



## UNDERGRADUATE CERTIFICATE – ADDITIONAL INFORMATION FORM

Note: Certificate programs offered at the University of Arizona, at the undergraduate or graduate level, are not approved as eligible programs for federal student financial aid. Although students enrolled in certificate programs are not eligible for any federal student aid programs, students may be eligible for private loans, outside scholarships, and University of Arizona department funding. For more information, please see [Federal Student Financial Aid Eligibility for Programs](#).

### I. General Information

- a. Proposed Title of Certificate: Undergraduate Certificate in Entomology and Insect Science
- b. CIP Code: 26.0702, Entomology
- c. Anticipated first admission term: Fall 2020

### II. Requested by [College, Department]

CALS, Department of Entomology

### III. Program Affiliation – specify whether the UA offers an affiliated undergraduate program – the affiliated program may or may not have the same name as the proposed certificate.

The Department of Entomology does not offer an affiliated undergraduate program.

### IV. Certificate Description

Insects make up most of multicellular life on earth, contribute to many human diseases and agricultural plagues, and provide superb model systems for studying all levels of biological organization. Insects can inform our understanding of how the planet responds to climate change and how we can increase sustainability and reduce our carbon footprint. The Department of Entomology is among the highest ranked among U.S. universities with a broad wealth of expertise in both basic and

applied fields. The 12-unit Undergraduate Certificate in Entomology and Insect Science offers a flexible course of study that the students can tailor to their own interests. Possible area of interest include (but are not limited to): insect pest management, public health and medical entomology, systematics, genomics, behavior, ecology, physiology and evolutionary biology.

- V. **Purpose.** This certificate will provide students with advanced education and skills in insect related fields to be competitive for graduate programs in disciplines, such as Environmental Sciences, Public Health, Epidemiology, Ecology, and Entomology and for employment in agricultural and biotech industries.
- VI. **Target Audience(s).** The target audience are undergraduates interested in continuing in a career associated with insects. This could be in Integrative Pest Management (IPM), public health such as with insect borne diseases, biotech, systematics, ecology or general agriculture. Students interested in these career paths will be more attractive to employers if they can demonstrate expertise and experience with insects. This certificate can be an introductory pathway at UA to a graduate degree in Entomology and Insect Science (EIS-GIDP).
- VII. **Certificate Requirements** - complete the table below to list the certificate requirements, including number of credit hours required and any special requirements for completion. Certificate requirements should include sufficient units to provide a substantive program and an appropriate level of academic rigor and in no case be less than 12 units of credit.

|  |      |
|--|------|
| <b>Minimum total units required</b><br><i>*minimum 12 units</i>  | 12   |
| <b>Minimum upper-division units required</b><br><i>*minimum 6 units of credit must be upper division UA coursework</i> | 6    |
| <b>Total transfer units that may apply to the certificate.</b>   | 6    |
| <b>List any special requirements to declare/admission to this certificate (completion of specific coursework,</b>      | None |

|  |   |
|--|---|
| <p>minimum GPA, interview, application, etc.)</p>  |   |
| <p><b>Certificate requirements. List all required certificate requirements including core and electives. Courses listed must include course prefix, number, units, and title. Mark new coursework (New). Include any limits/restrictions needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.</b></p> | <p>Required: ENTO 415R- Insect Biology<br/> Electives 9 additional units from list of approved courses below. No more than 4 units of ENTO 392, 492, 499, 499H</p> <p>ENTO 415R, 3, Insect Biology<br/> ENTO 300, 3, Insect Pest Management for Desert Cropping<br/> ENTO 401, 3, Ecological Physiology<br/> ENTO 407, 3, Insect Discovery<br/> ENTO 417, 4, Insect Systematics<br/> ENTO 432, 3, Comparative Immunology<br/> ENTO 436, 3, Agro Ecology<br/> ENTO 457, 3, Medical-Veterinary Entomology<br/> ENTO 403R, 3, Biology Animal Parasites<br/> ENTO 497C, 3, Greenhouse Pest Management<br/> ENTO 405, 4, Aquatic Entomology<br/> ENTO 468, 3, Integrated Pest Management<br/> ENTO 392, 1-3, Directed Research<br/> ENTO 492, 1-3, Directed Research<br/> ENTO 499, 1-3, Independent Study<br/> ENTO 499H, 1-3, Honors Independent Study</p> <p>Letters of support / emails for course not owned by Entomology are provided at the end of the certificate proposal</p> |

|  |      |
|--|------|
| Internship, practicum, applied course requirements (Yes/No). If yes, provide description.  | No   |
| Additional requirements (provide description)  | None |
| Any <a href="#">double-dipping restrictions</a> (Yes/No)? If yes, provide description.<br><br><i>*A maximum of 6 units may double-dip with a degree requirement (major, minor, General Education) or second certificate.</i> | No   |

**VIII. Current Courses**—using the table below, list all existing courses included in the proposed certificate. You can find information to complete the table using the [UA course catalog](#) or [UAnalytics](#) (Catalog and Schedule Dashboard> “Printable Course Descriptions by Department” On Demand Report; right side of screen). If the courses listed belong to a department that is not a signed party to this implementation request, upload the department head’s permission to include the courses in the proposed certificate and information regarding accessibility to and frequency of offerings for the course(s). Upload letters of support/emails from department heads to the “Letter(s) of Support” field on the UAccess workflow form. Add rows to the table, as needed.

| Course prefix and number (include cross-listings) | Units | Title | Course Description | Pre-requisites | Modes of delivery (online, in-person, hybrid) | Typically Offered (F, W, Sp, Su) | Dept signed party to proposal? (Yes/No) |
|---|-------|-------|--------------------|----------------|---|----------------------------------|---|
|---|-------|-------|--------------------|----------------|---|----------------------------------|---|

|           |   |  |   |                                  |           |   |     |
|-----------|---|--|---|----------------------------------|-----------|---|-----|
| ENTO 415R | 3 | Insect Biology                                     | Examination of how insects function morphologically, physiologically, and behaviorally. Investigation of relationships between members of Insecta and how they interact with other major taxa, both plant and animal. See <a href="http://ag.arizona.edu/classes/ento415/">http://ag.arizona.edu/classes/ento415/</a> for class information and list of lectures.   |                                  | In-person | F | Yes |
| ENTO 300  | 3 | Insect Pest Management for Desert Cropping Systems | The course will focus on the principles and practices of insect pest management in agricultural crops. IPM concepts and management tactics will be discussed in detail. Case studies of successful pest management programs unique to SW desert cropping systems will be examined.  |                                  | In-person | F | Yes |
| ENTO 401  | 3 | Ecological Physiology                              | During ontogeny, organisms constantly have to adjust their physiology in response to the environment they encounter. This course will provide an integrative understanding of life history evolution from the perspective of the constraints imposed by their underlying physiology. We will emphasize how physiological tradeoffs at the level of the whole organism ultimately define an organism's life history and fitness. The course will provide students with a conceptual approach to the integration of whole-organism physiology underlying life history traits. Relevant physiological, evolutionary and ecological background necessary to understand the concepts discussed will be given in lecture. Course will focus primarily on insects and will also use examples from other animals. | ECOL 302, ECOL 335 or equivalent | In-person | F | Yes |

|          |   |                        |   |                                     |           |      |     |
|----------|---|------------------------|---|-------------------------------------|-----------|------|-----|
| ENTO 407 | 3 | Insect Discovery       | Insect Discovery is a special course that combines an introduction to insect biology with practical experience in science outreach. Students will learn insect biology through lectures, labs and field trips, and communicate their knowledge to elementary school children by leading hands-on, inquiry-based science activities.   |                                     | In-person | F, S | Yes |
| ENTO417  | 4 | Insect Systematics     | Insect Systematics is a four unit lecture/lab course offered to undergraduate and graduate students with an interest in learning basic principles of systematics, insect structure, phylogeny and classification, and insect identification.  |                                     | In-person | F    | Yes |
| ENTO 432 | 3 | Comparative Immunology | How have vertebrate immune systems evolved from simple origins? We will cover comparative immunology of prokaryotes, protozoans, plants, fungi, invertebrates, and "lower" vertebrates. By studying the origins and evolution of immunity across the history of life, and following the progression of immune system complexity across different lineages, we begin to see patterns that help explain how our immune system developed from those of our ancestors. Such comparative study will highlight the strengths and weaknesses of our immune system, and point to ways in which other organisms have overcome the same pathogenic stresses we currently face. This class will pull together data from many fields, including immunology, molecular and cell biology, ecology, and evolution. | MCB 181R & 181L<br>ECOL 182R & 182L | In-person | F    | Yes |

|          |   |                               |  |  |           |   |     |
|----------|---|-------------------------------|--|--|-----------|---|-----|
| ENTO 436 | 3 | Agro-Ecology                  | <p>Agro-ecology is the application of ecological principles to the production of food and fiber. The underlying goals are to assess and promote the long-term sustainability of agricultural production systems. Through this course we will study how agro-ecosystems vary across time and space and will examine the trade-offs associated with different cropping systems and management practices. We will begin with a brief history of major trends in agriculture, then examine the ecological interactions involved in crop production, observe how these interactions shape agricultural practices and conclude with a discussion of domestic and international government policies that influence agricultural sustainability.</p> |  | In-person | S | Yes |
| ENTO 457 | 3 | Medical-Veterinary Entomology | <p>An overview of medically important arthropods and the diseases they transmit. Special attention will be paid to newly emerging and locally important vectors and diseases. Basic coursework in biology or entomology is required.</p>   |  | In-person | S | Yes |

|           |     |  |  |  |           |      |     |
|-----------|-----|--|--|--|-----------|------|-----|
| ENTO 403R | 3   | Biology of Animal Parasites                      | Biology of host-parasite relationships with emphasis on parasites of veterinary and human importance. Parasite morphology and physiology, life cycles, epidemiology, pathogenesis and zoonotic potential.  |  | In-person | S    | No  |
| ENTO 497C | 3   | Greenhouse Pest Management: Methods and Practice | Pest management skills development in the Controlled Environment Agriculture Center (CEAC) teaching/research greenhouses, with hands-on assignments, and group discussion covering pest management principles, methods, and current practice.  |  | In-person | S    | No  |
| ENTO 405  | 4   | Aquatic Entomology                               | Morphological, physiological and behavioral adaptations of insects to life in water; taxonomy and ecology of aquatic insects.  |  | In-person | S    | No  |
| ENTO 468  | 3   | Integrated Pest Management                       | Principles underlying the management of arthropods in agricultural systems.  |  | Online    | F    | Yes |
| ENTO 392  | 1-3 | Directed Research                                | This course will provide students with an opportunity for hands-on-experience on multidisciplinary research being conducted by faculty members in the department of Entomology. Joining a research lab will allow students to move beyond the traditional classroom environment into an atmosphere of discovery, collaboration and focus on projects with broad impacts to the modern world. Moreover, participation in directed research activities will contribute to the development of mentoring relationships with faculty and other members of research groups, stimulate familiarity with scientific literature and exposure to a variety of instrumentation or scientific techniques |  | In-person | F, S | Yes |



|           |     |                          |   |  |           |      |     |
|-----------|-----|--------------------------|---|--|-----------|------|-----|
|           |     |                          | while promoting awareness of safety practices.  |  |           |      |     |
| ENTO 492  | 1-3 | Directed Research        | This course will provide students with an opportunity for hands-on-experience on multidisciplinary research being conducted by faculty members in the department of Entomology. Joining a research lab will allow students to move beyond the traditional classroom environment into an atmosphere of discovery, collaboration and focus on projects with broad impacts to the modern world. Moreover, participation in directed research activities will contribute to the development of mentoring relationships with faculty and other members of research groups, stimulate familiarity with scientific literature and exposure to a variety of instrumentation or scientific techniques while promoting awareness of safety practices. |  | In-person | F, S | Yes |
| ENTO 499  | 1-3 | Independent Study        | Qualified students working on an individual basis with professors who have agreed to supervise such work.   |  | In-person | F, S | Yes |
| ENTO 499H | 1-3 | Honors Independent Study | Qualified students working on an individual basis with professors who have agreed to supervise such work.   | Student must be active in the Honors College | In-person | F, S | Yes |

*Note: Future changes to the curriculum originally approved for the certificate must be approved by the Undergraduate Council.*

**IX. New Courses Needed** – No new courses are needed for the proposed certificate

**X. Faculty & Resources**

- a. **Current Faculty** - complete the table below. If UA Vitae link is not provided/available, attach a short CV (2-3 pages) to the end of the proposal or upload to the workflow form. UA Vitae profiles can be found in the [UA directory/phonebook](#). Add rows as needed. Delete the EXAMPLE rows before submitting/uploading. **NOTE: full**

proposals are distributed campus-wide, posted on committee agendas and should be considered “publicly visible”.  
 Contact [Martin Marquez](#) if you have concerns about CV information being “publicly visible”.

| Faculty Member    | Involvement                              | UA Vitae link or “CV attached”  |
|-------------------|--|---|
| Michael Bogan     | ENTO 405                                 | <a href="https://sites.google.com/site/michaeltbogan/">https://sites.google.com/site/michaeltbogan/</a>                       |
| Yves Carriere     | ENTO 436, 392, 492, 499, 499H            | <a href="https://cals.arizona.edu/ento/content/yves-carriere">https://cals.arizona.edu/ento/content/yves-carriere</a>         |
| Margarethe Cooper | ENTO 403                                 | <a href="https://cooper.faculty.arizona.edu">https://cooper.faculty.arizona.edu</a>   |
| Goggy Davidowitz  | ENTO 401, 392, 492, 499, 499H            | <a href="https://goggy.faculty.arizona.edu">https://goggy.faculty.arizona.edu</a>   |
| Peter Ellsworth   | ENTO 392, 492, 499, 499H                 | <a href="https://cals.arizona.edu/ento/content/peter-c-ellsworth">https://cals.arizona.edu/ento/content/peter-c-ellsworth</a> |
| Alfred Fournier   | ENTO 392, 492, 499, 499H                 | <a href="https://cals.arizona.edu/ento/content/alfred-fournier-0">https://cals.arizona.edu/ento/content/alfred-fournier-0</a> |
| Dawn Gouge        | ENTO 392, 492, 499, 499H                 | <a href="https://cals.arizona.edu/ento/content/dawn-h-gouge">https://cals.arizona.edu/ento/content/dawn-h-gouge</a>           |
| Molly Hunter      | ENTO 392, 492, 499, 499H                 | <a href="http://www.hunterlaboratory.org">http://www.hunterlaboratory.org</a>   |
| Xianchun Li       | ENTO 468, 392, 492, 499, 499H            | <a href="https://cals.arizona.edu/ento/content/xianchun-li">https://cals.arizona.edu/ento/content/xianchun-li</a>             |
| Luciano Matzkin   | ENTO 392, 492, 499, 499H                 | <a href="https://matzkinlab.org">https://matzkinlab.org</a>   |
| Tristan McKnight  | ENTO 392, 492, 499, 499H                 | <a href="https://cals.arizona.edu/ento/content/tristan-mcknight">https://cals.arizona.edu/ento/content/tristan-mcknight</a>   |
| Wendy Moore       | ENTO 415R, 417, 392, 492, 499, 499H      | <a href="https://www.moorearthropods.com">https://www.moorearthropods.com</a>   |
| John Palumbo      | ENTO 300, 392, 492, 499, 499H            | <a href="https://cals.arizona.edu/ento/content/john-c-palumbo">https://cals.arizona.edu/ento/content/john-c-palumbo</a>       |
| Michael Riehle    | ENTO 457, 392, 492, 499, 499H            | <a href="https://riehlelab.arizona.edu">https://riehlelab.arizona.edu</a>   |
| Todd Schlenke     | ENTO 432, 392, 492, 499, 499H            | <a href="https://cals.arizona.edu/research/schlenke/">https://cals.arizona.edu/research/schlenke/</a>                         |
| Bruce Tabashnik   | ENTO 392, 492, 499, 499H                 | <a href="https://cals.arizona.edu/ento/content/bruce-e-tabashnik">https://cals.arizona.edu/ento/content/bruce-e-tabashnik</a> |
| Stacey Tollefson  | ENTO 497C                                | <a href="https://profiles.arizona.edu/person/stollefson">https://profiles.arizona.edu/person/stollefson</a>                   |
| Kathleen Walker   | ENTO 407, 415R, 436, 392, 492, 499, 499H | <a href="https://cals.arizona.edu/ento/content/kathleen-walker">https://cals.arizona.edu/ento/content/kathleen-walker</a>     |

- b. **Additional Faculty** – Describe the additional faculty needed during the next three years for the initiation of the program and list the anticipated schedule for addition of these faculty members.

No additional faculty are required for this certificate.

- c. **Library Acquisitions Needed** – Describe additional library acquisitions needed during the next three years for the successful initiation of the program.

No library acquisitions are needed for this certificate.

- d. **Physical Facilities & Equipment** - Assess the adequacy of existing physical facilities and equipment available for the proposed certificate. Include special classrooms, laboratories, physical equipment, computer facilities, etc. Describe additional physical facilities and equipment that will be required or are anticipated during the next three years for the proposed program.

No additional facilities or equipment are required for this certificate.

- e. **Other Support** - Describe other support currently available for the proposed certificate. Include support staff, university and non-university assistance. List additional staff and other assistance needed for the next three years.

No additional staff are required for this certificate. Currently available for support is Belinda Oden, Business Manager of the Department of Entomology who is UAccess certified for undergraduate course administration. Faculty also have administrative support of Office Specialist Senior, Jose Montante in the Entomology front office.

- f. **Marketing & Recruitment** - Provide a detailed and robust marketing strategy for this certificate.

Marketing will include CALS, entomology, and faculty websites and brochures. All faculty will introduce and describe the new certificate in their classes.

- g. **Financial** - Provide a copy of the budget for the certificate including start-up costs and the anticipated costs for the first three years. Include some indication of how this fits with the overall department budget.

No additional budget is required for this certificate. No startup costs are needed.

- XI. Student Learning Outcomes and Assessment** – describe what students should know, understand, and/or be able to do after completing this certificate, and how student outcomes will be assessed. Provide a detailed curricular map linking student outcomes to specific courses and class activities. Consider working with [Office of Instruction and Assessment](#) to create a curricular map using Taskstream.

The student should meet the following outcomes upon completion of the certificate:

1. Students will be able to differentiate the distinct roles insects play in human health, society and culture.
2. Students will be able to contrast and compare the diversity, life stages and ecology of major groups of insects.
3. Students will be able to extrapolate from insect model systems to ecosystems, agriculture and human health.

The Taskstream curricular map and specific assessment methods for each course are given below.

## Entomology Certificate Curriculum Map

Courses and Activities Mapped to Entomology Certificate

|  | Outcome   |   |  |
|--|---|---|--|
|  | Outcome 1<br>Students will be able to differentiate the distinct roles of insects in human health, society and culture. | Outcome 2<br>Students will be able to contrast and compare the diversity, life stages and ecology of major groups of insects. | Outcome 3<br>Students will be able to extrapolate from insect model systems to ecosystems, agriculture and human health. |
| Courses and Learning Activities                        |   |   |  |
| ENTO 160D1<br>How Insects Shaped Human History         | A   | A   | A  |
| ENTO 170C2<br>How Insects Conquered Earth              | A   | A   |  |
| ENTO 415R<br>Insect Biology                            | A   | A   | A  |
| ENTO 300<br>Insect Pest Management for Desert Cropping |   | A   | A  |
| ENTO 401<br>Ecological Physiology                      |   | A   | A  |

|   | Outcome   |   |  |
|---|---|---|--|
|   | Outcome 1<br>Students will be able to differentiate the distinct roles of insects in human health, society and culture. | Outcome 2<br>Students will be able to contrast and compare the diversity, life stages and ecology of major groups of insects. | Outcome 3<br>Students will be able to extrapolate from insect model systems to ecosystems, agriculture and human health. |
| ENTO 407<br>Insect Discovery              | A   | A   |  |
| ENTO 417<br>Insect Systematics            | A   | A   |  |
| ENTO 432<br>Comparative Immunology        |   |   | A  |
| ENTO 436<br>Agro Ecology                  | A   |   | A  |
| ENTO 457<br>Medical-Veterinary Entomology | A   |   | A  |
| ENTO 403R<br>Biology Animal Parasites     | A   |   | A  |
| ENTO 497C<br>Greenhouse Pest Management   |   | A   | A  |
| ENTO 405<br>Aquatic Entomology            |   | A   | A  |
| ENTO 468<br>Integrated Pest Management    | A   |   | A  |
| Research                                  |   |   |  |

| Outcome                           |   |   |  |
|-----------------------------------|---|---|--|
|                                   | Outcome 1<br>Students will be able to differentiate the distinct roles of insects in human health, society and culture. | Outcome 2<br>Students will be able to contrast and compare the diversity, life stages and ecology of major groups of insects. | Outcome 3<br>Students will be able to extrapolate from insect model systems to ecosystems, agriculture and human health. |
| Research<br>ENTO 392/399/499/499H | A   | A   | A  |

  

|                 |                     |                    |                   |                                 |                               |
|-----------------|---------------------|--------------------|-------------------|---------------------------------|-------------------------------|
| <b>Legend :</b> | <b>I</b> Introduced | <b>P</b> Practiced | <b>A</b> Assessed | <b>I/P</b> Introduced/Practices | <b>P/A</b> Practiced/Assessed |
|-----------------|---------------------|--------------------|-------------------|---------------------------------|-------------------------------|

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**XII. Certificate Outcomes and Assessment**– identify factors that indicate that completion of the certificate enhances the undergraduate experience. Describe measures for programmatic assessment, and provide a detailed plan for assessing certificate outcomes.

Specific assessment methods for each course are given in the table below. In general, the certificate assessment will entail successful completion of certificate requirements as outlined above.

| Course    | Course title                               | Lecturer      | Outcome 1   | Outcome 2   | Outcome 3  |
|-----------|--|---------------|---|---|--|
|           |  |               | Students will be able to differentiate the distinct roles of insects in human health, society and culture | Students will be able to contrast and compare the diversity, life stages and ecology of major groups of insects | Students will be able to extrapolate from insect model systems to ecosystems, agriculture and human health |
| ENTO 415R | Insect Biology                             | Walker, Moore | in-class and homework essays, quizzes, exams, mini-labs with written or oral reports                      | insect collection, quizzes, mini-labs   | in-class and Homework essays, quizzes, exams, Mini-labs  |
| ENTO 300  | Insect Pest Management for Desert Cropping | Palumbo       |   | exams, quizzes, assignments   | exams, quizzes, assignments  |
| ENTO 401  | Ecological Physiology                      | Davidowitz    |   | review paper, discussion summaries, exams, assignments, quizzes   | review paper, discussion summaries, exams, assignments, quizzes  |



|           |                               |                  |   |  |   |
|-----------|-------------------------------|------------------|---|--|---|
| ENTO 407  | Insect Discovery              | Walker           | teaching observations, quizzes, final outreach design project                         | teaching observations, quizzes, research paper             |   |
| ENTO417   | Insect Systematics            | Moore            | in-class and homework essays, quizzes, exams, mini- labs with written or oral reports | insect collection, quizzes, labs                           |   |
| ENTO 432  | Comparative Immunology        | Schlenke         |   |  | primary literature summaries, presentations, exams                    |
| ENTO 436  | Agro Ecology                  | Carriere, Walker | review paper, class discussion summaries, exams, assignments, quizzes                 |  | review paper, class discussion summaries, exams, assignments, quizzes |
| ENTO 457  | Medical-Veterinary Entomology | Riehle           | exams, discussions, critical reading assignments                                      |  | exams, discussions, critical reading assignments                      |
| ENTO 403R | Biology Animal Parasites      | Cooper           | participation quizzes, discussion, reading quizzes, exams                             |  | participation quizzes, discussion, reading quizzes, exams             |
| ENTO 497C | Greenhouse Pest Management    | Tollefson        |   | lecture, readings, assignments, observation in greenhouse, | lecture, readings, assignments, observation in greenhouse,            |

|           |                            |       |                             |  |   |
|-----------|----------------------------|-------|-----------------------------|--|---|
|           |                            |       |                             | exams  | exams   |
| ENTO 405  | Aquatic Entomology         | Bogan |                             | aquatic insect collection, class discussions, group activities in class, class research project on aquatic insect dispersal, in-class quizzes, readings of primary research papers | class discussions, group activities in class, class research project on aquatic insect dispersal, in-class quizzes, readings of primary research papers |
| ENTO 468  | Integrated Pest Management | Li    | exams, quizzes, assignments |  | exams, quizzes, assignments   |
| ENTO 392  | Directed Research          | All   | individual project          | individual project   | individual project  |
| ENTO 492  | Directed Research          | All   | individual project          | individual project   | individual project  |
| ENTO 499  | Independent Study          | All   | individual project          | individual project   | individual project  |
| ENTO 499H | Honors Independent Study   | All   | individual project          | individual project   | individual project  |

Note: Directed and Independent Research (ENTO 392, 492, 499, 499H) have the potential to meet all three outcomes depending on the specifics of each individual student's project.

**XIII. Certificate Demand** – *is there sufficient student demand for the certificate?*

- a. What is the anticipated student enrollment for this certificate by the third year the certificate is offered? Please provide measurable indicators of student interest in the certificate (survey results of current students or alumni) and with reference to similar programs elsewhere. Provide market analysis or other tangible evidence to support projected enrollment numbers.

We anticipate an enrollment of 30 students by the third year. We surveyed students from various courses currently being taught and found that of 191 students (see table below), about 56% (89 students) indicated an interest in registering for the entomology certificate. To be conservative, we estimated that of those, about 1/3 will actually register. The US Department of Labor Statistics projects a 5%-14% percent growth in this field through 2026, depending on subdiscipline. As climate change affects epidemiology, pest management, and pollination susceptibility, there will be a growing need for occupations with a working knowledge of insects.

| Course surveyed  | Number of students surveyed | Potential participants<br>(Possibly + yes) |
|--|-----------------------------|--|
| 160D1 How Insects Shaped Human History<br>spring semester    | 54                          | 39 (72%)                                   |
| ENTO 160D1 How Insects Shaped Human History<br>fall semester | 77                          | 27 (35%)                                   |
| informally polled undergrads                                 | 4                           | 4 (100%)                                   |
| Medical Entomology ENTO 457                                  | 22                          | 12 (55%)                                   |

|                                       |     |                                      |
|---------------------------------------|-----|--------------------------------------|
| How Insects Conquered Earth ENTO 170C | 34  | 7 (21%)                              |
| Totals                                | 191 | 89 (56.6%)*<br>* average of group %s |

- b. What community needs, preparation for professional certification exams, degree program recruitment, or employability enhancements will this certificate provide? Please provide evidence of feedback from potential employers regarding the value of the proposed program.

There is strong support among stakeholders for the undergraduate certificate in entomology. **For example, Ron Ketner, the owner of Convectex, LLC (bed bug eradication systems) says this:**

*"I absolutely feel that a certification such as the one you are proposing would go a long way in our hiring decisions. Any person who takes the initiative to gain knowledge outside of what the industry directly offers (company training and CEU presentations) would have a serious advantage in terms of selectability. I wish a program like this was available when I was in school!"*

**From John Townsend, Maricopa County Environmental Services, Vector Control Division Manager**

*"Yes, especially in the vector control aspect of environmental services, any program that prepares potential new hires with the knowledge of the ecology and biology of the pest they are dealing with would be beneficial. Many potential new hires come in with pest control experience and not vector control experience."*

- c. Will there be any collaboration with other departments or universities to maximize resources? If there is collaboration, please include a memo of support from the applicable parties.

Collaboration with other departments is restricted to cross-listed courses. These are addressed in section VIII, above.

#### **XIV. Contacts and Administration**

- a. List the name and contact information for the primary point of contact for the certificate.

Professor Goggy Davidowitz will be the primary point of contact for the certificate.

Email [goggy@email.arizona.edu](mailto:goggy@email.arizona.edu), office phone 520-626-8455, office- Marley 741J

- b. List the name and contact information for the person or persons who will serve in the role of Director of Undergraduate Studies (DUS) for the certificate. (This is not always the same as the DUS for affiliated programs or head of the managing academic unit.)

Professor Goggy Davidowitz will be the DUS for the certificate.

Email [goggy@email.arizona.edu](mailto:goggy@email.arizona.edu), office phone 520-626-8455, office- Marley 741J

## Supplemental Documents

From: Stock, S. Patricia - (spstock) spstock@email.arizona.edu  
Subject: ACBS 403R  
Date: February 5, 2020 at 10:42 AM  
To: Davidowitz, Goggy - (goggy) goggy@email.arizona.edu

PS

Dear Goggy: with this email I approve the inclusion of Biology of Animal Parasites (ACBS 403R) cross-listed as ENTO 403R for the curriculum of the Entomology Certificate Program. Please let me know if you need further information.

Cheers,

Patricia

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**Dr. S. Patricia Stock**  
Director and Professor, School of Animal and Comparative Biomedical Sciences  
Carl Weiler Endowed Chair for Excellence in Agriculture and Life Sciences  
The University of Arizona  
1117 E. Lowell St. P.O. Box 210090 Tucson, AZ 85721  
Office: +1-520-621-0868 Fax:+1- 520-626-5602  
e-mail: [spstock@email.arizona.edu](mailto:spstock@email.arizona.edu)  
URL: <https://acbs.cals.arizona.edu/people/s-patricia-stock>

**Additional Appointments:**  
Professor, Department of Entomology  
Professor, Honors College

**Lab address: Marley Bldg. Room 718/720/724**  
1145 E. 4th Street, Tucson AZ 85721  
**Lab Phone (+1-520) 621-1317**

From: Cooper, Margarethe A - (cooperma) cooperma@email.arizona.edu  
Subject: Re: ACBS course in entomology certificate

Date: February 5, 2020 at 10:14 AM

To: Davidowitz, Goggy - (goggy) goggy@email.arizona.edu, Stock, S. Patricia - (spstock) spstock@email.arizona.edu  
Cc: Trujillo, Dari - (kdrujil) kdrujil@email.arizona.edu

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Hi Goggy,

This is great news about the Entomology certificate! I just checked in UAaces, and can confirm that Biology of Animal Parasites has an active cross-listing (ENTO 403R, I currently have one student enrolled in that cross-listing right now).

I teach this course in Spring semesters only at this time.

All the best,  
Margarethe

Margarethe A. Cooper, Ph.D.  
*Assistant Professor of Practice*  
*Vietor P. Smith Endowed Chair in Food Safety Education*

[mer.faculty.arizona.edu](http://mer.faculty.arizona.edu)

THE UNIVERSITY OF ARIZONA  
COLLEGE OF AGRICULTURE & LIFESCIENCES  
**Animal & Comparative  
Biomedical Sciences**  
Food Safety



School of Natural Resources and the Environment  
College of Agriculture and Life Sciences  
Office of the Director

N333 ENR2  
P.O. Box 210043  
Tucson, AZ 85719  
Telephone: (520) 626-5895  
Fax: (520) 621-8801  
<http://snre.arizona.edu>

13 February 2020

Dr. Goggy Davidowitz  
Professor and University Distinguished Scholar  
Department of Entomology  
University of Arizona  
Tucson, AZ 85721

Dear Dr. Davidowitz:

I am pleased to write in support of the Entomology Certificate and the inclusion of ENTO 405 – Aquatic Entomology, taught by SNRE Assistant Professor Michael Bogan, with the proposed roster of courses.

Please do not hesitate to contact me if you have further questions.

Sincerely,

A handwritten signature in black ink that reads 'John L. Koprowski'.

John L. Koprowski, Professor and Director  
Phone: (520) 626-5895  
Email: [squirrel@ag.arizona.edu](mailto:squirrel@ag.arizona.edu)  
Web: [www.ag.arizona.edu/research/redsquirrel](http://www.ag.arizona.edu/research/redsquirrel)





From: Bogan, Michael - (mbogan) mbogan@email.arizona.edu  
Subject: Re: Aquatic ecology  
Date: February 7, 2020 at 10:34 AM  
To: Davidowitz, Goggy - (goggy) goggy@email.arizona.edu  
Cc: Koprowski, John L - (5quirre1) 5quirre1@ag.arizona.edu, Hughes, Katie Marie - (khughes) khughes@email.arizona.edu,  
**Scott, Shannon Mary - (sms8) sms8@email.arizona.edu**

Hi Goggy,

Thanks very much for keeping Aquatic Entomology in mind! It is still being offered, and is in progress this semester. Last year, we switched it to an every-other-year class, so now it is held during spring semesters in even years. It may be listed as WFSC 405 in the courselist on the web site, or the course list could be out-of-date. We're working on redoing the website this year.

I'm cc'ing my department chair and our academic advisors here-- I'd love to have Aquatic Ent listed on the undergrad certificate in entomology, so just let us know what we need to do to make that happen.

Thanks!  
Michael

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Michael T. Bogan  
Assistant professor  
SNRE, University of Arizona  
1064 East Lowell Street, Tucson, AZ 85721  
[https://www.google.com/search?q=michael+bo+snre&rlz=C3111C101\\_551111C1\\_1000000000\\_1512700000\\_0](https://www.google.com/search?q=michael+bo+snre&rlz=C3111C101_551111C1_1000000000_1512700000_0)  
<https://twitter.com/LmtboBfi>

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From: Farrell-Poe, Kathryn L - (kittfp) kittfp@email.arizona.edu  
Subject: RE: BE course in undergraduate certificate in entomology  
Date: February 13, 2020 at 4:45 PM  
To: Davidowitz, Goggy - (goggy) goggy@email.arizona.edu, Tollefson Stacy Joy - (stollefson) stollefson@email.arizona.edu

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Dear Goggy,

Yes, the Biosystems Engineering department approves of using ENTO/BE 497C as a course in the proposed Undergraduate Certificate in Entomology .

Cheers,

Kitt

From: Tollefson , Stacy Joy - (stollefson) stollefson@email.arizona.edu  
Subject: Re: BE course in undergraduate certificate in entomology  
Date: February 13, 2020 at 7:10 PM  
To: Farrell-Poe, Kathryn L - (kittfp) kittfp@email.arizona .edu, Davidowitz,Goggy - (goggy) goggy@email.arizon a.edu

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Sou nds good to me. Thanks to Kitt for the blessing. And yes the course is only offered in Spring semesters.  
Stacy

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