BIO-1814: SPECIAL TOPICS IN COURSE-BASED UNDERGRADUATE RESEARCH EXPERIENCE

Cuyahoga Community College

Viewing: BIO-1814 : Special Topics in Course-based Undergraduate Research Experience

Academic Term:
Spring 2026

Subject Code
BIO - Biology

Course Number:
1814

Title:
Special Topics in Course-based Undergraduate Research Experience

Catalog Description:
This course is designed to teach science majors how to gather factual evidence by applying the scientific process to their own curiosities about the biological world. The steps of the scientific method are investigated, with detailed attention given to quality performance, reproducibility, and rigor throughout the process. A relationship between the reproducibility of science and the application of rigorous steps towards evidence collection is explored. Students will perform various career responsibilities associated with the research pillar of land-grant institutions, including writing and submitting a peer-reviewed manuscript, and delivering an oral presentation.

Credit Hour(s):
3

Lecture Hour(s):
2

Lab Hour(s):
3

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
ENG-0995 Applied College Literacies, or appropriate score on English Placement Test.

Outcomes

Course Outcome(s):
Gain operational experience of performing reproducible and rigorous science by the application and execution of science processes via original research, using mosquitoes or other insects as model organisms.

Essential Learning Outcome Mapping:
Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):
1. Formulate novel, testable hypotheses from original, lab- and field-based observations and exploration of the literature base, with potential to discover information new to science.

2.Expand knowledge about aspects of mosquito and insect identification, natural history, behavior, ecology, species distribution, and public-health relevance, as related to the student's interests.

3. Understand the basics of reproducible science as they apply to other objectives of the course.

4.Discuss ways to eliminate bias from the scientific process, including blinding, randomization, and the critical step of formulating multiple hypotheses to answer a proposed question.

4.Extract variables from testable hypotheses and reframe them in control and experimental treatments.

5.Design and execute experiments to test formulated hypotheses.

6.Analyze and interpret gathered data with focus on supporting or falsifying hypotheses as well as future directions for research.

Course Outcome(s):

Gain professional proficiency in written and verbal science-based communication.

Objective(s):

1. Understand the basics of scientific writing. Write a final paper in the format of a peer-reviewed journal article submission based on the writing style guide lines of the Entomological Society of America and submit to a peer-reviewed journal when possible.

2. Create a final oral presentation of executed scientific processes, in the format of a twelve-minute timed conference presentation, to communicate performed science. Present at a conference when possible.

3. Develop collaborative relationships with other students (through research teams, regular peer-review of final papers, etc.) and faculty outside of the instructor (e.g. through data analysis with math faculty),as is crucial to the success of the process of science.

4. Discuss ethics in science and the need for transparency and the harm this does to the perception of the scientific community by analyzing cases of falsified data.

5. Discuss current challenges facing scientists today

Course Outcome(s):

Develop technical skills through the application of STEM equipment in experiment execution.

Objective(s):

1.Gain broader knowledge of STEM equipment available for the experimental phase of the semester research project.

2.Illustrate specific knowledge of experiment-relevant equipment through use.

Methods of Evaluation:

Exams
Quizzes
Softchalk modules
Experimentation competence
Presentations
Papers

Course Content Outline:

I. The Scientific Method
- A. Observation
  - 1. Definition
  - 2. Examples
  - 3. Application
- B. Question
  - 1. Definition
  - 2. Examples
  - 3. Application

- 4. Literature review
- C. Hypothesis
  - 1. Definition
  - 2. Ways to eliminate bias
  - 3. Examples
  - 4. Difference between hypothesis and scientific theory
  - 5. Application
- D. Prediction
  - 1. Definition
  - 2. Difference between hypothesis and prediction
  - 3. Application
- E. Experimental Design and Data Collection
  - 1. Variables
    - a. Independent
    - b. Dependent
    - c. Control/standardized
    - d. Confounding
    - e. Positive
    - f. Negative
    - g. Internal
  - 2. Experimental/control groups
  - 3. Sample size
    - a. Estimation/calculation
    - b. Justification
  - 4. Replication/reproducibility
    - a. Define biological and technical replicates
    - b. Random variation/noise
    - c. Accountability of variation in experiments
    - d. Importance of reproducible research
    - e. Pseudoreplication
  - 5. Ways to eliminate bias
    - a. Blind studies
    - b. Randomization
    - c. Multiple hypotheses
  - 6. Methodology and modification
    - a. Qualitative data studies
    - b. Quantitative data studies
  - 7. Case studies
- F. Conclusion
- G. Bias in Science

II. Molecular and Laboratory Techniques

- A. Sterile Techniques
- B. Polytene Chromosomes
  - 1. Definition
  - 2. Process of visualization
- D. DNA Extraction/Isolation
  - 1. Cell lysis
  - 2. DNA purification
  - 3. DNA elution
  - 4. DNA storage
- E. Polymerase Chain Reaction (PCR)
  - 1. Definition/uses

2. Primer mix/designing primers
3. Taq master mix
4. PCR master mix
5. Amplification of DNA
6. Application
7. Product sequencing

F. Electrophoresis
1. Definition
2. Sample preparation
3. Standards/markers/ladders
4. Buffers
5. Fixing gels
6. Staining gels
7. Determining molecular weight
8. Blots

G. BLAST searching
1. NCBI database
2. GenBank DNA sequence database

III. The Laboratory Setting

A. Personnel Hierarchy and Protocol
1. Types of labs
a. Area of research
I. Applied science
II. Basic science
b. Clinical research
2. Department/Division
3. Laboratory Personnel
a. Principal Investigator
b. Postdoctoral associate
c. Technician/Research assistant
d. Graduate student
e. Undergraduate student
f. Summer/High school student
g. Laboratory supervisors
h. Laboratory aides
i. Department/division secretary
4. Laboratory Routines
a. Hours
b. Dress code
c. Tasks/jobs
d. Meetings
e. Vacation
f. Courtesy to others
5. Safety

B. Laboratory Structure
1. Work spaces
a. Benches
b. Functional working areas
c. Tissue culture areas
d. Reagent preparation areas
e. Experimental areas
f. Other functional areas (microscopy, electrophoresis, equipment, etc.)

g. Offices/computer areas
2. Using Equipment
a. Learning use/protocols
b. Courtesy with shared equipment
c. Cleanliness of shared space
d. Emergency/damage protocols
3. Basic lab equipment
a. Biohazard/sharps containers
b. Hot plates
c. Ice
d. Lab coats
e. Gloves
f. Microfuge
g. Parafilm
h. Pipettors/pipettes/pipetting supplies
i. Sharpie markers
j. Squeeze bottles
k. Vortex
4. Laboratory Notebooks
a. Reproducibility
b. Data collection
c. Calculations
d. Ethical implications

IV. Data Presentation
A. Oral presentation
1. Research seminar
2. Journal club
3. Student competitions at professional conferences
4. Data presentation to lab members
B. Written presentation
1. Manuscript
2. Poster presentation
3. Grants

Religious Accommodation

Before reviewing the course schedule, students should carefully review the following religious accommodation policy and other required instructional policies:

Religious Accommodation:

Students seeking an accommodation for absences permitted under Ohio's Testing Your Faith Act must provide the instructor with written notice of the specific dates for which the student requires an accommodation and must do so not later than fourteen (14) days after the first day of instruction. Please submit requests for accommodations at this link: https://portal2.tri-c.edu/ReligiousAccommodation/ Religious Accommodation Form. Students with questions about their religious accommodations under Ohio's Testing Your Faith Act may contact the College's Office of General Counsel and Legal Services by phone at 216.987.4856 or via email at legal@tri-c.edu.

Other Required Instructional Policies:

https://www.tri-c.edu/student-resources/curriculum/documents/syllabus-part-b.pdf

Weekly Schedule

	Topics
Week 1	The Scientific Method
Week 2	The Scientific Method
Week 3	Arthropod Collection and Identification

Week 4	Arthropod Collection and Identification
Week 5	DNA Extraction
Week 6	DNA Extraction
Week 7	Polymerase Chain Reaction
Week 8	Polymerase Chain Reaction
Week 9	Gel Electrophoresis
Week 10	Gel Electrophoresis
Week 11	Mosquito Biology
Week 12	Mosquito Biology
Week 13	Bioinformatics/BLAST
Week 14	Bioinformatics/BLAST
Week 15	Redo necessary experiments
Week 16	Final exam

The Course Schedule is subject to change due to pedagogical needs, instructor discretion, parts of term, and unexpected events.

Required/Recommended Readings

Cecilia Y. Hasan, Reagan L. Sutton, and Jessica B. Sakash Replogle. The Presence of *Wolbachia* in Brood X Cicadas. Journal of Emerging Investigators Vol. 5, p 1-6.

Resources for the Instructor

Mohammed Meah and Elizabeth Kebede-Westhead. (2012) *Essential Laboratory Skills for Biosciences*, West Sussox, UK: Wiley-Blackwell.

K. Z. Masoodi, S. M. Lone, and R. S. Rasool. (2021) *Advanced Methods in Molecular Biology and Biotechnology: A Practical Lab Manual*, San Diego, CA: Elsevier.

L. Buckingham. (2019) *Molecular Diagnostics: Fundamentals, Methods and Clinical Applications*, Philadelphia, PA: F.A. Davis Company.

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