ii) Goal 2: Describe and assess the influence of plants and their management on environmental sustainability habitat restoration or low-impact development.
  - iii) Goal 3: Quantify the economic importance of plants in managed ecosystems and the impact of horticultural crops in food system.
  - iv) Goal 4: Describe the social, spiritual and cultural importance of plants to historical and contemporary communities of people.
  - v) Goal 5: Communicate effectively with various audiences using oral, written and visual presentation skills and multi-media techniques.
- e) Learning Outcome 5: Demonstrates professionalism and proficiency in skills that relate to horticulture.**
- i) Goal 1: Acquire knowledge of a range of cultures, values, and political perspectives relevant for living in a global community.
  - ii) Goal 2: Demonstrate a high level of personal and social responsibility.
  - iii) Goal 3: Demonstrate leadership and the ability to collaborate and work in teams.
  - iv) Goal 4: Plan, engage and learn from actions that demonstrate civic responsibility to community and society.
  - v) Goal 5: Develop a plan for life-long learning as it relates to career choice and professionalism.

See Tables 4, 5, and 6 for information related to these learning outcomes.

### **3) Assessment**

#### **a) Assessment Measures for General Skills:**

##### **i) Student Learning Outcome 1- Written Communication.**

- (1) Achievement will be assessed using a written communication rubric for laboratory reports and technical/scientific proposals where the student has analyzed, synthesized and evaluated information from independent sources as part of a class project and/or completed an independent research project as part of a special problems, research project or internship class. See example at the end of this section.
- (2) This is a *direct* measure of student learning.

##### **ii) Student Learning Outcome 2 – Oral Communication.**

- (1) Achievement will be assessed using an oral communication rubric during oral presentations where the student has compiled and evaluated the scientific literature as part of a class project and/or completed an independent research project as part of a special problems, research project or internship class. See example at the end of this section.
- (2) This is a *direct* measure of student learning.

**iii) Student Learning Outcome 3 – Critical Thinking.**

- (1) Achievement will be measured using a critical thinking scenario (in class or potentially included on the post-test for learner outcome 1) and scored using a critical thinking rubric. See example at the end of this section.
- (2) This is a *direct* measure of student learning.
- (3) Assessment scenarios will be generated to cover application of critical thinking in courses listed in Table 6.

**b) Acceptable and Ideal Targets for the General Skills: Student Learning Outcomes 1-3 (Tables 1-3).**

- i) Acceptable target: Graduating students must demonstrate skills in the continuum between Milestones 2 and 3 in the student learning outcomes for written communication, oral communications and critical thinking outlined in the rubrics listed in Tables 1-3 below.
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- ii) Ideal target: Students will be able to demonstrate skills outlined in the Capstone column for written communication, oral communication and critical thinking in Tables 1-3 below.

**c) Key Personnel for Student Learning Outcomes 1-3.**

- i) Selected faculty, who instruct courses appropriate for student learning objectives 1-3 listed in Table 6, will be responsible for assessment using the score rubric for each of the skills (see example below)

**d) Assessment Measure for the Discipline Specific Skills: Student Learning Outcomes 1-5 (Tables 4 and 5).**

- i) Achievement will be measured using a **pre- and post-assessment**.
- ii) This is a *direct* measure of student learning.

iii) Learning will be measured by generating an assessment of 20 questions from the HLTS faculty to cover horticulture concepts. These areas represent essential concepts for discipline specific knowledge of students completing a Horticulture degree.

e) **Acceptable and Ideal Targets**

i) Because use of pre- and post-assessments are a new initiative for HLTS and we are unsure of how incoming students in particular will perform on pre-assessments, we are initially targeting a 25% increase in the mean and/or median assessment scores between the two populations (incoming and graduating students).

ii) Target populations are at least half of the incoming fall freshmen and half of the spring graduating HLTS class.

f) **Key Personnel** (who is responsible for the assessment of this measure)

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i) HORT 2003, Principles of Horticulture, a required course for all HLTS students, is the target course for the pre-assessment.

ii) A mandatory exit interview with the Department Head and selected faculty will administer the post-assessment.

4) **Example of scoring rubric.**

**Department of Horticulture  
Written Communication Performance  
Assessment Rubric**

Student \_\_\_\_\_

Course \_\_\_\_\_

Assignment \_\_\_\_\_

Date \_\_\_\_\_

**Student Learning Outcomes**

**Score using Rubric**

1. Context of and Purpose for Writing

\_\_\_\_\_

2. Content Development

\_\_\_\_\_

- 3. Genre and Disciplinary Conventions \_\_\_\_\_
- 4. Sources and Evidence \_\_\_\_\_
- 5. Control of Syntax and Mechanics \_\_\_\_\_

In this example, scoring is based on the student’s performance in each of the outcomes based on the matrix in Table 1. Each assessment is based upon the appropriate rubric.

**5) Summary of Findings – Academic Year 2017-18**

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- This is the third year of using the newly created assessment and as a result, there is no direct link between pre-assessment data and the senior level data shown to determine a change in student learning outcomes between student entry into and matriculation from the B.S. Horticulture Program.
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- The data for graduating seniors is from HORT4403 Plant Propagation, HORT401V Internship, Departmental Club and Professional Development Activities, and the exit interview of the fifteen graduating students using selected student learning outcomes is as follows:
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  - a) General Skills – Student Learning Outcome 1: Oral Communication.
    - Based upon the communication value rubric in Table 1, the students surveyed in 2017-18 averaged an overall response that fell between Milestones 3 and 4. Thirteen percent exhibited communication skills consistent with Milestone 2, sixty-seven percent exhibited communication skills consistent with Milestone 3, and twenty percent exhibited Capstone skills, able to demonstrate a thorough understanding of context, audience, and purpose while using appropriate, relevant, and compelling content with attention to detail using high quality credible, relevant sources along with language that communicates meaning with clarity. See Figure 1.
  - b) General Skills – Student Learning Outcome 2: Critical Thinking Skills.
    - Based upon the oral value rubric in Table 2, the students surveyed in 2017-18 averaged an overall response at Milestone 3. Seven percent exhibited communication skills consistent with Milestone 1, thirty-three percent exhibited communication skills consistent with Milestone 2, fifty-three percent exhibited oral skills that consistent with

Milestones 3, and seven percent exhibited Capstone skills, able to organize and verbalize their thoughts clearly with compelling language and delivery techniques using a variety of explanations and illustrations to create a compelling message. See Figure 2.

c) Discipline Specific Skills – Student Learning Outcome 1: Acquire, integrate, and apply knowledge of plant science to managed systems.

- Based upon the discipline specific skills value rubric in Tables 4 and 5 for SLO 1, the students averaged an overall response between Milestones 3 and 4, able to demonstrate competence in both laboratory and field-based technologies used in horticulture and apply some concepts of plant biology, ecology and genetics to improve plants and their products. Thirty-three percent exhibited communication skills consistent with Milestone 2, forty percent exhibited communication skills consistent with Milestone 3, and twenty-seven percent exhibited skills consistent with the Capstone level. The latter students were able to apply concepts of plant biology, ecology, and genetics to improve plants and their products. See Figure 3.

d) Discipline Specific Skills – Student Learning Outcome 5: Demonstrate professionalism and proficiency that relate to horticulture.

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- Based upon the discipline specific skills rubric in Tables 4 and 5, the students averaged an overall response that fell between Milestones 3 and 4 able to demonstrate leadership and collaborative skills and some level of personal and social responsibility. Thirteen percent exhibited skills consistent with Milestone 1, twenty percent exhibited skills consistent with Milestone 2, forty percent were consistent with Milestone 3, and twenty-seven percent exhibited skills that are consistent with the Capstone level, able to demonstrate a high level of personal and social responsibility and have knowledge of a range of cultures, values, and political perspectives. See Figure 4.
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The current summary of findings presented for entry-level students is based upon data collected from UNI1001 University Perspectives or HORT2101 Horticultural Career Development. The data is as follows:

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- a) General Skills – Student Learning Outcome 1: Oral Communication.

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- Based upon the communication value rubric in Table 1, the entry-level students surveyed in 2017-18 averaged an overall response that fell between Milestones 1 and 2. Eighty-three percent exhibited oral communication skills consistent with Milestone 1

and seventeen percent exhibited oral communication skills consistent with Milestone 2.. See Figure 5.

b) General Skills – Student Learning Outcome 2: Written Communication Skills.

- Based upon the communication value rubric in Table 2, the entry-level students surveyed in 2017-18 averaged an overall response that fell between Milestones 1 and 2. Eighty-three percent exhibited written communication skills consistent with Milestone 1 and seventeen percent exhibited written communication skills consistent with Milestone 2. See Figure 6.

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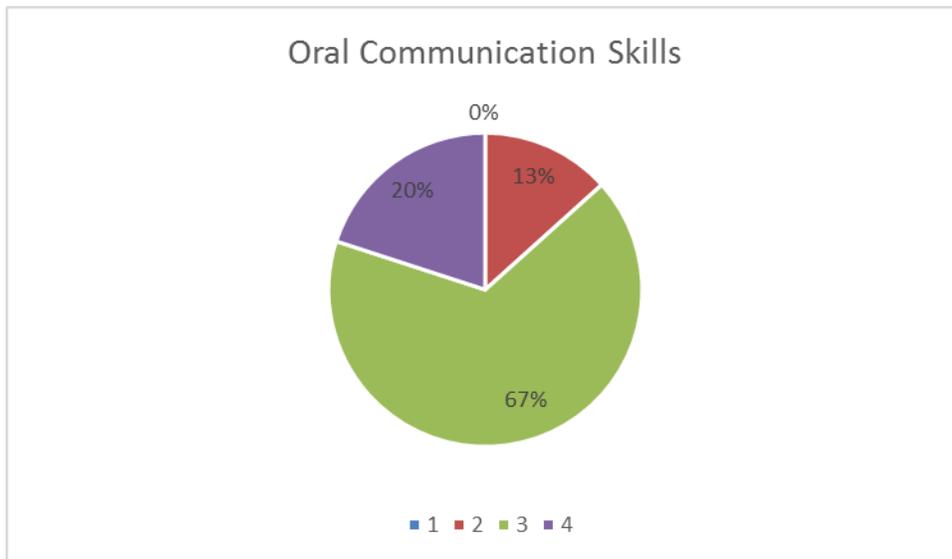
c) Discipline Specific Skills – Student Learning Outcome 3: Critical Thinking Skills.

- Based upon the communication value rubric in Table 3, the entry-level students surveyed in 2017-18 averaged an overall response that fell between Milestones 1 and 2. Sixty-seven percent exhibited critical thinking skills consistent with Milestone 1 and seventeen percent exhibited critical thinking skills consistent with Milestone 2. See Figure 7.

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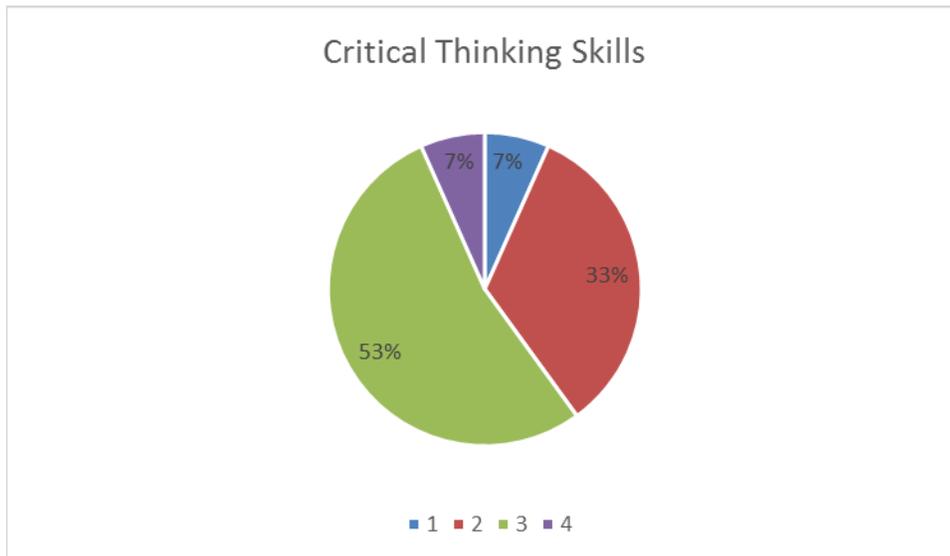
Results: Although the student populations in the incoming and graduating seniors are not the same students and a direct correlation between the two assessments is not available yet, it appears that the difference in the two populations is significant in the measured outcomes. Graduating students have improved their skills in the areas assessed and have gained discipline specific skills.

Figure 1. Oral communication skills assessment for graduating seniors in 2018.



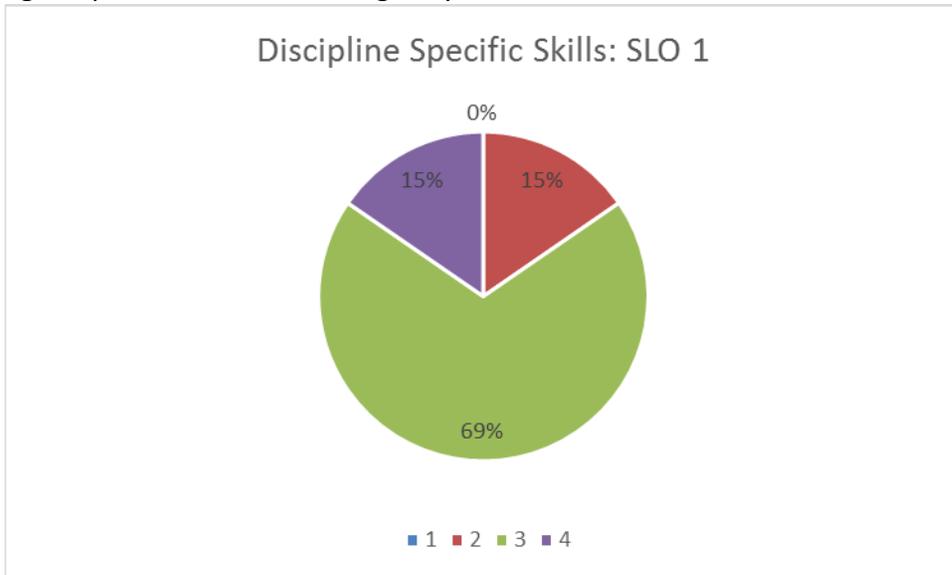
Legend Values: Benchmark =1; Milestones = 2 and 3; Capstone = 4. See details of assessment rubric values in Table 1.

Figure 2. Critical thinking skills assessment for graduating seniors in 2018.



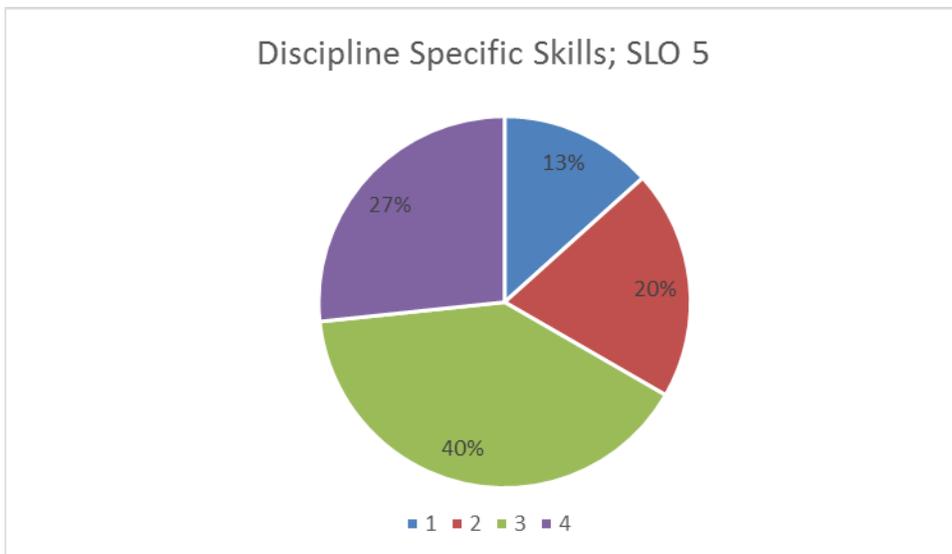
Legend Values: Benchmark =1; Milestones = 2 and 3; Capstone = 4. See details of assessment rubric values in Table 2.

Figure 3 Discipline Specific Skills – Student Learning Outcome 1: Acquire, integrate, and apply knowledge of plant science to managed systems.



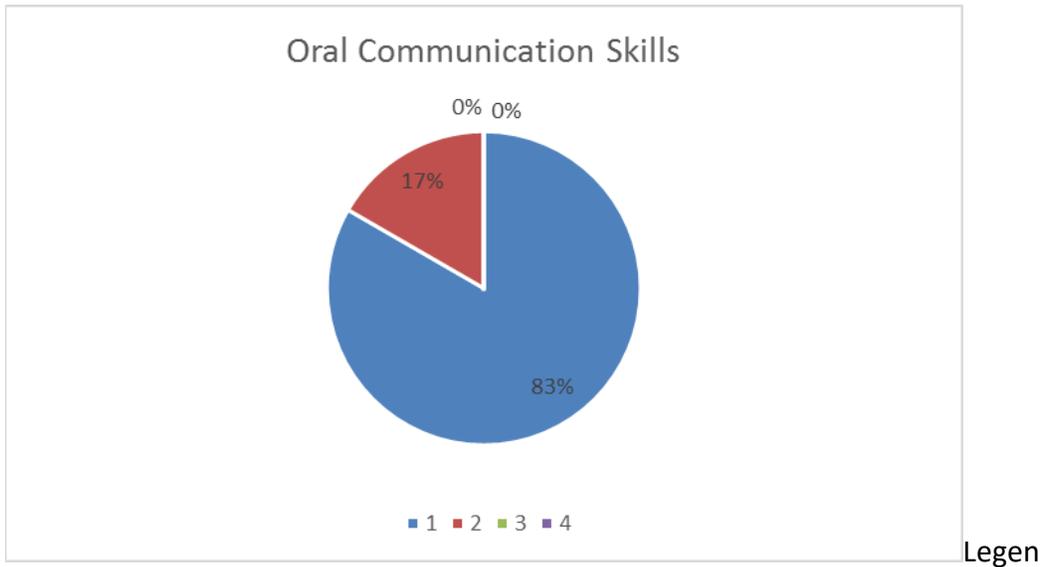
Legend Values: Benchmark =1; Milestones = 2 and 3; Capstone = 4. See details in Tables 4 and 5.

Figure 4. Discipline Specific Skills – Student Learning Outcome 5: Demonstrate professionalism and proficiency that relate to horticulture.



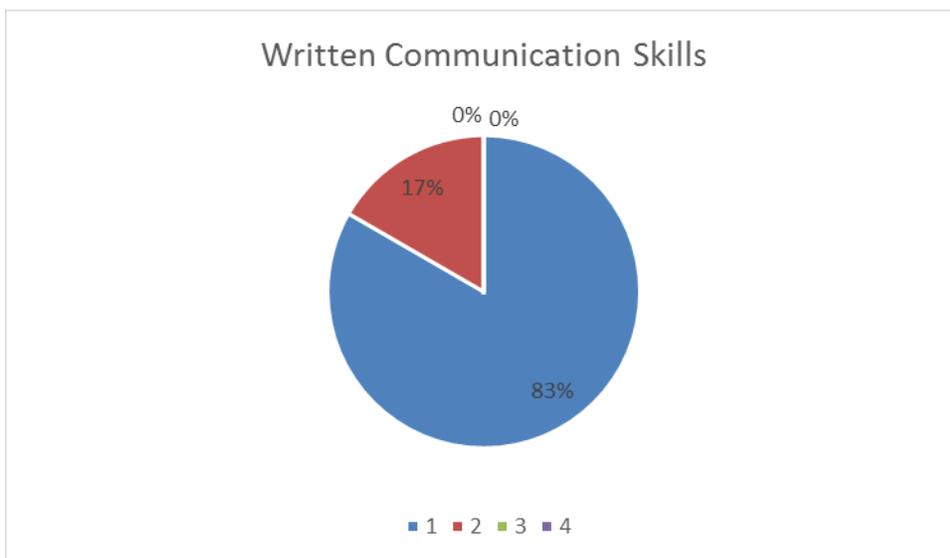
Legend Values: Benchmark =1; Milestones = 2 and 3; Capstone = 4. See details in Tables 4 and 5.

Figure 5. Oral communication skills assessment for incoming students in 2017-18.



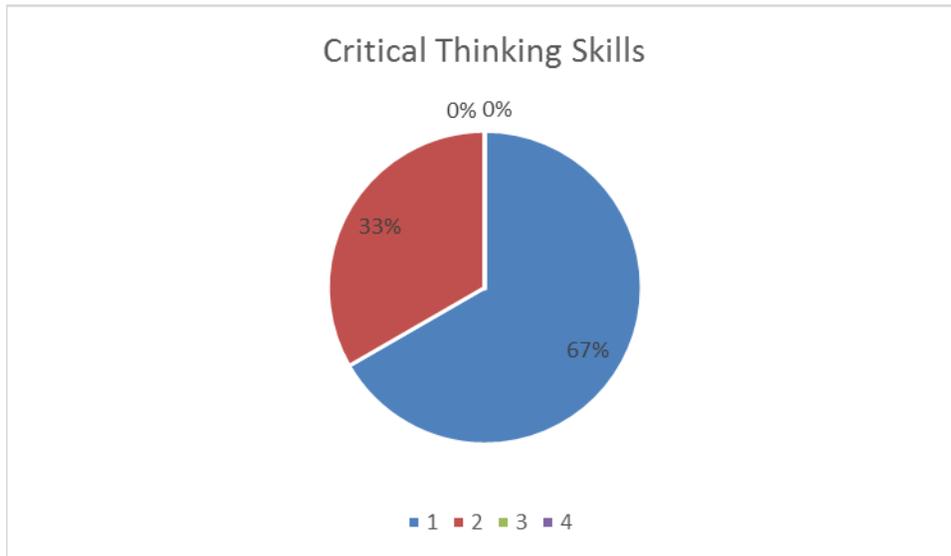
Legend Values: Benchmark =1; Milestones = 2 and 3; Capstone = 4. See details in Tables 4 and 5.

Figure 6. Written communication skills assessment for incoming students in 2017-18.



Legend Values: Benchmark =1; Milestones = 2 and 3; Capstone = 4. See details in Tables 4 and 5.

Figure 7. Critical thinking skills assessment for incoming students in 2017-18.



Legend Values: Benchmark =1; Milestones = 2 and 3; Capstone = 4. See details in Tables 4 and 5.

**Table 1. Written Communication VALUE Rubric:** The definition of written communication is the development and expression of ideas in writing. Written communication involves learning to work in many genres and styles. It can involve working with many different writing technologies, and mixing texts, data, and images. Written communication abilities develop through iterative experiences across the curriculum (*for more information, please contact [value@acu.org](mailto:value@acu.org)*).

	<b>Capstone 4</b>	<b>Milestones</b>		<b>Benchmark 1</b>
		3	2	
<b>Context of and Purpose for Writing</b> <i>Includes considerations of audience, purpose, and the circumstances surrounding the writing task(s).</i>	Demonstrates a thorough understanding of context, audience, and purpose that is responsive to the assigned task(s) and focuses all elements of the work.	Demonstrates adequate consideration of context, audience, and purpose and a clear focus on the assigned task(s) (e.g., the task aligns with audience, purpose, and context).	Demonstrates awareness of context, audience, purpose, and to the assigned tasks(s) (e.g., begins to show awareness of audience's perceptions and assumptions).	Demonstrates minimal attention to context, audience, purpose, and to the assigned tasks(s) (e.g., expectation of instructor or self as audience).
<b>Content Development</b>	Uses appropriate, relevant, and compelling content to illustrate mastery of the subject, conveying the writer's understanding, and shaping the whole work.	Uses appropriate, relevant, and compelling content to explore ideas within the context of the discipline and shape the whole work.	Uses appropriate and relevant content to develop and explore ideas through most of the work.	Uses appropriate and relevant content to develop simple ideas in some parts of the work.
<b>Genre and Disciplinary Conventions</b> <i>Formal and informal rules inherent in the expectations for writing in particular forms and/or academic fields (please see glossary).</i>	Demonstrates detailed attention to and successful execution of a wide range of conventions particular to a specific discipline and/or writing task (s) including organization, content, presentation, formatting, and stylistic choices	Demonstrates consistent use of important conventions particular to a specific discipline and/or writing task(s), including organization, content, presentation, and stylistic choices	Follows expectations appropriate to a specific discipline and/or writing task(s) for basic organization, content, and presentation	Attempts to use a consistent system for basic organization and presentation.
<b>Sources and Evidence</b>	Demonstrates skillful use of high-quality, credible, relevant sources to develop ideas that are appropriate for the discipline and genre of the writing	Demonstrates consistent use of credible, relevant sources to support ideas that are situated within the discipline and genre of the writing.	Demonstrates an attempt to use credible and/or relevant sources to support ideas that are appropriate for the discipline and genre of the writing.	Demonstrates an attempt to use sources to support ideas in the writing.
<b>Control of Syntax and Mechanics</b>	Uses graceful language that skillfully communicates meaning to readers with clarity and fluency, and is virtually error-free.	Uses straightforward language that generally conveys meaning to readers. The language in the portfolio has few errors.	Uses language that generally conveys meaning to readers with clarity, although writing may include some errors.	Uses language that sometimes impedes meaning because of errors in usage.

*\*Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.*

**Table 2. Oral Communication VALUE Rubric:** The definition of oral communication is a prepared, purposeful presentation designed to increase knowledge, to foster understanding, or to promote change in the listeners' attitudes, values, beliefs, or behaviors (*for more information, please contact [value@aacu.org](mailto:value@aacu.org)*).

	<b>Capstone 4</b>	<b>Milestones</b>		<b>Benchmark 1</b>
		3	2	
<b>Organization</b>	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is clearly and consistently observable and is skillful and makes the content of the presentation cohesive.	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is clearly and consistently observable within the presentation.	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is intermittently observable within the presentation.	Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is not observable within the presentation.
<b>Language</b>	Language choices are imaginative, memorable, and compelling, and enhance the effectiveness of the presentation. Language in presentation is appropriate to audience.	Language choices are thoughtful and generally support the effectiveness of the presentation. Language in presentation is appropriate to audience.	Language choices are mundane and commonplace and partially support the effectiveness of the presentation. Language in presentation is appropriate to audience.	Language choices are unclear and minimally support the effectiveness of the presentation. Language in presentation is not appropriate to audience.
<b>Delivery</b>	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation compelling, and speaker appears polished and confident.	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation interesting, and speaker appears comfortable.	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation understandable, and speaker appears tentative.	Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) detract from the understandability of the presentation, and speaker appears uncomfortable.
<b>Supporting Material</b>	A variety of types of supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) make appropriate reference to information or analysis that significantly supports the presentation or establishes the presenter's credibility/authority on the topic.	Supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) make appropriate reference to information or analysis that generally supports the presentation or establishes the presenter's credibility/authority on the topic.	Supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) make appropriate reference to information or analysis that partially supports the presentation or establishes the presenter's credibility/authority on the topic.	Insufficient supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) make reference to information or analysis that minimally supports the presentation or establishes the presenter's credibility/authority on the topic.
<b>Central Message</b>	Central message is compelling (precisely stated, appropriately repeated, memorable, and strongly supported.)	Central message is clear and consistent with the supporting material.	Central message is basically understandable but is not often repeated and is not memorable.	Central message can be deduced, but is not explicitly stated in the presentation.

*\*Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.*

**Table 3. Critical Thinking VALUE Rubric:** The definition of critical thinking is a habit of mind characterized by the comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion, and can be demonstrated in assignments that require students to complete analyses of text, data, or issues (*for more information, please contact [value@aacu.org](mailto:value@aacu.org)*).

	<b>Capstone 4</b>	<b>Milestones</b>		<b>Benchmark 1</b>
		3	2	
<b>Explanation of issues</b>	Issue/problem to be considered critically is stated clearly and described comprehensively, delivering all relevant information necessary for full understanding.	Issue/problem to be considered critically is stated, described, and clarified so that understanding is not seriously impeded by omissions.	Issue/problem to be considered critically is stated but description leaves some terms undefined, ambiguities unexplored, boundaries undetermined, and/or backgrounds unknown.	Issue/problem to be considered critically is stated without clarification or description.
<b>Evidence</b> <i>Selecting and using information to investigate a point of view or conclusion</i>	Information is taken from source(s) with enough interpretation/evaluation to develop a comprehensive analysis or synthesis. Viewpoints of experts are questioned thoroughly.	Information is taken from source(s) with enough interpretation/evaluation to develop a coherent analysis or synthesis. Viewpoints of experts are subject to questioning.	Information is taken from source(s) with some interpretation/evaluation, but not enough to develop a coherent analysis or synthesis. Viewpoints of experts are taken as mostly fact, with little questioning.	Information is taken from source(s) without any interpretation/evaluation. Viewpoints of experts are taken as fact, without question.
<b>Influence of context and assumptions</b>	Thoroughly (systematically and methodically) analyzes own and others' assumptions and carefully evaluates the relevance of contexts when presenting a position.	Identifies own and others' assumptions and several relevant contexts when presenting a position.	Questions some assumptions. Identifies several relevant contexts when presenting a position. May be more aware of others' assumptions than one's own (or vice versa).	Shows an emerging awareness of present assumptions (sometimes labels assertions as assumptions). Begins to identify some contexts when presenting a position.
<b>Student's position (perspective, thesis/hypothesis)</b>	Specific position (perspective, thesis/hypothesis) is imaginative, taking into account the complexities of an issue. Limits of position (perspective, thesis/hypothesis) are acknowledged. Others' points of view are synthesized within position (perspective, thesis/hypothesis).	Specific position (perspective, thesis/hypothesis) takes into account the complexities of an issue. Others' points of view are acknowledged within position (perspective, thesis/hypothesis).	Specific position (perspective, thesis/hypothesis) acknowledges different sides of an issue.	Specific position (perspective, thesis/hypothesis) is stated, but is simplistic and obvious.
<b>Conclusions and related outcomes (implications and consequences)</b>	Conclusions and related outcomes (consequences and implications) are logical and reflect student's informed evaluation and ability to place evidence and perspectives discussed in priority order.	Conclusion is logically tied to a range of information, including opposing viewpoints; related outcomes (consequences and implications) are identified clearly.	Conclusion is logically tied to information (because information is chosen to fit the desired conclusion); some related outcomes (consequences and implications) are identified clearly.	Conclusion is inconsistently tied to some of the information discussed; related outcomes (consequences and implications) are oversimplified.

\*Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.

**TABLE 4. HORTICULTURE DISCIPLINE SPECIFIC SKILLS RUBRIC:** After completing the Horticulture B.S. students will have a technical knowledge of horticulture, professional skills of communication, leadership, computing, critical thinking, problem solving, business and analysis, and have perspectives related to horticulture.

Discipline Specific Skills	Level 1	Level 2	Level 3	Level 4
<b>Acquire, integrate, and apply knowledge of plant science to managed systems</b>	Develop working knowledge of multiple sources, including current and older literature, to find, evaluate, organize, and manage information related to horticultural systems.	Demonstrate competence with both laboratory and field-based technologies used in modern horticulture.	Apply concepts of plant biology, systematics, ecology, and genetics to manage and improve plants and their products.	Apply scientific methods to test hypothesis.
<b>Demonstrate interdisciplinary knowledge and competency in managing horticultural system.</b>	Assess soils, soil health, plant fertility, water and site limitations.	Assess potential and evaluate realized interactions with the abiotic and biotic environment in which plants are grown.	Recommend and use appropriate application methods, materials, and diagnostic skills for addressing soil constraints and irrigation, nutrient, stress, and pest management issues.	Apply principles of accounting, business law, labor, marketing and personnel management to a horticultural business and contribute to developing the various components of a business plan.
<b>Synthesize knowledge and use insight and creativity to better understand and improve plant systems.</b>	Anticipate and recognize problems, identify causes of those problems, identify viable solutions to the problems and evaluate actions and consequences of treatments and interventions.	Develop, identify and employ best management practices that lead to sustainable solutions and outcomes.	Understand how global issues including climate change, energy use, water availability, and/or food safety impact on sustainability of horticultural systems locally, regionally and globally.	
<b>Appreciate and communicate the diverse impacts of horticulture on people.</b>	Describe the various ways plants impact human well-being (mental: psychological and restorative; and physiological).	Describe and assess the influence of plants and their management on environmental sustainability habitat restoration or low-impact development.  Quantify the economic importance of plants in managed ecosystems and the impact of horticultural crops in food system.	Describe the social, spiritual and cultural importance of plants to historical and contemporary communities of people.	Communicate effectively with various audiences using oral, written and visual presentation skills and multi-media techniques
<b>Demonstrates professionalism and proficiency in skills that relate to horticulture.</b>	Acquire knowledge of a range of cultures, values, and political perspectives relevant for living in a global community.	Demonstrate a high level of personal and social responsibility.	Demonstrate leadership and the ability to collaborate and work in teams.	Plan, engage and learn from actions that demonstrate civic responsibility to community and society.  Develop a plan for life-long learning as it relates to career choice and professionalism.

*Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet Level 1 performance.*

Table 5. Benchmarks for achieving discipline specific skills.

Modified from: Pritts, M.P. and T. Park. 2013. Proposed Learning Outcomes for Four-year Horticulture Programs in the United States. HortTech. 23(2): 237-240.

Goals	Benchmarks			
	4	3	2	1
<b>Learning outcome 1: Acquire, integrate, and apply knowledge of plant science to managed systems</b>				
Goal 1. Use multiple sources, including current and older literature, to find, evaluate, organize, and manage information related to horticultural systems.	Publish an article on a plant based system with a thorough literature review.	Write a thorough literature review about a specific topic for classroom credit.	Write a term paper utilizing primary resources related to a horticultural topic.	Be able to identify primary and secondary information sources and differentiate between referred and non-referred sources.
Goal 2. Demonstrate competence with both laboratory and field-based technologies used in modern horticulture.	Present research findings at regional or national meetings / competitions.	Participate in faculty directed research programs incorporating laboratory or field technology.	Gain competence operating laboratory/ field technology through internships or work-related activities.	Perform laboratory exercises using laboratory equipment/ technology in horticulture courses.
Goal 3. Apply concepts of plant biology, systematics, ecology, and genetics to manage and improve plants and their products.	Conduct capstone research projects related to genetics, plant breeding, genomics, plant identification, and cultivar performance.	Develop a plant selection guide for use in specific horticultural systems as part of an in-class assignment.	Complete courses in fruit/vegetable crops, or landscape/ turf management and understand the selection and appropriate use of plant species or cultivars unique to those courses.	Complete at least one course in plant identification, taxonomy/systematics or genetics.
Goal 4. Apply scientific methods to test hypotheses.	Write, submit to peer or instructor evaluation, defend, a capstone research thesis. Give a public presentation of the work.	Write a research proposal and conduct a research project leading to a published or presented paper.	Write a research proposal and conduct a research project leading to a summary paper as a special topic.	Conduct classroom laboratory experiments with hypothesis testing, data collection and analysis and conclusions.
<b>Learning outcome 2: Demonstrate interdisciplinary knowledge and competency in managing horticultural systems</b>				
Goal 1. Assess soils, soil health, plant fertility, water, and site limitations.	Conduct capstone or special problems research related to soil-plant interaction, plant nutrition, plant-water relations including abiotic stress on site management.	Participate in projects related to landscape management, or crop production practices. Internship focus on soil management, soil fertility, site assessment and design, or irrigation management.	Complete classes that include site analysis and management for crop production systems. Complete classes in landscape planning and landscape/turf management which includes site assessment.	Complete a soil science or soil physics course.
Goal 2. Assess potential and evaluate realized interactions with the abiotic and biotic environment in which plants are grown	Conduct a capstone or special problems research project focused on plant-pest interactions or abiotic stressors.	Complete assigned classroom projects developing integrated pest management strategies.	Identify key insect pests and diseases associated with limitations to plant growth and development. Identify abiotic factors critical in production and landscape/turf management systems.	Complete principles of horticulture course. Complete courses in entomology, weed science or plant pathology.
Goal 3. Recommend and use appropriate application methods, materials, and diagnostic skills for addressing soil constraints and irrigation, nutrient, stress, and pest management issues	Complete a capstone or special problems research project related to soil management, remediation, landscape management, crop fertility, or pest management.	Participate in an internship focused on substrate/soil or pest management, irrigation design/ installation or product testing and sales.	Complete classroom projects in soil/substrate management, soil fertility and applying fertilizers, irrigation design and management, plant protection strategies and schedules.	Complete classes in principles of horticulture, soil science, soil fertility, entomology, weed science, or plant pathology. Student complete class in landscape management, greenhouse management, fruit production or vegetable production.

Goals	Benchmarks			
	4	3	2	1
Goal 4. Apply principles of accounting, business law, labor, marketing, and personnel management to a horticultural business and contribute to developing the various components of a business plan.	Conduct a capstone or special problems research project developing a business plan for a start-up horticultural enterprise.	Conduct classroom projects related to developing the various components of a business plan.	Understand business models. Develop start-up and financing strategies, personnel management policies, marketing and sales strategies.	Complete courses in business management, business law, finance, marketing or entrepreneurship
<b>Learning outcome 3: Synthesize knowledge and use insight and creativity to better understand and improve plant systems</b>				
Goal 1. Anticipate and recognize problems, identify causes of those problems, quantify potential impacts, analyze options, identify viable solutions to the problems, and evaluate actions and consequences of treatments and interventions	Conduct a capstone or special problems research project related to testing or proposing a management system.	Participate in a service learning activity related to horticulture involving a multi-faceted approach to system management.	Complete classroom assignments related to critical analysis and decision making protocols on production or management systems.	Complete courses in plant pathology, entomology, weed science, soil fertility, landscape/turf management or controlled environments.
Goal 2. Develop, identify, and employ best management practices that lead to sustainable solutions and outcomes.	The SUST minor capstone project is a horticulture related project; project is presented to the department.	Enroll in and complete the SUST or ENSC minor.	Complete a project or term assignment related to sustainable management plan development; develop a best practices management plan.	Complete a course related to horticultural or system sustainability.
Goal 3. Understand how global issues including climate change, energy use, water availability, and/or food safety impact the sustainability of horticultural systems locally, nationally, and globally.	Complete a SUST capstone project, an honors project, or special topic research project related to climate change, and the FEWS nexus of horticulture production.	Enroll in and complete the SUST or ENSC minor.	Complete a project or term assignment related to the impacts of climate change on horticulture production systems.	Complete a course related to horticultural or system sustainability.
<b>Learning outcome 4. Appreciate and communicate the diverse impacts of horticulture on people</b>				
Goal 1. Describe the various ways plants impact human well-being (mental: psychological and restorative; physical: medicinal and physiological).	Complete a research project investigating the relationship or influence of horticulture on human well-being.	Participate in a service learning project focused on human-plant interaction or recreational or sports fields.	Complete a course in environmental sociology or ethno-horticulture.	Complete a general survey class in horticulture.
Goal 2. Describe and assess the influence of plants and their management on environmental sustainability, habitat restoration or low-impact development (LID).	Complete a capstone project, honors project or special research project related to sustainability, habitat restoration or low-impact development.	Participate in classroom projects focused on sustainable practices and implementation.	Complete a course in environmental restoration, ecosystem assessment or landscape/turf management.	Complete a class assignment or learning module focused on restoration or sustainable practices related to horticulture.
Goal 3. Quantify the economic importance of plants in managed ecosystems and the impact of horticultural crops in food systems.	Complete a capstone project, honors project or special problems course investigating the production and post-harvest economics of a horticultural food crop.	Complete a written or visual presentation comparing and contrasting various worldwide food production systems focusing on horticultural crops.	Complete a course in environmental economics or food and agricultural marketing.	Complete a learning module focused on economically important food crops and associated production and distribution systems.
Goal 4. Describe the social, spiritual, and cultural importance of plants to historical and contemporary communities of people.	Complete and present a capstone, honors or special problems project investigating in role of plants in human culture.	Write a research paper on a specific culture or community and how plant interaction and use affected or influenced that culture.	Complete a learning module on the role of ornamental, spiritual and medicinal plants in early and modern human culture.	Complete a general survey class in horticulture.
Goal 5. Communicate effectively with various audiences using oral, written, and visual presentation skills, and contemporary	Create and publish content on a horticulture related topic using digital media.	Prepare and present horticulturally related content at a professional or industry meeting/ conference.	Complete a project or term assignment which is presented orally, written or through digital media.	Complete a communication intensive course.

Goals	Benchmarks			
	4	3	2	1
networking/social media technologies.				
<b>Learning outcome 5. Demonstrate professionalism and proficiency in skills that relate to horticulture</b>				
Goal 1. Acquire knowledge of a range of cultures, values, and political perspectives relevant for living in a global community.	Complete a study abroad experience or international internship.	Participate in a department or college associated international travel opportunity.	Complete a research paper on a topic associated with human-plant interactions and the effect on culture.	Complete a course in world or regional geography.
Goal 2. Demonstrate a high level of personal and social responsibility.	Leadership position in a collegiate organization involved in local community interactions.	Develop an action plan using horticulture to engage a local or regional community.	Complete a research project investigating the role of horticulture in modern urban and rural society.	Complete a humanities course in ethics or social work.
Goal 3. Demonstrate leadership and the ability to collaborate and work in teams.	Election to a regional or national undergraduate organization associated with a professional society.	Leadership position in a student club or university related organization.	Active participation in an undergraduate related club or collegiate organization.	Demonstrate leadership in class group projects or team building activities.
Goal 4. Plan, engage, and learn from actions that demonstrate civic responsibility to community and society.	Propose, design and implement a project relating to a socio-horticulture topic such as a community/school garden or horticulture therapy program.	Write a research paper evaluating the effectiveness and/or impact of a school or community garden on the targeted community.	Complete a course with a service learning component.	Complete a course module on horticulture-based outreach activities, opportunities and responsibilities on a local, regional or national level.
Goal 5. Develop a plan for life-long learning as it relates to career choice and professionalism.	Postgraduate involvement and leadership in professional or trade organizations.	Participate in regional or national professional meetings as an undergraduate.	Participate in extracurricular activities; attend seminars, trade shows or industry meetings relating to a career choice.	Student membership in a profession-related organization.

Table 6. Course matrix for General and Discipline Specific skills.

Student Learning Outcomes to be Measured											
	General Skills			Discipline Specific Skills:							
	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 1: Acquire, integrate, and apply knowledge of plant science to managed systems				Learning Outcome 2: Demonstrate interdisciplinary knowledge and competency in managing horticultural systems			
Course Number and Description	Written Communication Skills: The development and expression of ideas in writing. Written communication involves learning to work in many genres and styles. It can involve mixed-media including digital format. Written	Oral Communication Skills: Oral communication is a prepared, purposeful presentation designed to increase knowledge, understanding, or to promote change in the listeners' attitudes,	Critical Thinking Skills: The comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion.	Level 1: Develop working knowledge of multiple sources, including current and older literature, to find, evaluate, organize, and manage information related to horticultural systems.	Level 2: Demonstrate competence with both laboratory and field-based technologies used in modern horticulture.	Level 3: Apply concepts of plant biology, systematics, ecology, and genetics to manage and improve plants and their products.	Level 4: Apply scientific methods to test hypothesis	Level 1: Assess soils, soil health, plant fertility, water and site limitations.	Level 2: Assess potential and evaluate realized interactions with the abiotic and biotic environment in which plants are grown.	Level 3: Recommend and use appropriate application methods, materials, and diagnostic skills for addressing soil constraints and irrigation, nutrient, stress, and pest management issues.	Level 4: Apply principles of accounting, business law, labor, marketing and personnel management to a horticultural business and contribute to developing the various components of a business plan
HORT 1103- PLANTS IN THE HOME ENVIRONMENT											
HORT 1303- INTRO TO FLORAL DESIGN	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>									
HORT 2003-PRINCIPLES OF HORTICULTURE		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
HORT 2303-INTRO TURFGRASS MANAGEMENT				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 3103-WOODY LANDSCAPE PLANTS				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>					
HORT 3113-HERBACEOUS AND INDOOR PLANT MATERIALS				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>					
HORT 3123- INTERNATIONAL HORTICULTURE	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>							
HORT 3203- SUSTAINABLE LANDSCAPE PRACTICES				<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 3303-VEGETABLE CROPS	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 3403- TURFGRASS MANAGEMENT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 3503- SUSTAINABLE AND ORGANIC HORTICULTURE	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
HORT 3803- HORTICULTURE PHYSIOLOGY	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
HORT 3901-HORTICULTURAL CAREER DEVELOPMENT	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>								
HORT 400v-SPECIAL PROBLEMS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
HORT 4033- PROFESSIONAL LANDSCAPE INSTALLATION AND	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
HORT 4103- FRUIT PROD SCI AND TECH	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 4403- PLANT PROPAGATION	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
HORT 4503- SUSTAINABLE NURSERY PRODUCTION	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
HORT 4603- PRACTICAL LANDSCAPE PLANNING	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 462v- HORTICULTURE, LANDSCAPE, TURF SCIENCES	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
HORT 4701L- GREENHOUSE MANAGEMENT AND CONTROLLED	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
HORT 4703- GREENHOUSE MANAGEMENT AND CONTROLLED			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 4801L-GREENHOUSE CROPS PRODUCTION LABORATORY	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 4803 - GREENHOUSE CROPS PRODUCTION			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 4903- GOLF AND SPORTS TURF MANAGEMENT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 4913- ROOTZONE MANAGEMENT FOR GOLF AND	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 4921- GOLF COURSE OPERATIONS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 4932 - TURF BMPs		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
HORT 4043 - LANDSCAPE MANAGEMENT	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>