## Term Information

| | |
|---|---|
| **Effective Term** | Spring 2023 |

## Course Change Information

**What change is being proposed? (If more than one, what changes are being proposed?)**

Add designation as general education course under Origins & Evolution theme.

**What is the rationale for the proposed change(s)?**

Course fits well with the aims and scope of the Origins & Evolution theme. Please see attached cover sheet for details.

**What are the programmatic implications of the proposed change(s)?**

**(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?**

None

**Is approval of the requrest contingent upon the approval of other course or curricular program request?** No

**Is this a request to withdraw the course?** No

## General Information

| | |
|---|---|
| **Course Bulletin Listing/Subject Area** | Evol, Ecology & Organismal Bio |
| **Fiscal Unit/Academic Org** | Evolution, Ecology & Org Bio - D0390 |
| **College/Academic Group** | Arts and Sciences |
| **Level/Career** | Undergraduate |
| **Course Number/Catalog** | 2250 |
| **Course Title** | Dynamics of Dinosaurs |
| **Transcript Abbreviation** | Dyn Dinosaurs |
| **Course Description** | A review of current information on dinosaur biology, emphasizing scientific approaches to reconstructing dinosaurs as living, dynamic animals. |
| **Semester Credit Hours/Units** | Fixed: 3 |

## Offering Information

| | |
|---|---|
| **Length Of Course** | 14 Week, 12 Week, 8 Week, 7 Week, 6 Week |
| **Flexibly Scheduled Course** | Never |
| **Does any section of this course have a distance education component?** | No |
| **Grading Basis** | Letter Grade |
| **Repeatable** | No |
| **Course Components** | Lecture |
| **Grade Roster Component** | Lecture |
| **Credit Available by Exam** | No |
| **Admission Condition Course** | No |
| **Off Campus** | Never |
| **Campus of Offering** | Columbus, Lima, Mansfield, Marion, Newark, Wooster |
| ***Previous Value*** | *Columbus, Lima, Mansfield, Marion, Newark* |

## Prerequisites and Exclusions

| | |
|---|---|
| **Prerequisites/Corequisites** | Prereq: 4 sem cr hrs in Biological Sciences or Historical Geology. |
| **Exclusions** | |
| **Electronically Enforced** | Yes |

## Cross-Listings

**Cross-Listings**

## Subject/CIP Code

| | |
|---|---|
| **Subject/CIP Code** | 26.1303 |
| **Subsidy Level** | Baccalaureate Course |
| **Intended Rank** | Freshman, Sophomore, Junior, Senior |

## Requirement/Elective Designation

Origins and Evolution
The course is an elective (for this or other units) or is a service course for other units

***Previous Value***

*The course is an elective (for this or other units) or is a service course for other units*

## Course Details

**Course goals or learning objectives/outcomes**

- Learn the basic principles and concepts guiding paleobiological study of life on earth.
- Understand how paleobiology works as a science that tests hypotheses about extinct organisms and past environments.
- Know the evolutionary origin and radiation of the dinosaur lineages, and develop an informed historical perspective of how dinosaurs have impacted life on earth.
- Understand how aspects of the life of dinosaurs (and other extinct organisms) can be reconstructed using scientific methods
- Be able to distinguish between science-based and non-science based opinions expressed in popular press accounts of dinosaur biology

**Content Topic List**

- Geological history of earth
- Evolution of life up to and during the Mesozoic era
- Fossilization, methods of fossil collection and interpretation
- Scientific method
- Dinosaur evolution and systematics
- Scaling in nature and effect of body size
- Sexual selection
- Ecology of dinosaurs

**Sought Concurrence** No

## Attachments

- EEOB2250 syllabus NEW updated for Origins and Evolution v 2.docx: Syllabus

  *(Syllabus. Owner: Hamilton,Ian M)*

- EEOB 2250 ELO Questionnaire.docx: ELOs

  *(Cover Letter. Owner: Hamilton,Ian M)*

- EEOB Curriculum Maps April 2022.xlsx: Curriculum Maps

  *(Other Supporting Documentation. Owner: Hamilton,Ian M)*

## Comments

## Workflow Information

| Status | User(s) | Date/Time | Step |
|---|---|---|---|
| Submitted | Hamilton,Ian M | 06/14/2022 01:16 PM | Submitted for Approval |
| Approved | Hamilton,Ian M | 06/14/2022 01:20 PM | Unit Approval |
| Approved | Vankeerbergen,Bernadette Chantal | 08/26/2022 10:18 AM | College Approval |
| Pending Approval | Cody,Emily Kathryn<br>Jenkins,Mary Ellen Bigler<br>Hanlin,Deborah Kay<br>Hilty,Michael<br>Vankeerbergen,Bernadette Chantal<br>Steele,Rachel Lea | 08/26/2022 10:18 AM | ASCCAO Approval |

# Dynamics of Dinosaurs Syllabus

EEOB2250 Autumn 2023

## Course Information

- **Course times:** Tuesdays and Thursdays from 3:00 p.m. - 4:20 p.m.
- **Credit hours:** 3
- **Mode of delivery:** In person

### Instructor

- **Name:** Erin Lindstedt
- **Email:** lindstedt.2@osu.edu
- **Office location:** Aronoff 106
- **Office hours:** Tuesdays and Thursdays from 2:00 p.m.-255 p.m.
- **Preferred means of communication:**
    - My preferred method of communication for questions is **email.**
    - My class-wide communications will be sent through the Announcements tool in CarmenCanvas. Please check your notification preferences (go.osu.edu/canvas-notifications) to be sure you receive these messages.

### Teaching Assistant

- **Name:** [first and last name of TA]
- **Email:** [lastname.#@osu.edu]

### Course Prerequisites

There are no course pre-requisites

### Course Description

In recent decades there has been a dramatic increase in what we know about dinosaurs. Much of this new information has come from fossil discoveries, but many novel ideas have come from reinterpretation of available material and creative approaches to testing longstanding

assumptions. The dinosaurs portrayed by biologists today are radically different from the old stereotypes of dinosaurs as lumbering, dim-witted giants doomed to extinction. Instead, they are viewed as active, likely warm-blooded animals with complex social behaviors. How did this transformation take place? This course will examine the new ideas about dinosaurs and document how a variety of scientific studies have changed our perspective of them. Along the way, many different principles of biological science applicable to the study of dinosaurs will be discussed. A major theme of the class will be to examine how scientists working in a variety of disciplines can study and understand the nature and evolution of organisms long extinct.

This class is designed to be appropriate for undergraduates who are not majoring in biological sciences, though it should prove informative and challenging for biology majors.

## Course Goals

1. **Learn the basic principles and concepts guiding paleobiological study of life on earth.**
2. **Understand how paleobiology works as a science that tests hypotheses about extinct organisms and past environments.**
3. **Know the evolutionary origin and radiation of the dinosaur lineages, and develop an informed historical perspective of how dinosaurs have impacted life on earth.**
4. **Understand how aspects of the life of dinosaurs (and other extinct organisms) can be reconstructed using scientific methods**
5. **Be able to distinguish between science-based and non-science based opinions expressed in popular press accounts of dinosaur biology**

## Learning Outcomes

By the end of this course, students should successfully be able to:

**Describe the basic geological history of the Earth and the evolution of life through the Mesozoic Era.**

**Explain the process of fossilization, the methods of fossil collection and preparation, and approaches to fossil interpretation.**

**Explain how paleobiological methods can reconstruct past environmental conditions (e.g., climate, etc.)**

**Describe the general history of dinosaur research, the major individuals involved and their contributions, and the role of personality in advancing (or hindering) our knowledge of dinosaurs.**

**Describe the evolutionary origin and radiation of the dinosaur lineages and explain the systematic methods used to determine their evolutionary relationships**

**Identify the major dinosaur taxa and describe their general way of life.**

**Explain scaling in nature and describe how size impacts the biology of organisms (such as dinosaurs).**

**Demonstrate how scaling and biomechanical techniques can be used to estimate body weights and locomotory abilities of dinosaurs**

**Explain the scientific evidence used to argue for or against endothermy in dinosaurs**

**Explain the fossil evidence underlying reconstructions of the reproductive and social behaviors of dinosaurs**

**Explain how sexual selection may be responsible for the evolution of many spectacular features of dinosaurs**

**Describe the evolution and biology of pterosaurs (the first flying vertebrates), and explain the biomechanical principles underlying the evolution of flight**

**Describe the evolution and biology of Mesozoic marine reptiles, and explain the evolutionary transformations involved in returning to life in the sea**

**Explain why birds actually are dinosaurs and how modern birds evolved**

**Discuss the scientific explanations for the great extinction event at the end of the Mesozoic Era**

## General Education Expected Learning Outcomes

As part of the Origins and Evolution Category of the General Education curriculum, this course is designed to prepare students to be able to do the following:

1 Successful students will analyze the origins and evolution of natural systems, life, humanity, or human culture at a more advanced and in-depth level than in the Foundations component.

2 Successful students will integrate approaches to the origins and evolution of natural systems, life, humanity, or human culture by making connections to their own experiences and by making connections to work they have done in previous classes and/or anticipate doing in the future.

3 Successful students will appreciate the time depth of the origins and evolution of natural systems, life, humanity, or human culture, and the factors that have shaped them over time.

4 Successful students will understand the origins and evolution of natural systems, life, humanity, or human culture, and the factors that have shaped them over time.

## More specifically, the Expected Learning Outcomes for the Origins and Evolution theme are:

1.1 Apply their understanding of scientific methods to quantitative calculations.

1.2 Engage in critical and logical thinking about the origins and evolution of the universe, physical systems, life on earth, humanity, or human culture.

2.1 Identify, describe, and synthesize approaches to or experiences of origins and evolution questions in different academic and non-academic contexts.

2.2 Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts.

3.1 Illustrate the time depth of the universe, physical systems, life on earth, humanity, or human culture by providing examples or models.

3.2 Explain scientific methods used to reconstruct the history of the universe, physical systems, life on earth, humanity, or human culture and specify their domains of validity.

3.3 Engage with current controversies and problems related to origins and evolution questions.

4.1 Describe how the universe, physical systems, life on earth, humanity, or human culture have evolved over time.

4.2 Summarize current theories of the origin and evolution of the universe, physical systems, life on earth, humanity, or human culture.

**EEOB 2250 addresses the origins and evolution of life on earth.** This course fulfills these learning outcomes by combining critical thinking and class discussion, examining case studies, quantitative tools and analysis of real fossil data. The 3-credit hour course is comprised of class meetings involving lecture and small-group, active learning discussions, as well as in-class questions based on those discussions, and concludes in an end-of-semester paper which requires students to critique the portrayal of dinosaurs in popular media. In addition, three midterms test mastery of course material. The in-class assignments play central roles in achieving the ELOs for the Origins and Evolution theme and assessing those achievements. Examples of an in-class assignment might be asking students to examine real growth data from fossilized dinosaur bones and asking them to calculate growth rates, and then based on their calculations, hypothesize as to which lineages of dinosaurs may provide parental care to their offspring given differences in early growth. These will then be part of a large in-class discussion in which groups share their conclusions.

# How This Course Works

**Mode of delivery:** Lectures are 100% in person. Recorded lectures will be available to students after course meeting times.

Midterm exams are online and will be delivered on Carmen.

**Credit hours and work expectations:** This is a [3] credit-hour course. According to Ohio State bylaws on instruction (go.osu.edu/credithours), students should expect around [3] hours per week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to [6] hours of homework (reading and assignment preparation, for example) to receive a grade of [C] average.

**Participation and assignment requirements:** The following is a summary of students' expected participation:

- **Attendance: every lecture**
  You are expected to attend all lectures.
- **Participating in in-class activities**: **at least once per week**
  During at least one lecture each week, we will be participating in an in-class activity. You will be required to participate in activities that are assigned during class and submit these by the end of the week.
- **Office hours and discussion boards**: **optional**
  Office hours, are optional. Additionally, posting in the discussion board is optional, but we encourage students to post interesting articles or pictures related to all things dinosaur!
- **Popular Media Assignment: Required**

# Course Materials, Fees and Technologies

## Required Materials and/or Technologies

- You are required to have access to internet for CarmenCanvas access for announcements and lecture material, and exams will be given online through CarmenCanvas

## Recommended/Optional Materials and/or Technologies

The textbook is strongly recommended but not required **Dinosaurs: A Concise Natural History** by Fastovsky and Weishampel (3rd edition, 2016) **Textbook:**

Finding an appropriate textbook for this class has been challenging. Dinosaur "textbooks" either tend to be too simplistic, too technical, or too idiosyncratic for the needs of this course. I have selected the paperback text **Dinosaurs: A Concise Natural History** by Fastovsky and Weishampel (4th edition, 2021). Some aspects of the book are too detailed for this course (e.g., phylogenetic relationships of specific genera and skeletal features determining those relationships). On the other hand, my lectures frequently will include information not covered in the text. In many cases information that I discuss in one class period (e.g., analysis of fossil nests) is scattered throughout several chapters of the text. Should you buy the text? This is a very up-to-date book written by active dinosaur researchers, so if you want a good dinosaur book in your personal library, I would recommend it. On the other hand, my exams typically are based only on lecture material, and I plan to use the text largely as a reference book. If you attend lecture regularly, take good notes to supplement the powerpoint slides provided you, and understand the material, you probably can get by without the text. However, if you have limited familiarity with dinosaur taxonomy, evolution, and biology, the book should be very useful as a reference guide. Also, given that the book will serve mainly as a reference text, the 3rd edition may be adequate.

## Required Equipment

- **Computer:** current Mac (MacOS) or PC (Windows 10) with high-speed internet connection
- **Other:** a mobile device (smartphone or tablet) to use for BuckeyePass authentication

## Required Software

**Microsoft Office 365:** All Ohio State students are now eligible for free Microsoft Office 365. Visit the installing Office 365 (go.osu.edu/office365help) help article for full instructions.

# CarmenCanvas Access

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you do each of the following:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device (go.osu.edu/add-device) help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Install the Duo Mobile application (go.osu.edu/install-duo) on all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

# Technology Skills Needed for This Course

- Basic computer and web-browsing skills
- Navigating CarmenCanvas (go.osu.edu/canvasstudent)
- CarmenZoom virtual meetings (go.osu.edu/zoom-meetings)

# Technology Support

For help with your password, university email, CarmenCanvas, or any other technology issues, questions or requests, contact the IT Service Desk, which offers 24-hour support, seven days a week.

- **Self Service and Chat**: go.osu.edu/it
- **Phone:** 614-688-4357 (HELP)
- **Email:** servicedesk@osu.edu

# Grading and Faculty Response

## How Your Grade is Calculated

| Assignment Category | Points |
|---|---|
| In-class assignments (10 x 10 points) | 100 |
| Midterm exams (3 x 90) **- online** | 270 |
| Popular media assignment (30 points) | 30 |
| Total | 400 |

See Course Schedule for due dates.

## Writing assignment

### Popular media writing assignment

**Description:**
An essay critiquing some popular media account of dinosaurs is on **Tuesday Nov. 23**. **YOU ARE ENCOURAGED TO TURN THE ESSAY IN EARLY IF YOU CAN.** The account can be an article, a movie, a TV show, etc. I want you to apply your knowledge of dinosaur biology to critically evaluate how realistically the dinosaur(s) are represented. What was accurate, highly speculative, unlikely, or blatantly wrong? Did the representation include outdated misperceptions about dinosaurs? Did the account include up-to-date information on dinosaur biology? **Focus your critique on information we have discussed in class that specifically concerns dinosaur biology (rather than just critique superficial, basic biological aspects that anyone might criticize).** If you use information from sources other than the course or textbook, provide references (in whatever format you prefer). The essay will be graded on content and also on organization and clarity of writing. Be sure to specify what article, film, etc. you are evaluating. Good essays need not to be more than about 3 (double-spaced) pages long. The assignment is worth 30 points.

**Academic integrity and collaboration:** Your written assignments should be your own original work with the exception of in-class assignments which are collaborative with other students. In formal assignments, you should follow [MLA/APA/Chicago etc.] style to cite the ideas and words of your research sources. You are encouraged to ask a trusted person to proofread your assignments before you turn them in but no one else should revise or rewrite

your work. For in class assignments, all collaborators/group members must be listed by name on the assignment

## Late Assignments

Late submissions will not be accepted unless discussed with instructor.An assignment is considered late If it is 30 minutes past the due date/time. Please refer to Carmen for due dates

## Instructor Feedback and Response Time

I am providing the following list to give you an idea of my intended availability throughout the course. Remember that you can call 614-688-4357 (HELP) at any time if you have a technical problem.

- **Preferred contact method:** If you have a question, please contact me first through my Ohio State email address. I will reply to emails within **24 hours on days when class is in session at the university**.
- **Class announcements:** I will send all important class-wide messages through the Announcements tool in CarmenCanvas. Please check your notification preferences (go.osu.edu/canvas-notifications) to ensure you receive these messages.
- **Discussion board:** This is a place for you to post interesting/cool articles videos etc related to the content of the class. This will not be graded but I may show items posted here in class
- **Grading and feedback:** For large weekly assignments, you can generally expect feedback within **seven days**

## Grading Scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70–72.9: C-
67–69.9: D+
60–66.9: D
Below 60: E

# Other Course Policies

## Discussion and Communication Guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style**: While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. A more conversational tone is fine for non-academic topics.
- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably.
- **Citing your sources**: When we have academic discussions, please cite your sources to back up what you say. For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.
- **Backing up your work**: Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.

## Academic Integrity Policy

See Descriptions of Major Course Assignments for specific guidelines about collaboration and academic integrity in the context of this online class.

### Ohio State's Academic Integrity Policy

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's Code of Student Conduct (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

**If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct.** If COAM determines that you have violated the university's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.
If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- Committee on Academic Misconduct (go.osu.edu/coam)
- Ten Suggestions for Preserving Academic Integrity (go.osu.edu/ten-suggestions)
- Eight Cardinal Rules of Academic Integrity (go.osu.edu/cardinal-rules)

## Copyright for Instructional Materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

## Statement on Title IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources.

If you or someone you know has been harassed or discriminated against based on your sex or gender, including sexual harassment, sexual assault, relationship violence, stalking, or sexual exploitation, you may find information about your rights and options on Ohio State's Title IX website (titleix.osu.edu) or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu. Title IX is part of the Office of Institutional Equity (OIE) at Ohio State, which responds to all bias-motivated incidents of harassment and discrimination, such as race, religion, national origin and disability. For more information, visit the OIE website (equity.osu.edu) or email equity@osu.edu.

## Commitment to a Diverse and Inclusive Learning Environment

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them.

We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

## Your Mental Health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. No matter where you are engaged in distance learning, The Ohio State University's Student Life Counseling and Consultation Service (CCS) is here to support you. If you find yourself feeling isolated, anxious or overwhelmed, on-demand mental health resources (go.osu.edu/ccsondemand) are available. You can reach an on-call counselor when CCS is closed at 614- 292-5766**. 24-hour emergency help** is available through the National Suicide Prevention Lifeline website (suicidepreventionlifeline.org) or by calling 1-800-273-8255(TALK). The Ohio State Wellness app (go.osu.edu/wellnessapp) is also a great resource.

# Accessibility Accommodations for Students with Disabilities

## Requesting Accommodations

The university strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services (SLDS). After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

### Disability Services Contact Information

- Phone: 614-292-3307
- Website: slds.osu.edu
- Email: slds@osu.edu
- In person: Baker Hall 098, 113 W. 12th Avenue

## Accessibility of Course Technology

This online course requires use of CarmenCanvas (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- CarmenCanvas accessibility (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- CarmenZoom accessibility (go.osu.edu/zoom-accessibility)
- Collaborative course tools

# Course Schedule

Refer to the CarmenCanvas course for up-to-date due dates.

| Week | Points | Topics, Readings, Assignments, Due Dates |
|---|---|---|
| **1** | 5 | **T Topic: Introduction and aims – Why study dinosaurs? The history of the study of dinosaurs (Chapters 2,15)**<br><br>**H Topic: Review of the geological history of the earth and the evolution of life up to the Mesozoic - setting the stage for the dinosaurs (Chs.2,14)**<br><br>In-class assignment: Constructing a geologic Time Scale |
| **2** | 5 | **T Topic: Fossil formation, excavation, and interpretation (contd) (Chs.1,2)**<br><br>**H Topic: Taphonomy – the study of the circumstances of fossil deposition and their relationship to the biology of fossil organisms; methods of reconstructing paleoclimates and environments**<br><br>In-class assignment: Interpreting taphonomy of a fossil (case study) |
| **3** | 5 | **T Topic: Taphonomy – the study of the circumstances of fossil deposition and their relationship to the biology of fossil organisms; methods of reconstructing paleoclimates and environments**<br><br>**H Topic: The evolutionary origin and radiation of the dinosaurs; dinosaurs as "revolutionary" organisms (Chs. 4, 5, and 14).**<br><br>In-class assignment: Constructing a phylogenetic tree |
| **4** | 5 | **T Topic: The evolutionary origin and radiation of the dinosaurs; dinosaurs as "revolutionary" organisms cont (Chs. 4, 5, and 14)**<br><br>**H Topic: The classification and phylogenetic relationships of dinosaurs; review of the Saurischian lineages (Chs. 5, 6, 7, and 9)** |

| | | |
|---|---|---|
| | | In-class assignment: Discussion: Old vs New View of Dinosaur phylogeny (What to believe?) |
| **5** | 90 | **T Topic: Review of the Ornithischian lineages (chapters 5, 10, 11, and 12)**<br><br>**H: **MIDTERM I: Covers material from weeks 1-5, open from 7:00 a.m.-11:59 p.m.****<br>In-class assignment: NONE |
| **6** | 5 | **T Topic: Explaining the spectacular success of dinosaurs (good genes or good luck?); selecting living models for dinosaurs; The problem of size and scaling in nature (or how do you design really big animals?); understanding the evolution of large size is dinosaurs (no readings)**<br><br>**H Topic: How big were the largest dinosaurs? – methods of estimating body weights; how fast could dinosaurs move? - biomechanical methods of estimating athletic abilities**<br><br>In-class assignment: Estimating mass of dinosaurs: a comparison of methods |
| **7** | 5 | **T Topic: The formation and interpretation of fossil trackways; reconstructing dinosaur movements and calculating speeds from fossil trackways**<br><br>**H Topic: Warm-blooded dinosaurs? Reconstructing the metabolic strategies of dinosaurs (Ch. 13)**<br><br>In-class assignment: Estimating dinosaur speed (case study) |
| **8** | 0 | **T Topic: Warm-blooded dinosaurs? (contd) (Ch. 13)**<br><br>**H: *Autumn break (no class)*** |

| | | |
|---|---|---|
| | | In-class assignment: NONE |
| **9** | 5 | **T Topic: Studying the social behavior of extinct animals - evidence of herding and parental behavior in dinosaurs**<br><br>**H Topic: Sexual selection and dinosaurs (parts of chapters 11 and 12)**<br><br>In-class assignment: Estimating Age a growth Rates from LAG data and discussion of parental care in dinosaurs |
| **10** | 5 | **T Topic: Sexual selection and dinosaurs (contd) (parts of chapters 11 and 12)**<br><br>**H Topic: Biology of the largest terrestrial animals to ever exist - the sauropods**<br>**(Ch.9)**<br><br>In-class assignment: Interpreting cranial ornamentation: sexual selection, species recognition or growth? |
| **11** | 90 | **T: **MIDTERM II (on CarmenCanvas): Covers material from weeks 6-10, open from 7:00 a.m.-11:59 p.m.****<br><br>**H Topic: The biology of the largest terrestrial predators –the tyrannosaurids and other large theropods – active hunters or scavengers? (parts of chapters 6 and 7)**<br><br>In-class assignment: NONE |
| **12** | 5 | **T Topic: The remarkable dromaeosaurids (aka "raptors") – the dinosaurs that launched the revolution in dinosaur biology (parts of chapters 6 and 7)**<br><br>**H: *Veterans Day (no class)*** |

| | | |
|---|---|---|
| | | In-class assignment: What happened to all the big predators? |
| **13** | 5 | **The Mesozoic battle tanks – biology of the Thyreophorans (Ch. 10)**<br><br>**The evolution and biology of the first and the largest flying vertebrates - the pterosaurs**<br><br>In-class assignment: How many species are present? |
| **14** | 30 | **The Mesozoic sea monsters - the ichthyosaurs, sauropterygians, and mosasaurs**<br><br>**25 THANKSGIVING HOLIDAY (traditional meal of dinosaur)**<br><br>In-class assignment: NONE<br><br>***Popular Media Assignment: DUE*** |
| **15** | 5 | **Dinosaurs and the origin of birds (Ch 7)**<br><br>**The great Cretaceous extinction - hypotheses and evidence (Ch.16)**<br><br>In-class assignment: The K-T Extinction-how rapid was it? |
| **16** | 90 | **T: *MIDTERM III (on CarmenCanvas): Covers material from weeks 11-15, open from 7:00 a.m.-11:59 p.m.**** |

EEOB 2250 Dynamics of Dinosaurs

**Submitted for approval for the new theme Origins and Evolution**

***Background*:** Dynamics of dinosaurs has been offered as a 2 credit hours course in the past; a course change request to increase credit hours for EEOB 2250 to 3 credit hours has been approved by ASCC for Spring 2023.

This course explores fundamentals of evolution and physiology through the framework of the diversification of non-avian dinosaurs. This course examines complex biological concepts such as allometry (and asks questions like "what are the unique challenges of being big?") and sexual selection (with questions like "How can I attract more mates than my neighbor?") in the context of the evolution of dinosaurs over time. Using dinosaurs as a model system to examine important biological questions, provides a unique opportunity to get students excited about biology and science in general through a group of beloved and fascinating organisms many of them already know and love. It also allows them an opportunity to see something familiar in a "different light" giving them the opportunity to experience the joy of scientific discovery through the course of the semester. Students also use quantitative tools to explore the dynamic lives of dinosaurs.

This course is comprised of class meetings involving lecture and small-group, active learning discussions, as well as in-class questions based on those discussions, and concludes in an end of semester paper which requires students to critique the portrayal of dinosaurs in popular media. Examples of an in-class assignment might be asking students to examine real growth data from fossilized dinosaur bones and asking them to calculate growth rates, and then based on their calculations, hypothesize as to which lineages of dinosaurs may provide parental care to their offspring given differences in early growth. These will then be part of a large in-class discussion in which groups share their conclusions. In addition, three midterms test mastery of course material. This course teaches proficiency with evolutionary concepts at an intermediate level.

***Expected learning outcomes specific to the course*:** Successful students will: (1) Learn the basic principles and concepts guiding paleobiological study of life on earth, (2) understand how paleobiology works as a science that tests hypotheses about extinct organisms and past environments, (3) know the evolutionary origin and radiation of the dinosaur lineages, and develop an informed historical perspective of how dinosaurs have impacted life on earth, (4) understand how aspects of the life of dinosaurs (and other extinct organisms) can be reconstructed using scientific methods and (5) be able to distinguish between science-based and non-science based opinions expressed in popular press accounts of dinosaur biology

***(I) How EEOB 2250 meets ELOs shared by all themes***

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| ELO 1.1 Engage in critical and logical thinking. | Lectures and textbook readings will teach students how to make inferences about significant aspects of the biology of dinosaurs that cannot be observed directly using calculations with data from fossils and an interpretive framework provided by study of living animals. For example, in different exercises, students will (1) estimate body masses of dinosaurs using empirically derived relationships between body mass and skeletal dimensions in |

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| | terrestrial vertebrates, (2) derive growth rates of dinosaurs using the number and spacing of linear arrestation of growth (LAG) lines preserved in bone combined with bone size, and (3) infer walking speeds of dinosaurs from stride length, measured in trackways and limb length, inferred from footprint length. In each case, students work from the observable to make novel inferences about unknowns and learn to appreciate the power of scientific inference. |
| ELO 2.1 Identify, describe, and synthesize approaches or experiences. | Students will engage in critical and logical thinking about the physical systems of the earth and the history of life on earth as background to the evolution of the dinosaurs. Topics covered in reading, lectures, discussions, and homework include the nature and depth of geologic time, how scientists tell time in the geologic record (which requires a basic understanding of the chemistry of radioisotopes), the methods and general conclusions of paleogeography and paleoclimatology as they apply to the Mesozoic world of the dinosaurs, the history of vertebrates prior to the origin of dinosaurs, and the animals and plants that shared the world of the dinosaurs. Students learn what they need to know to understand the world of the dinosaurs, but, more importantly, they learn how we know what we know. |
| ELO 2.2 Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts. | On the first day of class, we hand out to the students a brief questionnaire inquiring about their academic interests and major, primarily to determine their level of preparedness, which we use to plan at what level we need to pitch lecture. We also ask why they enrolled in the course and what did they hope to get out of it. At the end of the course, we will return these questionnaires to them to ask, among other things, whether they got what they were looking for. This will provide opportunity for reflection and self-assessment. For example, most students initially simply want to learn more about dinosaurs. We anticipate that many of these students will feel that they did learn something about dinosaurs that they did not know before, but that they also learned new ways of thinking or of making inferences. Some may learn new ways of seeking out information (see below). Some may come away with a greater appreciation for how advances in one science may make possible advances in another.<br>In addition, the course includes a writing assignment in which students critically evaluate the presentation of dinosaurs in the media. This assignment allows students to reflect on their understanding of dinosaur biology and their experiences with portrayals of these organisms in popular culture. As part of this assignment, students explain how approaches, ways of thinking, or new points of view that they have learned in the class have informed their view of dinosaur portrayals. |

***(I) How EEOB 2250 meets ELOs of the Origins and Evolution Theme.***

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| **ELO 1.1** Apply their understanding of scientific methods to quantitative calculations. | Lectures and textbook readings will teach students how to make inferences about significant aspects of the biology of dinosaurs that cannot be observed directly using calculations with data from fossils and an interpretive framework provided by study of living animals. For example, in different exercises, students will (1) estimate body masses of dinosaurs using empirically derived relationships between body mass and skeletal dimensions in terrestrial vertebrates, (2) derive growth rates of dinosaurs using the number and spacing of linear arrestation of growth (LAG) lines preserved in bone combined with bone size, and (3) infer walking speeds of dinosaurs from stride length, measured in trackways and limb length, inferred from footprint length. In each case, students work from the observable to make novel inferences about unknowns and learn to appreciate the power of scientific inference. |
| **ELO 1.2** Engage in critical and logical thinking about the origins and evolution of the universe, physical systems, life on earth, humanity, or human culture. | Students will engage in critical and logical thinking about the physical systems of the earth and the history of life on earth as background to the evolution of the dinosaurs. Topics covered in reading, lectures, discussions, and homework include the nature and depth of geologic time, how scientists tell time in the geologic record (which requires a basic understanding of the chemistry of radioisotopes), the methods and general conclusions of paleogeography and paleoclimatology as they apply to the Mesozoic world of the dinosaurs, the history of vertebrates prior to the origin of dinosaurs, and the animals and plants that shared the world of the dinosaurs. Students learn what they need to know to understand the world of the dinosaurs, but, more importantly, they learn how we know what we know. |
| **ELO 2.1** Identify, describe, and synthesize approaches to or experiences of origins and evolution questions in different academic and non-academic contexts. | Our understanding of the biology of the dinosaurs has evolved tremendously over the past two-hundred years, and even more so over just the past few decades. To some extent, our expanding understanding of how dinosaurs lived reflects the accumulation of new finds and the activities of more dinosaur paleontogists. Technological advances certainly have played a role too. For example, the development of new non-invasive imaging technologies, such as microCT scanning, have made it possible to extract unprecendented detail from fossils without destroying them. Arguably, however, scientific revolutions that have changed the way in which scientists think and change the questions that scientist ask have played an even greater role. To give two examples, the adoption of evolutionary thinking by scientists in the 19$^{th}$ century provided a context for considering ancestor-descendent relationships among dinosaurs, whereas the cladistic revolution in the late twentieth century provided |

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| | a methodology and toolkit for investigating the evolutionary relationships of dinosaurs to one another and to living vertebrates, leading ultimately to the recognition that birds are dinosaurs. Following soon thereafter was the insight that many aspects of bird biology (endothermy, rapid growth to maturity, high levels of sustained activity, efficient respiration, complex behavior, parental care) may also apply to all, or at least to some other dinosaurs. These inferences would been inconceivable to most 19th century scientists and even many 20th century scientists. The way in which dinosaurs have been depicted in popular accounts, the arts, and movies has also evolved reflecting the scientific consensus of their times. Students experience this interplay between evolving scientific knowledge of dinosaurs, technological advances, scientific revolutions, and transfer of information and insights from the scientific realm into the public imagination through lectures and reading, in-class questions, homework assignments, and exams. |
| **ELO 2.2** Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts. | On the first day of class, we hand out to the students a brief questionnaire inquiring about their academic interests and major, primarily to determine their level of preparedness, which we use to plan at what level we need to pitch lecture. We also ask why they enrolled in the course and what did they hope to get out of it. At the end of the course, we will return these questionnaires to them to ask, among other things, whether they got what they were looking for. This will provide opportunity for reflection and self-assessment. For example, most students initially simply want to learn more about dinosaurs. We anticipate that many of these students will feel that they did learn something about dinosaurs that they did not know before, but that they also learned new ways of thinking or of making inferences. Some may learn new ways of seeking out information (see below). Some may come away with a greater appreciation for how advances in one science may make possible advances in another.<br>In addition, the course includes a writing assignment in which students critically evaluate the presentation of dinosaurs in the media. This assignment allows students to reflect on their understanding of dinosaur biology and their experiences with portrayals of these organisms in popular culture. As part of this assignment, students explain how approaches, ways of thinking, or new points of view that they have learned in the class have informed their view of dinosaur portrayals. |
| **ELO 3.1** Illustrate the time depth of the universe, physical systems, life on earth, | Understanding the depth of geologic time and how scientists tell time in the geologic record are fundamental aspects of the course *Dynamics of Dinosaurs*. Coverage |

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| humanity, or human culture by providing examples or models. | begins from introductory lectures on geologic time and the methods of dating rocks and fossils including radio-isotopic age estimation, biostratigraphy, magnetostratigraphy, and even recent advances in chemostratigraphy. Relative dating and numerical age estimation are compared with illustrations from the Mesozoic on how the different approaches can be used together to construct a timescale for dinosaur evolution. The necessity of reliable and precise dates in estimating rates of evolution and extinction is highlighted. Examples illustrating the major events in the history of the dinosaurs include some that are dated tentatively with a large margin of error (such as their origin of the group sometime in the Late Triassic) as well as others that dated with great precision (such as the mass extinction at the end of the Cretaceous). |
| **ELO 3.2** Explain scientific methods used to reconstruct the history of the universe, physical systems, life on earth, humanity, or human culture and specify their domains of validity. | Students learn how geologists and paleontologists reconstruct the history of the Earth and of life on Earth using observations and physical principles. As explained in the lectures and readings, radio-isotopic age estimation of rocks and fossils – to give one example - relies on the uniformitarian assumption that the underlying mechanisms of physics have operated in the same way through time. That is, to estimate the age of rocks, we assume that the empirically derived rate constants describing the rate of decay of radioisotopes does not change over time. This property makes it possible for researchers to choose one radioisotope over another depending on the depth of time sampled and required level of resolution. Students also learn about recent advances, from standardization of lab techniques to calibration of dating technique, to astronomical cycles, that have greatly increased precision and reduced margins of error. The course applies similar approaches to the study of paleogeography, paleoclimatology, phylogeny reconstruction, and inference about the paleobiology of dinosaurs. Students' understanding of these methods is deepened and assessed through in-class questions, homework problems, and exam questions. |
| **ELO 3.3** Engage with current controversies and problems related to origins and evolution questions. | That evolution has occurred and is still occurring today are nowadays considered to be objective facts in the scientific community. The theory that evolution by natural selection has been responsible for generating the diversity of life on Earth is now so well supported by all available observations that there really is no other scientific theory that stands as a viable alternative. Nevertheless, for religious, philosophical, or cultural reasons, some members of American society have difficulty accepting evolution as the best, indeed only explanation for the history of life. For those individuals who can be persuaded by evidence, the fossil record |

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| | provides some of the best demonstrations of the fact that evolution has occurred. One example discussed in the class is the well-known correspondence between the sequence in time in which new biologic groups have appeared and the sequence predicted by their phylogeny, which has been demonstrated in numerous groups including dinosaurs. The fossil record of the origin of birds provides evidence of how large-scale evolutionary change that is difficult to imagine can occur. Current evidence shows the acquisition of the traits that distinguish modern birds from their closest living relatives evolved in a stepwise fashion over tens of millions of years with some traits evolved very deep in time (e.g., feathers, which are now known across dinosaurs and even pterosaurs) and others acquired only the clade defined by extant birds (e.g., loss of teeth). Students are challenged to relate these observations and inferences to their own expectations through answering questions, discussions, exams, and essays. |
| **ELO 4.1** Describe how the universe, physical systems, life on earth, humanity, or human culture have evolved over time. | EEOB 2250 concentrates on the empirically well-established evolution of the dinosaurs, including birds, with emphasis on their evolution during the Mesozoic Era. Dinosaurs did not evolve in a vacuum, however, and so it is necessary to consider their world, including the configuration of the continents and climate and how it during the Mesozoic. Because dinosaur environments included the biotic environment, it is also necessary to consider the range of potential food resources, competitors, parasites, and indeed the full range of potential ecological interactions. Ecological impacts of dinosaurs, especially the large herbivorous dinosaurs, in shaping their own physical and biotic environment cannot be understated either, with reciprocal evolution of dinosaurs with other organisms in their trophic webs being real possibility. This evolutionary and ecological history of dinosaurs is a constant theme of the lectures and readings, and students explore it further through in-class questions and homework assignments. |
| **ELO 4.2** Summarize current theories of the origin and evolution of the universe, physical systems, life on earth, humanity, or human culture. | The theory of evolution by natural selection is one of the great achievements of the scientific revolution and of human culture. Evolution is responsible for revolutionizing biology, proving a unifying conceptual framework, and for fundamentally changing how we view ourselves as a species and our place in the cosmos. Our understanding of evolution has itself matured as more has been learned since Darwin of mechanisms of inheritance, how changes in development produce changes in phenotype and how genes shape development, and how a diversity of selection mechanisms operating at different levels of the biological hierarchy can supplement “simple” natural selection. As our |

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| | understanding of evolution in general has matured, so too have our interpretations of dinosaur evolution. For example, the evolution of horns in ceratopsians, crests in hadrosaurs, and domed skulls in pachycephalosaurs is now interpreted in the context of intraspecific competition, species-recognition signals, and sexual selection. Questions about homology, including outstanding problems in identifying corresponding fingers in the hands of birds and nonavian theropods, now benefits from a modern understanding of how digit identity is established in development. In EEOB 2250, students learn some of modern evolutionary thought and apply it to the evolution of dinosaurs, in in-class questions, homework assignments, and exams. |

# Course Listing and Curriculum Map for the Evolution and Eco

## Required supportive courses (do not count towards hours in the ma

| Requirements | Semester Course Number | Course Title | Semester Units |
|---|---|---|---|
| **Biology** | BIOL 1113 | Introductory Biology | 4 |
| **Biology** | BIOL 1114 | Introductory Biology | 4 |
| **Math** | MATH 1151 | Calculus 1 | 5 |
| **General Chemistry** | CHEM 1210, 1220 | General Chemistry | 10 |
| **Organic Chemistry** | CHEM 2310 or CHEM 2510 | Organic Chemistry | 4 |
| **Physics** | 1250 & 1251 OR 1200 & 1201 | General Physics | 10 |
| **Statistics** | STAT 2480 | Statistics for Life Sciences | 3 |

## Required core courses

| Requirements | Semester Course Number | Course Title | Semester Units |
|---|---|---|---|
| | EEOB 3310 or 3310H | Evolution | 4 |
| | EEOB 3410 or 3410H | Ecology | 4 |
| | BIOL 3401 | Integrated Biology | 4 |
| | MATH or STAT | Advanced quantitative analysis course | |

## Elective courses in Biodiversity (choose at least two)

| Requirements | Semester Course Number | Course Title | Semester Units |
|---|---|---|---|
| | EEOB 2210 | Ohio Plants | 2 |
| | EEOB 2220 | Ohio Birds | 2 |
| | EEOB 3320 | Organismal Diversity | 2 |
| | EEOB 4210 | Evolution & Ecology: Vertebrates | 2 |
| | EEOB 4220 | Evolution & Ecology: Mammals | 3 |
| | EEOB 4230 | Evolution & Ecology: Invertebrates | 2 |
| | EEOB 4240 | Evolution & Ecology: Plants & People | 2 |

## Elective courses in Evolution and Ecology (choose at least two)

| Requirements | Semester Course Number | Course Title | Semester Units |
|---|---|---|---|
| | EEOB 3420 | Behavioral Ecology | 4 |
| | EEOB 4410 | Conservation Biology | 3 |
| | EEOB 4420 | Tropical Field Studies | 2 |
| | EEOB 4430 | Ecological Methods I | 1 |
| | | | |
| | EEOB 5310 | Advanced Evolution | 3 |
| | EEOB 5320 | Creation & Evolution | 3 |
| | EEOB 5410 | Ocean Ecology | 1.5 |
| | EEOB 5420 | Ecology of Inland Waters | 1.5 |
| | EEOB 5430 | Fish Ecology | 1.5 |
| | EEOB 5450 | Population Ecology | 3 |
| | EEOB 5460 | Physiological Ecology | 3 |
| | EEOB 5470 | Community Ecosystem Ecology | 3 |

## All elective courses in EEOB that could count toward major

| | | | |
|---|---|---|---|
| | EEOB 2210 | Ohio Plants | 2 |
| | EEOB 2220 | Ohio Birds | 2 |
| | EEOB 2250 | Dynamics of Dinosaurs | 3 |
| | EEOB 2410 | Biological Invasions | 3 |
| | EEOB 2510 | Human Anatomy | 3 |
| | EEOB 2520 | Human Physiology | 3 |

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| EEOB 2911 | The Climate Crisis: Mechanisms, Impact, and Mitigation | 4 |
| EEOB 3189 | UG Field Experience or Work | 1-3 |
| EEOB 3191 | UG Internship | 1-3 |
| EEOB 3193 | UG Individual Studies | 1-3 |
| EEOB 3270 | Infectious disease ecology, evolution, and transmission | 3 |
| EEOB 3320 | Organismal Diversity | 3 |
| EEOB 3420 | Behavioral Ecology | 4 |
| EEOB 3510 | Cellular & Developmental Biology | 3 |
| EEOB 3520 | Micro Anatomy | 1.5 |
| EEOB 3797 | UG Foreign Study | 1-12 |
| EEOB 3798 | UG Study Tour | 1-12 |
| EEOB 4210 | Evolution & Ecology: Vertebrates | 2 |
| EEOB 4220 | Evolution & Ecology: Mammals | 3 |
| EEOB 4320 | Evolution & Ecology: Invertebrates | 2 |
| EEOB 4240 | Evolution & Ecology: Plants & People | 2 |
| EEOB 4410 | Conservation Biology | 3 |
| EEOB 4420H | Tropical Field Studies | 2 |
| EEOB 4430 | Ecological Methods I | 2 |
| EEOB 4510 | Comparative Vertebrate Anatomy | 3 |
| EEOB 4520 | Comparative Physiology | 3 |
| EEOB 4520H | Comparative Physiology - Honors | 3 |
| EEOB 4550 | Neurobiology of Behavior | 3 |
| EEOB 4560 | Endocrinology | 2 |
| EEOB 4910 | Plant Biology for Teachers (Stone Lab) | 2 |
| EEOB 4920 | Ornithology for Teachers (Stone Lab) | 2 |
| EEOB 4930 | Stream Ecology for Teachers (Stone Lab) | 2 |
| EEOB 4950 | Field Ecology (Stone Lab) | 2 |
| EEOB 4998 | UG Research | 1-3 |
| EEOB 4998H | UG Research - Honors | 1-3 |
| EEOB 4999 | UG Thesis Research | 1-5 |
| EEOB 4999H | UG Thesis Research - Honors | 1-5 |
| EEOB 5189 | Field Work | 1-4 |
| EEOB 5194 | Bioacoustic Ecology | 2 |
| EEOB 5194 | Host-Microbial Symbioses | 3 |

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| EEOB 5310 | Advanced Evolution | 3 |
| EEOB 5320 | Society & Evolution | 3 |
| EEOB 5330 | Population Genetics & Phylogeography | 3 |
| EEOB 5340 | Evolution & Taxonomy of Vascular Plants | 3 |
| EEOB 5350 | Evolutionary Ecology | 3 |
| EEOB 5410 | Ocean Ecology | 1.5 |
| EEOB 5420 | Ecology of Inland Waters | 1.5 |
| EEOB 5430 | Fish Ecology | 1.5 |
| EEOB 5440 | Plankton Ecology | 3 |
| EEOB 5450 | Population Ecology | 3 |
| EEOB 5460 | Physiological Ecology | 3 |
| EEOB 5470 | Community & Ecosystem Ecology | 3 |
| EEOB 5480 | Advanced Plant Ecology | 3 |
| EEOB 5490 | Insect Behavior: Mechanisms and Function | 3 |
| EEOB 5505 | Wicked Science | 3 |
| EEOB 5510 | Interdisciplinary Team Science | 3 |
| EEOB 5610S | Translating Evolution | 3 |
| EEOB 5798 | Tropical Behavioral Ecology & Evolution | 3 |
| EEOB 5910 | Field Herpetology (Stone Lab) | 2 |
| EEOB 5920 | Field Biology of Aquatic & Wetland Plants (Stone Lab) | 3 |
| EEOB 5930 | Ichthyology (Stone Lab) | 3 |
| EEOB 5940 | Field Zoology (Stone Lab) | 3 |
| EEOB 5950 | Algae Identification Workshop (Stone Lab) | 0.5 |
| EEOB 5960 | Plankton Identification Workshop (Stone Lab) | 0.5 |
| EEOB 5970 | Larval Fish Identification Workshop (Stone Lab) | 0.5 |

## Program Learning Goals

1. Students are able to describe the processes that underlie evolution and their manifestation in th

2. Students are able to explain ecological concepts, methods of study, and the interactions among organisms and betwe

3. Students are able to understand organismal diversity and functioning at all levels, from the molecular and cellula understand the interplay between organismal functioning and ecological and evolutionary p

4. Students participate in the process of discovery by conducting experimental and observational studies, synthesizing re communicating their questions, hypotheses, observations, and experiences to other

5. Students demonstrate proficiency in mathematics, statistics, computer modeling, and the use of computers, as

6. Students know the theoretical framework of evolution, ecology and organismal biology and understand science as a pr as it relates to these three disciplines within biology.

7. Students are aware of current issues in biology, especially those that have significant ethical and societal implicatior scientific concepts and processes.

## Notes

Program goal numbers that have no asterisk indicate a beginner level; * = intermediate level; ** = advanced level.
Honors versions of courses may be substituted in all cases.
No more than three units of S/U credit can count toward the major.

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| Notes | Relevant Program Goals |
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| Notes | Relevant Program Goals |
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| | 1*, 3*, 5*, 6*, 7* |
| | 2*, 3*, 5* |
| | 1*, 2*, 3* |
| | 5* |

| Notes | Relevant Program Goals |
|---|---|
| | 1, 2, 3, 4, 6, 7 |
| | 1, 2, 3, 4, 6, 7 |
| | 1*, 2*, 3*, 4*, 7* |
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| | 1*, 2*, 3*, 4*, 7* |

| Relevant Program Goals | Relevant Program Goals |
|---|---|
| | 2*, 3* |
| | 2*, 5*, 7* |
| | 2*, 5* |
| | 2*, 3*, 5 |
| | 1**, 2*, 3**, 4*, 5*, 6**, 7** |
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Cross-listed with EarthSc and History 2,6,7*

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| | 2**, 3**, 4**, 5** |
| | 1**,2**,3**,5*,6**,7** |
| Cross-listed with ENTO 5490 | 1**,2**,3**,4**,6**,7** |
| Cross-listed with ANTHROP 5505 | 4*,5,6** |
| Cross-listed with ANTHROP 5510 | 4*,5,6** |
| SL Course in sci comm | 1**, 4**, 6** |
| | |
| Field course at Smithsonian Tropical Research Institute, Panama | 1**, 2**, 3**, 4**, 6** |
| | 1*, 2*, 3* |
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# Course Listing and Curriculum Map for the

## Required supportive courses (do not count toward

| Requirements | Semester Course Number | Course Title |
|---|---|---|
| **Biology** | BIOL 1113 | Introductory Biology |
| **Biology** | BIOL 1114 | Introductory Biology |
| **Math** | MATH 1151 | Calculus 1 |
| **General Chemistry** | CHEM 1210, 1220 | General Chemistry |
| **Organic Chemistry** | CHEM 2310 or CHEM 2510 & 2520 | Organic Chemistry |
| **Physics** | PHYS 1106 & 1007 OR 1250 & 1251 OR 1200 & 1201 | General Physics |
| **Statistics** | STAT 2480 | Statistics for Life Sciences |

## Required core courses

| Semester Course Number | Course Title |
|---|---|
| EEOB 3310 or 3310H | Evolution |
| EEOB 3410 or 3410H | Ecology |
| MOLGEN 4500 | General Genetics |

## Elective courses in Biodiversity (choo

| Semester Course Number | Course Title |
|---|---|
| EEOB 2220 | Ohio Birds |
| EEOB 3320 | Organismal Diversity |
| EEOB 4210 | Evolution & Ecology: Vertebrates |
| EEOB 4220 | Evolution & Ecology: Mammals |
| EEOB 4230 | Evolution & Ecology: Invertebrates |
| EEOB 4410 | Conservation Biology |
| EEOB 4420H | Tropical Field Studies |

## Elective courses in Organismal Biology (ch

| Semester Course Number | Course Title |
|---|---|
| EEOB 2510 | Human Anatomy |
| EEOB 3510 | Cellular & Developmental Biology |
| EEOB 4510 | Comparative Vertebrate Anatomy |
| EEOB 4520 | Comparative Physiology |
| EEOB 4550 | Neurobiology of Behavior |

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|---|---|
| EEOB 4560 | Endocrinology |

## All elective courses in EEOB that could count toward majo

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|---|---|
| EEOB 2210 | Ohio Plants |
| EEOB 2220 | Ohio Birds |
| EEOB 2250 | Dynamics of Dinosaurs |
| EEOB 2410 | Biological Invasions |
| EEOB 2510 | Human Anatomy |
| EEOB 2911 | The Climate Crisis: Mechanisms, Impact, and Mitigation |
| EEOB 2520 | Human Physiology |
| EEOB 3189 | UG Field Experience or Work |
| EEOB 3191 | UG Internship |
| EEOB 3193 | UG Individual Studies |
| EEOB 3270 | Infectious disease ecology, evolution, and tr |
| EEOB 3320 | Organismal Diversity |
| EEOB 3420 | Behavioral Ecology |
| EEOB 3510 | Cellular & Developmental Biology |
| EEOB 3520 | Micro Anatomy |
| EEOB 3797 | UG Foreign Study |
| EEOB 3798 | UG Study Tour |
| EEOB 4210 | Evolution & Ecology: Vertebrates |
| EEOB 4220 | Evolution & Ecology: Mammals |
| EEOB 4230 | Evolution & Ecology: Invertebrates |
| EEOB 4240 | Evolution & Ecology: Plants & People |
| EEOB 4410 | Conservation Biology |
| EEOB 4420H | Tropical Field Studies |
| EEOB 4430 | Ecological Methods I |
| EEOB 4510 | Comparative Vertebrate Anatomy |
| EEOB 4520 | Comparative Physiology |
| EEOB 4520H | Comparative Physiology - Honors |
| EEOB 4550 | Neurobiology of Behavior |
| EEOB 4560 | Endocrinology |
| EEOB 4910 | Plant Biology for Teachers (Stone Lab) |
| EEOB 4920 | Ornithology for Teachers (Stone Lab) |
| EEOB 4930 | Stream Ecology for Teachers (Stone Lab) |
| EEOB 4950 | Field Ecology (Stone Lab) |
| EEOB 4998 | UG Research |
| EEOB 4998H | UG Research - Honors |
| EEOB 4999 | UG Thesis Research |
| EEOB 4999H | UG Thesis Research - Honors |
| EEOB 5189 | Field Work |
| EEOB 5194 | Bioacoustic Ecology |
| EEOB 5194 | Host-Microbial Symbioses |
| EEOB 5310 | Advanced Evolution |

| | |
|---|---|
| EEOB 5320 | Society & Evolution |
| EEOB 5330 | Population Genetics & Phylogeography |
| EEOB 5340 | Evolution & Taxonomy of Vascular Plants |
| EEOB 5350 | Evolutionary Ecology |
| EEOB 5410 | Ocean Ecology |
| EEOB 5420 | Ecology of Inland Waters |
| EEOB 5430 | Fish Ecology |
| EEOB 5440 | Plankton Ecology |
| EEOB 5450 | Population Ecology |
| EEOB 5460 | Physiological Ecology |
| EEOB 5470 | Community & Ecosystem Ecology |
| EEOB 5480 | Advanced Plant Ecology |
| EEOB 5490 | Insect Behavior: Mechanisms and Function |
| EEOB 5505 | Wicked Science |
| EEOB 5510 | Interdisciplinary Team Science |
| EEOB 5610S | Translating Evolution |
| EEOB 5798 | Tropical Behavioral Ecology & Evolution |
| EEOB 5910 | Field Herpetology (Stone Lab) |
| EEOB 5920 | Field Biology of Aquatic & Wetland Plants (Stone Lab) |
| EEOB 5930 | Ichthyology (Stone Lab) |
| EEOB 5940 | Field Zoology (Stone Lab) |
| EEOB 5950 | Algae Identification Workshop (Stone Lab) |
| EEOB 5960 | Plankton Identification Workshop (Stone Lab) |
| EEOB 5970 | Larval Fish Identification Workshop (Stone Lab) |

## Program Learning Goals

1. Students are able to describe the processes that underlie evolution and their manifestation in the natural w
2. Students are able to explain ecological concepts, methods of study, and the interactions among organisms a
3. Students are able to understand organismal diversity and functioning at all levels, from the molecular and c
4. Students participate in the process of discovery by conducting experimental and observational studies, synt
5. Students demonstrate proficiency in mathematics, statistics, computer modeling, and the use of computers
6. Students know the theoretical framework of evolution, ecology and organismal biology and understand scie
7. Students are aware of current issues in biology, especially those that have significant ethical and societal im

## Notes

Program goal numbers that have no asterisk indicate a beginner level; * = intermediate level; ** = advanced le
Honors versions of courses may be substituted in all cases.
No more than three units of S/U credit can count toward the major.

# e Zoology BS Major

## s hours in the major)

| Semester Units | Notes | Relevant Program Goals |
|---|---|---|
| 4 | | 1, 2, 3 |
| 4 | | 1, 2, 3 |
| 5 | MATH 1156 also accepted | 5 |
| 10 | 2 semesters of general chemistry required for program | 4 |
| 4 | 1 semester organic chemistry required for majors; pre-professional track advised to take 2 semesters | 4 |
| 10 | | 4 |
| 3 | STAT 2450 also accepted | 5 |

| Semester Units | Notes | Relevant Program Goals |
|---|---|---|
| 4 | | 1*, 3*, 5*, 6*, 7* |
| 4 | | 2*, 3*, 5* |
| 3 | | 1*, 2*, 3* |

## se two)

| Semester Units | Notes | Relevant Program Goals |
|---|---|---|
| 2 | 7-week course | 1, 2, 3, 4, 6, 7 |
| 2 | | 1*, 2*, 3*, 4*, 7* |
| 2 | | 1*, 2*, 3*, 4* |
| 3 | | 1*, 2*, 3*, 4* |
| 2 | | 1*, 2*, 3*, 4* |
| 3 | | 2*, 5*, 7* |
| 2 | | 2*, 5* |

## oose at two)

| Semester Units | Notes | Relevant Program Goals |
|---|---|---|
| 3 | | 3, 4 |
| 3 | | 1, 3*, 7 |
| 3 | | 1*, 3*, 6* |
| 3 | | 2*, 3*, 5* |
| 3 | | 3**, 5*, 6* |

| | | |
|---|---|---|
| 2 | | 1*, 3**, 4* |

## or (up to 10 semester units)

| | | |
|---|---|---|
| 2 | 7-week course | 1, 2, 3, 4, 6, 7 |
| 2 | 7-week course | 1, 2, 3, 4, 6, 7 |
| 3 | 7-week course | 1*,3*,6 |
| 3 | | 1, 2, 3, 4, 6, 7 |
| 3 | | 3, 4 |
| | | |
| 4 | Cross-listed with EarthSc and Hist | 2,6,7* |
| 3 | | 1, 3, 6, 7 |
| 1-3 | | |
| 1-3 | | |
| 1-3 | | |
| 3 | | 1*,2*,3,4**,5**,6**,7* |
| 3 | | 1*, 2*, 3*, 4*, 7* |
| 4 | | 2*, 3* |
| 3 | | 1, 3*, 7 |
| 1.5 | | 3**, 4*, 5*, 6*, 7** |
| 1-12 | | |
| 1-12 | | |
| 2 | | 1*, 2*, 3*, 4* |
| 3 | | 1*, 2*, 3*, 4* |
| 2 | | 1*, 2*, 3*, 4* |
| 2 | | 1*, 2*, 3*, 4*, 7* |
| 3 | | 2*, 5*, 7* |
| 2 | | 2*, 5* |
| 2 | | 2*, 3*, 5 |
| 3 | | 1*, 3*, 6* |
| 3 | | 2*, 3*, 5* |
| 3 | | 2*, 3*, 5* |
| 3 | | 3**, 5*, 6* |
| 2 | | 1*, 3**, 4* |
| 2 | | 1*, 2*, 3* |
| 2 | | 1*, 2*, 3* |
| 2 | | 2*, 3* |
| 2 | | 2*, 3* |
| 1-3 | | |
| 1-3 | | |
| 1-5 | | |
| 1-5 | | |
| 1-4 | | |
| 2 | | 1*,2*,3,4**,5**,6,7** |
| 3 | | 1**, 2**, 3*, 4**, 5** |
| 3 | | 1**, 2*, 3**, 4*, 5*, 6**, 7** |

| | | |
|---|---|---|
| 3 | | 1**, 6**, 7** |
| 3 | | 1**, 4**, 5** |
| 3 | | 1**, 3**, 6** |
| 3 | | 1**, 2**, 3*, 5** |
| 1.5 | | 2**, 3*, 5* |
| 1.5 | | 2**, 3*, 5* |
| 1.5 | | 2**, 3*, 5* |
| 3 | | 2**,3**,4**,5**,6**,7** |
| 3 | | 2**, 5** |
| 3 | | 2**, 5** |
| 3 | | 2**, 3**, 4**, 5** |
| 3 | | 1**,2**,3**,5*,6**,7** |
| 3 | Cross-listed with ENTO 5490 | **,2**,3**,4**,6**,7** |
| 3 | Cross-listed with ANTHROP 5505 | 4*,5,6** |
| 3 | Cross-listed with ANTHROP 5510 | 4*,5,6** |
| 3 | SL Course in sci comm | 1**, 4**, 6** |
| 3 | Field course at Smithsonian Tropical Research Institute, Panama | 1**, 2**, 3**, 4**, 6** |
| 2 | Summer course at Stone Lab | 1*, 2*, 3* |
| 3 | Summer course at Stone Lab | 1*, 2*, 3* |
| 3 | Summer course at Stone Lab | 1*, 2*, 3* |
| 3 | Summer course at Stone Lab | 1*, 2*, 3* |
| 0.5 | Summer course at Stone Lab | 3* |
| 0.5 | Summer course at Stone Lab | 3* |
| 0.5 | Summer course at Stone Lab | 3* |

orld.
and between organisms and their environment.
ellular to the whole organism, and will understand the interplay between organismal functioning and ecol
hesizing results with the primary literature, and communicating their questions, hypotheses, observations
, as these topics relate to biology.
ence as a process, including the history of science as it relates to these three disciplines within biology.
plications, and will be able to communicate scientific concepts and processes.

evel.

logical and evolutionary processes.

# Course Listing and Curriculum Map for tl

## Required supportive courses (do not count towa

| Requirements | Semester Course Number | Course Title |
|---|---|---|
| **Biology** | BIOL 1113 | Introductory Biology |
| **Biology** | BIOL 1114 | Introductory Biology |
| **Math** | MATH 1148 | College Algebra |
| **General Chemistry** | CHEM 1210, 1220 | General Chemistry |
| **Organic Chemistry** | CHEM 2310 | Organic Chemistry |
| **Physics** | PHYS 1106 & 1007 OR 1250 & 1251 OR 1200 & 1201 | General Physics |
| **Statistics** | STAT 1450 | Intro Stats |

## Required core courses

| Semester Course Number | Course Title |
|---|---|
| EEOB 3310 or 3310H | Evolution |
| EEOB 3410 or 3410H | Ecology |
| MOLGEN 4500 | General Genetics |

## Elective courses in Biodiversity (ch

| Semester Course Number | Course Title |
|---|---|
| EEOB 2220 | Ohio Birds |
| EEOB 3320 | Organismal Diversity |
| EEOB 4210 | Evolution & Ecology: Vertebrates |
| EEOB 4220 | Evolution & Ecology: Mammals |
| EEOB 4230 | Evolution & Ecology: Invertebrates |
| EEOB 4410 | Conservation Biology |
| EEOB 4420H | Tropical Field Studies |

## Elective courses in Organismal Biology (

| Semester Course Number | Course Title |
|---|---|
| EEOB 2510 | Human Anatomy |
| EEOB 3510 | Cellular & Developmental Biology |
| EEOB 4510 | Comparative Vertebrate Anatomy |
| EEOB 4520 | Comparative Physiology |
| EEOB 4550 | Neurobiology of Behavior |
| EEOB 4560 | Endocrinology |

## All elective courses in EEOB that could count toward m

| | |
|---|---|
| EEOB 2210 | Ohio Plants |
| EEOB 2220 | Ohio Birds |
| EEOB 2250 | Dynamics of Dinosaurs |
| EEOB 2410 | Biological Invasions |
| EEOB 2510 | Human Anatomy |
| EEOB 2520 | Human Physiology |
| EEOB 2911 | The Climate Crisis: Mechanisms, Impact, and Mitigation |
| EEOB 3189 | UG Field Experience or Work |
| EEOB 3191 | UG Internship |
| EEOB 3193 | UG Individual Studies |
| EEOB 3270 | Infectious disease ecology, evolution, and tr |
| EEOB 3320 | Organismal Diversity |
| EEOB 3420 | Behavioral Ecology |
| EEOB 3510 | Cellular & Developmental Biology |
| EEOB 3520 | Micro Anatomy |
| EEOB 3797 | UG Foreign Study |
| EEOB 3798 | UG Study Tour |
| | |
| EEOB 4210 | Evolution & Ecology: Vertebrates |
| EEOB 4220 | Evolution & Ecology: Mammals |
| EEOB 4230 | Evolution & Ecology: Invertebrates |
| EEOB 4240 | Evolution & Ecology: Plants & People |
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| EEOB 4430 | Ecological Methods I |
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| EEOB 4998H | UG Research - Honors |
| EEOB 4999 | UG Thesis Research |
| EEOB 4999H | UG Thesis Research - Honors |
| EEOB 5189 | Field Work |
| EEOB 5194 | Bioacoustic Ecology |
| EEOB 5194 | Host-Microbial Symbioses |
| | |
| EEOB 5310 | Advanced Evolution |
| EEOB 5320 | Society & Evolution |

| | |
|---|---|
| EEOB 5330 | Population Genetics & Phylogeography |
| EEOB 5340 | Evolution & Taxonomy of Vascular Plants |
| EEOB 5350 | Evolutionary Ecology |
| EEOB 5410 | Ocean Ecology |
| EEOB 5420 | Ecology of Inland Waters |
| EEOB 5430 | Fish Ecology |
| EEOB 5440 | Plankton Ecology |
| EEOB 5450 | Population Ecology |
| EEOB 5460 | Physiological Ecology |
| EEOB 5470 | Community & Ecosystem Ecology |
| EEOB 5480 | Advanced Plant Ecology |
| EEOB 5490 | Insect Behavior: Mechanisms and Function |
| EEOB 5505 | Wicked Science |
| EEOB 5510 | Interdisciplinary Team Science |
| EEOB 5610S | Translating Evolution |
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| EEOB 5940 | Field Zoology (Stone Lab) |
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| EEOB 5970 | Larval Fish Identification Workshop (Stone Lab) |

## Program Learning Goals

1. Students are able to describe the processes that underlie evolution and their manifestation in the natural w
2. Students are able to explain ecological concepts, methods of study, and the interactions among organisms a
3. Students are able to understand organismal diversity and functioning at all levels, from the molecular and c
4. Students participate in the process of discovery by conducting experimental and observational studies, synt
5. Students demonstrate proficiency in mathematics, statistics, computer modeling, and the use of computers
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7. Students are aware of current issues in biology, especially those that have significant ethical and societal im

## Notes

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# he Zoology BA Major

## rds hours in the major)

| Semester Units | Notes | Relevant Program Goals |
|---|---|---|
| 4 | | 1, 2, 3 |
| 4 | | 1, 2, 3 |
| 5 | MATH 1156 also accepted | 5 |
| 10 | 2 semesters of general chemistry required for program | 4 |
| 4 | 1 semester organic chemistry required for majors | 4 |
| 10 | | 4 |
| 3 | | 5 |

| Semester Units | Notes | Relevant Program Goals |
|---|---|---|
| 4 | | 1*, 3*, 5*, 6*, 7* |
| 4 | | 2*, 3*, 5* |
| 3 | | 1*, 2*, 3* |

## oose two)

| Semester Units | Notes | Relevant Program Goals |
|---|---|---|
| 2 | 7-week course | 1, 2, 3, 4, 6, 7 |
| 2 | | 1*, 2*, 3*, 4*, 7* |
| 2 | | 1*, 2*, 3*, 4* |
| 3 | | 1*, 2*, 3*, 4* |
| 2 | | 1*, 2*, 3*, 4* |
| 3 | | 2*, 5*, 7* |
| 2 | | 2*, 5* |

## choose at two)

| Semester Units | Notes | Relevant Program Goals |
|---|---|---|
| 3 | | 3, 4 |
| 3 | | 1, 3*, 7 |
| 3 | | 1*, 3*, 6* |
| 3 | | 2*, 3*, 5* |
| 3 | | 3**, 5*, 6* |
| 2 | | 1*, 3**, 4* |

## ajor (up to 10 semester units)

| | | |
|---|---|---|
| 2 | 7-week course | 1, 2, 3, 4, 6, 7 |
| 2 | 7-week course | 1, 2, 3, 4, 6, 7 |
| 3 | 7-week course | 1*,3*,6 |
| 3 | | 1, 2, 3, 4, 6, 7 |
| 3 | | 3, 4 |
| 3 | | 1, 3, 6, 7 |
| | | |
| 4 | Cross-listed with EarthSc and Hist | 2,6,7* |
| 1-3 | | |
| 1-3 | | |
| 1-3 | | |
| 3 | | 1*,2*,3,4**,5**,6**,7* |
| 3 | | 1*, 2*, 3*, 4*, 7* |
| 4 | | 2*, 3* |
| 3 | | 1, 3*, 7 |
| 1.5 | | 3**, 4*, 5*, 6*, 7** |
| 1-12 | | |
| 1-12 | | |
| | | |
| 2 | | 1*, 2*, 3*, 4* |
| 3 | | 1*, 2*, 3*, 4* |
| 2 | | 1*, 2*, 3*, 4* |
| 2 | | 1*, 2*, 3*, 4*, 7* |
| 3 | | 2*, 5*, 7* |
| 2 | | 2*, 5* |
| 2 | | 2*, 3*, 5 |
| 3 | | 1*, 3*, 6* |
| 3 | | 2*, 3*, 5* |
| 3 | | 2*, 3*, 5* |
| 3 | | 3**, 5*, 6* |
| 2 | | 1*, 3**, 4* |
| 2 | | 1*, 2*, 3* |
| 2 | | 1*, 2*, 3* |
| 2 | | 2*, 3* |
| 2 | | 2*, 3* |
| 1-3 | | |
| 1-3 | | |
| 1-5 | | |
| 1-5 | | |
| 1-4 | | |
| 2 | | 1*,2*,3,4**,5**,6,7** |
| 3 | | 1**, 2**, 3*, 4**, 5** |
| 3 | | 1**, 2*, 3**, 4*, 5*, 6**, 7** |
| 3 | | 1**, 6**, 7** |

| | | |
|---|---|---|
| 3 | | 1**, 4**, 5** |
| 3 | | 1**, 3**, 6** |
| 3 | | 1**, 2**, 3*, 5** |
| 1.5 | | 2**, 3*, 5* |
| 1.5 | | 2**, 3*, 5* |
| 1.5 | | 2**, 3*, 5* |
| 3 | | 2**,3**,4**,5**,6**,7** |
| 3 | | 2**, 5** |
| 3 | | 2**, 5** |
| 3 | | 2**, 3**, 4**, 5** |
| 3 | | 1**,2**,3**,5*,6**,7** |
| 3 | Cross-listed with ENTO 5490 | 1**,2**,3**,4**,6**,7** |
| 3 | Cross-listed with ANTHROP 5505 | 4*,5,6** |
| 3 | Cross-listed with ANTHROP 5510 | 4*,5,6** |
| 3 | SL Course in sci comm | 1**, 4**, 6** |
| 3 | Field course at Smithsonian Tropical Research Institute, Panama | 1**, 2**, 3**, 4**, 6** |
| 2 | Summer course at Stone Lab | 1*, 2*, 3* |
| 3 | Summer course at Stone Lab | 1*, 2*, 3* |
| 3 | Summer course at Stone Lab | 1*, 2*, 3* |
| 3 | Summer course at Stone Lab | 1*, 2*, 3* |
| 0.5 | Summer course at Stone Lab | 3* |
| 0.5 | Summer course at Stone Lab | 3* |
| 0.5 | Summer course at Stone Lab | 3* |

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ellular to the whole organism, and will understand the interplay between organismal functioning and ecological

hesizing results with the primary literature, and communicating their questions, hypotheses, observations, and

, as these topics relate to biology.

ence as a process, including the history of science as it relates to these three disciplines within biology.

plications, and will be able to communicate scientific concepts and processes.

evel.

and evolutionary processes.
experiences to others.