# SCHOOL OF PLANT SCIENCES 2021 STRATEGIC PLAN

**Purpose**: Increase productivity and sustainability in agricultural and urban environments, especially in semi-arid and arid environments. Specifically, we will:

1. Generate fundamental knowledge about plants and their associated microbial communities at the molecular, cellular, organismal, population, and community levels.

2. Integrate basic, translational, and applied research to improve growth, development, and adaptation of crop and urban plants in varied and changing environments.

3. Disseminate our discoveries through extension and outreach activities for stakeholders locally, regionally, nationally, and internationally.

4. Combine our research with activities for undergraduate and graduate students at the University of Arizona, and beyond, to provide world-class education and training.

**2021 Vision**: A leadership role for the School of Plant Sciences in generating and disseminating the knowledge needed to address looming crises in productivity and sustainability of agricultural and urban plant systems in arid environments. Outcomes from fulfilling our vision will include: genetically improved plant materials, novel strategies for mitigating plant disease, improved food safety, enhanced and innovative land management strategies for optimal plant growth, and a broadly trained, job-ready workforce prepared to meet future challenges to agricultural and urban plant systems.

**Mission**: Achieving our vision will require us to:

- Capitalize on our research diversity.
- Develop strong communication among faculty and with stakeholders.
- Continually identify strategic opportunities in research and outreach.

**Shared Values:** Importance of combining and maximizing our strengths in basic and applied science to combat obstacles to agricultural production and urban plant use.

**Summary:** This document represents faculty-generated goals, priorities, and associated activities that will position us as leaders in meeting the challenges facing plant and microbial science in arid environments. Included are plans for strengthening our educational activities (expand/enrich undergraduate experience and success and enhance graduate education), integrating fundamental, applied, and extension research into novel strategies for our diverse stakeholders (increase research funding and productivity and meet challenges in plant and microbial science in arid environments.

All members of the SPLS faculty were given the opportunity to participate in the preparation of this document and to comment on its content. As much as is possible, the goals presented represent the general consensus of participating faculty. However, we are a diverse faculty and there is dissent and debate on aspects of this strategic vision. Alternative viewpoints will continue to be considered as faculty in the School works towards these goals.

## STRATEGIC GOAL ONE:
## Expand/enrich Undergraduate Experience and Success

### A. Current situation and gap between current situation and desired situation

The number of PLS undergraduate majors (Plant Sciences and Sustainable Plant Systems) has traditionally been low; however, it doubled from 37 to 73 in the last four years. The low number of undergraduates made individual mentoring and advising by faculty members possible. We aim to:

- Grow PLS majors while maintaining exceptional mentoring and advising.
- Prepare students for employment by offering more internship and training opportunities.
- Increase our involvement in campus-wide plant and microbial biology instruction.
- Integrate our research experience into classroom teaching.
- Provide students with a collaborative and interactive learning environment.
- Engage distant and global students with the use of online technology.

Present and target enrollment numbers:

- FY12: 73 undergraduate majors
- FY15: 100 undergraduate majors (37% increase)
- FY17: 120 undergraduate majors (20% increase)

### B. Strategies to achieve goal

- Outreach to high school and community college students, and incoming freshmen.
- Promote PLS majors, career opportunities, and courses to students.
- Provide faculty-mentored research for PLS undergraduates.
- Appoint a liaison to seek funding and internship opportunities in industry and government.
- Develop special activities (e.g., posters, arts, online discussions, research symposia) to promote personalized, collaborative and interactive learning.
- Create online classes that combine electronic content delivery and social media for interactions.

| C. Actions | Time Period |
|---|---|
| **1.** Regular contact with high school and community college students and advisors. | FY13-onward |
| **2.** Advertise PLS majors, careers, and courses to students via presentations and flyers. | FY13-onward |
| **3.** Promote PLS programs to University Professional Advisors. | FY13-onward |
| **4.** Mentor and advise student researchers in laboratories. | FY13-onward |
| **5.** Identify internship and practical training opportunities. | FY13-onward |
| **6.** Develop interactive online classes. | FY13-onward |
| **7.** Implement collaborative and interactive learning activities in classes. | FY13-onward |
| **8.** Participate in SCI 295b (Research Readiness for underrepresented minorities). | FY13-onward |

### D. Inputs needed to achieve the goal

- Industry and government liaison.
- High school/community college outreach coordinator/faculty committee.
- Scholarships for summer student research (sources: grants, industry, donations, University).
- Funds for in class special projects (sources: grants, industry, donations, University).
- Video recording and editing equipment and web development for online classes.
- A part-time undergraduate advisor to assist with undergraduate advising.

### E. Objective metrics that will be used to track progress towards attaining goal

- Student enrollment in PLS majors.
- Number of student credit hours.
- Number of students placed post-graduation.
- Number of presentations to biology classes and minority groups.
- Number of outreach talks.
- Number of student researchers.
- Number of interns and practical trainees.
- Number of online classes and enrollment.

## STRATEGIC GOAL TWO:
## Enhance Graduate Education

### A. Current situation and gap between current situation and desired situation

- FY12: 19 graduate students (+5 matriculating in fall 2012), ~0.49 graduate students/primary faculty member.
- FY16: 1 graduate student/faculty member.

### B. Strategies to achieve goal

- Increase participation in umbrella and interdisciplinary graduate programs.
- Initiate and support international dual Ph.D. programs with partner institutions in the U.S. and across the globe.
- Enhance recruitment of graduate students through development of winter and summer research institutes for domestic and international students.
- Identify and expand opportunities for training corporate employees.
- Attract corporate funding for graduate studies.
- Leverage iPlant for training our graduate students.
- Train the next generation of graduate students in plant and microbial science.
- Expand teaching opportunities for PLS and PLP graduate students.
- Increase graduate funding through training grants.
- Develop fast-track M.S. and B.S.-M.S. programs in Plant Sciences and Plant Pathology.

| C. Actions | Time Period |
|---|---|
| **1.** Identify and participate in interdisciplinary graduate programs (e.g., Arizona Biological and Biomedical Sciences Program). | FY13-16 |
| **2.** Create a dedicated Graduate Program Outreach & Development Committee to carry out the actions associated with the expansion of the graduate program. | FY13-onward |
| **3.** Establish a dual Ph.D. program with China and Huazhong Agricultural Universities. | FY13-onward |
| **4.** Identify other candidate institutions in the U.S. and abroad to establish dual Ph.D. programs with special emphasis on peer institutions in the U.S. (e.g., UC Davis, Texas A&M) and countries such China, India, Brazil, Russia, Mexico, and the countries in the Middle East and North Africa. | FY13-13 |
| **5.** Develop a sustaining program funded by participating faculty member grants and CALS to provide short-term winter and summer programs/institutes to attract undergraduate students including those from liberal arts colleges and students from abroad. | FY14-16 |
| **6.** Identify corporate collaborators for funding of our graduate program. | FY13-16 |
| **7.** Identify opportunities and implement a long-term program of incorporating iPlant's expertise and research as a training component of our graduate program. | FY13-16 |
| **8.** Develop a set of online graduate courses in areas that are unique to our programs including post-harvest physiology, controlled environment agriculture, computational biology. | FY13-16 |
| **9.** Increase outreach to existing programs at UA and other minority-serving institutions to increase recruitment of underrepresented graduate students. | FY13-16 |
| **10.** Develop a curriculum that would enable training of our graduate students in understanding plants and microbes at a systems level, incorporating whole plant, plant-environment, and molecular/biochemical understanding of plant functions. | FY13-16 |
| **11.** Leverage our current contribution to teaching courses outside the school (e.g., VSM, MCB, EEB) to increase the number of TA positions for those courses funded by the managing program. | FY13-onward |
| **12.** Identify and apply for graduate training funding from NSF, USDA, and NIH in collaboration with other units where appropriate. Areas of focus could include computational biology (iPlant), controlled environment agriculture (ABE), plant/microbial systems biology (MCB, EEB), and comparative genomics (EEB). | FY13-16 |

**13.** Develop a 5-year combined undergraduate-graduate (B.S.-M.S.) program in Plant Sciences incorporating education and training in Plant Sciences and bioinformatics that is funded entirely through tuition fees. FY13-16

**14.** Develop fast-track M.S. programs in Plant Sciences and Plant Pathology geared towards training scientific staff/workforce for industry, non-profit and academia funded partly or entirely through tuition fees. FY13-16

**D. Inputs needed to achieve the goal**

- Faculty participation in additional outreach and coordination roles.
- One GRA equivalent per year in FY12 increasing to 3 per year in FY13 and beyond.
- A new Graduate Program Outreach and Development Committee as part of the larger existing Graduate Student Program Committee.
- Winter and summer training institutes coordinated by a faculty volunteers.
- Funding for undergraduate researchers from small colleges).
- Online course-development personnel funded by CALS.

**E. Objective metrics that will be used to track progress towards attaining goal**

- Number of graduate students matriculating per year in PLS and PLP programs.
- Number of MS and PhD degrees obtained per year in PLS and PLP programs.
- Number of graduate student credit hours.
- Amount of graduate funding from non-grant sources.
- Relationships with corporate entities.
- Relationship with small colleges and liberal arts institutions.
- Proportion of underrepresented graduate students in our school.
- Average time to completion of degree.
- Peer-reviewed graduate student publications.
- Number of online classes and enrollment.

## STRATEGIC GOAL THREE:
## Participate Collaboratively in the Administrative Restructuring and Leadership of the Microbiology Undergraduate Major

### A. Current situation and gap between current situation and desired situation

- Over recent years, the undergraduate major in Microbiology has been overseen by the Microbiology Commission, the Associate Dean of Academics, and the Department Heads/Directors of Veterinary Sciences and Microbiology, Plant Sciences and Soil, Water and Environmental Science. Thus, Microbiology has had no single person focused full time on its oversight and no official standing committees.
- In Fall 2012, Associate Dean Joy Winzerling proposed a cross-unit committee that will develop a structure for overseeing the curriculum, recruitment, and related operations of the Microbiology undergraduate major. The committee will work with the home unit for Microbiology, the new School of Animal and Comparative Biomedical Sciences, through which the unit head will oversee the administrative aspects of the major. The principles that frame the aims of this committee are as follows:
    - The undergraduate microbiology major is one of the largest in CALS (~300 students), one of the larger biology-based undergraduate programs in the University and one with potential to grow.
    - To enhance undergraduate programs in Microbiology we should develop coordinated efforts to adapt them to 21st century technologies and recruit students using a faculty-inspired approach.
    - There is a great need for trained microbiologists in diagnostics, food safety, quality control, environmental microbiology, plant and animal health, bioremediation, alternative fuel production, health care and clinical laboratories.
    - Losses of faculty and instructors in VSM via resignations, recent and upcoming retirements, and death have resulted in a very small group of Microbiology-focused faculty in that department. In the absence of new hires, a solution is needed that leverages the strengths in Microbiology across the college.
    - Microbiology courses are taught by faculty in several CALS departments, with a decentralized structure that has separated faculty effort from faculty leadership. Four of five core courses (Microbial Diversity MIC329a, Microbial Physiology MIC328, Microbial Genetics lecture and laboratory MIC428R and L, and the largest introductory course section of MIC205, fall semester, ~400 students) are taught by faculty in the School of Plant Sciences.
- Many of the SPLS faculty with programs in microbial sciences work in areas unrelated to plant sciences and thus would benefit from participating in an academic unit that is inclusive and covers all aspects of microbiology, recognizing it as a distinct discipline.
- **To best serve students and the state, a strong program in Microbial Sciences must be maintained in CALS. We propose that our microbiology-related faculty participate actively in charting the future of the Microbiology Program by: (a) participating collaboratively in the new cross-unit microbiology committee; (b) considering adjunct appointments in the School that will house the program; (c) continuing to teach the core courses in Microbiology for which we are responsible; and (d) working to strengthen ties with other microbiology-oriented units in CALS.**

### B. Strategies to achieve goal

- Participate in cross-unit Microbiology committee to help chart future of Microbiology program
- Continue our strong tradition of teaching in microbiology
- Encourage SPLS faculty to seek adjunct positions in the new School of ACBS
- Continue to cultivate appreciation of microbiology-related faculty in SPLS

**C. Actions** **Time Period**

**1.** Begin SPLS participation in cross-unit committee and consider leadership roles therein. FY13-onward for all
**2.** Investigate adjunct positions in the new School of ACBS.
**3.** Allow self-identified faculty to move to other programs should they feel under-represented or isolated in the current structure.
**4.** Encourage SPLS faculty whose work relates to microbiology to continue to participate actively in SPLS activities.
**5.** Explore cross-campus and college-wide collaborations for outreach, research, and related activities that will enhance Microbiology presence on campus.

**D. Inputs needed to achieve the goal**

- Cohesion among CALS Microbiology faculty with a common goal: enhancing major and, in future efforts, graduate program.
- Integration of SPLS faculty interested in Microbiology with efforts underway in other units.

**E. Objective metrics that will be used to track progress towards attaining goal**

- Increase in applicants, enrollees, and graduates of the Microbiology undergraduate program.
- Development of a privately sponsored cross-university Microbiology seminar series.
- Development of internship programs and corporate/private sponsorship for program enhancements.
- Increased recognition of Microbiological research excellence in SPLS and CALS via coverage by the school and CALS websites, faculty honors and student achievements.

## STRATEGIC GOAL FOUR:
## Increase Research Funding and Productivity

**A. Current situation and gap between current situation and desired situation**

- Annual averages for the past 5 years: 90 grants submitted; $9 million raised; 127 research publications.
- FY14: 120 grant submissions; $11 million in external funding; 150 research publications.
- FY17: 150 grant submissions; $14 million in external funding; 175 research publications.

**B. Strategies to achieve goal** (list if more than one)

- Support and strengthen research programs of current faculty.
- Increase interdisciplinary and/or intramural collaborations within the School, College, and University to enhance funding from traditional sources.
- Expand faculty efforts to obtain extramural funding from new and non-traditional sources (local, state, national, international, industry, commodity, foundations, private investors, and philanthropic organizations).

| **C. Actions** | **Time Period (Fiscal Years)** |
|---|---|
| **1.** Form consortia of faculty working in focused areas (such as genomics, reproductive biology, microbial ecology, etc.) to establish research collaborations for extramural funding opportunities. | FY13-onward |
| **2.** Establish a Fundraising/Development Committee to identify potential donors (alumni, local, state, national, and international) to fund seminars, individual research or educational projects or endowed faculty positions. | FY13-onward |
| **3.** Enhance interdepartmental communication by conducting monthly faculty research meetings and annual School research retreats. | FY13-onward |
| **4.** Establish an Educational Outreach Committee that will plan and lead faculty educational outreach activities; these activities will be used by participants as part of research grant proposal broader impacts and/or educational grants. | FY13-onward |
| **5.** Develop joint seminar programs with other units in the College/University to reduce costs and promote interactions among faculty. | FY13-onward |
| **6.** Develop interactive Microbiology webpage to attract students and inform the public of the importance of UA Microbiology to human health and the environment. | FY13-onward |
| **7.** Partner with campus and professional organizations to conduct semi-annual workshops to train and educate faculty on fundraising from non-traditional sources. | FY13-onward |

**D. Inputs needed to achieve the goal** (do not limit to financial inputs)

- Research consortia.
- Fundraising/Development Committee.
- School funds, teaching assistantships.
- Educational Outreach Committee.
- Joint seminar programs.
- Funds for retreats and workshops.

**E. Objective metrics that will be used to track progress towards attaining goal**

- Number and dollar value of funding proposals submitted.
- Number and dollar value of funding awards granted.
- Number of School fundraising activities.
- Number of outreach and extension events and presentations at scientific meetings and extension gatherings (posters, oral).
- Number of School publications (peer-reviewed, communiqué and newsletters).

## STRATEGIC GOAL FIVE:
## Meet Challenges to Plant and Microbial Science in Arid Environments

**A. Current situation and gap between current situation and desired situation**

World challenges relevant to agriculture and plant and microbial science include an increasing population and rapidly expanding urbanization, limited natural resources, and increasing environmental pollution. These challenges will require us to rethink how we sustainably produce food, feed, fiber, and fuel with limited water, high temperatures, and poor quality soils, while simultaneously improving plant, human and environmental health. SPLS has high impact fundamental plant and microbial science programs, highly effective applied research and extension/outreach programs with strong stakeholder networks, and access to strong and diverse campus entities for partnering (e.g., iPlant, the Controlled Environment Agriculture Center, the Department of Veterinary Science and Microbiology, the Department of Soil, Water and Environmental Science, and the Karsten Turfgrass Research Facility). Our goal is to position ourselves as leaders in overcoming these challenges.

**B. Strategies to achieve goal**

- Integrate our strengths in basic, translational and applied research with our extension capacity to improve crops, crop productivity, sustainability, and the urban plantscape in semi-arid and arid agriculture.
- Develop initiatives and focused working groups to promote research collaboration.
- Develop novel uses for plants and microbes.

| **C. Actions** | **Time Period** |
|---|---|
| 1. Engage various stakeholders to identify research and extension initiatives and to develop a 5-year action plan. | FY13-onward |
| 2. Determine the feasibility of/develop a National Center for Semi-arid and Arid Plant and Microbial Sciences. Possible Center emphases include: plant breeding and transformation, computational and synthetic biology, high throughput phenotyping, urban sustainability, and cataloging arid biodiversity. | FY13-15 |
| 3. Identify external funding sources. | FY13-14 |
| 4. Enhance our School's communication with the public | FY13-onward |

**D. Inputs needed to achieve the goal**

- Stronger faculty participation and improved communication.
- Committees/working groups (including stakeholders) to identify and review shared priorities regularly (annually in the context of a 5-year plan).
- An operational plan for the proposed National Center for Semi-Arid and Arid Plant and Microbial Sciences.
- Grant applications to support students and research activities in relevant areas.

**E. Objective metrics that will be used to track progress towards attaining goal**

- Regular faculty research meetings.
- Meetings and other interactions with stakeholders and potential strategic partners.
- Identification of shared research-stakeholder priorities.
- Construction of a White Paper on feasibility of/areas of emphases for the National Center for Semi-Arid and Arid Plant and Microbial Sciences.
- Extramural funding.
- Research and extension publications in relevant areas.

Note: The faculty is in agreement that we are well positioned to meet local, national, and global challenges for plant and microbial science in arid environments. Complete agreement on specific goals and strategies proposed by a working group has not been achieved, but conversations are ongoing.