Fall 2020

Bachelor of Science in Agricultural Biology

Comprehensive Program Proposal

BIOAGRICULTURAL SCIENCES AND PEST MANAGEMENT
COLORADO STATE UNIVERSITY

Amy Charkowski, Professor and Head

Cynthia Brown, Professor

Vamsi Nalam, Assistant Professor

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I. Overview of Proposed Program

1. Bioagricultural Sciences and Pest Management

Please note that we are working to change the name of the department to **Agricultural Biology** before the end of 2019.

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Dr. Amy Charkowski, Professor and Department Head, Department of Bioagricultural Sciences and Pest Management

2. College of Agricultural Sciences

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Dr. Ajay Menon, Dean, College of Agricultural Sciences

3. Contact persons

Dr. Cynthia (Cini) Brown	(970) 491-1949	cynthia.s.brown@colostate.edu
Dr. Vamsi Nalam	(970) 491-4189	vamsi.nalam@colostate.edu

4. **Type of degree:** BS – Bachelor of Science
5. Not applicable to this bachelor degree program
6. **Program Instructional format type:** Resident Instruction (main campus, face-to-face)
7. **Name of Degree:** Agricultural Biology
8. **Proposing unit:** Department of Bioagricultural Sciences and Pest Management (1177) in the College of Agricultural Sciences
9. **Total number of credits required for degree:** 120
10. **Estimated length of degree in semesters:** 8
11. **Admission plan:** fall and spring entry
12. **Full- or part-time enrollment:** Full-time and part-time students are welcome. Connections among students within their cohort is important for the students' experiences and retention in the program. Thus, efforts will be made to assure that each student takes the core courses (AB/BSPM 120, AB/BSPM 130, AB/BSPM 230, AB/BSPM 270 [for transfer students], AB/BSPM 330 and AB/BSPM 430) of the major with their cohort, whether they are attending full- or part-time.
13. **Expected total number of students enrolled in program**
    We expect 100 to 200 students to be enrolled in the program 5 years post-implementation.

14. Summary of Program Rationale

Academic area

The Agricultural Biology major provides students with a scientific foundation in the complex interactions that occur among microbes, insects, and plants in natural and managed ecosystems. Students in this major will develop skills to use systems thinking to solve real-world agricultural problems. They will be prepared to work to improve ecosystem sustainability and address pressing issues in both biophysical and sociocultural components of agricultural ecosystems in a variety of careers. There is no similar major at our peer institutions and only one other similar major at a land grant university in the United States. Therefore, this academic area is likely to draw students who would not otherwise attend CSU and aid us in competing for students with land grant universities nationally.

Learning Outcomes

- Integrate skills and knowledge to solve problems related to plants, insects, and microbes in natural and managed ecosystems
- Demonstrate understanding of social, economic, and biophysical aspects of the management of biological problems in natural and managed ecosystems
- Describe, assess, analyze, and synthesize knowledge from across the curriculum to create solutions for pests and beneficial species in natural and managed ecosystems
- Promote and practice inclusion to form effective teams that solve complex problems in natural and managed ecosystems
- Communicate effectively with diverse audiences regarding sustainable pest and pathogen management in natural and managed ecosystems

Potential Occupations

This major will be an excellent choice for students interested in careers as researchers, crop advisors, extension educators, growers, agriculture consultants, production managers, inspectors, entomologists, plant disease diagnosticians, weed scientists, plant pathologists, natural resource and land managers, regulatory professionals and for those who wish to pursue careers in academia. To support their career path, this major includes laboratory courses in entomology, plant pathology, and weed science, as well as practical training through internships and/or research experiences. It also emphasizes development of soft skills, such as communication skills, teamwork, and leadership because agricultural scientists must interact regularly with a wide range of clientele.

Rational for Offering this Major

There are numerous reasons to offer a major in this academic area at Colorado State University at this time, including:

1. Universities in the United States are not producing enough graduates to meet employer needs in agriculture. This is reflected in multiple datasets and is likely behind the observation that salaries for students graduating with 4-year degrees in agriculture are increasing at a faster rate than for any other area in STEM. Surprisingly, even though employment prospects in agriculture are excellent, it is not mentioned in recruitment materials as a reason for studying biology for standard biology majors at most universities in Colorado.

2. Colorado State University is the only university in Colorado that can offer agricultural degrees (Colorado Department of Higher Education). Therefore, among universities in Colorado, CSU is the only campus that can help fill the gap in the number of STEM graduates in agriculture. We can collaborate with other CSU system universities to offer agricultural degrees, and this will be more effective if we are also offering our own major.
3. Among our peer universities, there are no majors that provide students with a comprehensive education in entomology, plant pathology, and weed science. Therefore, if students are interested in studying agricultural biology at a highly ranked university, we will be the only choice among our peer institutions. It will be difficult for peer universities to copy this major because the disciplines required are split across multiple departments at peer universities.
4. Among land grant universities, CSU and New Mexico State University (NSMU) are the only universities that house entomology, plant pathology, and weed science in a single department. However, NSMU is the only land grant that currently offers a degree in Agricultural Biology. This degree is growing in popularity, even though enrollment at NMSU is shrinking.
5. Because of numerous articles in main stream media, potential students and employers recognize the topics and controversies in agricultural biology as important and high impact. This will aid us in both recruitment and student placement after graduation. Some examples include:
    a. Food production challenges (pollination and honeybee colony collapse, invasive species, the need to feed 10 billion people by 2050)
    b. Pesticide use (cancer or birth defects, water contamination, insect apocalypse and neonicotinoid insecticides)
    c. Loss of natural resources caused by pest and pathogen management methods (water contamination, loss of top soil)
    d. Preparing for the impact of climate change on agricultural ecosystems
6. This major will also provide graduates with expertise needed to participate in emerging agricultural industries, such as vertical farming, production of alternate protein sources, or gene editing plants, insects, or microbes for agricultural production. They will also be prepared to take part in developing policies for these emerging industries.

Evidence of State and National Demand

There is a current and growing need for persons with the training that will be gained by students who major in Agricultural Biology. A 2015 Purdue University report created with U.S.D.A. predicted 57,900 new jobs in food, agriculture, renewable natural resources, or the environment each year between 2015 and 2020 (Goecker et al. 2015). Occupations in these fields for college graduates with bachelor degrees or higher were predicted to increase by 5% during this time. Only 61% of these new positions were predicted to be filled by graduates with training in these areas, despite employers' preference for hiring such graduates (Goecker et al. 2015). This report recognized that graduates with training in food, agriculture, renewable natural resources, or the environment will provide critical leadership in addressing and resolving challenges facing the U.S. and the world in food systems, sustainable food and energy systems, and environmental quality.
This need is reflected in local data as well. Employment sectors in Colorado in which Agricultural Biology graduates will be well-qualified to work are expected to grow up to 28% in the coming decade (Colorado Department of Labor and Employment). However, no current CSU major prepares undergraduates with a comprehensive understanding of how

biotic stress (weeds, microbes, arthropods) impact crop yields and natural ecosystems. As a result, employers in this area do not currently look to CSU for potential employees. Importantly, surveys of employers in agricultural industries consistently show that employers seek broadly trained students who understand systems rather than students with narrow training in specific disciplines. Unlike our peer institutions, CSU houses all disciplines related to biotic stress of plants in one department. Therefore, we can offer a major with a systems-based approach to managing the health of agricultural and natural ecosystems that meets employer demands for broadly trained students.

15. Identify accreditations that apply: Not applicable

16. Proposed funding mechanism (indicate all that apply)

a. X Base funding from the sponsoring department/college

b. X UNDERGRADUATE PROGRAMS ONLY: 2-3-6 funds

c. X UNDERGRADUATE Differential Tuition (DT). DT is a charge in addition to the regular University tuition. DT provides a funding mechanism to assist in covering program costs. It is funded through charges based on students enrolled in 60 or more credits with the exception of first year freshmen.

d. __GRADUATE Differential Tuition (DT). **If selected, complete No. 17 below.** DT is a charge in addition to the regular University tuition. DT provides a funding mechanism to assist in covering program costs. Departments receive the full graduate DT. Cost per credit is the recommended pricing structure for graduate DT.

i. Indicate estimated cost per credit:

ii. OR indicate estimated cost per semester:

e. __Provost's tuition sharing program for GRADUATE PROGRAMS. Sharing applies only when NEW students are enrolled in the University.

f. X Other. We will receive assistance from the college student success team in student advising during the years of the program as it develops.

Section I References

Colorado Department of Education. Roles and Missions of Colleges. https://highered.colorado.gov/academics/colleges/rolemission.html#csu Accessed 7/8/2019.

Goecker, A.D., E. Smith, J. Marcos Fernandez, R. Ali, R. Goetz. 2015. Employment Opportunities for College Graduates in Food, Agriculture, Renewable Natural Resources, and the Environment; United States 2015 – 2020. United States Department of Agriculture. https://www.purdue.edu/usda/employment/

II. Fit with CSU Role and Mission and University's Most Current Strategic Plan

1. What are the objectives of the program?

Students who complete the major in Agricultural Biology will be able to:

- Integrate skills and knowledge to solve problems related to plants, insects, and microbes in natural and managed ecosystems
- Demonstrate understanding of social, economic, and biophysical aspects of the management of biological problems in natural and managed ecosystems
- Describe, assess, analyze, and synthesize knowledge from across the curriculum to create solutions for pests and beneficial species in natural and managed ecosystems
- Promote and practice inclusion to form effective teams that solve complex problems in natural and managed ecosystems
- Communicate effectively with diverse audiences regarding sustainable pest and pathogen management in natural and managed ecosystems

2. How does the proposed program support the mission of the University?

Agricultural Biology is a core competency in agriculture, forestry and natural resources.

3. How does the proposed program support the most current University Strategic Plan (http://provost.colostate.edu/strategic-plan/) of the institution?

The Agricultural Biology major is unique in the state. It also covers many specialized majors that used to be offered at CSU and other land grant universities, but that are no longer offered, such as Plant Pathology, Entomology, and general Agricultural Sciences. Based on a similar major at New Mexico State University (NMSU), we believe that this major will attract a diverse pool of highly qualified students from throughout Colorado and beyond who would not otherwise join our university and college. The Agricultural Biology major is growing at NMSU, even though the university has shrunk overall by about 20% since 2010, demonstrating the popularity of this major.

Using scientific knowledge, such as that gained in biology, and being able to apply it to the grand challenges of the near future, such as food production and ecosystem protection, is of great interest to tomorrow's students. This major will provide many relevant educational opportunities to address the global challenges of sustaining our food and fiber supply in natural and managed ecosystems. Learning outcomes will be achieved through the systems level thinking required to arrive at economically, socially, and environmentally sound solutions to these challenges.

This major incorporates university strategic objectives regarding rates of credit completion, retention rates, credit requirements, and graduation rates. It also is designed to foster the campus-wide values of diversity, inclusion and cultural literacy. Students majoring in Agricultural Biology will engage in internships, experiential learning and other high impact practices to achieve defined degree-end learning objectives.

4. How does the program contribute to attaining long-term goals and directions of the institution and department?

Teaching excellence is one of the core values of the BSPM department. Despite not having an undergrad major, BSPM has strength in teaching and faculty in BSPM contribute to numerous other majors through teaching introductory and advanced courses in entomology, plant pathology, and weed science, as well as teaching in the LIFE courses. Development of a major will allow us to reach the following long-term goals:

- Further develop excellence in teaching, research, and extension by aiding us in connecting concepts across the courses that we teach.
- Strengthen relationships with stakeholders interested in hiring students with B.S. degrees in Agricultural Biology.
- Train the next generation of students who wish to pursue graduate degrees in Entomology, Plant Pathology, and Weed Science.

This major, with its systems-based approach to management of the health of agricultural and natural ecosystems, fits well with the land grant mission of our college and university. Our college is becoming a leader in agribiome and agri-tech and our major will encompass both of these concepts. For example, plant pathology is essentially the study of how the microbiome impacts plant health, insect vector behavior and management of weeds involves biotechnology and many aspects of agricultural engineering, thus, includes agri-tech. CAS is also planning to increase in the number of undergrad majors and our program will aid in achieving this goal as well.

5. How does the proposed program meet the needs of Colorado and enhance the state's capacity to respond effectively to social, economic, and environmental challenges and opportunities?

The Agricultural Biology major integrates expertise on entomology, plant pathology, and weed science. Agricultural, forest and other natural systems are key to social and economic well-being worldwide, and they are under increasing stress from endemic and invasive pests, pathogens, and weeds. Providing a degree program at CSU in Agricultural Biology will enhance Colorado's ability to respond to social, economic, and environmental challenges and opportunities in agriculture and will help CSU become a global leader in the education of students on biotic stress in plants.

Food production must increase by 50-70% by 2050 to feed a growing human population and this must happen during a time of resource limitation and climate change. With our current food production systems, we lose over 40% of pre-harvest yields to insect pests, plant diseases, and weeds (Savary et al. 2019) Additionally, between 8–70% of the world's food is lost to insects and other pests after harvest, depending on location and resources for post-harvest pest management (Mason 2003). Therefore, much of the agricultural production needs for our growing population could be met by reducing these losses. However, our current crop protection methods can contribute to environmental degradation, so are at best a short-term solution to food security. Very few people today understand agriculture and biology, but many major challenges of today and tomorrow intersect with these fields. We must train the next generation of students to understand the biology of agricultural systems so that they can discover and implement long-term solutions to improve the health of our agricultural ecosystems.

The global ecosystem services value is estimated at $125 trillion annually and human survival, well-being, and agriculture relies entirely on ecosystem services (Costanza et al. 2014). The ecosystems that provide agricultural services such as reservoirs for insect pollinators and predators, wild crop relatives for plant breeding, and water for agriculture are all under stress from human activities that increase pressure from invasive pests, pathogens, and weeds and that intensify demands on natural resources. To support our own health and that of natural ecosystems, we must understand how species within ecosystems interact and evolve and which biological traits lead to ecosystem resilience or species

invasiveness. Students with an Agricultural Biology major will be able to contribute to managing ecosystem health overall and not just in agricultural systems.

Because of the magnitude of the challenges faced in agriculture, employers from industry, non-governmental organizations, academia, and government need well-educated employees with a comprehensive understanding of how to manage biotic stress (weeds, microbes, arthropods). They are currently unable to hire students with an integrated understanding of biotic plant stressors from CSU, but once we have an Agricultural Biology major in place, this will be one of only two places in the U.S. that trains students comprehensively in these areas. Because few universities offer this major, we will be able to attract students from Colorado and elsewhere who might not otherwise choose CSU. The only other similar program in the U.S. is located at NMSU. This type of program is limited nationally for two main reasons:

- Non-land grant universities either lack depth in or entirely lack the disciplines of entomology, plant pathology, and weed science, thus, cannot offer a program in Agricultural Biology.
- Most land grant universities house these disciplines is multiple departments, schools, or colleges, and the administrative barriers are too high to allow sufficient coordination among departments to offer a major in Agricultural Biology.

For these reasons, plus the higher academic ranking of CSU compared to our one competitor, we expect our major to draw students nationally and internationally to CSU.

Section II References

Costanza, R., R. de Groot, P. Sutton, S. van der Ploeg, S. J. Anderson, I. Kubiszewski, S. Farber and R. K. Turner. 2014. Changes in the global value of ecosystem services. Global Environmental Change 26: 152–158.

Mason, L. 2003. Insects and Mites. In Food Plant Sanitation; Hui, Y.H., Bruinsma, L.B., Gorham, J.R., Nip,W.-K., Tong, P.S., Ventresca, P., Eds.; Marcel Dekker, Inc.: New York, NY, USA ; pp. 293–316.

Savary, S.; Willocquet, L.; Pethybridge, S.J.; Esker, P.; McRoberts, N.; Nelson, A. 2019. The global burden of pathogens and pests on major food crops. Nature Ecology & Evolution. 10.1038/s41559-018-0793-y, doi:10.1038/s41559-018-0793-y.

III. Quantitative Data Supporting Evidence of Need for the Program and Student Demand

1. Identify statewide employment supply and demand data the proposed program would assist in filling. Provide evidence of need for additional qualified individuals the proposed program would produce. (Use data from the Bureau of Labor Statistics. Other sources may include professional societies, accreditation boards, state/national organizations, etc.)

The knowledge, skills, and abilities possessed by graduates of the Agricultural Biology major will be in high demand by industries that are drivers of Colorado's economy and are projected to grow in the coming decade. These graduates will have highly transferable skills of critical thinking, problem solving, systems thinking, verbal and written communication, and leadership. The disciplinary knowledge they possess will enable them to conduct research and solve biological problems in agricultural, natural, and urban systems. Thus, our graduates will be prepared to work in many economic sectors. These may include the North American Industry Classification System industry sectors and subsectors of: Agriculture, Forestry, Fishing and Hunting; Crop Production; Forestry and Logging; Support Activities for Agriculture and Forestry; Professional, Scientific, and Technical Services; Research and Development in the Physical, Engineering, and Life Sciences; Public Administration; and Administration of Conservation Programs. In Agriculture, Forestry, Fishing and Hunting, our graduates are most likely to be employed in agricultural support activities working with companies providing services needed for farm operation as employees or eventually owners. But they also may be involved in agricultural production. This sector does not include companies that conduct agricultural research and those that administer programs for regulating and conserving land, mineral, wildlife, and forest use. These jobs are classified as Research and Development in the Physical, Engineering, and Life Sciences and Administration of Conservation Programs, respectively, positions for which Agricultural Biology graduates will be highly qualified and likely to be employed.

The Colorado Department of Labor and Employment (CODLE) projects employment in nearly all these industry sectors and subsectors to increase in the next decade (Table 1). Forestry and Logging is the one exception and employment in this sector is expected to shrink. The greatest increase in job availability in relevant industry sectors is expected to be in Professional, Scientific, and Technical Services with a nearly 28% increase projected by 2027. This is the third highest growth predicted for the 22 industries evaluated by the CODLE, trailing only Construction (35% increase) and Health Care and Social Assistance (34% increase). Jobs in other sectors and subsectors in which Agricultural Biology graduates may be employed are projected to increase by 6% to 21% over the next 9 years. No data were available for Research and Development in the Physical, Engineering, and Life Sciences, a subsector of Professional, Scientific, and Technical Services, which will be a major employer of Agricultural Biology graduates.

Industry Projections (Long-term) for Multiple Industries in Colorado in 2017-2027

Industry Projections Table

Table 1. Long term industry projections for Multiple Industries in Colorado for the 2017-2027 projection period.

Industry	Industry Code	2017 Estimated Employment	2027 Projected Employment	Total 2017-2027 Employment Change	Annual Percent Change	Total Percent Change
Agriculture, Forestry, Fishing and Hunting	11	17,604	20,995	3,391	1.78%	19.26%
Crop Production	111	7,385	8,607	1,222	1.54%	16.55%
Forestry and Logging	113	124	114	-10	-0.84%	-8.06%
Support Activities for Agriculture and Forestry	115	3,396	4,117	721	1.94%	21.23%
Professional, Scientific, and Technical Services	541	215,754	276,107	60,353	2.50%	27.97%
Physical, Engineering, and Life Sciences	54171	N/A	N/A	N/A	N/A	N/A
Public Administration	92	33,734	35,937	2,203	0.63%	6.53%
Administration of Conservation Pro	92412	N/A	N/A	N/A	N/A	N/A

Source: Colorado Dept. of Labor, Labor Market Information

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2. Provide the same information for nationwide employment supply and demand as above.

The Bureau of Labor Statistics maintains data on several jobs in Agricultural Biology (Table 2). The median salary for these positions ranges from $43,800 to $118,970. The projected growth in these positions is at or above the average labor market growth predicted for 2026. Jobs in these categories are not limited to specific regions within the United States and are also available internationally. This degree would also prepare students for graduate school and persons with jobs that require graduate degrees in disciplines encompassed by agricultural biology have higher median salaries than those listed below.

Table 2. Bureau of Labor Statistics on jobs related to Agricultural Biology

	Annual Median Salary	Number of Jobs in 2016	Growth by 2026
Agricultural and Food Scientists	$62,910	43,000	7%
Biological Technicians	$43,800	82,100	10%
Conservation Scientists	$60,970	34,600	6%
Environmental Scientists	$69,700	89,500	11%
Microbiologists	$69,960	23,200	8%

Zoologists	$62,290	19,400	8%
Natural Sciences Managers	$118,970	56,700	10%
Soil and Plant Scientists	$62,430	14,180	9%

3. Identify anticipated salary range for program graduates.

Several internet employment websites list jobs in agricultural biology, entomology, plant pathology, and weed science (Table 3). Salaries for these positions range from $27,000 to $95,000 and positions are available in private industry, government agencies, universities, and non-governmental organizations throughout the country (Table 3).

Table 3. Salaries for jobs related to Agricultural Biology posted on internet job employment websites, such as indeed.com and usajobs.gov.

	Advertised Salary Range	
Job Title	**Low**	**High**
Agricultural Biologist Aide	$43,000	$54,000
Agricultural Biologist Inspector	$40,000	$69,000
Agricultural Program or Research Assistant	$30,000	$44,000
Agricultural Standards Specialist	$47,000	$60,000
Insect Conservation Specialist	$42,000	$44,000
Forest Insect Pest Aide	$27,000	$40,000
Integrated Pest Management and Natural Enemies Specialist	$60,000	$80,000
Integrated Pest Management Grower Manager	$52,000	$72,000
Integrated Pest Management Technician	$29,000	$59,000
Pest Abatement Manager	$64,000	$95,000
Pest Control or Agricultural Products Sales	$60,000	$82,000

	Advertised Salary Range	
Job Title	**Low**	**High**
Pest Control Technician or Specialist	$35,000	$70,000
Pesticide Safety Educator Assistant or Investigator	$36,000	$61,000
Plant Entomologist	$51,000	$68,000
Research Technician or Specialist in Entomology, Plant Pathology, IPM, or similar)	$28,000	$66,000
Tree and Shrub Health Care Manager	$50,000	$80,000

4. Provide quantitative data from at least one survey that you have conducted that indicates students would actually enroll in this program. Suggestions include surveying undergraduates and graduates of the proposing department or related departments enrolled in RI and Distance/CSU Online programs. These numbers are the basis for fiscal and curricular planning and, therefore, must be thoroughly developed and accurate. Include additional information from interviews or other data sources.

We held focus groups with university and high school students to help us understand their level of interest in the Agricultural Biology undergraduate major. We met with one group of CSU students who were leaders in the College of Agricultural Sciences, the Ag Ambassadors, and two groups of high school students, Saint Vrain Valley Future Farmers of America (FFA) and Fossil Ridge High School (STEM) science students. Focus groups were led by Dr. Karen Falkenberg from The Institute on Learning and Teaching at CSU with Dr. Cynthia Brown in attendance. Sessions were recorded and transcribed by a professional transcription service. For one of the questions, students were asked to respond with a "thumb-o-meter," pointing their thumbs up for high interest, parallel to the ground for neutral or ambivalence, and down for little or no interest in the topic. The question was set up as follows:

"Most jobs in agriculture do not involve actual farming. Rather, they support the production and distribution of food. Much of this work depends on understanding the science behind food production. Knowing that, which of the following curriculum topics sounds appealing to you and why?"

A. Food and food production
B. Sustainable agriculture
C. Invasive pests (plant diseases, insects and weeds) and how they affect natural, agricultural and urban systems
D. Improving food security
E. How pests impact agriculture and how to manage them
F. How plants, insects, and microbes function in natural systems

These options represent topics taught in the Agricultural Biology major and are elements of careers for which the program will prepare students. All six Ag Ambassadors were enthusiastic about "Improving food security" and four of six FFA students and four of seven STEM students were highly interested in this topic. 67% of Ag Ambassadors, 100% of FFA students, and 67% of STEM students were excited about "Sustainable agriculture." Six of seven STEM high school students were interested in "How plants, insects and microbes function in natural systems," whereas, few Ag Ambassadors and FFA students reacted positively to this topic. Our results demonstrate that students with different backgrounds were most interested in different aspects of the Agricultural Biology major, but all were excited by at least one of the topics listed.

Enrollment patterns in courses currently taught in BSPM indicates that students are interested in the disciplines encompassed by the Agricultural Biology major and may choose it for their major. Enrollment in five of the 15 undergraduate courses offered by BSPM has averaged over 90% of the enrollment limit in the last 5 years. Courses with lower enrollments are specialized or limited in size by facilities or resources.

The Agricultural Biology major at New Mexico State University (NMSU), which is growing, currently enrolls approximately 50 undergraduates on a campus that enrolls 11,700 undergraduate students. Total enrollment at NMSU has decreased from a high of 14,300 in 2010, but the Agricultural Biology major there is still growing, demonstrating students are interested in this topic. CSU currently enrolls twice as many undergraduates as NMSU, thus, an estimate of 100 students enrolled at CSU is on par with current NMSU enrollment. CSU has a higher academic rank. Thus, we believe it is likely that we will attract an even greater number of students to our program.

The students entering the Agricultural Biology major in its initial 15 years will be representatives of Generation Z, the Post-Millennial Generation. They were born between 1996 and 2010 and the oldest will graduate from college by 2020 (Insider, Inc. 2019). This generation has the largest number of individuals of any generation yet, and they will be the largest group of consumers (82%) in 2026 (Insider, Inc. 2019). The statistical probability of recruiting Generation Z students to the Agricultural Biology major is higher than any past generation, thus, the timing for initiating the major is good.

Generation Z is the most diverse generation ever, with nearly half being minorities compared to Baby Boomers with 22% minorities (Insider, Inc. 2019, Turner 2015). This is the first generation that does not know a world without the internet (Insider, Inc. 2015, Turner 2015), and its members have had access to smart phones for much of their lives (Turner 2015). They are the first true digital natives. They lived through 9/11, the Afghanistan and Iraq Wars, the 2008 financial crisis and its aftermath, and mass shootings such as those at Columbine High School in 1999 and the Aurora theater shooting in 2012.

These experiences have shaped their values and attitudes. They may view the world as unsafe (Turner 2015) and feel that adults are neither able to protect them (e.g., school shootings) nor solve the problems facing the world (e.g., climate change) (personal observation). As a result of these generational experiences, they tend to be more cautious (Turner 2015) and motivated by security (Patel 2017) and safety (Williams 2015) than Millennials. They value education (Turner 2015) but are concerned about the financial burden formal education may entail. They are interested in independence, thus, are more likely than Millennials to skip undergraduate degrees to enter the work force (Patel 2017). Generation Z wants employment flexibility (Turner 2015) and networking abilities (Turner 2015). Members of this generation are more entrepreneurial and competitive, desire

independence more than collaboration, will multitask more, and are more entrepreneurial than Millennials (Patel 2017). Patel (2017) says Generation Z will want to communicate more face to face than Millennials, but Turner (2015) notes they may be uncomfortable and unskilled at in-person interactions.

The Agricultural Biology major will cater to the wants and needs of Generation Z. The program has been designed to provide maximum flexibility by including many elective credits that will allow students to pursue double majors, minors, and disciplines such as business that will help them pursue their entrepreneurial interests. The desire for flexibility will be addressed by allowing students to enter the program at any time of year and to attend full- or part-time.

Generation Z's wish for financial security (Turner 2015, Williams 2015, Patel 2017) and desire to make a difference by solving fundamental problems (Seemiller 2017) will be met by the preparation students receive in the Agricultural Biology major. We have taken care to design opportunities for students to build skills in oral and written communication, leadership, and working in diverse teams into the core curriculum. Internships and hands-on learning are integral to the academic program. These aspects of the major will address deficits Generation Z may have due to life-long emersion in the digital world. Furthermore, the job market in fields for which graduates will be prepared is growing and there is currently a shortage of qualified candidates to fill the positions available (Goecker et al. 2015). Thus, this pragmatic generation will be assured of well-paying jobs in which they can solve problems in agricultural and natural ecosystems facing Colorado and the world.

5. For UNDERGRADUATE programs, identify any of the department's current program areas that are "controlled" or "capped" at the undergraduate level and the number at which the cap occurs.

Our department has no program areas that are currently controlled or capped at the undergraduate level.

Section III References

Goecker, A.D., E. Smith, J. Marcos Fernandez, R. Ali, R. Goetz. 2015. Employment Opportunities for College Graduates in Food, Agriculture, Renewable Natural Resources, and the Environment; United States 2015 – 2020. United States Department of Agriculture. https://www.purdue.edu/usda/employment/.

Insider, Inc. 2019. Generation Z: Latest characteristics, research, and facts. Business Insider https://www.businessinsider.com/generation-z . Accessed 5/12/2019.

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Seemiller, C. 2017. Generation Z: Making a difference their way. TedX Dayton. https://video.search.yahoo.com/yhs/search?fr=yhs-itm-001&hsimp=yhs-001&hspart=itm&p=corey+seemiller+generation+z+tedx#id=1&vid=3d9aef3fa07dd164a611902b52e87967&action=click . Accessed 5/12/2019.

Turner, A. 2015. Generation Z: Technology and social interest. Journal of Individual Psychology 71: 103-113.

Williams, A. 2015. Move Over Millennials: Here Comes Generation Z. New York Times, September 18. https://www.nytimes.com/2015/09/20/fashion/move-over-millennials-here-comes-generation-z.html. Accessed 5/12/2019.

IV. Duplication/Similar Programs in the State and Nation

1. Identify other closely related programs in the same academic domain in Colorado. Please include closely related programs within the CSU System (Global and Pueblo) and ideas about collaborating within the system where possible.

Currently, the College of Agricultural Sciences is the only institution that can grant a 4-year baccalaureate in agriculture in Colorado (Table 4). This has at least two major impacts. The first is that degrees from other universities in Colorado do not have an agricultural focus, so there are no closely related programs in Colorado. A surprising effect of this is that agriculture is not even mentioned as a career option for biology students at Colorado universities, including CSU. This occurs even though salaries for people with 4-year degrees in agriculture are comparable to others working in biology and projections for the future are good. For example, salaries for people in agriculture are projected to have the greatest gain among STEM salaries in 2019 and to rise by 4.1% (National Association of Colleges and Employers, https://www.naceweb.org/job-market/compensation/stem-majors-projected-to-be-class-of-2019s-top-paid/).

A second result of CSU being the only Colorado university to offer agricultural degrees is that place-bound students have no option for earning agricultural degrees unless they live near Fort Collins. As a result, our college has begun collaborations with Adams State to offer joint agricultural degrees to students. Our department will be able to participate in these joint programs more effectively if we have our own undergraduate major. We will also be able to more effectively develop an online major in the future to serve place-bound students if we first have a residential degree.

Table 4. Summary of closely related programs in Colorado and the CSU System.

Institution	Major	Comparison
CSU Global	No related major	CSU Global offers online B.S. degrees in Agricultural Business and Horticulture, neither of which overlap significantly with our proposed major. They do not offer an online degree in biology. Development of our major will aid us in developing an online major in the future.
Adams State University	Agriculture, Biology Track	This program has some similarities to our proposed major and already includes classes offered through our department. It lacks cohort building and seminar courses and lacks lab courses offered in our proposed major. We have held initial discussion with Adams State faculty on how to collaborate more effectively with them and development of our own major will aid in this endeavor.
Adams State University	Biology	The B.S. degree in biology at Adams State University has three areas of emphasis: Cellular and Molecular, Organismal, and Wildlife. None of these emphasize agriculture and unlike our major, this major has a strong emphasis on vertebrate biology.
Colorado State University – Pueblo	Biology	This program does not focus on agriculture and the core courses and electives differ. For example, plant pathology and weed science are not options, there is only one entomology class offered, and there is a strong emphasis on vertebrate biology. Development of our major may

Institution	Major	Comparison
		help us find ways to collaborate with the Biology Department at CSU-Pueblo and work with them to offer additional agricultural biology courses to their students.
University of Colorado-Boulder	Ecology and Evolutionary Biology	This B.A. degree does not include courses in entomology, plant sciences, or agriculture. Overall, there are few options for studying plant sciences or agriculture at UCB.
University of Colorado-Denver	Integrative Biology	Courses in entomology, plant pathology, and weed science are not offered at CU-Denver. Overall, there are few options for studying plant sciences or agriculture at UCD, so there is little overlap with our proposed major.
University of Northern Colorado	Biological Sciences	This is a standard biology major and students can choose one of three emphases: Cell and Molecular Biology, Ecology and Evolutionary Biology, or Pre-health and Biomedical Sciences. There are no plant pathology or weed science courses and only one course in entomology available. There is little overlap with our proposed major.
Western Colorado University	Biology	This is a standard biology major. Only one plant science course is offered and only as a summer option. There is only one entomology course. There is little overlap with our proposed major.
Colorado Mesa University	Biology	This is a standard biology major with few options in entomology and plant science and no mention of agriculture. There is little overlap with our proposed major.
University of Colorado, Colorado Springs	Biology	This is a standard general biology major. No entomology, plant pathology, weed science, or agriculture courses are offered. There is little overlap with our proposed major.

2. Identify other closely related programs around the country. List these by title of program and name/campus of institution that might be perceived as having programs in the same academic domain. For each, provide the following:

a. Program Title: Agricultural Biology

b. Name of Institution: College of Agricultural, Consumer, and Environmental Sciences at New Mexico State University, Las Cruces (NMSU)

c. Current enrollment and number of graduates per year

Table 5. Enrollment at New Mexico State University, Las Cruces (NMSU) overall, in the agricultural college, and in the Agricultural Biology Major from 2015-2018. Enrollment in Biology at NMSU is also shown to demonstrate that Biology enrollment remains very strong in the presence of an Agricultural Biology major.

Year	Campus Enrollment	College of Agricultural, Consumer, and Environmental Sciences	Agricultural Biology	Biology
2015	12,526	1,495	59	472
2016	12,027	1,472	64	474
2017	11,713	1,416	65	510
2018	11,687	1,448	56	555

If we have the same proportion of enrollment at CSU, we would expect a major of at least ~115-200 students, depending on whether we calculate it based on a comparison of campus size or compared to the NMSU Biology Major.

d. Compare/contrast CSU's proposed program to the other program

The Agricultural Biology major at NMSU is essentially an applied biology degree. The major has five possible concentrations, including Applied Biology, Applied Microbiology, Entomology, Environmental Biology, and Pest Biology and Management. It is described as:

"The agricultural biology course work prepares you for a variety of careers in the biological sciences and agriculture. You will develop your curriculum with an academic advisor to attain your individual goals. Many will pursue advanced degrees in the sciences or prepare for admittance to professional schools (medical, dental, etc.). A diverse program is offered with five separate options that allow you to tailor your program for careers in the commercial sector, such as agricultural consulting, and pest management or for careers with county, state, or federal agencies, such as research technicians, land managers, and extension agents."

The NMSU Agricultural Biology major does not feature any cohort-building classes, internships, capstone course, or research experiences. It does not emphasize experiential learning or have an intentional focus on professional development or leadership. The major requires a greater number of required courses, so does not allow students much flexibility to earn a minor or double major within a 4-year time span. A comparison of the two academic programs can be found in Table 6.

The cost of a semester at NMSU as a full-time student is $3,685 for residents and $11,754 for non-residents.

Table 6. Comparison of cohort building, professional development, and core courses of the CSU and NMSU Agricultural Biology majors.

Curricular Element	**CSU Agricultural Biology Major**	**NMSU Agricultural Biology Major**
Cohort building program	AB 120, AB 130, AB 230, AB 330, AB 430	*No cohort-building courses are included in the NMSU Agricultural Biology major*
Professional Development	SPCM 200 Public Speaking AB 230 Becoming an Agricultural Biology Professional	COMM 253G Public Speaker or COMM265G Principles of Human Communication or AXED 210G Effective Leadership and Communication in Agricultural Organizations
	BSPM 487 Internship	*No internships are included in the NMSU Agricultural Biology major.*
Major Requirements	BZ 220 Introduction to Evolution	*No course on evolution is required*
	LAND/LIFE 220 Fundamentals of Ecology	ES 301 Principles of Ecology[a] or BIOL 473 Ecology of Microorganisms[b]
	SOCR 240 Introductory Soil Science	SOIL 252 Soils[c]
	BSPM 302 Applied and General Entomology BSPM 303 A, B, or C Entomology Lab	EPWS 301 General Entomology
	BSPM 308 Ecology and Management of Weeds	EPWS 311 Introduction to Weed Science
	BPSM 310 Understanding Pesticides	EPWS 420 Environmental Behavior of Pesticides[b]
	LIFE 320 Ecology	*No comparable course is required*
	BZ 350 Molecular and General Genetics	AGRO 305 Principles of Genetics

Curricular Element	CSU Agricultural Biology Major	NMSU Agricultural Biology Major
	BSPM 361 Elements of Plant Pathology	EPWS 310 Plant Pathology
	No comparable course is required	BIOL 311 General Microbiology EPWS 301 Agricultural Biotechnology EPWS 447 Seminar BIOL 313 Structure and Function of Plants or BIOL 322 Zoology
	BSPM 467 Capstone	*No comparable course is required*

[a]Only required for the Environmental Biology concentration
[b]Only required for the Applied Microbiology concentration
[c]Only required for the Environmental Biology and the Pest Biology and Management concentrations

Other than CSU and NMSU, no other land grant university has a department with this combination of expertise. Table 7 shows the related departments in our peer universities as examples of what is typical at other land grant universities. It is unlikely that other land grant universities will start a similar major because the institutional barriers to starting interdisciplinary majors are high, especially when the departments do not already have undergraduate programs. As a result, our only direct competitor will be a popular major at NMSU.

The lack of majors in this area at our peers is not because these topics are unimportant. We are facing the potential for massive planetary environmental degradation and food shortages. We are already seeing the effects of insect declines, pesticide contamination in water, and invasive pests, pathogens, and weeds on a worldwide scale. The lack of undergrad training in these areas by our peers is not because of the lack of importance of these topics, but because of institutional history and institutional barriers. CSU is uniquely poised to have a high enrollment and high impact major in this realm because of our department's combination of expertise and the higher university ranking compared to the one other university with a similar department.

Table 7. Our peer departments at CSU peer universities and their undergrad enrollment from Fall 2018. Weed science is often spread across multiple departments. The department housing all or the majority of weed scientists at each campus is listed.

	Entomology	Plant Pathology	Weed Science
Iowa State University 30,671 undergrads 4,397 in Agricultural College	Entomology No major	Microbiology and Plant Pathology 126 enrolled in an interdepartmental major	Agronomy 274 enrolled

	Entomology	Plant Pathology	Weed Science
Kansas State University 19,472 undergrads 2,512 in Agricultural College	Entomology No major	Plant Pathology No major	Agronomy 135 enrolled
Michigan State University 39,090 undergrads 4,182 in Agricultural College	Entomology 10 enrolled	Plant, Soil, and Microbial Sciences No major	
Oklahoma State University 21,101 undergrads 2,861 in Agricultural College	Entomology and Plant Pathology Entomology major with 29 enrolled No major in Plant Pathology		Plant and Soil Science Undergrad major exists, unclear how many enrolled
Oregon State University 25,327 undergrads 2,177 in Agricultural College	No Entomology department	Botany and Plant Pathology No major	Crop and Soil Science 44 enrolled
Purdue University 31,105 undergrads 2,803 in Agricultural College	Entomology 35 enrolled	Botany and Plant Pathology 47 enrolled	
Texas A&M University 50,735 undergrads 6,466 in Agricultural College	Entomology 70 enrolled in Entomology 41 enrolled in Forensics	Plant Pathology and Microbiology 180 enrolled in Bioenvironmental Sciences 55 enrolled in Environmental Studies	Soil and Crop Science 81 enrolled in Plant and Environmental Soil Science 26 enrolled in Turfgrass Science
University of Tennessee 22,139 undergrads 1,477 in Agricultural College	Entomology and Plant Pathology No major		Plant Science No major

	Entomology	Plant Pathology	Weed Science
Univ. of California-Davis 29,379 undergrads 7,347 in Agricultural College	Entomology and Nematology 35 enrolled	Plant Pathology No major	Plant Sciences multiple majors: 176 in Biotechnology 27 in Ecological Management and Restoration 53 International Agricultural Development 102 Plant Sciences
University of Illinois 33,932 undergrads 3,308 in Agricultural College	Entomology No major	Crop Sciences 247 enrolled	
Virginia Polytechnic Institute 25,791 undergrads 4,397 in Agricultural College	Entomology No major	Plant Pathology, Physiology, and Weed Science No major	
Washington State University 24,904 undergrads 1,346 in Agricultural College	Entomology No major	Plant Pathology No major	Crop and Soil Science Unclear how many are enrolled

3. **If a Colorado and/or national program(s) is similar to the one being proposed at CSU, what is the documented state or national demand legitimizing the need for an additional program in the state/nation?**

   One source of evidence of the need for a major in Agricultural Biology comes from the only similar program in the country, the Agricultural Biology major at NMSU. This program currently enrolls approximately 50 undergraduates on a campus that enrolls 11,700 undergraduate students. Although total enrollment at NMSU has decreased from a high of 14,300 in 2010, the Agricultural Biology major there is still growing. CSU currently enrolls twice as many undergraduates as NMSU, thus, an estimate of 100 students enrolled at CSU is on par with current NMSU enrollment. CSU has a higher academic rank. Thus, we believe it is likely that we will attract an even greater number of students to our program.

   Further evidence comes from assessments of the future need for employees with the knowledge and skills graduates from our proposed Agricultural Biology major will have. A 2015 Purdue University report created with USDA predicted 57,900 new jobs in food, agriculture, renewable natural resources, or the environment each year between 2015 and

2020. Occupations in these fields for college graduates with bachelor degrees or higher were predicted to increase by 5% during this time. Only 61% of these new positions were predicted to be filled by graduates with training in these areas, despite employers' preference for hiring such graduates (Goecker et al. 2015). This report recognized that graduates with training in food, agriculture, renewable natural resources, or the environment will provide critical leadership in addressing and resolving challenges facing the U.S. and the world in food systems, sustainable food and energy systems, and environmental quality.

As described in Section III.1, the industry sectors for which graduates of the Agricultural Biology major will be qualified are growing in Colorado and the nation (Table 1).

Section IV References

Goecker, A.D., E. Smith, J. Marcos Fernandez, R. Ali, R. Goetz. 2015. Employment Opportunities for College Graduates in Food, Agriculture, Renewable Natural Resources, and the Environment; United States 2015 – 2020. United States Department of Agriculture. https://www.purdue.edu/usda/employment/.

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V. Student Body

1. Using your survey data, data from Bureau of Labor and Statistics and other relevant sources, create a table with estimates of annual and total enrollment of resident and nonresident students for each of the first 5 years of the program. Also, include the annual estimated number of students *graduating* from the program.

Estimates of annual and total enrollment in the Agricultural Biology major over the first 5 years after establishment can be found in Table 8 and is based upon the number of students enrolled in the Agricultural Biology major at New Mexico State University (NMSU). The Agricultural Biology major at NMSU currently enrolls approximately 50 undergraduates on a campus that enrolls 11,700 undergraduate students. Total enrollment at NMSU has decreased from a high of 14,300 in 2010, but the Agricultural Biology major there is still growing, demonstrating students are interested in this topic. CSU currently enrolls twice as many undergraduates, so an estimate of 115-200 students enrolled is on par with what the NMSU program currently enrolls based on the ratio to total students (115) or ratio to number of biology students (200) at NMSU. CSU has a higher academic rank and this will be only the second such program at a land grant institution in the United States (U.S.), so we believe it is likely that we may attract an even greater number of students to our program.

Table 8. Student enrollment estimates based on a similar major at NMSU.

Student enrollment	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
New resident	15	17	36	90	120
New non-resident/international	10	11	24	60	80
Continuing resident		13	24	60	
Continuing non-resident/international		9	16	40	
Total enrolled	25	50	100	150	
# Graduating after completing year	0	0	10	20	50

2. Explain how the proposed program will draw students who would not otherwise come to Colorado State University.

Students are interested in making a positive difference in the world, and they are aware of the grand challenges posed by population growth and climate change. Majoring in Agricultural Biology will prepare them to use their scientific knowledge to improve our agricultural and natural ecosystems, and it will make them better informed on the biological, economic, and social rationale behind decisions such as whether to use pesticides, genetic modification or other controversial choices in agriculture.

Currently, there is only one other undergraduate program at a land grant university in the U.S. that focuses on Agricultural Biology. Therefore, students who are interested in studying biology with the purpose of protecting agricultural and natural systems from biotic stresses currently have only one choice at land grant universities in the U.S. Despite the natural synergies among entomology, plant pathology, and weed science, these disciplines are housed in different departments, schools, or colleges at other universities, so a similar major is unlikely to be initiated at most other land grants. Therefore, we are likely to maintain an advantage in recruiting in this area for several years.

Importantly, this major is also designed to be flexible, with the potential to add additional concentrations, such as biosecurity or food security, and this may allow us to draw students to CSU who would not otherwise come here.

3. **Is the proposed program intended to provide another program option to a significant number of students who are already being attracted to or attending CSU? Provide explicit detail:**

   a. What ongoing program(s) will students be recruited from?

   Our program is not designed to compete directly with other programs at CSU. Rather, we intend to focus our recruiting on students who would not otherwise attend CSU.

   We anticipate, however, that we may draw some students from the Biology major. This major currently enrolls a greater number of students than are in the entire College of Agriculture and most of these students are interested in health-related education. Those students interested in applied biology or food systems may find a more suitable home in Agricultural Biology. We may also attract students from the Ecosystems Science and Sustainability major, but as with biology, expect that this will only be a small fraction of students who currently enroll in this major.

   b. What number of students do you estimate will enroll in the new program from above program(s)?

   We estimate that we may draw at most 50 students from the Biology major and the Ecosystems Science and Sustainability major.

4. **If the program is expected to attract students from other majors or programs, attach a letter from the relevant department head and dean indicating their support (or lack thereof) for the new program in terms of shift of student enrollment from that particular department.**

   The Agricultural Biology major is not intended to recruit students from other majors. Rather we seek to draw new students to the university, students who cannot find what they want at other universities and students from diverse backgrounds who we attract through broad recruiting efforts.

5. **For UNDERGRADUATE programs: describe how new freshmen, transfer students, and students changing their major would be transitioned into the new program in the first and subsequent years of the program.**

   The curriculum requires all students majoring in Agricultural Biology to be part of a cohort program, which includes the following courses: AB/BSPM 120, AB/BSPM 130, AB/BSPM 230, AB/BSPM 330 and AB/BSPM 430. Students will be required to take the courses in a sequence starting in year 1. The cohort program allows all Agricultural Biology majors to meet regularly each semester and provides an active, interactive, and dynamic setting for students to grow their knowledge and skills. Rather than the professor-teaching-student model of traditional learning, the cohort program will bring students together to build community, foster creativity, build leadership skills, and encourage greater progress.

   Students transferring into the Agricultural Biology major from other majors on campus or from community colleges or other universities will be required to take BSPM 270 - Agricultural Biology Orientation for Transfers. The purpose of this course is four-fold: First, students will be acclimated to CSU, the College of Agricultural Sciences (CAS), and the Department of Bioagricultural Sciences and Pest Management (BSPM). (Note that the

department name is expected to change to Agricultural Biology by the end of 2019). Students will be started on a dedicated path to career development including course and elective selection, as well as ownership and responsibility in the career development process. Second, students will demonstrate competence in applying the scientific method to real world situations pertaining to agricultural biology and identify how systems thinking can aid in the understanding of complex situations. Third, the class will introduce students to various methods of communication including written reports and oral presentations. Fourth, this course provides experience and feedback on writing effective and concise resumes, preparing and delivering written and oral presentations and on developing leadership skills essential in any professional field. And finally, students will develop their skills in qualitative and quantitative data analysis, which will prepare them to succeed in careers related to agriculture and pest management. This course will allow students to get on par with students who have been in the major since year 1. The activities conducted as part of the course will allow students who are changing their major and transfer students to feel part of a cohort and the Department for the Agricultural Biology major.

6. What are the numbers and characteristics of the *current* students in the department?

We have no undergraduate majors in our department currently. Demographics for our graduate students are provided below (Table 9, Table 10), which may be indicative of the characteristics of undergraduates who would be enrolled in the Agricultural Biology major.

Table 9. Student demographics in the BSPM M.S. and Ph.D. programs since 2014, as of spring 2019. College leadership changed in 2015, departmental leadership changed in 2016, and graduate student recruiting strategies were changed in 2017. In addition, eight new faculty were hired into BSPM since 2014, including four women and four from under-represented groups.

	Year	Gender		Domestic Students					Inter-national	Total
		F	M	Asian	Black	Hispanic	Native	White		
M.S.	2014	9	14	0	0	0	0	22	1	23
	2015	10	7	0	0	0	0	16	1	17
	2016	14	9	1	0	1	0	21		23
	2017	13	8	1	0	1	0	18	1	21
	2018	13	9	1	0	0	1	15	4	22
Ph.D.	2014	15	11	1	0	0	0	18	7	26
	2015	22	13	1	0	0	0	28	6	35

	2016	20	14	2	0	0	0	25	7	34
	2017	12	21	2	0	0	0	21	10	33
	2018	18	16	2	1	1	0	20	10	34

Table 10. Student demographics shown in percentage. Student gender is shown for all students (domestic and international). Student race/ethnic group is shown only for domestic students.

	Year	**Gender**		**Domestic Students**				
		F	**M**	**Asian**	**Black**	**Hispanic**	**Native**	**White**
M.S.	2014	39%	61%	0%	0%	0%	0%	100%
	2015	59%	41%	0%	0%	0%	0%	100%
	2016	61%	39%	4%	0%	4%	0%	91%
	2017	62%	38%	5%	0%	5%	0%	90%
	2018	59%	41%	6%	0%	0%	5%	88%
Ph.D.	2014	58%	42%	5%	0%	0%	0%	95%
	2015	63%	37%	3%	0%	0%	0%	97%
	2016	59%	41%	7%	0%	0%	0%	93%
	2017	36%	64%	9%	0%	0%	0%	91%
	2018	53%	47%	8%	4%	4%	0%	83%

7. Provide a detailed plan for recruiting students. Include staff and faculty responsibilities, annual timeline, etc. In addition to your general recruitment plan, please include the following information:

The recruitment program for the Agricultural Biology major will be integrated with recruitment efforts of CAS and CSU. Printed recruiting materials will be distributed to students at recruiting events on- and off-campus by recruiting staff, which will include CAS Director of Student Success, Academic Success Coordinators, and BSPM faculty and staff.

a. Describe your recruitment goals and plans to recruit domestic underrepresented minority students (African American, Hawaiian and Pacific Islanders, Latinx, Native Americans and Alaskan natives) to the new program.

We will strive to meet the CAS Strategic Plan for Student Success and Diversity Enhancement goals of 20 percent of enrolled students from underrepresented groups and 50 percent of enrolled students from rural areas by the fifth year after establishment of the major. Our goal is for 20 percent of the first class that graduates from the Agricultural Biology major to be first-generation or from racial, ethnic or social groups that have been underrepresented in the past. One of the core disciplines of BSPM is entomology. This field tends to be more diverse than other agricultural fields (FAIES database; https://faeis.cals.vt.edu/), which will help us recruit and retain students of diverse backgrounds and benefit the department and college.

With CAS and the departments that comprise it, BSPM will collaborate with and leverage the efforts of the many diversity and inclusion programs at CSU to raise awareness of the Agricultural Biology major and the life-long opportunities it will provide. We will build and maintain relationships with precollegiate programs through the CSU Access Center and other student diversity programs and services on campus. BSPM already collaborates with the Alliance Partnership to build awareness of the educational and employment opportunities the major in Agricultural Biology will provide. For example, faculty member Dr. Cynthia Brown attended the Alliance Partnership annual meeting at Montezuma-Cortez High School in Cortez, CO in April 2019 and shared with students of an advanced science course the research done by BSPM faculty on insect pests, plant diseases, and invasive plants and weeds to help Colorado agriculture succeed. This included hands-on experiences with preserved insects and diseased plant samples and an activity with a soil amendment that is used to help establish native species without promoting weeds in a restoration setting. We wish to continue and expand activities like this in which faculty, staff and graduate students visit the Alliance Partnership schools to raise awareness about the disciplines we study and teach and the career opportunities they provide.

This is one example of how we will take information and activities related to the Agricultural Biology major to potential future students where they are. But our off-campus recruiting begins with elementary school students and community outreach. For example, our department houses the CSU Bug Zoo (CSUBZ), a volunteer outreach organization that collaborates with the Gillette Entomology Club to educate the public about arthropods and their importance. CSUBZ reached 43,085 individuals through 83 different events in 2018, including 33 schools, 16 community organizations, 21 private organizations, and 12 university groups. This model is one we would like to develop for plant pathology as well. We will strive to share our expertise with elementary, middle, and high schools that have agricultural or gardening programs, such as GrowIt! at Lincoln Middle School in Fort Collins, for their students. We can both advise these

programs on their endeavors and illuminate the importance of insect, microbial, and plant pests and their management. We will also work to develop programs at the eight CSU Research Centers across the state to leverage the infrastructure and research projects they provide for educational purposes. We will encourage faculty to engage with schools in the communities near their field sites to further expand the awareness of the work we do and the educational resources available to individuals from these communities.

We will also recruit diverse students to the Agricultural Biology major by bringing them to us. We are currently working to develop a summer institute in cooperation with the Access Center at CSU, which will bring about 20 students from urban and rural Alliance Partnership high schools to campus for one week each summer to learn about the sciences, careers and college-life. Finally, we will join the CSU-wide recruiting activities held on campus each year (Table 11).

Table 11. Example annual recruiting schedule for the undergraduate major in Agricultural Biology.

Dates	**Activity**
Fall 19 – Spring 20	Prepare recruiting materials (handouts for on-campus visits and off-campus recruiting events)
Summer 20	County Fairs – 4H, FFA, and discipline related activities at county fairs throughout Colorado
SU 20	Summer Agriculture Institute
Sep 2020	Senior Scholarship Day Ag Day Game Day 1st Generation Visit Day
Oct 2020	TRIO Visit Day Explore CSU
Nov 2020	Military Veteran Visit Day Colorado Counselor Visit Experience Transfer Student Visit Day #1
Dec 2020	Choose CSU #1
Feb 2021	Choose CSU #2 Discover CSU #1
Mar 2021	Transfer Student Visit Day #2 Choose CUS #3 Honors Visit Day
Apr 2021	Discover CSU #2
May 2021	Decision Day Celebration

Recruiting diverse students to the Agricultural Biology major is important, but retention of these students is critical. The major includes components needed for students to succeed academically and professionally. We know that sense of belonging is an important determinant of student success and retention (Strayhorn 2012). The cohort program of the Agricultural Biology major will provide opportunities for students to connect with each other and faculty in the context of their academic studies to promote a sense of belonging. Faculty and staff in academic institutions who have backgrounds that resonate with students' experiences can help foster students' sense of belonging. Towards this end, BSPM is working to increase the diversity of its faculty and staff, and has hired eight new faculty since 2014, including four women and four from under-represented groups.

Faculty mentoring will be a key feature of the major. Faculty will provide disciplinary mentoring and will be matched to students with interests that align most with theirs. Academic Success Coordinators (ASC) will provide programmatic and career advising to complement that provided by faculty. At first, CAS ASCs will provide mentoring, but the department will fund one or more ASCs when the major has become established.

Members of BSPM work to create a climate of inclusion for students of diverse backgrounds, which will attract these students to the Agricultural Biology major and contribute to their success. Many BSPM faculty and staff are trained in awareness and avoidance of implicit bias and microaggressions, and in how to create inclusive learning and working environments. Some have participated in university programs such as Faculty Institute on Inclusive Excellence, or Creating Inclusive Excellence, or the Social Justice Leadership Institute. Members of the department are encouraged and supported by department and college leadership to pursue these and other opportunities for diversity and inclusion training.

National organizations that promote underrepresented groups in science will be important sources of personal connection, engagement opportunity, and professional support for students majoring in Agricultural Biology. The department will promote and support chapters of the national societies SACNAS (Society for the Advancement of Chicanos/Hispanics and Native Americans in Science) and MANNRS (Minorities in Agriculture, Natural Resources, and Related Sciences). and will help Agricultural Biology majors attend the annual meetings of these groups.

BSPM offers an undergraduate research fellowship that is available to all students and provides a stipend for two semesters while a student works closely with a faculty member and their lab group. This opportunity can be highlighted during recruitment activities and is part of making the Agricultural Biology major accessible to students of diverse backgrounds.

Through collaborations with CSU's diversity enhancing programs, we will make it known that the Agricultural Biology major will ensure the success of students who are first in their families to attend college or are from rural or urban communities with little exposure to higher education. Not only will students gain the disciplinary knowledge needed for success, but the program is carefully designed to build students' abilities to communicate orally and in writing, to analyze, summarize and present qualitative and quantitative data, to address problems in agricultural and natural ecosystems using a systems approach, and to work effectively in and lead diverse groups.

b. Describe your recruitment goals and plans to recruit international students to the new program.

Our goal is to meet the CAS Strategic Plan for Student Success and Diversity Enhancement goals of having 10 percent of enrolled students being from outside of the U.S. Our program will be one of only two in the country offering a degree in Agricultural Biology and CSU is more highly ranked than NMSU, where the other program is located. Agricultural Biology is likely to be in high demand by international students because there is a better understanding of the importance of pest management in other countries, where the share of the labor pool involved in farming is much greater than in the United States (https://ourworldindata.org/search?q=share+of+labor+in+agriculture). Thus, this will be a familiar major to students and to employers abroad, which will facilitate recruiting students and interacting with employers to place students in internships and post-

graduation employment. For example, University of Saskatshewan, which has student enrollment of about 60% of CSU's, has a program in Agricultural Biology. There were 11 students enrolled in this program in the 2016-17 academic year and it has grown to 25 students (University of Saskatchewan). University of Hohenheim also has a bachelor degree program in Agricultural Biology. Its enrollment in 2017 was 2017 with university enrollment of about 9,000 making it the 10th largest major on campus and similar to their Biology major (University of Hohenheim 2017).

8. Are any admission requirements to the proposed program being recommended that are higher than CSU's minimum requirements?

We do not plan to use admission requirements higher than CSU's minimum requirements.

Section V References

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VI. Program Learning Goals

1. **Define meaningful, measurable Student Learning Outcome (SLO) goals that specify the disciplinary knowledge, competencies, skills, and values that students will be expected to attain in the new program. Consider reviewing similar programs at other institutions for examples of SLOs in your discipline.**

2. **Student Learning Outcomes must be sufficiently specific to differentiate the program from all other programs and degree levels on campus.**

   The Student Learning Outcomes for the AB major are:

   - *Technical Competencies: Integrate skills and knowledge to solve problems related to plants, insects, and microbes in natural and managed ecosystems.*
     - Detailed SLOs: In natural and managed ecosystems students will able to apply knowledge of current technologies to
       - Identify important plants, insects, and microbes, integrating methods such as molecular approaches and ocular use of taxonomic keys.
       - Explain the biology and ecology of important pests and beneficial species
       - Provide cost effective, socially acceptable, and environmentally sound pest management solutions
       - Explain the economic, social, and environmental effects and implications of treatment of pest species (e.g. weeds, insects, diseases)
   - *Agricultural Literacy: Demonstrate understanding of social, economic, and biophysical aspects of the management of biological problems in natural and managed ecosystems.*
     - Detailed SLOs:
       - Identify participants and evaluate their roles in pest management policy, including regulatory frameworks
       - Describe the similarities and differences among management of biological problems such as infestations of weeds, insect pests, and/or diseases in natural and managed ecosystems
       - Develop logical, objective, balanced arguments regarding contemporary issues in natural and managed ecosystems
       - Explain the benefits and risks of management practices in natural and managed ecosystems
   - *Critical Thinking:* Describe, assess, analyze and synthesize knowledge from across the curriculum to create solutions for pests and beneficial species in natural and managed ecosystems.
     - Detailed SLOs:
       - Describe critical problems and gaps in information for natural and managed ecosystems through assessment, analysis, and integration of facts
       - Integrate, synthesize, and apply information from across the curriculum to create solutions to complex problems
       - Analyze qualitative (facts) and quantitative (numerical) information and derive conclusions about challenges in the productivity, sustainability, and management of natural and managed ecosystems
   - *Leadership: Promote and practice inclusion to form effective teams that solve complex problems in natural and managed ecosystems.*
     - Detailed SLOs:

- Function effectively within diverse* teams to solve complex problems and achieve desired outcomes in natural and managed ecosystems
- Create and facilitate inclusive and diverse teams

❖ <u>*Communication:*</u> *Communicate effectively with diverse audiences regarding sustainable pest and pathogen management in natural and managed ecosystems.*

- <u>Detailed SLOs:</u>
  - Engage stakeholders such as researchers, farmers, and industry representatives in the identification of pest and pathogen management needs.
  - Excel in written and verbal communication of scientific results and analyses of information related to sustainable pest and pathogen management to diverse audiences including peers, stakeholders, public and the media

3. Create a table that provides the following information:

a. A minimum of four (4) Student Learning Outcomes are required for the program.

b. Identify the specific courses in which each Student Learning Outcome is 1) introduced, 2) practiced, and 3) mastered.

Table 12. Specific courses in which each Student Learning Outcome is INTRODUCED (I), PRACTICED (P), and MASTERED (M).

Code	Technical Competency	Agricultural Literacy	Critical Thinking	Leadership	Communica-tion
[a] AB/BSPM 120		I		I	I
CO 150			I		
<u>Select ONE course from the following</u>					
AREC 202	I	I	P	I	I
AREC/ECON 240	I	I	P	I	I
ECON 204	I	I	P	I	I
ANTH 100			I		
SOC 100			I		
SOC 105			I		
ANTH/MU 232			I		
PSY 100			I		I
PSY 152		I	I		

AGED 210		I			
AB/BSPM 130	I	I	I	I	I
Select one group from the following					
Group A					
LIFE 102	I		I		
LIFE 103	I		I		
Group B					
BZ 110	I		I		
BZ 111				I	I
BZ 120	I		I		
CHEM 107	I		I	I	I
CHEM 108	I		I	I	I
MATH 155			P		
SPCM 200				P	P
BSPM 302	P	P	P		
Choose one of the following					
BSPM 303A	P	P	P	P	P
BSPM 303B	P	P	P	P	P
BSPM 303C	P	P	P	P	P
Choose one of the following					
LAND/LIFE 220	P		P	P	I
LIFE 320	P	P	P	P	I
AB/BSPM 230		P	P	P	P
CHEM 245	P		P	P	
CHEM 246	P		P		P
Choose one of the following:					
CO 301 B	P	P	P	P	P
JTC 300	P	P	P	P	P
LB 300	P	P	P	P	P

Choose one of the following:					
AGRI/IE 116	P	P	P		
SOCR/HORT 171	P	P	P		
SOC 220	P	P	P		
Choose one of the following:					
STAT 301		P	P		
STAT 307		P	P		
SOCR 240	I	P	P	P	P
BZ 220	I		P		
BSPM 308	P	P	P	P	P
BZ 350	P		P		P
AB/BSPM 330	M	M	M	M	M
BSPM 487	P	P	M	P	M
BSPM 361	P	P	P	P	
AB/BSPM 430	M	M	M	M	M
BSPM 310	P	P	M		
BSPM 451	M	M	M	M	M

[a] The newly developed core courses of the major will have subject code AB and are listed as AB/BSPM here because this transition is not yet complete. Existing courses taught in the department have the subject code BSPM.

c. Briefly explain how the sequence of courses is designed to support students' progress toward mastery of the SLOs.

AUCC requirements: As per university guidelines, all students wishing to graduate must complete the requirements for a major and the All-University Core Curriculum. This comprises 36 required credits that target basic competencies (intermediate writing and mathematics), advanced writing, foundations and perspectives (includes courses that address -Biological and Physical Sciences, Arts and Humanities, Social and Behavioral Sciences, Historical Perspectives, and Global and Cultural Awareness), and depth and integration.

Cohort Program: The curriculum requires all students majoring in Agricultural Biology to be part of a Cohort program which includes the following courses: AB/BSPM 120, AB/BSPM 130, AB/BSPM 230, AB/BSPM 330, and AB/BSPM 430. Students will be

required to take the courses in a sequence starting in year 1. The cohort program allows all Agricultural Biology majors meet once a semester and provides an active, interactive, and dynamic setting for students to grow their knowledge and skills. Rather than the professor-teaching-student model of traditional learning, the cohort program will bring students together to build community, foster creativity, build leadership skills, and encourage greater progress. Students transferring into the Agricultural Biology major from other majors on campus or from community colleges/other universities will be required to take BSPM 320 - Agricultural Biology Orientation for Transfers. The purpose of the cohort program is:

- Students will be acclimated to Colorado State University, the College of Agricultural Sciences, and the Department of Agricultural Biology. Students will be started on a dedicated path to career development including course selection, elective selection, as well as ownership and responsibility in the career development process.
- Students will demonstrate competence in applying the scientific method to real world situations pertaining to agricultural biology and identify how systems thinking can aid in the understanding of complex situations.
- Students will be introduced to various methods of communication including written reports and oral presentations.
- The program will provide students experience and feedback on writing effective and concise resumes, preparing and delivering written and oral presentations and on developing leadership skills essential in any professional field.
- Students will develop their skills in qualitative and quantitative data analysis which will prepare students for to succeed in careers related to agriculture and pest management.

Major Requirements: Proper structuring of the course scheme in curriculum contribute to better learning. Therefore, our curriculum requires all students majoring in Agricultural Biology to be take 39 credits. The following courses (29-30 credits) are required by: BSPM 308, BSPM 310, BSPM 361, BSPM 451, SOCR 240, BZ 220, BZ 350, BSPM 302 & one of the associated labs BSPM 303A, B or C, and either LIFE 220 or LIFE 320. This set of courses will broadly educate students in the fundamentals of plant pathology, entomology and weed science. The curriculum is designed so students also receive a foundation in agricultural biology that includes the importance of soils for plant growth, genetics, evolution and ecology. Upon completion of the major requirements students will have the choice to choose one of four concentrations: (1) Plant health management, (2) Plant Pathology, (3) Entomology and (4) Weed Sciences. For the concentrations students will choose 9 credits that courses that provide advanced training in plant science, plant pathology, entomology or a combination of the three. The sequence of courses was determined based on the curriculum matrix (Table 1) which was developed after a careful analysis of the course learning objectives for each course.

Department Requirements: In order to meet the program learning objectives, agricultural biology majors will also be required to complete one semester of inorganic chemistry and one semester of organic chemistry. The chemistry courses are essential for students to be competent in the program learning objective of technical competence. Students will also complete one semester statistics to be competent in the program learning objectives of critical thinking and the interpretation of data.

d. For UNDERGRADUATE programs: Explain ways program level learning outcomes will build upon transferable skills articulated in SLOs within the AUCC.

Student learning outcomes (SLOs) in the All University Core Curriculum (AUCC) include three main areas, which build upon one another: Fundamental Competencies; Foundations and Perspectives; and Depth, Application, and Integration. The following descriptions are from the version of the AUCC approved by CSU Faculty Council on November 6, 2018.

Fundamental Competencies in the AUCC (1A, 1B, and 2) are central to success in all courses. These include written and oral communication and quantitative reasoning. Therefore, the learning outcomes and instructional aims of these courses seek to develop and reinforce such competencies.

Fundamental Competencies courses emphasize the acquisition of capabilities involving writing, communicating, and quantitative reasoning as primary objectives (1A, 1B, and 2). Therefore, the learning outcomes and instructional aims for this category are to develop and practice these competencies, as they are integral to Foundations and Perspectives courses (3A, 3B, 3C, 3D, and 3E), as well as to students' major fields of study.

Foundations and Perspectives in the AUCC (3A, 3B, 3C, 3D, and 3E) emphasize subject area methodologies, diverse perspectives and ways of knowing, modes of expression and creativity, concepts, and knowledge. Courses in this category help students apply effective use of fundamental competencies to bring diverse viewpoints, knowledge, applications and skills to life. Such courses emphasize distinctive characteristics as well as critical linkages among fields of study, promoting synthesis of learning.

Foundations and Perspectives courses emphasize subject area methodologies, perspectives, modes of expression and creativity, concepts, and knowledge. Courses in this category help students effectively use fundamental competencies to bring diverse viewpoints, knowledge, application, creativity, and skills to life. Courses explore distinctive characteristics as well as critical linkages among fields of study, promoting synthesis of learning.

Depth, Application, and Integration in the AUCC (4A, 4B, and 4C) engage students in depth and integration of content knowledge (factual, procedural, and metacognitive). These courses help students incorporate and apply learning set forth in Fundamental Competencies and Foundations and Perspectives courses. These courses will provide a capstone experience that helps students integrate, apply, and reflect on the cumulative learning from all courses in their academic experience and major.

The objective of the Depth, Application, and Integration requirement is to ensure that all students continue to develop their academic competencies and build upon the Fundamental Competencies and Foundations and Perspectives courses in manners consistent with learning objectives of their major's program of study. These courses provide integrative and/or applied learning through which students demonstrate the ability to integrate multiple threads from prior learning, to complex, novel, or re-contextualized problems.

Additionally, courses in this category strive to prepare students to demonstrate University learning outcomes, which include creativity, communication, reasoning, stewardship, and collaboration. These foster dispositions toward lifelong learning and the ethical and responsible use of knowledge and information.

The SLOs of the Agricultural Biology (AB) major will build upon skills and knowledge gained in the AUCC student learning outcomes as follows:

Technical Competencies in AB are analogous to AUCC Fundamental Competencies and will provide opportunities for students to practice written and oral communication and build their quantitative and qualitative analytical reasoning skills as they gain basic subject matter knowledge and understanding. The subject matter in AB cohort courses (AB/BSPM 120, AB/BSPM 130, AB/BSPM 230, AB/BSPM 270 [for transfer students], AB/BSPM 330 and AB/BSPM 430) and major requirement courses (e.g., BSPM 302, BSPM 308, BSPM 310), which achieve these outcomes, builds upon the foundations gained in required AUCC courses (e.g., CO 150, MATH 155, CO 301B, LIFE 102, and AGRI/IE 116). Systems thinking is an approach that students will be introduced to incrementally throughout the academic program. Students will first be introduced to individual elements of systems through AUCC and major requirement courses. Systems thinking will be introduced in AB cohort courses and students will begin to integrate individual elements to gain a holistic view of how the elements interact in the system. Ultimately, students will apply systems thinking to case studies and their capstone projects in the Capstone Experience courses AB/BSPM 330 and AB/BSPM 430, which will fulfill the capstone requirement for the major and the AUCC Depth, Application, and Integration AUCC requirement.

Agricultural Literacy SLOs will require that students utilize their written and oral communication and reasoning skills gained through AUCC Fundamental Competencies and Foundations and Perspectives courses such as AGED 210, AGRI 116, and SOCR/HORT 171. The AB cohort courses (listed above) will require development of qualitative and quantitative reasoning skills and knowledge and understanding of the socioeconomic and historic contexts required to address challenges in sustainably managing agricultural systems. Students will have the opportunity to integrate and apply their knowledge to case studies and their capstone project in the AUCC Capstone Experience courses, AB/BSPM 330 and AB/BSPM 430.

Critical Thinking SLOs of the AB major will be achieved through cohort courses (lited above) and required major courses, which will build upon knowledge and skills gained in required AUCC courses (CO 150, AREC 202, ECON 240, ANTH 100, SOC 100, SOC 105, ANTH/MU 232, PSY 100, PSY 152). The pinnacle of their skills development and experience will be reached when students take the Capstone Experience courses, AB/BSPM 330 and AB/BSPM 430. In these courses students will synthesize and apply the knowledge and skills they gained throughout their academic career (AUCC, cohort, and major requirement courses) to solve problems presented in case studies and capstone projects using systems thinking and systems modeling software.

Leadership SLOs of the AB major will be achieved through the many opportunities to work in and lead teams in the major's cohort courses (listed above) and the content that raises awareness and builds skills to create inclusive cultures and promote diversity. These skills will build upon experiences gained in AUCC Fundamental Competency courses that include students from across the university (e.g. LIFE 102, LIFE 103 and,

AGRI/IE 116) and Foundations and Perspectives courses that provide insight into different domestic and international cultures (e.g., AGRI/IE 116, ANTH 100, SOC 105, PSY 100). Students will achieve mastery of the Leadership SLOs through the Capstone Experience courses (AB/BSPM 330 and AB/BSPM 430), through selection and development of their capstone projects and collaboration with other students to solve one or more important problems in agricultural or natural systems presented as case studies and as part of their capstone projects.

Communication SLOs of the AB major will be achieved through cohort and major requirement courses in which students write papers of varying lengths that target different audiences and give oral presentations presenting their work. Every cohort course in the major includes these elements. AUCC Fundamental Competencies courses provide the foundation on which the AB major cohort courses will build. AB/BSPM 120, AB/BSPM 130, AB/BSPM 230, AB/BSPM 270 [for transfer students] will provide opportunities for students to practice and develop their skills and abilities in communication. Like the other AB major SLOs, the Capstone Experience courses will give students the ultimate opportunity to integrate the skills and knowledge they have gained from AUCC, cohort, and major requirement courses to address complex problems in natural or managed ecosystems. Then, they must effectively communicate their knowledge of, ideas about, and solutions to these problems to a general audience through written reports, posters, and oral presentations.

VII. Continuing Assurance of Student Success and Learning

Undergraduate Major in Agricultural Biology housed in Bioagricultural Sciences and Pest Management (We expect the name of the department to be changed to Agricultural Biology by the end of 2019, thus, Agricultural Biology is used as the department name below.)

1. **Identify the processes for determining that program Student Learning Outcomes (Section VI) are attained through direct and indirect assessment where direct methods require student to demonstrate skills/knowledge (e.g. projects, examinations, papers, portfolios, performances, etc.), and indirect methods capture proxy signs of learning (e.g. job placement, student surveys, graduation rates, course grades, etc.)**

   Systematic review of continuing assurance of student learning will be a priority for the Agricultural Biology undergraduate major to ensure that the Student Learning Outcomes are being met and remain appropriate for the major. This program review will be on-going, occurring on an annual basis. Through annual reviews, we seek to demonstrate that our students are learning the knowledge and skills necessary to achieve the program goals and objectives, the curriculum is coherent, current and consistent, the instruction is effective in enabling student learning, and that resources are adequate for student learning.

   - Direct assessments will include faculty recording course grades, scores of exams, papers and presentations, and indirect assessment will include student surveys, job placement numbers and graduation rates.
   - The Department of Agricultural Biology will also develop a rubric to be used by the faculty to assess whether classes address appropriate student learning outcomes, such as critical thinking, written communication, oral communication, and/or technical skills.
   - The instructor for each departmental course will survey students with questions to assess student perception of information gained and course structure once each semester. Instructors will also ask students for course evaluations once per semester. These evaluations will be written following TILT guidelines.
   - In addition to student feedback, we will also have our faculty do self-assessment surveys to interpret the data they have collected throughout the semester on student learning. In this survey, we will have faculty provide overviews on student scores and reviews. To promote a growth mindset in a faculty member's practice of teaching, we will also ask them to brainstorm possible changes to methods of delivery, content to improve future performance, and ways to improve student experience and learning. Since this will be assessed on an annual basis, instructors will also review previous years' comments and suggestions to track progress over time.
   - Lastly, we will also survey alumni to track the success of students and get feedback on what helped them be successful.

   Data generated on an annual basis will provide the foundation for an effective program review, assessment of student learning, and other quality improvement strategies. However, to have an impact, data need to be turned into evidence and communicated in useful formats. A program review report will be developed every year in the initial stages of the program, and once the program is established, every five years, and assessed by the faculty. Areas in need of adjustment will be discussed and corrective action will be taken.

2. **Describe the processes for using Student Learning Outcomes evidence to continuously improve the program.**

   Faculty and the Department Undergraduate Major Committee (which includes six faculty and staff members) have worked together in the preparation phase to ensure that the classes cover each of the Student Learning Outcomes for the major. An undergraduate education committee will be established in Agricultural Biology to oversee and direct the program to best fit student needs once the major has been approved. The committee will meet twice per semester to review student progress, the curriculum, and student success, and to work out the inevitable "bumps in the road" that come with a new degree program.

3. **Describe placement outcome goals (for graduate programs, career enhancement when relevant) for students graduating from the program. Explain how this evidence will be used to continuously improve the program.**

   We expect our students will find permanent jobs in industry, USDA Agricultural Research Service, USDA Forest Service, USDA Animal & Plant Health Inspection Service, US Environmental Protection Agency, seed and plant companies, state departments of agriculture and in research as crop advisers, port inspectors, diagnosticians, international and national agricultural research centers as research associates, and biotechnology firms. Our placement goal is that at least 90% of our students will be placed either in positions like these or will pursue graduate studies.

   Placement information will be critical for us as we position the program for the long run. Depending on where our students find jobs, we can adjust the program to better suit the needs of incoming students. We are also well connected to the Colorado agriculture community, industry and USDA partners. We will look to these groups for guidance to adapt the program to best prepare our students for positions in these platforms. We will also partner with CAS Career Services and the recruiting team to help get our students connected within the CSU and Colorado agricultural networks.

4. **Describe High Impact Practices (curricular and co-curricular) that will be integrated into the program to enhance student learning, provide transformational experiences, and promote graduate by helping students achieve Student Learning Outcomes. Briefly explain how the placement and nature of High Impact Practices will help students to master the Student Learning Outcomes.**

   High Impact Practices are vital to the success of student learning, and these practices are incorporated in all classes required for the Agricultural Biology major. To excite freshman about the major, in the Freshman Seminar Class BSPM 130 - Working with Agricultural Biology Data, students will get a transformational experience by collecting and analyzing data relevant to Agricultural Biology. Typically, these types of experiences occur in third or fourth year classes. In groups, students will generate a set of hypotheses and use their generated data to test these hypotheses. Further, they will present their scientific findings in a two-page report and an in-class presentations. This class demonstrates well how High Impact Practices will help students achieve the Student Learning Outcomes. Even in their first year, students will be working on analytical, writing, and communication skills.

   Many of the required classes, including BSPM 303, General Entomology and associated Lab Sections, BSPM 361 - Elements of Plant Pathology, and BSPM 308 - Ecology and Management of Weeds, have many High Impact Practices. These classes include insect, disease and weed collections, projects that include inoculating plants with fungi, viral or bacterial pathogens, written reports and individual or group presentations. These types of

High Impact Practices help students form bonds with the subject material by making long lasting memories of the experience. Many times, too, working in group projects can help students bond with each other, enhancing each student's support network, which can help students graduate. Lastly, students will also take part in two Capstone courses that integrate and apply knowledge gained from all courses.

Further, Agricultural Biology has the Gillette Entomology Club, which has many opportunities for undergraduate students. The main focus of the club is to broaden the tools for learning by hosting special seminars, going on field trips, and educating K-12 students. We will also implement a Plant Pathology club with similar goals of broadening learning for Agricultural Biology undergraduates focused on plant pathology. Again, special seminars, field trips and outreach opportunities will be provided for students, which enhance student learning for success.

VIII. Curriculum

1. **List all courses comprising the program's curriculum. Please provide the following information for each course: subject code, course number, title, credits, prerequisites, and catalog description.** ***Please BOLD entries for each NEW course being proposed.***

Table 13. Courses comprising the Agricultural Biology major's curriculum.

Course Number	Course Title	Credits	Pre-Requisite	Catalog Description
[a] AB/BSPM 120	Agricultural Biology: Freshman Orientation	1	None	Introduce students to information and skills necessary to succeed in the undergraduate major in Agricultural Biology.
AB/BSPM 130	Working with Agricultural Biology Data	1	BSPM 120	Introduce students to the scientific method and systems thinking in terms of agricultural biology. Students will develop a hypothesis based on field observations, collect and analyze data to determine if their findings align with their hypothesis.
AB/BSPM 230	Becoming an Agricultural Biology Professional	1	BSPM 120, BSPM 130	Prepare students to be a successful Agricultural Biology professional by designing professional resumes, developing interpersonal skills to succeed in a professional environment, developing criteria to write a report from their internships, and developing skills in interpretation of qualitative and quantitative data.

Course Number	Course Title	Credits	Pre-Requisite	Catalog Description
AB/BSPM 330	Applications in Agricultural Biology I	2	(BSPM 120, BSPM 130, BSPM 230) or BSPM 320	Provide students with the knowledge, skills, and abilities to design a capstone project that poses sustainable solutions to biological problems in natural or managed ecosystems; discussion of a diverse set of case studies that incorporate systems approach in solving agricultural biology issues.
AB/BSPM 430	Application in Agricultural Biology II	3	(BSPM 120, BSPM 130, BSPM 230) or BSPM 320 & AB 330	Integrating and applying the knowledge, skills, and abilities they have gained across the curriculum of the Agricultural Biology major; Apply systems thinking and dynamic systems modeling to case studies and a capstone project that poses sustainable solutions to biological problems in natural or managed ecosystems.
AB/BSPM 270	Agricultural Biology Orientation for Transfers	2	None	For transfer students and introduces them to information and skills necessary to succeed in the major. Introduction to the scientific method and systems thinking, develop a hypothesis based on field observations, collect and analyze data; Design resumes and practice skills to succeed in a professional environment.

Course Number	Course Title	Credits	Pre-Requisite	Catalog Description
SPCM 200	Public Speaking	3	None	Fundamentals of public speaking emphasizing content, organization, delivery, audience response.
BSPM 487	Internship	3	None	
BSPM 308	Ecology and Management of Weeds	3	(BZ 120 or LIFE 103) and (CHEM 107 or CHEM 111).	Classification, characteristics; weed biology and ecology; control by cultural, mechanical, chemical, and biological means; successional management.
BSPM 310	Understanding Pesticides	3	BZ 100 to 199 - at least 3 credits or CHEM 100 to 199 - at least 3 credits.	Identification, properties, use, labeling, environmental interactions, and application of major classes of pesticides.
BSPM 361	Elements of Plant Pathology	3	BZ 104 or BZ 120 or HORT 100 or LIFE 102.	Diseases of economic plants.
BSPM 451	Integrated Pest Management	3	BSPM 302 or BSPM 308 or BSPM 361.	Concepts of integrated pest management and the strategies and tactics employed in the application of these concepts.
SOCR 240	Introductory Soil Science	4	CHEM 107 or CHEM 111.	Formation, properties, and management of soils emphasizing soil conditions that affect plant growth.

Course Number	Course Title	Credits	Pre-Requisite	Catalog Description
BZ 220	Introduction to Evolution	3	BZ 110 or BZ 120 or LIFE 103.	Fundamental concepts in evolutionary biology.
BZ 350	Molecular and General Genetics	4	(BZ 110 or BZ 120 or LIFE 102) and (STAT 201, may be taken concurrently or STAT 301, may be taken concurrently or STAT 307, may be taken concurrently or ERHS 307, may be taken concurrently).	Mendelian, molecular, and population genetics emphasizing the molecular basis of genetics.
BSPM 302	Applied and General Entomology	2	None	Biology and management of insects.
BSPM 303A	Entomology Laboratory: General	2	BSPM 302	Biology and recognition of insects.
BSPM 303B	Entomology Laboratory: Horticultural	1	BSPM 302	Biology and recognition of insects.

Course Number	Course Title	Credits	Pre-Requisite	Catalog Description
BSPM 303C	Entomology Laboratory: Agricultural	1	BSPM 302	Biology and recognition of insects.
LAND/LIFE 220	Fundamentals of Ecology	3	(BIO 100 to 199 - at least 3 credits or BZ 100 to 199 - at least 3 credits or LIFE 100 to 199 - at least 3 credits or HORT 100) and (MATH 100 to 199 - at least 3 credits).	Interrelationships among organisms and their environments.
LIFE 320	Ecology	3	(BZ 101 or BZ 104 or BZ 110 or BZ 120 or LIFE 102) and (MATH 141 or MATH 155 or MATH 160).	Interrelationships among organisms and their environments using conceptual models and quantitative approaches.
	Group 1: Electives			
BZ 223	Plant Identification	3	BZ 120 or LIFE 103	Relationships and identification of flowering plants.
BZ 331	Developmental Plant Anatomy	4	BZ 120 or LIFE 103	Structure of plant cells, tissues, and organs as they develop.

Course Number	Course Title	Credits	Pre-Requisite	Catalog Description
BZ 338	Comparative morphology of Vascular Plants	4	BZ 120 or LIFE 103	Origin, evolution, structure, and reproduction of the vascular plants, including comparative study of organs occurring in each group.
BZ 440	Plant Physiology	3	BZ 120 or LIFE 103	Functions and activities of plants.
BZ 450	Plant Ecology	4	BZ 120 or LIFE 103	Relation of plants to their environment.
SOCR 460	Plant Breeding		BZ 350, may be taken concurrently or LIFE 201A, may be taken concurrently or SOCR 330, may be taken concurrently.	Theory and practice of plant breeding using principles of genetics and related sciences.
HORT 464A	Arboriculture	3	HORT 100 and SOCR 240.	Practices used by arborists and landscape managers to plant, appraise and maintain landscape trees.
HORT 341	Turfgrass Management	3	HORT 100, may be taken concurrently.	Principles and practices of turfgrass propagation and maintenance.

Course Number	Course Title	Credits	Pre-Requisite	Catalog Description
HORT 221	Landscape Plants	4	None	Identification, landscape features, cultural requirements, and landscape use of coniferous and deciduous trees and shrubs, vines, and evergreens.
	Group 2: Plant Pathology			
MIP 300	General Microbiology	3	(BZ 110 or BZ 120 or LIFE 102) and (CHEM 245, may be taken concurrently or CHEM 341, may be taken concurrently or CHEM 345, may be taken concurrently).	Structure, function, development, physiology, and molecular biology of microorganisms emphasizing bacteria.
BZ 333	Introductory Mycology	4	BZ 120 or LIFE 103	Groups of fungi including classification, structure, morphogenesis, phylogeny, and genetics and reproduction.
SOCR 455	Soil Microbiology	3	MIP 300 or SOCR 240	Microbial activities in agricultural, forest, and grassland soils; in soil-plant relationships; and in maintenance of environmental quality.

Course Number	Course Title	Credits	Pre-Requisite	Catalog Description
SOCR 456	Soil Microbiology Laboratory	1	SOCR 455, may be taken concurrently	Techniques used in study of ecology and activities of soil microorganisms.
BSPM 365	Integrated Tree Health Management	4	BZ 120 or LIFE 102.	Insects and diseases in forest and urban ecosystems. Effects, diagnosis, prevention, and interactions.
MIP 432	Microbial Ecology	3	MIP 300	Principles of microorganism interactions with their living and non-living environments; implications for the environment, plants and animals.
MIP 433	Microbial Ecology Laboratory	1	MIP 432, may be taken concurrently	Principles of microorganism interactions with their living and non-living environments; implications for the environment, plants and animals.
BSPM 450	Molecular Plant-Microbe Interaction	3	(BZ 100 to 499 - at least 3 credits) and (BZ 346 or SOCR 330)	Principles of plant-microbe/insect interactions, physiological and molecular aspects of plant defense, genomics approaches to study plant defense.
	Group 3 Electives: Entomology			
BSPM 280A1	Insect Biotechnology	3		

Course Number	Course Title	Credits	Pre-Requisite	Catalog Description
BSPM 415	Pollinator Management in Agroecosystems	2	HORT 100 or SOCR 100	Fundamental concepts of pollinator biology and management, sustainable crop-pollinator interactions, regional and global issues on pollinator management and conservation, best management practices for commercially managed pollinators.
BSPM 423	Evolution and Classification of Insects	3	None	Major groups of insects, living and fossil; major evolutionary trends in structure and behavior.
BSPM 445	Aquatic Insects	4	BZ 111 or LIFE 103	Biology and recognition of major orders and families of aquatic insects; a collection is required.
BSPM 462	Parasitology and Vector Biology	5	(BZ 110 or LIFE 103) and (BZ 212 or LIFE 206 or MIP 302)	Protozoa, helminths, and insects and related arthropods of medical importance; systematics, epidemiology, host damage and control.

[a] The newly developed core courses of the major will have subject code AB and are listed as AB/BSPM here because this transition is not yet complete. Existing courses taught in the department have the subject code BSPM.

2. Discuss all learning formats to be utilized in the program curriculum.

The following learning formats will be utilized in the courses that fall into the Cohort program and Major requirements:

- Lectures: The courses providing knowledge needed to function as an Agricultural Biologist are BSPM 308, BSPM 310, BSPM 361, BSPM 451, SOCR 240, BZ 220, BZ 350, BSPM 302, and either LIFE 220 or LIFE 320. These courses will be taught in the traditional lecture format.
- Laboratories: Several courses in the major requirements are associated with laboratories. The laboratories use the high impact practice of experiential learning and

allow students to learn through reflection on doing. The courses are: BSPM 308, BSPM 310, BSPM 303 (A or B or C), SOCR 240 and BZ 350 (recitation).

- ❖ Group projects: Several of the courses under the major requirements such as BSPM 361, BSPM 308 and BZ 350 require group projects. Additionally, courses that are part of the cohort program will all require group projects. BSPM 330 and BSPM 430 form the capstone requirement for Agricultural Biology majors and will require students will work in groups to design a capstone project that poses sustainable solutions to biological problems in natural or managed ecosystems.
- ❖ Seminars/Field Trips: BSPM 130 is designed for students to develop a hypothesis based on field observations, collect and analyze data to determine if their findings align with their hypothesis. Further BSPM 330 and BSPM 430 will require field visits to observe in person biological problems that face farmers and natural ecosystem managers in Colorado.

3. Address supply and demand for placement in career development activities such as practica and/or internships. Be sure to address this in the budget narrative and form.

The internship forms an important component of the major and all students majoring in Agricultural Biology will be required 3 credits of an internship. Students can choose to either work in a professional setting or in a research setting (with CSU faculty). We believe the internships will provide students with the knowledge, skills and experience of working in both professional and research environments. Students will also be able to establish critical networking connections and work experience. We have had several conversations with potential sponsors including Eurofins, Bayer (students perform research studies in the Weed Research Lab for Bayer) and Frito-Lay.

4. Describe explicit activities and specify the courses in which they occur that promote social justice, diversity, and inclusion.

We strongly believe in CSU's principles of community. Understanding, accepting and valuing diverse backgrounds will help our majors thrive in an ever-changing society. BSPM 230 has specific modules in the course that help students understand microaggression and implicit bias. Further, we will strongly recommend to our students that they enroll in and complete the Leadership Preparation Certificate by the end of their junior year. The certification prepares participants for leadership and service in their communities and encourages them to develop a personal philosophy of leadership that includes an understanding of self, groups and society.

IX. Current Faculty Resources

1. **Identify current program faculty, using the table below. List those specifically contributing to the proposed program first. Include the faculty member's appointment type (Tenured, Tenure-Track, Contract, Continuing, or Adjunct), highest degree held, and a brief description of each faculty member's expertise/specialization.**

Table 14. Faculty who will participate in the Agricultural Biology major.

Last, First Name	Appointment Type	Highest Degree Held	Area of Specialization	Contribution	Link to CV
Argueso, Cris	Tenure-Track	Ph.D.	Plant Pathology	BSPM 451 Undergrad Research Fellows Program	https://bspm.agsci.colostate.edu/cris-argueso-2/
Bjostad, Louis	Tenured	Ph.D.	Chemical Ecology & Insect Behavior		https://bspm.agsci.colostate.edu/people-button/faculty/louis-bjostad/
Brown, Cynthia	Tenured	Ph.D.	Ecology of Invasive Plants & Restoration Ecology	AB/BSPM[a] 430	https://bspm.agsci.colostate.edu/people-button/faculty/cynthia-brown/
Camper, Matt	NTTF	M.S.	Entomology	BSPM 102	https://bspm.agsci.colostate.edu/people-button/faculty/matt-camper/
Cranshaw, Whitney	Tenured	Ph.D.	Horticultural Entomology	BSPM 102, BSPM 303B	https://bspm.agsci.colostate.edu/people-button/faculty/whitney-cranshaw/
Dayan, Franck	Tenured	Ph.D.	Weed Science	AB/BSPM 230	http://bspm.agsci.colostate.edu/franck-dayan/

Gaines, Todd	Tenure-Track	Ph.D.	Molecular Weed Science	Advisor for students also participating in sequential Pest Management M.S.	https://bspm.agsci.colostate.edu/people-button/faculty/todd-gaines/
Hufbauer, Ruth	Tenured	Ph.D.	Applied Evolutionary Ecology	LIFE 320	https://bspm.agsci.colostate.edu/people-button/faculty/ruth-hufbauer/
Jahn, Courtney	Tenure-Track	Ph.D.	Biofuels	AGRI 116	https://bspm.agsci.colostate.edu/people-button/faculty/courtney-jahn/
Kondratieff, Boris	Tenured	Ph.D.	Entomology	BSPM 303A, BSPM 303C, BSPM 423, BSPM 445	https://bspm.agsci.colostate.edu/people-button/faculty/boris-kondratieff/
Nachappa, Punya	Tenure-Track	Ph.D.	Entomology	BSPM 120, BSPM 320, BSPM 280A1	http://bspm.agsci.colostate.edu/people-button/faculty/punya-nachappa/
Nalam, Vamsi	Tenure-Track	Ph.D.	Molecular Plant-pathogen Interaction	BSPM 130, BSPM 320 BSPM 361	http://bspm.agsci.colostate.edu/people-button/faculty/vamsi-nalam/
Nissen, Scott	Tenured	Ph.D.	Integrated Weed Management	BSPM 308	https://bspm.agsci.colostate.edu/people-button/faculty/scott-nissen/
Norton, Andrew	Tenured	Ph.D.	Pest Ecology and Management	AGRI 116	https://bspm.agsci.colostate.edu/people-button/faculty/

					andrew-norton-2/
Ode, Paul	Tenured	Ph.D.	Plant-Insect Interactions	BSPM 302	https://bspm.agsci.colostate.edu/people-button/faculty/paul-ode/
Peairs, Frank	Tenured	Ph.D.	Integrated Pest Management	BSPM 450	https://bspm.agsci.colostate.edu/people-button/faculty/frank-peairs/
Stewart, Jane	Tenure-Track	Ph.D.	Plant Pathology	BSPM 365	https://bspm.agsci.colostate.edu/people-button/faculty/jane-stewart/
Trivedi, Pankaj	Tenure-Track	Ph.D.	Microbiome	AB/BSPM 330	http://bspm.agsci.colostate.edu/pankaj-trivedi/
TBD (Vice-Broders)	Tenure-Track	Ph.D.	Plant Pathology		
TBD	NTTF	M.S. or Ph.D.	Agricultural Biology Engagement	Summer camp Recruiting and advising Bug Zoo	

X. Impact of Program on Faculty and Advising

1. Do you have plans to deactivate a program or courses in order to support this new degree program?

We do not plan to deactivate a program or courses to support this new degree program.

2. Current capacity of the unit(s) to deliver the proposed degree:

a. Number of current students at level of degree and major

We have 23 faculty members in our department, and a search underway for a 24th faculty member. We do not currently have a B.S. degree in our department.

b. Current ratio of students to faculty for teaching purposes

Our current ratio of students to faculty for teaching purposes is sufficient for the courses taught, as long as faculty lines are maintained in our department as people retire. We will need to add GTAs to some courses. We also will need to add faculty lines to be able to offer high priority courses in subjects such as insect physiology, mycology, and nematology, if this major grows as expected. Enrollment data for courses included in the Agricultural Biology major are listed in Table 15.

Table 15. Enrollment data for courses in our major. 2019 data are only included for courses taught in Spring 2019.

Course	Cr.	Semester Offered	Instructor	Enrolled		
				2017	2018	2019
BSPM102 Insects, Science, and Society	3	Spring Fall Summer	Cranshaw Camper Camper	527	552	234
AGRI 116 Plants and Civilization	3	Spring Fall	Norton Jahn	523	492	
[a] AB/BSPM[a] 120 Agricultural Biology: Freshman Orientation	1	Fall	Nachappa			New course
AB/BSPM 130: Working with Agricultural Biology Data	1	Spring	Nalam			New course
AB/BSPM 230: Becoming an Agricultural Biology Professional	1	Fall	Dayan			New course
AB/BSPM 270: Agricultural Biology Orientation for Transfers	2	Fall	Nalam			New course

Course	Cr.	Semester Offered	Instructor	Enrolled		
				2017	2018	2019
BSPM 281A1 Insect Biotechnology	3	Odd Spring	Nachappa			9 New course
BSPM 300 Livestock Entomology	1	Spring	Kondratieff Peairs	18	11	10
BSPM 302 Applied and General Entomology	2	Fall	Ode	167	176	
BSPM 303A General Entomology Lab	2		Kondratieff	52	48	
BSPM 303B Horticultural Entomology Lab	1		Cranshaw	57	62	
BSPM 303C Agricultural Entomology Lab	1		Kondratieff Peairs		9	
BSPM 308 Ecology and Management of Weeds	3	Fall	Nissen	52	59	
BSPM 310 Understanding Pesticides	3		Peairs		7	
AB/BSPM 330: Applications in Agricultural Biology I	2	Fall	Trivedi			New course
BSPM 361 Elements of Plant Pathology	3	Spring	Nalam	72	68	81
BSPM 365 Integrated Tree Health	4	Fall	Stewart	30	33	
BSPM 423 Evolution and Classification of Insects	3	Fall, odd years	Kondratieff	4		
AB/BSPM 430: Applications in Agricultural Biology II	3	Fall	Brown			New course
BSPM 445 Aquatic Insects	4	Fall	Kondratieff	25	30	

Course	Cr.	Semester Offered	Instructor	Enrolled		
				2017	2018	2019
BSPM 450/550 Molecular Plant-Microbe Interactions	3	Even Spring	Argeuso		12	
BSPM 451/551 Integrated Pest Management	4	Fall, odd years	Peairs	23		23

[a] The newly developed core courses of the major will have subject code AB and are listed as AB/BSPM here because this transition is not yet complete. Existing courses taught in the department have the subject code BSPM.

Our department has two professors, Bjostad and Hufbauer, who contribute to the LIFE series. We also have seven professors who do not currently teach undergraduate courses (Brown, Charkowski, Dayan, Gaines, Leach, McKay, Trivedi, and Westra), so we believe that we have the teaching capacity within our department to offer this major. We also have a search underway for a plant pathologist and this faculty member will also contribute to undergrad teaching in our new major.

c. Current ratio of students to faculty for advising purposes

We do not have an undergraduate major, thus, do not currently advise undergrads in a major. We typically have 20-25 students minoring in Entomology or Plant Health and current have 3 faculty members advising these students. We have capacity to for additional undergrad advising.

d. Estimated ratio of students to faculty for teaching purposes with admits from new program

There are three courses that will require additional resources after our major is initiated. The courses and the plan to provide additional support are listed below in Table 16.

Table 16. Estimated resources required for current courses if new majors has ~200 students by 2025. We anticipate that most students will take 4 to 5 years to graduate, so project 40 additional students per year in required courses and 20 more students per year in electives.

Course	Current Enrollment	Projected Enrollment	Approach
AGRI 116 Plants and Civilization	~500	~520	No additional support needed
BSPM 281A1 Insect Biotechnology	~10	~30	No additional support needed
BSPM 302 Applied and General Entomology	~175	~215 (~150*)	1 additional GTA to assist with course and a larger lecture hall or change BSPM 303B (*see BSPM 303B below)
BSPM 303A General Entomology Lab	~50	~70	May add additional staff or TA support
BSPM 303B Horticultural Entomology Lab	~60	~80 (~125*)	Depending on a new hire in 2021 and growth of the Horticulture majors, we may change this to a 2 credit course to serve Horticulture majors and add 1 TA to this course. This will reduce the size of BSPM 302.
BSPM 303C Agricultural Entomology Lab	~10	~20-40	No additional support needed
BSPM 308 Ecology and Management of Weeds	~60	~100	We would need to add 2 additional GTAs to this course and 2 additional lab sections.
BSPM 310 Understanding Pesticides	~10	~30	No additional support needed
BSPM 361 Elements of Plant Pathology	~80	~120	We would need 2 additional lab sections for this course and 1 additional GTA.
BSPM 365 Integrated Tree Health	~30	~50	This course is an elective for our major. Depending on growth of the major, a GTA and an additional lab section may be added to this course.
BSPM 423 Evolution and Classification of Insects	~5	~10	No additional support needed

Course	Current Enrollment	Projected Enrollment	Approach
BSPM 445 Aquatic Insects	~30	~35	No additional support needed
BSPM 450/550 Molecular Plant-Microbe Interactions	~10	~20	No additional support needed
BSPM 451 Integrated Pest Management	~25	~65	The course will be offered annually instead of only in odd years.
BSPM 462 Parisitology and Vector Biology			No additional support needed (Enrollment data are held in Department of Biology, thus is unknown at this time)

e. Estimated ratio of students to faculty for advising purposes with admits from new program

Our department currently has 23 faculty and one open faculty line. If our major draws 100 to 200 students, we will have an advising ratio in the range of 1:5 to 1:10 faculty:student, which is relatively low. We currently have no formal undergrad advising responsibilities other than advising for two minors.

f. Will these ratios be adequate to support teaching and advising needs?

These ratios will be adequate to support advising needs with regard to the student:faculty ratio, as long as faculty lines from retiring faculty remain in our department. As part of our proposed program budget, we have included 3 additional faculty lines to support teaching needs and to aid us in advising students on high priority careers where we lack expertise at CSU, such as in protecting cattle from mycotoxins or in molecular insect physiology.

We anticipate substantial faculty turnover in the next 5 to 10 years. Two professors who have announced retirement dates in 2020 teach core courses (Cranshaw and Nissen). We will need to replace these positions to be able to offer this major and, depending on the growth of the major, may seek GTA support as part of their start-up packages. We may also adjust the course currently taught by Cranshaw (BSPM 303B) to reduce pressure on BSPM 302 and potentially reduce the need for additional GTAs, but this would not occur until the vice-Cranshaw incumbent is in place in order to allow that person to direct changes made in this course. This will occur after the launch of our new major.

3. For UNDERGRADUATE programs, indicate how the department will address undergraduate mentoring/advising loads of the new program within and outside of the department.

a. How will the proposed program affect undergraduate student access to faculty?

The faculty in our department currently have no formal mentoring or advising responsibilities other than for the 20-25 undergrads in our entomology and plant health minors. The proposed program will increase access of undergraduate students with interest in agricultural biology, specifically entomology, plant pathology, weed science, and applied ecology to CSU faculty.

b. How will knowledge of the new program be shared with the advising community (CSA, ASC, etc.)?

We will hire an academic success coordinator and this person will become part of the CAS team. This person will be responsible for sharing knowledge of this new program with the advising community.

c. Does the department currently use Academic Success Coordinators? Please explain how advising is provided currently for your majors. With the addition of this new undergraduate program, how will the ASC's meet the increased advising needs?

We do not currently have a major and therefore do not have an Academic Success Coordinator. We will hire an Academic Success Coordinator as part of the development of this program. The College of Agriculture has developed a comprehensive plan for academic success and our coordinator will be part of the team implementing this plan.

4. If approved, how will launching this new program impact the commitment already made to students in other program areas within or outside the unit?

a. For new UNDERGRADUATE programs, provide a detailed plan as to how resources within the department would be re-allocated to contribute to the resource base needed for this proposed program (e.g., will the department need to "cap" another program? Would additional enrollment growth funding be necessary to meet current student demand for courses?).

New courses required for this major are based on discussions, seminars, and lectures and will be taught by existing faculty, some of whom do not currently teach undergraduate courses.

Our 300-level courses, which nearly are all laboratory courses, will need additional resources to support both this major and students in programs outside of our unit. We have described a plan in Table 14 for meeting this commitment. We should be able to meet our commitments by adding six additional semesters of GTA support for existing courses if our major enrolls 100-200 students in the first few years. Details are provided in our proposed program budget.

The space limitations that we currently face in teaching our 300-level courses will be addressed by new lecture hall and laboratory classroom space in the Shepardson addition.

The mentoring load for this new major will be, on average, 5 to 10 students per faculty member, which is not a large burden. In addition, the new courses designed for our major take advantage of a cohort model and should aid in student mentoring.

b. For new UNDERGRADUATE programs, what are "additional expenses" that must be taken into account to offer this academic program? For example, other than AUCC 1-3 (core) courses, how will other departments' teaching loads and facilities be affected by inclusion of their courses in the proposed curriculum. Provide a letter from other units indicating whether they will be able to "absorb" the projected number of students into existing sections or whether they will need to add sections. If extra sections must be added, how will this be financially supported?

Our department teaches multiple 300-level laboratory courses that are required for this major. Additional equipment and supplies will be required for these classes as our major grows and this is detailed in our proposed program budget.

Students in the Agricultural Biology major will be required to take eight courses that are an integral part of the major requirements and are offered by other departments. (Table 17). All required courses are large enrollment courses and are offered in both the Fall and Spring semesters. Letters of support have not been solicited from the affected departments because we expect the number of students will not have significant impact on the classes and will not require any additional sections in the initial years of the Agricultural Biology major and these courses will be able to "absorb" Agricultural Biology students. After the initial few years, we expect to have ~50 students enrolling to the major every year. Even with the increased number of students, we do not anticipate these large enrollment courses will need to create additional sections. Agricultural Biology majors will have the option of enrolling in the classes in either the Fall or the Spring semester. The one course that is offered only in the Fall semester is LAND/LIFE 220 with 135 seats available. This course is a required course for several majors on the campus and my prove a bottleneck for Agricultural Biology majors. To overcome this issue, Agricultural Biology majors are provided with a choice between LAND/LIFE 220 or LIFE 320, either of which will be considered towards the completion of Agricultural Biology major requirements.

Table 17. Courses required by Agricultural Biology majors offered by other departments.

Course	Sem	Sections #	Total number of Students	Delivery
CHEM 107	F	2	445	On-campus
	F	1	999	Online
	Sp	2	445	On-campus
	Sp	1	999	Online
CHEM 108	F	17	408	On-campus

Course	Sem	Sections #	Total number of Students	Delivery
	Sp	17	408	On-campus
CHEM 245	F	2	386	On-campus
	Sp	2	438	On-campus
CHEM246	F	11	264	On-campus
	Sp	11	264	On-campus
STAT 301	F	12	2400	On-campus
	Sp	13	2600	On-campus
STAT 307	F	3	165	On-campus
	Sp	3	165	On-campus
SPCM 200	F	21	504	On-campus
	Sp	21	504	On-campus
SOCR 240	F	1	162	On-campus
	Sp	1	162	On-campus
BZ 220	F	2	220	On-campus
	Sp	2	240	On-campus
BZ 350	F	1	160	On-campus
	Sp	1	160	On-campus
LAND/LIFE 220	F	1	135	On-campus
LIFE 320	F	2	277	On-campus
	Sp	2	280	On-campus

XI. Impact of Program on Staff and Graduate Assistants

1. **Estimate the number and type of support staff needed in each of the first five years of the program. Indicate FTE.**

   a. **Indicate title and responsibilities for each FTE.**

   Six additional GTA lines (3 FTE)

   One academic success coordinator (1 FTE)

   One museum curator (1 FTE)

   Three faculty lines (3 FTE)

   b. **What resource commitment is required and how will it be provided?**

   The majority of the FTE resources required for initiating this major are already available within our department. Additional resources are detailed in our program budget and described in sections XIII and XIV. In brief, they include a student success coordinator, a museum curator, and, if the major grows as expected, four additional GTA lines and three additional faculty lines over the course of 5 years. We currently lack sufficient space for this program, but the new Shepardson addition will provide the necessary lecture and lab class space required for this major. We are facing multiple retirements in our department and some of these faculty teach core courses for this major. We will also require these faculty lines to be refilled in order to offer this program.

2. **How many graduate assistants are currently funded on Resident Instruction funds?**

   Current funding sources for our Ph.D. and M.S. students (plan A) are shown in Table 19.

   Table 19. Current funding sources for Ph.D. and M.S. students (plan A)

	Ph.D students		M.S. students	
Funding Source	**Fall**	**Spring**	**Fall**	**Spring**
GRA-grant funds	12	12	7	8
GRA-department funds	2	1	2	3
GRA-GDPE program	0	1	0	0
Research Fellowship	4	4	0	0
GTA-grant funds	1	0	0	0
GTA-department	4	3	4	3
GTA-LIFE or another department	4	4	5	3
No funding	0	0	1	3
Continuing Registration	4	6	3	2

   Graduate student duties differ depending on how they are funded. GTAs are typically provided through a competitive process and the duties depend upon the course that the student is assisting. Students with GRAs funded by grants tend to have a thesis project

closely aligned with the grant. Students with GRAs funded by R&I funds are assisting faculty members with high extension or teaching loads. We recently revised our offer letters for GRAs and GTAs to clearly describe the expectations for these positions, training opportunities available, and their rights and responsibilities as GTAs or GRAs.

3. **How many additional funded assistantships are needed to support students in this proposed program?**

   If the program grows as anticipated, then we will need additional GTA support for BSPM 302 (or BSPM 303B), BSPM 303A, BSPM 308, and BSPM 361. These graduate students will assist with class management (BSPM 302 or BSPM 303B, and BSPM 303A), or will manage an additional laboratory section (BSPM 308, BSPM 361).

XII. Library Reference Sources

1. **Submit a description which has been certified by the Dean of the Libraries of the adequacy of student and faculty access to library and department resources (including, but not limited to: printed media, electronically published materials, videotapes, motion pictures, CD- ROM and online databases, and sound files) relevant to the proposed program (e.g., is there a recommended list of materials issued by the American Library Association?).**

2. **What additional financial support are required to bring access to such reference materials to an appropriate level?**

   a. **How will these additional resources be provided?**

      The following report was provided by Pat Burns, Vice President for Information Technology and Dean of Libraries

Library New Program Review

Bioagricultural Sciences and Pest Management Undergraduate Degree

January 28, 2019

Background

The College of Agricultural Sciences is proposing a new undergraduate degree program in bioagricultural sciences and pest management.

Collection and Services

The CSU Libraries is comprised of two physical locations and an extensive collection of electronic resources that are available to CSU affiliates 24/7, anywhere in the world. The Libraries provides a range of services to students and faculty in specific programs of study and maintain a networking infrastructure and an information technology staff to facilitate student and faculty access to research materials in electronic form. The Libraries maintains an extensive Web site (http://lib.colostate.edu), two staffed services points in Morgan Library, 24/7 chat reference, and an email reference service to provide research assistance for students. Additionally, the Libraries maintains a proxy server to facilitate remote student and faculty access to electronic journals, books, and reference materials.

The Libraries currently purchases materials to support the M. S. and Ph.D. degree programs in bioagricultural sciences, as well as minors in entomology and plant health. As outlined below, these

resources, including books, databases, and journals, would also support the new bioagricultural sciences and pest management B. S. degree program.

Additionally, each department at Colorado State University is assigned a librarian liaison who is charged with providing library services to the faculty, staff, and students. Renae Watson is the liaison librarian to multiple departments in the College of Agricultural Sciences, including Bioagricultural Sciences and Pest Management. She provides research support and is available for in-person consultations, as well as email and phone assistance, to help with research strategies, evaluating sources, citation management, and more. Liaison librarians also create and maintain online research guides to help students and faculty with subject-specific information. The guide for agriculture, including bioagricultural sciences and pest management, is at https://libguides.colostate.edu/agriculture. As part of research support, Ms. Watson provides research instruction to the College of Agricultural Sciences at the request of teaching faculty members. Ms. Watson regularly provides instruction for AGRI116, AGRI192, and BSPM365 and could provide additional instruction to support the new bioagricultural sciences and pest management undergraduate program.

Books

The Libraries' collections rank within the top 105 academic libraries in North America in quantity and quality. The CSU Libraries is committed to maintaining a comprehensive collection of materials to support the university's teaching and research missions, and the collection includes titles in both print and electronic formats. The Libraries has moved from a per-department resource budget to a consolidated, unified materials budget; there is not a specific fund allocated for Bioagricultural Sciences and Pest Management or any other academic unit. Books supporting research, teaching, and learning in academic departments are currently acquired through the fulfillment of faculty requests submitted to the liaison librarian and the automated purchase plan for both electronic and print format books. The CSU Libraries are committed to providing an outstanding collection of journals and books to support the teaching and research missions of Bioagricultural Sciences and Pest Management.

We anticipate continuing to purchase all such books as requested. The Libraries also subscribes to online access for specialized reference tools, such as the Invasive Species Compendium and the Crop Protection Compendium.

Databases

The Libraries maintains subscriptions and facilitates access to several hundred databases that support the teaching and research missions of the university. Key databases for Bioagricultural Sciences and Pest Management include Web of Science, CAB Abstracts, Agricola, Zoological Record, Biological Abstracts Archive, The Arabidopsis Information Resource (TAIR), and the ProQuest Agricultural & Environmental Science Collection. Database and electronic journal access outside the campus is provided through a library proxy server or the campus VPN client.

Journals

For over a decade, the Libraries has had a policy of purchasing journals in electronic format whenever possible, and library collections include over 30,000 electronic journals from major scholarly publishers, including Elsevier (Science Direct), Springer, Wiley, JSTOR, Informa, Ovid, Taylor and Francis, Oxford University Press, BioOne Complete, and Nature. Many of the journals from large publishers are purchased as packages, which allows the Libraries to offer content from a variety of disciplines at a discounted rate. The Libraries also purchases publications by professional societies, including the American Phytopathological Society, the Entomological Society of America,

the Royal Entomological Society of London, the Lepidopterists' Society, and the Weed Science Society of America. Materials that are not available online can be ordered through Interlibrary Loan or Document Delivery services.

Summary

The Libraries' current resources are sufficient to support the new undergraduate program in Bioagricultural Sciences and Pest Management.

XIII. Facilities, Equipment, and Technology

1. **What unique resources (in terms of buildings, laboratories, computer hardware/software, Internet or other online access, distributed-education capability, special equipment, and/or other materials) are necessary to offer a quality program?**

a. We will need to invest in virtual reality (VR) technology to offer this major.

We already have computational and network resources in place to offer the Agricultural Biology major. CAS manages three computer classrooms equipped with AV, computers, and software (Office, Matlab, SAS, Stata, JMP, etc.) supported with student technology fees. Computer systems are replaced on a 4-year cycle. Faculty and students currently use VR technology to learn about biochemistry by, for example, assembling and disassembling molecules to help understand how the molecules function in virtual learning spaces. We will need to add VR capability to study microbe, insect, and plant biology and to allow students to experience, virtually, agricultural ecosystems. Students in the major will utilize VR resources available at Morgan Library (https://lib.colostate.edu/technology/virtual-reality-room-request-form/), and we will add needed capacity in our department and college.

b. We will need to invest in sensor technology.

The 9-acre area south of the Horticulture Center will have dedicated outdoor wireless coverage for the college Internet of Things (IoT) teaching/research /demonstration area, giving our students a place to learn how to deploy and use inexpensive sensors in agriculture within walking distance from campus. We will need to purchase appropriate sensors for monitoring environmental factors important to insect, microbes, and plants for this area.

c. We will need to invest in communications technology.

We can instantly connect with experts at any one of seven experiment stations around the state via video to talk about agricultural problems with our students, but will need to have improved equipment for this in our classrooms. This will allow us to have guests join our classes on campus from across Colorado.

d. We will need to continue to invest in software for data analysis.

CAS technology is supported by dedicated IT staff that includes both academic and research IT support. The college research IT support works closely with the college bioinformatics consultant to support learning in advanced computational biology and with faculty to assist in VR technology and communications technology. The research IT support staff administers the college High Performance Computing system (HPC), purchased using both college and student technology fees. Staff can quickly install open source software on the HPC, modelling scientific community methodology, for student learning. Students and faculty receive CAS support for the campus Summit HPC for larger projects.

e. We will need to invest in new classroom space for lecture-based, discussion-based, and laboratory classes.

The college will break ground on the new agriculture building in January. The Shepardson building will be completely renovated, including an addition that will double its size and include collaborative learning areas, maker spaces for designing systems, and student success areas. The new building will be a place for learning, collaboration, and success and be home for our students. We will need this additional space in the Shepardson building as our major grows.

However, we will certainly need additional classroom and lab teaching space in the future. The five buildings in which our department is currently housed lack modern classroom facilities, and this will continue to make it difficult for us to offer cutting-edge courses in entomology, plant pathology, and weed science. We are also severely limited in office, meeting room, and storage space, which will make it difficult to house the staff and GTAs, and store the resources that our students will need. Because our department is split among five buildings and none of these buildings have a gathering or study location that undergrads in our major can use, we will have a difficult time building community among those in our major. Therefore, our goal is to work toward a building that can house our entire department and that will include modern classrooms and study areas for the students in our major.

2. **What resources for facilities, beyond those now in use, are necessary to offer this program? Be specific (e.g., include need for new space, renovated space) and address classrooms, instructional labs, office space, etc. How do you propose these additional resources will be provided/funded?**

   We can start to offer the program using the existing classroom, lab, and office space available in Plant Science and Shepardson, and will plan to expand into the newly renovated space in Shepardson when available, which should coincide with when the Agricultural Biology major is first offered. We will need teaching labs in which microscopy, specimen analysis, and other wet lab techniques can be taught. We will need a range of classroom sizes and additional office space for a student success advisor and GTAs. We currently lack space for student study areas, student gatherings, and other student events. The Shepardson remodel will provide some of these spaces in the near term. However, since our department is now spread across five buildings and this will be yet another building that we will need to work in, it will make it difficult for our department to build community and interact with students. Therefore, if our major is successful, we will seek out opportunities through donor and state funding for our department to be housed in a few number of buildings (ideally a single building) that includes the classrooms and student gathering areas that our undergrad will be using.

3. **What resources for equipment and technology, beyond those now available, are necessary to offer this program? How do you propose these additional resources will be provided/funded?**

   We can start to offer the program with the equipment and technology currently in place. We will maintain and update equipment and technology through applications to the CAS student technology fee board. Future program growth will likely require additional VR capacity.

XIV. Summary of Budget Needs

1. **Complete the New Program Planning Budget Form.**

   See New Program Planning Budget Form

2. **Prepare a narrative including the following new resources in the calculations:**

   a. **Faculty lines. Include FTEs and salary for each line**

      CSU has the lowest number of entomologists, nematologists, and plant pathologists among its peer institutions, and it is currently at 50% of the median number for each of these specialties. This limits the number and type of classes we can offer and also limits the number of undergrad research experiences and amount and type of career advising we can do. New faculty lines will be filled in 2022 (Nematology), 2023 (Plant Pathology-Mycology), 2024 (Entomology) to bring new and required expertise to CSU for this program. Each position will be 1 FTE. The salary for the first line filled is $90,000 and a 3% increase is built into the budget, each year, for the 2023 and 2024 positions. Fringe is budgeted at 30% of total salary.

   b. **Administrative support lines (e.g., academic support coordinator, program director). Include FTE and salary for each line.**

      We do not currently employ a student success coordinator. A coordinator will be hired in FY21 at 1 FTE and with a salary of $50,000. Fringe is budgeted at 30% of total salary. We currently manage one of the largest research arthropod museums in North America and the only one focused on insects of the Intermountain West. This museum is critical for teaching entomology courses. To ensure the sustainability of the museum, we will hire a museum curator in FY22 at 1 FTE with a salary of $60,000.

   c. **Graduate teaching assistantship lines. Include the FTE and stipend amount for each line.**

      Two GTA lines will be added in FY21, FY23, and FY25, primarily to assist with the 300-level laboratory courses that are part of this degree. The stipend is calculated at $1977/month for 12 months and each GTA position is 0.5 FTE. We used 12 months for the budget because we expect to increase enrollment in our summer course. The total amount is budgeted to increase each year at 3%.

   d. **Equipment needs**

      We budgeted a $10,000 increase in our base budget for equipment to support our laboratory courses (small equipment, field sensors) and for communications technology. An additional $100,000 is budgeted in FY22 and FY24 to support purchase of modern microscopes and virtual reality (VR) equipment for our laboratory courses.

   e. **Facility needs**

      Our classroom space has not been upgraded in several years. Some of our classes will move to the new Shepardson building, but classes will still also be taught in Plant Sciences and the Weed Science Laboratory buildings. $10,000 is added to the base budget in FY21 and FY23 to improve classroom space and technology in these two buildings.

f. Other expenses

We budgeted $150,000 per year for 3 years for each of the new faculty hires for startup costs. We also added $5,000 to our base budget to cover expenses of the student success coordinator and the museum curator. We also included a $2,000 increase in the library base budget because additional resources for VR, sensor technology, and bioinformatics will be required for our major.