

**Horticulture and Crop Science Department**
submitted on behalf of the HCS faculty by Scott Steinmaus, HCS Dept Head

**Tier 3 – Curriculum, Pedagogy, Space**

**a. Teaching, Learning, Scholarship**

*1a) For the academic programs you expect to offer and the students you expect to serve: What effective approaches to teaching and learning are emerging in your field and related interdisciplinary areas?*

- The disciplines of horticulture and crop science are applied sciences requiring applied skills. Several of the other disciplines at the university introduced during K-12 education have a pedagogy that may be more conducive to the “newer” teaching styles based on self-learning. This is because most students come to the university with the basic skills necessary to get into the more advanced concepts and theories of those disciplines. In those disciplines, new approaches such as the “flipped classroom” or having student discussion groups tasked with self-discovery of a concept, may be more fruitful. The agricultural and environmental plant sciences are well and better suited to the lecture:lab teaching and learning style because students entering these disciplines often do not come from K-12 programs with the many basic principles required to understand the complex and dynamic nuances and interdependencies that define these disciplines. For example, in plant production, identification of a plant variety with specific functions - such as aesthetic, food, or fiber – to the environment in which it will grow (considering climate, soil, the urban:rural interface, societal needs and constraints, etc.) is a requirement. Similarly, in pest management (insects, vertebrate pests, pathogens, and weeds), accurate identification of the pest organism is the first crucial step in diagnosing and solving a particular problem. Lectures are the proper venue to introduce students to fundamental principles and qualitative information in a framework that will allow them to solve problems and find solutions. Labs are the venue -- conducted in our production and landscape environments (orchards, fields, greenhouses, nurseries and arboretum -- that provide the only appropriate settings for students to apply their acquired knowledge and to develop/enhance their critical-thinking skills. The development of discipline-specific critical thinking skills during labs is crucial because solutions in horticulture and crop science are very specific to situation and environment; there is rarely one consistently correct answer that remains constant over time and space.

- Many universities around the country are rediscovering the value of what we already call “Learn by Doing.” Despite the proven academic rigor of experiential learning (as compared to more didactic approaches), many major universities are eliminating undergraduate laboratories or grossly simplifying the laboratory requirements of their undergraduate courses. We must maintain our experiential learning environment: it has always defined us and now sets us apart from the majority of universities with which we compete for top students. Experiential learning in the HCS Department occurs, primarily, through the labs taught in its production and landscape environments, and through its Enterprise projects and internships. Its Enterprise projects allow students to apply and integrate the concepts introduced in course lectures and labs by growing and selling food and plants, epitomizes Learn by Doing, and nurtures the entrepreneurial
spirit that characterizes many of its students. Internships provide students with real world experience and allow them the opportunity to apply the critical thinking skills developed in lectures, labs and Enterprise projects. These internship experiences give students the chance to explore career opportunities, allow industries to vet students for future employment, and strengthen the HCS Department’s (and by extension the College’s and University’s) relationships with industry.

2a) How should Learn by Doing incorporate new learning needs, opportunities and technologies (in your field, etc.)?

- As reported in the Tier 1 and 2 narrative, there is a need to attract students who have little to no experience in agriculture. The HCS Department is currently in collaboration with universities across the country through the American Society of Horticultural Science, to develop a campaign to increase the visibility of horticulture and crop science by focusing on the reality that these are STEM disciplines: they are applied biological science with the credibility of any scientific discipline.
- Since many future horticulture and crop science students will be coming from non-traditional backgrounds, the pedagogy of experiential learning will be especially critical because these students will not come equipped with the intrinsic understandings -- derived from hands-on experiences related to production agriculture -- that many former students had when they enrolled at Cal Poly.
- One significant challenge will be to overcome the societal stigma agriculture appears to have where it is perceived that plant production involves hard work and long hours with little monetary reward. This stigma must be overcome by clearly demonstrating that the horticulture and crop sciences are applied Science, Technology, Engineering, and Mathematics, i.e., STEM disciplines, in every sense of the words.
- In agriculture, information is power. The more information that is gained about crops, the greater the opportunity there is to efficiently solve problems while minimizing impacts. Emerging technologies include the use of smartphone technologies that span GPS-based applications such as calculating the area of a field and mapping pest locations to allow for more precise control, to easily accessing databases and search engines that allow efficient product selection. The HCS Department is developing the industry relationships to utilize geo-referenced data collection and remote sensing. These technologies represent the leading edge in horticulture and crop science and will allow HCS students to monitor pests, follow real-time crop growth, and monitor fertility and water status in order to vastly improve crop productivity while reducing resource inputs – a true measure of the sustainability, or best management, of a system. Students must be provided with as many opportunities as possible to use these technologies in the Department’s production areas and to interact with the industries that develop and utilize them, as this is an area of rapid development and change.
- The HCS Department’s faculty must remain both current and discriminating in finding and demonstrating the most legitimate information sources and applications, whether smartphone-based or otherwise. Teaching students how to be discriminating in their selection of information sources has always been important, but now that information has become so easily accessible but credibility so difficult to discern, source discrimination, i.e., knowledge validity, has become one of the most important lessons HCS faculty can provide their students. Having the critical thinking tools to be discriminating with information will be some of the most important skills HCS students
have to have in order to be valuable employees and responsible future citizens.

3a) How does the teacher-scholar model fit (again in your field, etc.)?

- Scholarship keeps faculty current in their disciplines, which is imperative if faculty are to deliver the quality education students, state citizens, and industries expect and need. Student involvement in faculty research and scholarship activities has been shown to be a high-impact educational experience. Furthermore, the tenets of the Teacher Scholar Model are imperative to the delivering of a quality product: graduates highly valued by industry because they are knowledgeable in the application of the most current methods and approaches in their respective fields.
- The Horticulture and Crop Science faculty are actively engaged in scholarly activities and conduct investigations and research in the areas of corn genomics, pest management, controlled-environment production systems, turfgrass management, applied plant physiology, postharvest technology, climatic-tolerance-testing of landscape plants, etc. It is common for undergraduate and graduate students in the HCS Department to become involved at every level of a research project, from experimental setup, to data collection, statistical analysis of results, formal interpretation and publication, and presentation of results. This must continue if the HCS Department is to remain a robust provider of the next generation of plant scientists and agricultural producers.
- The most significant needs for the future are the retention of production acreage, and release time for faculty to engage in scholarly activities. It is imperative that high quality agricultural land be retained close to the campus’ central core. Reduced access to conveniently-situated research facilities (i.e., greenhouses and land) for faculty and students will result in a significant reduction in research activities and a decrease in the quality of HCS undergraduate students’ educational experiences. Traveling to outlying research and production sites requires time and effort and faculty are already over-extended.
- The HCS Department’s land and greenhouse facilities are a significant lure for outside entities wishing to conduct research through the Department. Grower commodity groups and commissions such as the California Citrus Board, University of California Extension Service, and the California Strawberry Commission, for example, would not come to Cal Poly if the HCS Department did not have its current facilities and prime agricultural land situated closed to the campus core. Adjacent land allows research activities to be conducted efficiently and accurately because faculty, equipment, greenhouses and storage are located close by. On campus land and facilities also support industry research in the areas of turfgrass management, ornamental flower production, landscape management, orchard fruit production and pest management.

b. Learning Environments

**What learning environments should Cal Poly develop or modify to accommodate (1) new modes of teaching and learning, (2) Learn by Doing, and (3) the teacher-scholar model in the future? Please respond in terms of the qualitative characteristics of the facilities and other spaces (including technology) critical to your programs and students:**

1b) Formal, scheduled or organized instruction
• Of all facilities considered imperative to Cal Poly’s effectiveness and growing uniqueness among US universities, it is the close proximity its agricultural land, greenhouses and landscaped teaching facilities to its campus core. These closely-situated facilities are becoming very rare in university environments as agricultural lands have been developed on campuses throughout the country – they are usually the easiest to build upon. It is imperative that Cal Poly and CAFES preserve its adjacent agricultural lands as it would be very difficult to convey the nuances, complexities and interrelationships of living organisms through herbaria, insect collections and online databases.

• Organism collections are utilized in horticulture and crop science. Preserved insect, weed, and pathogen collections are aids that help deliver basic qualitative information those students need for pest management. Living collections such as the HCS Department’s arboretum and foliage house, as well as its row crops and orchards, provide students with a collection of specimens that are absolutely necessary to the Department’s teaching efforts and which form the “living laboratories” that define this department’s curriculum.

• The equipment the Department requires is in a constant state of flux. New technologies that measure the status of plants in their environments are always being updated. In order for growers, researchers, and producers to remain competitive, the tools needed to assess plant nutrition, water status, pest identification, fruit development and maturity, and soil and water quality must be current. For example, top quality microscopes with cameras and the capacity to project and capture images are imperative to both teaching and research in horticulture and crop science. The Department has a few of these tools but more are needed and many of the Department’s current instruments are in need of updating.

• A new Produce Packing and Food Safety facility at the Crops Unit will greatly serve the needs of the students and faculty involved in fruit and vegetable production and research. This facility is critical if the Department is to teach its students modern postharvest and food safety techniques and regulations. This facility will serve as a setting for state-of-the-art grading equipment already on site and will allow for its better placement and function, and will provide the space needed for additional equipment that will enhance and modernize the Department’s on-campus food safety program.

• The greenhouses at the Horticulture Unit are also in dire need of upgrading and repair. With the anticipated relocation of the Horticulture Unit, such upgrading may not be prudent. Therefore, it is imperative that relocation efforts begin soon so that the HCS Department can invest its time, efforts, money and morale into a facility that will serve both students and faculty in the near future.

• The Horticulture and Crop Science department has the highest cost per student of any department in CAFES. The fact that the Department requires facilities that must be maintained by skilled, full-time technicians is one factor that increases the cost per student. However, these same facilities benefit students throughout the College, as many students in other departments take HCS courses and many of the labs of other CAFES departments are conducted on the land the HCS Department must pay to maintain. CAFES should absorb those costs and balance them against other disciplines that are inherently less costly. To require that every department have an equal cost-
per-student is not realistic and to do so will seriously negatively affect the HCS Department’s ability to train quality graduates, graduates who often have 2-3 or more job offers before graduation. Another option would be to allow more students who apply to the HCS department, and who meet minimum CSU standards, into its programs. Justification for this strategy is the job offers per graduate -- i.e., the very strong industry demand and need for HCS graduates -- and the future employment success, of HCS graduates compared to some other departments in CAFES. This argument is very clearly based on evidence provided in the Tier 1 and 2 narratives.

- Laboratories and classrooms of the future in horticulture and crop science are one and the same. The Department’s learning model of lecture combined with lab will necessitate having large open indoor areas with modern projection capabilities, including some capacity to project microscope or tabletop images. These large areas will require movable tables that serve as desks as well as lab benches. Ideally, the labs will have “dirty” areas where plants may be propagated and where soil and growing media may reside, and “clean” areas where more basic activities will be accomplished such as genetic work (e.g., PCR), tissue/pathogen culture, etc. The areas will require both laminar and fume hoods. The “dirty” and “clean” areas could be in separate rooms but they will have to be in close proximity since students and faculty will often have to use both simultaneously or in a close sequence of protocol. These teaching labs could also serve as research areas for faculty but there will have to be some safeguards to protect equipment and supplies.

- Connectivity throughout campus is expected in all disciplines. The Horticulture and Crop Science facilities are immediately adjacent to the campus core and are therefore subject to connectivity interruptions and lack capacity. Many of the lab activities in our curricula require that students generate and analyze data. The Department’s computer capacities are rapidly becoming outdated. Updated computers for experimental design, data collection and storage, statistics, inventory and landscape design are necessary for if the Department is to have a viable future.

2b) Informal student learning outside the classroom or laboratory

- Extra-curricular experiences for the HCS Department’s students have an enormous impact on their educational experience at Cal Poly and must continue into the future if the Department is to preserve its uniqueness. The Crops Club is one of the largest clubs on campus and is heavily focused on career-building experiences and activities. The Horticulture Club is also focused on student success after graduation. The Horticulture Club facilitates the operations at the Horticulture Unit including the Poly Plant Shop and some of the Enterprise Projects. These clubs must be encouraged and nurtured by the university because they provide the social networking that is so important for students’ future careers.

- Horticulture and Crop Science students benefit immensely from the competitions in which they participate including the PLANET SCD competition, many Floral Design and Flower competitions, and undergraduate and graduate student oral and poster competitions at scientific conferences, including those of the California Weed Science Society, the American Society for Horticultural Science and the Entomological Society of America.
3b) The teacher-scholar model

- In light of the anticipated relocation of the Horticulture Unit, modern controlled growth environments such as fully controllable greenhouses and growth chambers, outdoor plant production pads, shade houses, and retractable roof greenhouses are planned for the future. It is imperative that these facilities have “dirty” and “clean” areas as the burgeoning field of commercial controlled-environment plant production for cut flowers and vegetables is providing numerous opportunities for applied research in support of the Teacher-Scholar Model. Due to these research activities, it will be important to consider limiting public access to these facilities. Also, as part of the relocation process, the Crops Unit will be redesigned both for functionality and to provide an aesthetically pleasing entrance to the campus.

- Currently, the only crop protection diagnostics centers reside at UC, Davis and UC, Riverside. Cal Poly would benefit greatly if the HCS Department developed a plant diagnostics center where students would follow prescribed protocols developed by faculty to diagnose plant problems from clients around the State. This would require more space in terms of labs, collections, growth chambers, incubators, microscopes, and photographic capacity, in order to deliver a quality diagnosis and solution worthy of charge. These activities would support faculty scholarship because plant problems needing diagnosis by such a center would most likely be due to a new cause or unusual situation worthy of the scientific method.

- The Strawberry Research Center at Cal Poly is a prime example of the outside relationships that Cal Poly can cultivate with organizations such as the California Strawberry Commission. Preserving prime agricultural land close to the campus core is imperative if these relationships are to be facilitated.

- New computers in our labs will be necessary if the HCS Department to fully support the Teacher Scholar Model (see above).