Engaging diverse teams of students in research via Course-Based Undergraduate Research Experiences (CUREs)

Interface 2021: Better Together

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The Value of Undergraduate Research

Engaging in a **guided research experience** can provide undergraduate students with a wealth of benefits in terms of their **learning**, **professional development**, and **personal development**.[1-5] These gains have been demonstrated by numerous studies and apply to students in a wide variety of disciplines (both STEM and non-STEM). Among the many positive student outcomes of undergraduate research are:

- Increased **content knowledge** in their field
- Development of **technical skills**
- Enhanced **critical thinking** abilities
- A greater **interest** in science & the discipline
- Increased **clarity** regarding future **careers**
- Increased **self-confidence**

For these reasons (and others), many educators consider undergraduate research to be a **high-impact educational practice**.[6] And students who participate in undergraduate research consistently report that it is one of the most valuable experiences they gained during their entire time at the university.

Undergraduate research can be highly valuable to faculty as well. Contributions from undergraduate researchers can further the research programs of their faculty supervisors, and many faculty find personal fulfilment in mentoring the next generation of researchers.[7-9]

Limitations of Traditional Research Assistantships

The most common way that undergraduates engage in research is through a 1-on-1 assistantship with a faculty, postdoc, or graduate student supervisor. These individual research experiences can be highly beneficial to both students and their mentors. However, a major limitation of this approach is that most research groups can only support **a small number of students** due to constraints in time, space, and funding.

There are also many **barriers** that can prevent students who want research experience from seeking out a program like this;[10-13] these include:

- **Financial limitations**: Many research positions for undergrads are unpaid. Not all students can afford to do an unpaid apprenticeship, especially if they are paying their own way through college
- **Time constraints**: Many students find it difficult to balance an extracurricular research experience with their coursework and other obligations (e.g., jobs, family, etc.)
- **Lack of confidence**: Some students may feel underprepared for research, or may be intimidated by contacting potential supervisors for a 1-on-1 meeting
- **Other social and cultural barriers**
- **Lack of exposure** to information about available research opportunities

Research suggests that many these obstacles disproportionately affect students from **underrepresented groups**, such as first-generation students, minority students, non-traditional students, and students from low socio-economic backgrounds.[10,13,14]

Thus, if we want to increase diversity and inclusion in undergraduate research and maximize the number of students who can benefit from these experiences, we must directly address these challenges and expand how we think about undergraduate research.

CURE: An Alternative Model for Undergrad Research

Course-based **U**ndergraduate **R**esearch **E**xperiences (or **CUREs**) address many of the above limitations by incorporating meaningful research experiences into the undergraduate curriculum. Effectively, CUREs combine the best elements of traditional coursework and independent research assistantships to **"bridge the gap" between the classroom and the research laboratory**.

CURE courses can be developed in any discipline in which students conduct research and can contribute new knowledge. There is no one "template" for a CURE course; they can take many different forms. However, there are five elements that all well-designed CUREs share:[15]

- Students **actively participate in a research project**, gaining hands-on experience in study design, applying research methods, and other aspects of conducting research.

- The research is **novel**– ideally, students generate publishable data and contribute new knowledge to their field.

- The research is **relevant/important** outside of the classroom; it addresses questions that are of interest to the broader academic community and stakeholders.

- The work is **collaborative**– students engage in discussions about research and work in a team to conduct the project.

- The research is **iterative**– students repeat their experiments, troubleshoot, and revise their work as the research progresses.

At the core of every CURE is the collaborative research project itself, which will be highly specific to the field and the PI's research goals. Typically, the research project will encompass ~60-75% of the course. CUREs should also place the research project in a **broader context**, by encouraging students to think about topics such as research ethics, objectivity & bias, the role of research in our society, and other important issues. Ideally, CUREs should also expose student to **opportunities for future research**, at the university and beyond. Finally, most CUREs help guide students in how to **effectively communicate** their research to a variety of audiences. These goals are often achieved via discussions and other active learning exercises in a flipped classroom setting.

In these ways, CUREs differ from traditional lab classes and inquiry-based courses and aim to provide students with a more meaningful and authentic research experience.

Benefits of CUREs for Students and Faculty

Evidence suggests that CUREs can provide students with many of the same benefits as traditional 1-on-1 research experiences.[10,16-20] Our data on CURE courses at UF, in conjunction with studies from other institutions, have shown that CUREs help students gain:

- Increased **interest** in the field
- A higher **likelihood to pursue research as a career**
- A better **understanding of the research process** as a whole
- **Transferrable research skills** that enhance employability after graduation
- Increased knowledge of **core concepts** in the discipline as well as **specific topics** relating to their project
- Enhanced **critical thinking, reading, and communication skills**
- Increased **self-confidence**

In addition, multiple studies have shown that CUREs are <u>especially effective</u> at reaching and retaining students from **underrepresented populations**, and that the benefits mentioned above are especially high for these students.[10]

CUREs also circumvent many of the limitations and barriers of traditional 1-on-1 research experiences:

- They can **accommodate more students**–up to several dozen students per CURE vs. 1-3 per research lab.

- Since CUREs are part of a student's coursework, they are **covered by students' tuition** and **do not interfere with obligations outside of the classroom** (like jobs or family care)

- They provide a **supportive collaborative environment** for students to explore research for the first time; many students are more likely to enroll in a course than they are to contact a potential faculty mentor.

Teaching CURE courses can also provide numerous benefits to faculty:[8,9]

- Data from CUREs can be used in **publications and grant proposals**, thus furthering one's research programs–you can think of CURE students as your "expanded lab group!"

- CUREs provide access to talented and experienced students that can be **recruited i**nto your lab group after the course is over

- CUREs are a meaningful way to **bridge research and teaching goals** and enhance one's impact as a mentor.

Challenges of Teaching CUREs

Although CUREs can be immensely beneficially to both students and faculty– a true "win-win" situation for all involved– there are also several **challenges** associated with developing and teaching CURE courses. These can include:

- Developing CUREs requires a **large amount of time and work upfront**– faculty need to both design a course *and* plan out a research project.

- The **role of the instructor is expanded**– faculty leading CUREs act as both teachers and research mentors, which is also time-consuming.

- Depending on the nature of the research, there may be **financial constraints**– the cost of supplies may be substantial.

- Choosing a research project requires a lot of consideration– it must be **feasible** within the confines of a semester-long course and also **scalable** to the number of students enrolled.
- Many students in CUREs are early in their college career and have no prior experience in research, which means that they will **require extra guidance**.
- **Students may lose motivation** during the research process, especially when data collection becomes repetitive and tedious.
- One must have a way to ensure that student-collected data is **accurate and useable**.
- Research is **inherently uncertain**, and there is no guarantee that the project will work and yield publishable results.

Importantly, *none of these challenges are insurmountable*, and should not deter you if you are interested in developing a CURE of your own! We are extremely fortunate that there is a great amount of institutional support for CUREs here at the University of Florida, especially through the **Center for Undergraduate Research (CUR)**. A full list of resources for CURE faculty is provided at the end of this handout.

Case Study: ENY 2890 (Insect Research CURE at UF)

ENY 2890 (Insect Research & Scientific Engagement) is a CURE course offered through the Entomology & Nematology department here at UF, which can serve as a useful model for faculty who want to develop CUREs in other units.

The key to ENY 2890's success is that it is a **joint effort** between teaching faculty and research faculty. Dr. Anthony Auletta is a lecturer who has designed a framework for the course and who serves as the course coordinator. He partners with a different member of the research faculty in Entomology & Nematology each time the course is offered; this person serves as the principal investigator (PI) of the research project and lends their expertise and other resources to the course. This model allows us to divide the work of offering a CURE between two people, each of whom plays to their greatest strengths. In Fall 2020, Dr. Peter DiGennaro was the PI for the course and helped guide students in a project to sequence novel nematode genomes.

Again, there are many ways to teach a CURE, and ENY 2890 is just one of several viable approaches. In this workshop, we will share some of the teaching techniques that we use in this course, as well as strategies for overcoming some of the challenges described above. On the next page there is space for you to take notes. The syllabus for the Fall 2020 offering of ENY 2890 is also included in this packet.

Acknowledgments

ENY 2890 was originally conceived by two faculty in Entomology & Nematology– Drs. Christine Miller and Adam Dale– with substantial contributions from postdoctoral researchers Dr. Ginny Greenway and Dr. Pablo Allen, as well as a large team of talented graduate and undergraduate TAs. In addition to Dr. Auletta, Dr. Cameron Jack also teaches a section of ENY 2890, in partnership with Dr. Jamie Ellis and other researchers at the UF Honeybee Research & Extension Lab. Staff at the UF Center for Undergraduate Research (especially Center Director Dr. Anne Donnelly) provided excellent support and assistance as well.

My Notes

Activity: Let's Develop a CURE!

Below are a few guiding question/reflective prompts that can help you start generating ideas for your future CURE course! Jot down some ideas during today's workshop… the goal is to get some preliminary thoughts on paper right now.

1. What are your goals for yourself as a faculty member for this CURE? In other words, what do *you* hope to gain from the experience?

2. What goals do you have for the students in your CURE course? What do you want *them* to gain from the experience? These ideas will serve as seeds for concrete, measurable student learning outcomes.

3. Let's think about research goals! What are some active projects in your research program that students in a CURE could contribute to? List some the specific research questions that you could address in your CURE. If you're having trouble thinking of a good question, some options that are great fits for CURE courses include comparative studies or projects that require collecting/analyzing large volumes of data.

4. How would you make the research amenable to a CURE course? Is it feasible for students to meaningfully contribute to the project within a single semester? Is the project scalable to include the number of students you would anticipate having in the course? If not, how might you adjust the project to make it more amenable?

5. Which parts of the research process will students actively participate in? Will they be involved in formulating the question and hypotheses? Or will you provide those and have students jump right into data collection? Or perhaps students will analyze data that has already been collected?

6. Who will be involved in the course? Think about co-instructors, collaborators, prep staff, TAs, and peer mentors. What are the specific roles/duties of each person?

7. Who is your target audience for the course– are you looking to reach a particular group of students? How many students do you envision having in the course?

8. What do you envision as the end-product/main deliverable of the course? Will students make a poster, write a report, give an oral presentation? Or something else? Let the goals you outlined above help inform what you ask the students to do.

9. Which teaching strategies will you use to help students reach the learning outcomes you have identified? If you need some ideas, check out the UF Center for Teaching Excellence Resource Library: https://teach.ufl.edu/resource-library/

10. How many hours per week should students expect to work on the project, including time outside of class? It is important to set clear expectations upfront! [Note: 1 credit of coursework typically = 3 hours of work]

11. What materials are needed? Which ones do you already have access to, and which would you need to procure?

12. How will you fund your project (if applicable)? Will you seek external funding? If so, from where? Course fees are an option, but note that if the course fees are too high, students may not enroll.

13. What is the timeline you envision for your CURE? When would you teach it? If you need to apply for funding, when would you submit the proposal?

14. What background information will students need to successfully work on the research project? How will you help them build this background? Think about readings and other resources you could use, keeping in mind that students may need coaching on how to critically read academic literature.

15. How will you ensure that the data collected by students is accurate and useable?

16. Will you make use of guest speakers and/or experiences outside of the classroom? If so, who/what do you envision? Give yourself plenty of time to coordinate with the appropriate parties!

17. How will you handle publications that arise from your CURE? How will you decide what merits authorship vs. a mention in the acknowledgements?

18. How will you assess your CURE? Will you rely solely on standard course evaluations? Or do you intend to use additional assessment tools to collect data on your students' perceptions and experiences? If so, be sure to apply for IRB approval!

19. How and when will you advertise the course?

Additional Resources for CURE Faculty

So, you're excited to design your own CURE now, right? Fantastic! You're not in this alone–there are many great resources available at UF and beyond to help you get started. Please feel free to reach out to us if you'd like to know more about our CURE (ENY 2890) or if you want to bounce some ideas around! In addition, the following resources are all excellent:

- **The UF Center for Undergraduate Research (CUR)** provides a wealth of resources and guidance for undergraduate researchers and the faculty who mentor them. CUR has helped faculty across multiple departments and colleges at UF design CURE courses of their own:

    https://cur.aa.ufl.edu/
    https://cur.aa.ufl.edu/cure/

- **CURENet** promotes networking among faculty who are developing, teaching, and assessing CUREs across the nation. Their website contains many great resources both for newcomers to CUREs and seasoned CURE instructors:

    https://serc.carleton.edu/curenet/index.html
    https://serc.carleton.edu/curenet/collection.html (this is an extensive list of different CUREs that you can use for inspiration as you design your own!)

- **The CURE Survey** developed by Dr. David Lopatto and colleagues is a great tool that you can use to assess student gains from your CURE course:

    https://www.grinnell.edu/academics/resources/ctla/assessment/cure-survey

References

1. Carter D, Ro H, Alcott B, Lattuca L. 2016. Co-curricular connections: the role of undergraduate research experiences in promoting engineering students' communication, teamwork, and leadership skills. Research in Higher Education 57: 363–393. https://psycnet.apa.org/doi/10.1007/s11162-015-9386-7

2. Hernandez PR, Woodcock A, Estrada M, Schultz P. Undergraduate research experiences broaden diversity in the scientific workforce. BioScience 68: 204-211. https://doi.org/10.1093/biosci/bix163

3. Hunter AB, Laursen SL, Seymour E. 2006. Becoming a scientist: the role of undergraduate research in students' cognitive, personal, and professional development. Science Education 91: 36-74. https://doi.org/10.1002/sce.20173

4. Lopatto D. 2007. Undergraduate research experiences support science career decisions and active learning. CBE Life Sciences Education 6: 251-360. https://doi.org/10.1187/cbe.07-06-0039

5. Seymour E, Hunter A, Laursen S, DeAntoni T. 2004. Establishing the benefits of research experiences for undergraduates in the sciences: first findings from a 3-year study. Science Education 88: 493–534. https://doi.org/10.1002/sce.10131

6. Miller RL, Rycek R, Fritson K. 2011. The effects of high impact learning experiences on student engagement. Procedia Social and Behavioral Sciences 15: 53-59. https://doi.org/10.1016/j.sbspro.2011.03.050

7. Morales DX, Grineski SE, Collins TW. 2017. Increasing research productivity in undergraduate research experiences: exploring predictors of collaborative faculty–student publication. CBE Life Sciences Education 16: ar42. shttps://doi.org/10.1187/cbe.16-11-0326

8. Shortlidge EE, Bangera G, Brownell SE. 2016. Faculty perspectives on developing and teaching course-based undergraduate research experiences. BioScience 66: 54-62. https://doi.org/10.1093/biosci/biv167

9. Shortlidge EE, Bangera G, Brownell SE. 2017. Each to their own CURE: faculty who teach course-based undergraduate research experiences report why you too should teach a CURE. Journal of Microbiology & Biology Education 18: 2.29. https://dx.doi.org/10.1128%2Fjmbe.v18i2.1260

10. Bangera G, Brownell SW. 2014. Course-based undergraduate research experiences can make scientific research more inclusive. CBE Life Sciences Education 13: 602-606. https://doi.org/10.1187/cbe.14-06-0099

11. Mahatmya D, Morrison J, Jones RM, Garner PW, Davis SN, Manske J, Berner N, Johnson A, Ditty J. 2017. Pathways to undergraduate research experiences: a multi-institutional study. Innovative Higher Education 42: 491–504. https://doi.org/10.1007/s10755-017-9401-3

12. Wayment HA, Dickson KL. 2008. Increasing student participation in undergraduate research benefits students, faculty, and department. Teaching of Psychology 35: 194–197. https://doi.org/10.1080/00986280802189213

13. Webber KL, Laird TFN, BrckaLorenz AM. 2013. Student and faculty member engagement in undergraduate research. Research in Higher Education 54: 227–249. https://doi.org/10.1007/s11162-012-9280-5

14. Hurtado S, Cabrera NL, Lin MH, Arellano L, Espinosa LL. 2009. Diversifying science: underrepresented student experiences in structured research programs. Research in Higher Education 50: 189–214. https://doi.org/10.1007/s11162-008-9114-7

15. Auchincloss LC, Laursen SL, Branchae JL, Eagan K, Graham M, Hanauer DI, Lawrie G, McLinn CM, Pelaez N, Rowland S, Towns M, Trautmann NM, Varma-Nelson P, Weston TJ, Dolan EL. 2014. Assessment of course-based undergraduate research experiences: a meeting report. CBE Life Sciences Education 13: 29-40. https://doi.org/10.1187/cbe.14-01-0004

16. Brownell SE, Hekmat-Scafe DS, Singla V, Seawell PC, Imam JFC, Eddy SL, Stearns T, Cyert MS. 2015. A high-enrollment course-based undergraduate research experience improves student conceptions of scientific thinking and ability to interpret data. CBE Life Sciences Education 14: ar11. https://dx.doi.org/10.1187%2Fcbe.14-05-0092

17. Harrison M, Dunbar D, Ratmansky L, Boyd K, Lopatto D. 2011. Classroom-based science research at the introductory level: changes in career choices and attitude. CBE Life Sciences Education 10: 279-286. https://dx.doi.org/10.1187%2Fcbe.10-12-0151

18. Jordan TC, Burnett SH, Carson S, Caruso SM, Clase K, DeJong RJ, Dennehy JJ, Denver DR, Dunbar D, Elgin SCR, Findley AM, Gissendanner CR, Golebiewska UP, Guild N, Hartzog GA, Grillo WH, Hollowell GP, Hughes LE, Johnson A, King RA, Lewis LO, Li W, Rosenzweig F, Rubin MR, Saha MS, Sandoz J, Shaffer CD, Taylor B, Temple L, Vasquez E, Ware VC, Barker LP, Bradley KW, Jacobs-Sera D, Pope WH, Russell DA, Cresawn SG, Lopatto D, Bailey CP, Hatfull GF. 2014. A broadly implementable research course in phage discovery and genomics for first-year undergraduate students. mBio 5: e01051-13. https://doi.org/10.1128/mBio.01051-13

19. Rodenbusch S , Hernandez PR, Simmons SL, Dolan EL. 2016. Early engagement in course-based research increases graduation rates and completion of science, engineering, and mathematics degrees. CBE Life Sciences Education 15: 1–10. https://doi.org/10.1187/cbe.16-03-0117

20. Ward JR, Clarke HD, Horton JL. 2014. Effects of a research-infused botanical curriculum on undergraduates' content knowledge, STEM competencies, and attitudes toward plant sciences. CBE Life Sciences Education 13: 387-396 https://doi.org/10.1187/cbe.13-12-0231

Sample Course Activity: "Science Across Borders"

Below are the guidelines for one of the capstone assignments in ENY 2890– the **"Science Across Borders" essay**. This assignment is conducted independently of the semester-long research project and is designed to help students think meaningfully about how to form global research collaborations. The assignment helps place the students' own research in a broader context and also provides them with a host of valuable skills that will help them in their future endeavors (regardless of whether or not they continue to pursue research as a career). Students consistently report that this assignment is one of the most valuable parts of the course for them (alongside the research project itself). The assignment also fosters student collaboration, as the interview aspect of the assignment is a group project.

This assignment was developed during the Global Learning Institute, a cohort-based faculty development program offered by the UF International Center. We would like to thank Paloma Rodriguez and the other wonderful staff at UFIC for their assistance!

Assignment Goals

Throughout the semester, we have discussed the many benefits of **international research collaborations** as well as some of the very real barriers that one may encounter when working internationally. The goal of this assignment is for you to *synthesize* the information from those discussions (and other sources) and use that information to *reflect* on these important questions:

- What is the **value** of conducting science across international borders (i.e., what are some of the **benefits** gained from global collaboration)?

- What are some of the **challenges** that researchers may face when working across international borders?

- How might we **address and mitigate** those challenges (and perhaps turn them into **opportunities** instead)?

This assignment has two main components, which are described below:

Part 1: Interview with an International Researcher

To help you develop your ideas for this assignment, you will conduct an **interview with an international researcher** who has kindly agreed to share their experiences with us. These are group interviews; you will work in your project groups for this part of the assignment (you can find which group you are in by clicking "People" on the left-hand menu, and then clicking on the "Groups" tab.)

Below are the researchers that each group will interview:

[List of Interviewees inserted here]

You are responsible for contacting the scientist you've been assigned and scheduling the interview. Before reaching out, you should do some background research on your interviewee first to get a better sense of who they are and what they work on. When sending them an email, make sure that you are always <u>professional and courteous</u>!

There are no strict limits on the length of your interview, but you should aim for at least 30-45 minutes (not including setup, introductions, closing comments etc.). If your interview is too short, you won't have time to get enough useful information out of it. On the other end of the spectrum, you should be respectful of your interviewee's time, as they are all very busy. To make the most of your time, make sure that you <u>write out your list of questions in advance;</u> a list of 8-10 questions is recommended. Other questions may arise during the conversation, and it is okay to ask those too... but you should have a list of questions to fall back on!

Reflection #8ª will help you come up with some great questions for your interview; please see that reflection page for more information about how to craft interview questions. Generally speaking, you should aim for <u>open-ended questions;</u> avoid yes/no questions or factual questions that can be answered in just a few words. Instead, ask questions that encourage your researcher to share their experiences and advice. Most of your questions should focus specifically on issues relating to global research, but you can ask questions about other aspects of science or their research programs as well.

All members of the group are expected to <u>contribute to the interview</u>– that includes helping craft the list of questions, being present during the interview itself, and helping prepare the transcript.

Below are some tips for conducting your interview:

- Be sure to be <u>courteous and professional</u> throughout the entire process!

- Choose<u> a quiet, distraction-free environment</u> for the interview.

- Everyone in your group should <u>show up early to the Zoom room</u> to test their audio/video and welcome the interviewee when they show up.

- Before the interview begins, ask your interviewee for <u>permission to record the session</u> (so that you can go back later to write your transcript).

- Begin your interview with <u>brief introductions</u>.

- Give your interviewee <u>sufficient time to answer each question</u>.

ª Reflection #8 is a guided activity that helps students recognize what makes for "good" interview questions– ones that will lead to deep, insightful responses and spark discussion. A copy of this assignment is available upon request.

- As your interviewee is speaking, make sure that you are being an <u>active listener</u> and <u>show interest</u> in what they are saying. Your facial expressions/body language are important here. If you have follow-up questions, be sure to ask them... but wait until the interviewee is done with their initial response first (in other words, don't interrupt!).

- Have <u>a list of questions written out in advance</u>, in the order that you intend to ask them. Before the day of the interview, <u>decide who will ask each question</u>. Remember that this is a conversation that involves everyone. Each member of the group should ask at least one question from the list.

- Take lots of notes during the interview– the interviewee's responses will likely spark a lot of ideas, so jot those down for future reference!

- Be respectful of the interviewee's time by making sure that you <u>don't go past the time allocated</u> for the interview.

- Make sure to thank your interviewee for their time at the end!

After the interview has concluded, you should meet with your group members to discuss the ideas that you all generated. Each group will be required to submit a **transcript of the interview** by **11:59pm on November 30th**. The transcript you submit should be <u>annotated</u> with the notes that you and your group mates took. This part of the project is worth **25 points** towards your grade.

Part 2: Reflective Essay

The second part of this assignment is a **reflective essay** that addresses the three main questions listed at the top of this page. This part of the project is an <u>individual assignment</u>. Although you worked together in groups for the interview, each student is expected to write their own original paper.

The insights that your international researcher shared with you during the interview will serve as a major source of information for your essay, and you are expected to directly reference the interview in your final paper. However, your paper should also include your own interpretations as well.

In addition to your interview transcript, you may also choose to use some or all of the following resources as you work on your paper:

- Our in-class discussion about global research (and associated readings)
- Information from the panel discussion held during Week 11
- Any other credible sources you may find online (journal articles, published interviews, etc.)
- Your own personal experiences working globally (if applicable)

All sources that you use to support your arguments must be cited in the main text of your essay, and full references for all sources must be listed in a "Works Cited" section at the end of the paper. You may use any standard academic reference format (e.g., APA) that you wish.

Other formatting requirements for the essay are as follows:

- It should be between 5-6 pages, double spaced
- Font size must be no larger than 12 pt
- Page margins must be no larger than 1" on all sides (MS Word default)

Your final paper is due by **11:59pm on December 15th**. Remember that there is no final exam for this course; this essay assignment is taking the place of a final. This part of the project is worth **75 points** towards your grade.

"Science Across Borders" Essay Rubric

Student Name:

CONTENT (55 pts)	Score	Points	Comments
Essay addresses the question, "What is the **value** of doing science across international borders?" by fully explaining <u>at least three distinct benefits</u>.	Excellent Good Needs Improvement Cannot Assess	___ / 12	
Essay addresses the question, "What are the **challenges** of conducting international research?" by fully explaining <u>at least three distinct challenges</u>.	Excellent Good Needs Improvement Cannot Assess	___ / 12	
Essay includes a detailed discussion of specific ways to **address the challenges** mentioned.	Excellent Good Needs Improvement Cannot Assess	___ / 10	
Author fully explains the **reasoning** behind their arguments and supports those arguments with clear **examples** as appropriate.	Excellent Good Needs Improvement Cannot Assess	___ / 8	
Content indicates **analytical thinking**, including sufficient depth and complexity.	Excellent Good Needs Improvement Cannot Assess	___ / 8	
All **sources** used are properly cited in text, and a complete, properly formatted **references list** is included at the end of the paper.	Excellent Good Needs Improvement Cannot Assess	___ / 5	

WRITING STYLE & FORMATTING (20 pts)	Score	Points	Comments
Organization: Essay includes a clear <u>introduction</u> and <u>concluding paragraph</u>; content flows in a logical order, with minimal redundancy and smooth transitions between ideas.	Excellent Good Needs Improvement Cannot Assess	___ / 7	
Writing Quality: Writing style is clear, concise, and appropriate for an academic paper; ideas are well-developed and coherent.	Excellent Good Needs Improvement Cannot Assess	___ / 7	
Proofreading: Paper is free of grammatical, spelling, and formatting errors.	Excellent Good Needs Improvement Cannot Assess	___ / 4	
Length & Formatting: Paper is within the recommended length of 5-6 pages (double-spaced in size 12 font with 1 inch margins).	Excellent Good Needs Improvement Cannot Assess	___ / 2	

TOTAL SCORE: ___ / 75

Overall comments for author:

Insect Research (CURE)
ENY 2890

Fall 2020 (3 credits)

⭐ Course Overview

This is a **course-based undergraduate research experience (CURE)**, which bridges the divide between the classroom and the research laboratory. Students will become part of a collaborative research team, and help **sequence, assemble, & analyze nematode genomes using next-generation technology**. Through this immersive, hands-on research experience, students may generate publishable data and contribute new knowledge to the field of nematology. We will also discuss important topics and best practices in science, including science ethics, doing science across borders, and communicating our science to a variety of audiences. This course is a great introduction to research, especially for students interested in genomics and molecular biology. Committed and hard-working students will leave this course well-prepared to join research teams at UF and beyond.

This course fulfills one of the curriculum requirements for the International Scholars Program (ISP). Learn more about the ISP here: https://internationalcenter.ufl.edu/student-opportunities/international-scholars-program

Course Catalog description: *ENY 2890 is a classroom undergraduate research experience (CURE) which bridges the divide between the classroom and the science laboratory and prepares for advanced opportunities in entomological science. Become part of an entomology research team, collecting publishable data on insect evolution, ecology, and systematics.*

☑ Student Learning Outcomes

By the end of the course, students will be able to:

• **Explain** the scientific method and best practices for conducting scientific research.

• **Identify** key challenges that scientists encounter when conducting research and **assess** strategies to mitigate them.

• **Critically read** and **evaluate** primary scientific literature.

• Accurately **collect**, **analyze**, and **interpret** scientific data.

• Effectively **communicate** the findings of their research to both the scientific community and general public.

• **Explain** the benefits of global collaborations in science, as well as strategies for effectively working with scientists from other cultures.

• **Reflect** on their personal career goals and **identify** resources and opportunities for future research on campus and beyond.

Course Information

Mondays & Wednesdays
Period 8 (3:00pm – 3:50pm)

Room: ufl.zoom.us/j/91094084901
(password= nematodes)

Prerequisites: None

Canvas Website:
ufl.instructure.com/courses/405646

Instructor Information

Dr. Anthony Auletta
Course Coordinator

Email: anthonyauletta@ufl.edu
Phone: (352) 273-3954
Office: ufl.zoom.us/j/721424942
Office Hours: Thursdays & Fridays, 1:00pm - 2:00pm (or by appointment)

Dr. Peter DiGennaro
Principal Investigator

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Office Hours: By appointment

Joshua Botti-Anderson
Graduate Teaching Assistant

Email: jbottianderson@ufl.edu
Office Hours: By appointment

Readings & Course Materials

Required Readings & Videos: There is no textbook for this course. Readings will consist of articles and book chapters that will be posted on the Canvas website before each class session. Students may be required to view brief videos and/or other media before class as well; links to these materials will also be posted on Canvas..

Other Required Materials: This is an online course. All students must have regular access to a computer with a reliable internet connection and Zoom installed (https://ufl.zoom.us). A desktop or laptop computer will also be required to run HiPerGator, which will be used for data analysis.

Course Communication

Meeting Policy: We are happy to discuss any aspect of this course with you! Outside of office hours, email is the preferred method of contact for all instructors. We will attempt to respond within 24 hours to emails received Monday-Friday, or by the following workday to emails sent during weekends/holidays. As a courtesy, please check this syllabus and Canvas for answers to your questions before reaching out.

Canvas: Important announcements and updates will be regularly posted to the course Canvas website, so be sure to check Canvas frequently! To ensure that you do not miss anything, please ensure that your Canvas profile is set to receive notifications.

Email Accounts: UF policies require you to use your GatorLink account or the Canvas mail system when emailing your instructors; we will not answer emails sent from other accounts (e.g., Gmail).

Professional Conduct: All participants in this class are expected to conduct themselves in a professional and respectful manner at all times. As such, please use appropriate etiquette when interacting with your peers and instructors, including during class, on Canvas, and via email.

Attendance & Participation

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/.

Instructors' Note: Due to the nature of this course, attendance in class is critically important. If you are absent, you will not be able to contribute fully to the research project or our discussions. Thus, all students are expected to **attend every class session on time** and **stay for the entire session**. Students are also expected to be **fully prepared for and engaged** in each class session— this includes doing all of the assigned readings, submitting all assignments by their deadlines, and actively participating in class activities.

If you need to miss a class due to an **excusable absence**, you must let the instructor know as far in advance as possible to discuss arrangements for making up any missed work. The instructor may request documentation. If you are absent for any other reason or fail to notify the instructor of an excusable absence in a timely manner, you may not be able to make up in-class work.

If you miss a session, please contact a classmate for notes— the instructors will not provide notes.

In addition to working on the project in class, students should also plan to allocate time <u>outside of class</u> for data collection and analysis (approximately <u>3 hours/week</u>).

Exams & Assignments

Quizzes: There will be 7 <u>online quizzes</u> throughout the semester (see the Course Schedule for dates), which must be submitted in Canvas before the start of class (3:00pm) on the due date. These assignments are designed to help you keep up with the readings and ensure that you are prepared for our discussions and other in-class activities.

Reflections: Throughout the semester, you will be asked to submit <u>brief written reflections</u> of our class sessions via Canvas. The goal of these assignments is to help you think deeply about the content, including the ideas shared by your peers and colleagues. There will be one reflection due per week, with several exceptions (see Course Schedule & Canvas for details & dates).

Lab Notebook: Each student will be required to maintain a <u>digital lab notebook</u> throughout the semester, in which they will record their data and other notes regarding their experiments. Proper lab notebook protocol will be discussed in class before the start of the research project. The lab notebook will be checked for completeness and accuracy twice during the semester and will be collected for a final evaluation during the last week of class.

Research Poster: Each research group will design a <u>scientific poster</u> which highlights their experimental design and preliminary findings as a capstone project for the course. Specific guidelines for this assignment will be discussed in class. The posters will be presented at the end of the semester.

"Science Across Borders" Assignment: One of the major themes woven throughout this course is the value of conducting science globally. To explore this topic more deeply, each student will conduct an <u>interview with an international researcher</u>, and use that information to prepare an essay in which they discuss the <u>benefits and challenges of international collaborations in science</u>. Detailed information about this assignment will be discussed in class, and the instructor will help connect you with a scientist for the interview.

Homework Assignments: There will be five graded <u>homework assignments</u> during the course (see the Course Schedule for due dates). The format of these assignments will vary. These assignments will help you practice critically reading the scientific literature or allow you to explore certain topics in more depth. Guidelines for each assignment will be posted to Canvas.

Extra Credit: You may earn up to 10 bonus points for attending an <u>international research seminar</u> during the semester and preparing a 2 page (single-spaced) reflective paper about it. Other extra credit assignments may be posted at the instructor's discretion. Any other extra work submitted in order to raise a grade will not be accepted.

> ***Submitting assignments:*** *All assignments must be submitted electronically through Canvas unless otherwise noted. You are responsible for ensuring that all of your work is uploaded <u>correctly and completely</u> by the deadline. Documents that are incomplete, corrupted, or blank will be treated as <u>late work</u> (with associated penalties) until they are re-uploaded correctly, so please always double check your files!*

⏰ Policy on Late Work

All assignments must be submitted <u>by the due date and time indicated in this syllabus/on Canvas</u>. If an assignment is submitted after that time, 20% of its total point value will be deducted for every day that it is late. You will not receive credit for late work if it is submitted more than 5 days late or after the instructors have graded and returned the assignment to the class.

If you miss a class session, you are <u>still responsible</u> for turning in the work due on that date at the required time. Penalty-free extensions on assignments will be considered on a *case-by-case basis* only in the event of an unforeseen excusable absence or other emergency. In such a case, you must contact the instructors as soon as you are able to discuss these arrangements.

Ⓐ Grading

This course uses a points scale for grading. You can earn up to a maximum of **680 points** in the course, distributed as follows:

Online Quizzes: **70 pts (10 pts ea.)**
Reflections: **110 pts (10 pts ea.)**
Lab Notebook: **150 pts**
Research Poster: **150 pts**
"Science Across Borders" Assignment: **100 pts**
Homework Assignments: **100 pts (20 pts ea.)**

At the end of the semester, your point total will be converted into a percentage of the maximum and the corresponding letter grade will be assigned:

90 – 100% = **A**	70 – 76.9% = **C**
87 – 89.9% = **B+**	67 – 69.9% = **D+**
80 – 86.9% = **B**	60 – 66.9% = **D**
77 – 79.9% = **C+**	below 60% = **E**
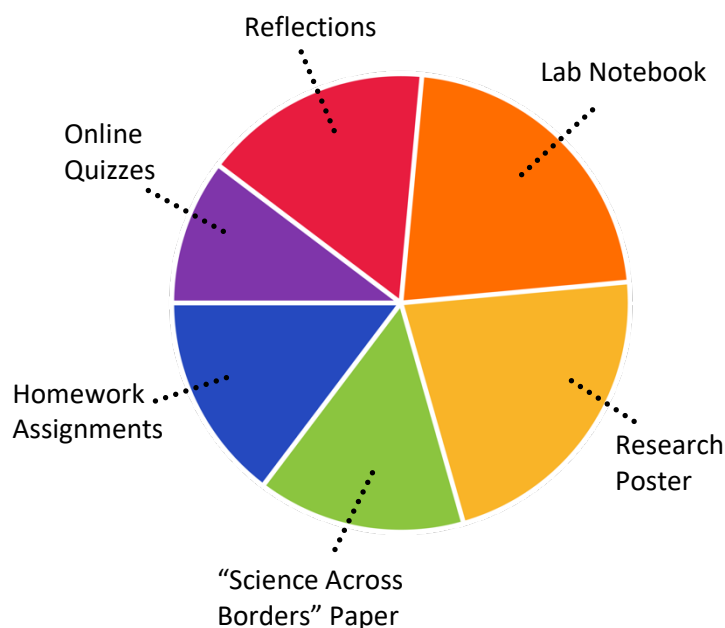
Please note that the instructors <u>do not round up grades</u>– requests to do so will not be honored.

For current UF policies on assigning grade points, consult the following policy website: https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

> ***Disputing a grade:*** *If you wish to dispute a grade for any exam/assignment, you must contact the instructors <u>in writing</u> within two days (48 hours) after the assignment has been returned. In your message, you must include a specific explanation for why you think the grade is incorrect and how you think it should be changed. An instructor will then arrange a meeting with you to discuss the issue and determine whether or not to the grade should be changed. The grade assigned following this meeting will be final.*

Course Schedule

Below is a tentative* schedule of topics and assignments for the semester. Readings and other materials for each session will be posted on Canvas. Unless otherwise noted, all readings and assignments must be completed/submitted before the start of class (3:00pm) on the indicated due date.

In addition to the assignments listed below, students will be required to complete their weekly reflection posts on Canvas by Friday at 11:59pm each week, unless otherwise noted. There are no reflections due on Weeks 1, 9, 13, and 15.

Week	Date	Topic	Instructors	Assignments Due
1	8/31 (M)	**Course Intro / What is a CURE? / What is (Good) Science?**	Auletta, DiGennaro	
	9/2 (W)	**Critically Reading Scientific Literature / Finding Sources**	Auletta	
2	9/7 (M)	**Labor Day Holiday – NO CLASS!**	---	
	9/9 (W)	**Research Background: Nematology**	DiGennaro	Quiz #1
3	9/14 (M)	**Research Background: Genomics/ Genome Sequencing**	DiGennaro	Quiz #2
	9/16 (W)	**Formulating Research Questions & Hypotheses**	Auletta	
4	9/21 (M)	**Experimental Design**	DiGennaro	Homework #1
	9/23 (W)	**DNA Extraction & Genome Amplification**	DiGennaro	
5	9/28 (M)	**Objectivity & Bias in Science**	Auletta	Quiz #3
	9/30 (W)	**DNA Quantification**	DiGennaro	
6	10/5 (M)	**How do we Communicate Science Effectively?**	Auletta	Quiz #4
	10/7 (W)	**Presenting to a Scientific Audience: What Makes a Good Poster?**	Auletta	Homework #2
7	10/12 (M)	**Work on Project: Tour of Sequencing Facility**	Guest	
	10/14 (W)	**Work on Project: Intro to HiPerGator**	Guest	
8	10/19 (M)	**Work on Project: Data Analysis & Visualization**	DiGennaro	Homework #3
	10/21 (W)	**Work on Project: Data Analysis & Visualization**	DiGennaro	
9	10/26 (M)	**Work on Project: Data Analysis & Visualization**	DiGennaro	
	10/28 (W)	**Global Science: Research Across Borders**	Auletta	
10	11/2 (M)	**Work on Project: Data Analysis & Visualization**	DiGennaro	Lab Notebook Check #1
	11/4 (W)	**What Does It Mean to be an Ethical Scientist?**	Auletta	Quiz #5
11	11/9 (M)	**Panel Discussion with Graduate Student Researchers**	Auletta	
	11/11 (W)	**Veteran's Day Holiday–NO CLASS!**	---	
12	11/16 (M)	**Work on Project: Data Analysis & Visualization**	DiGennaro	Homework #4
	11/18 (W)	**Paper Discussion**	Auletta, DiGennaro	Quiz #6 Lab Notebook Check #2

13	11/23 (M)	**Science & the Media: How do we Build Public Trust in Science?**	Auletta	Quiz #7 Research Poster Draft
	11/26 (W)	**Thanksgiving Holiday–NO CLASS!**	---	
14	11/30 (M)	**Work on Project: Data Analysis & Visualization**	DiGennaro	Interview Transcript for "Science Across Borders" Essay
	12/2 (W)	**Your Future Research: Opportunities @ UF and Beyond**	Auletta	Homework #5
15	12/7 (M)	**Poster Presentations**	Auletta, DiGennaro	Research Poster
	12/9 (W)	**Reflecting on our Research Experience** **Course Evaluations**	Auletta, DiGennaro	Turn in Lab Notebook
Finals Week	12/15 (T)	---		"Science Across Borders" Essay (by 2:30pm)

* Although we will do our best to adhere to this schedule, it may be adjusted during the semester to accommodate opportunities, disruptions, etc. These changes will be communicated clearly via Canvas.

📅 List of Important Dates
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Key dates to remember are below– be sure to add them to your calendar!

September 7th: No class (Labor Day)
November 11th: No class (Veterans' Day)
November 26th: No class (Thanksgiving Break)
December 7th: Research Poster due
December 9th: Last day of class– Lab Notebook turned in
December 15th: Scheduled final exam date– "Science Across Borders" essay due

Due dates for smaller assignments (such as quizzes, homework assignments, and preliminary stages of larger projects) are listed in the Course Schedule above and on Canvas.

* There is <u>no final exam</u> for this class; instead, your "Science Across Borders" essay will be due at our scheduled exam time. *

🛡️ University Policy on Academic Honesty
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As a student at the University of Florida, you have committed yourself to uphold the **Honor Code**, which includes the following pledge: *"We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity."* You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code.

Accommodations for Students with Disabilities

The **Disability Resource Center** coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

Disability Resource Center

001 Reid Hall
(352) 392-8565
https://disability.ufl.edu/

Instructors' Note: Remember, we want to help you succeed in this course! After we receive your request and documentation, we will arrange a meeting with you to discuss the accommodation options in more detail. To ensure that the necessary accommodations are in place as early as possible, please be sure to start this process **at (or before) the beginning of the semester**!

Ensuring Privacy in Online Courses

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

During the course, you will use **HiPerGator** to analyze data for your project. By participating in this course, you agree to the following policies regarding HiPerGator:

ACCEPTABLE USE: I acknowledge that the access to the HPC resources operated by UF Research Computing is subject to the UF Acceptable Use Policy at https://it.ufl.edu/policies/acceptable-use/acceptable-use-policy/ *and the Research Computing policies at* http://www.rc.ufl.edu/services/procedures/ *and that I am responsible for following these policies.*

RESTRICTED DATA: I also certify that using restricted data and software on the HPC resources requires extra steps described at UFRC Policies and at UFRC Export Policies, and that I will notify both my account sponsor and the Office of Research (Research Compliance) and Research Computing at support.rc.ufl.edu when I am working with such data.

Course Evaluations

Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via **GatorEvals**. Guidance on how to give feedback in a professional and respectful manner is available at: https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at: https://gatorevals.aa.ufl.edu/public-results/.

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general wellbeing are encouraged to utilize the university's counseling resources. **The Counseling & Wellness Center** provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance:

University Counseling & Wellness Center
Counseling Services, Groups and Workshops, Outreach and Consultation, Self-Help Library, Wellness Coaching

3190 Radio Road
(352) 392-1575; https://counseling.ufl.edu

Other campus resources include:

- **U Matter, We Care**: http://umatter.ufl.edu

- **Career Connections Center**: Reitz Student Union- First Floor; (352) 392-1601; http://career.ufl.edu

• **<u>Student Success Initiative</u>**: http://studentsuccess.ufl.edu

• **<u>Student Complaints</u>**: Complaints regarding on-campus courses may be filed at **https://sccr.dso.ufl.edu/policies/student-honor-code-studentconduct-code/**. For online courses, please see https://distance.ufl.edu/getting-help/student-complaint-process/.

*** It is your responsibility to make sure that you fully understand and comply with the policies outlined in this syllabus, as well as the policies of the university as they relate to this course. If you have any questions, please contact the instructors! ***