Term Information

Effective Term	Spring 2024
Previous Value	*Spring 2023*

Course Change Information

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

Change prerequisites from '4 credit hours in biological sciences or historical geography' to '4 credit hours in biological sciences or earth sciences'

Resubmit to Origins and Evolution theme

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

Request is a resubmission of Origins and Evolution theme request. Original submission was accidentally deleted.

Change of prerequisites is intended to clarify which classes count as sufficient preparation for the course. A background in either the biological sciences or earth sciences will prepare students for this class.

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

Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: 4 credit hrs in Biological Sciences or Earth Sciences
Previous Value	*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

- EEOB 2250 Cover Letter.docx: Response to Panel Feedback

  (Cover Letter. Owner: Hamilton,Ian M)
- EEOB2250 syllabus NEW updated for Origins and Evolution v 2_2.docx: Syllabus

  (Syllabus. Owner: Hamilton,Ian M)
- In class assignment details EEOB2250.docx: Additional detail on assignments

  (Other Supporting Documentation. Owner: Hamilton,Ian M)
- EEOB Curriculum Maps April 2023.xlsx: EEOB Curriculum Maps

  (Other Supporting Documentation. Owner: Hamilton,Ian M)
- EEOB2250 syllabus NEW updated for Origins and Evolution v 2 OLD.docx: OLD Syllabus

  (Other Supporting Documentation. Owner: Hamilton,Ian M)
- submission-origins-evolution-3 filled 2250.docx: ELO Questionnaire - Readable

  (Other Supporting Documentation. Owner: Hamilton,Ian M)
- submission-origins-evolution-3 filled.pdf: ELO Questionnaire EEOB 2250

  (Cover Letter. Owner: Hamilton,Ian M)

Comments

- EEOB 2250 is being resubmitted as a new submission because we accidentally deleted the previous, in progress submission. We have included panel feedback on the previous submission here.
  In response to panel feedback we have clarified the prerequisites for the course, changing them from 4 credit hours of biological sciences or historical geology to 4 credit hours of biological sciences or earth sciences.
  Our information on the Origins and Evolution submission form are difficult to read; therefore, I have attached the same information as a MSWord document, under Other Supporting Documentation "ELO Questionnaire - Readable"

  (by Hamilton,Ian M on 05/03/2023 05:24 PM)

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Hamilton,Ian M	05/03/2023 05:24 PM	Submitted for Approval
Approved	Hamilton,Ian M	05/03/2023 05:25 PM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	08/18/2023 03:55 PM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Hilty,Michael Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	08/18/2023 03:55 PM	ASCCAO Approval

Dear Themes Panel 1,

We are re-submitted EEOB 2250, Dynamics of Dinosaurs for consideration for the Origins and Evolution General Education Theme. We apologize for the incorrect ELOs on our previous submission.

EEOB 2250, Dynamics of Dinosaurs 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.

Please see our responses to the Panel's comments on the previous submission in ***bold italics:***

On Friday, September 2, the Themes Panel 1 of the ASC Curriculum Committee reviewed the course proposal for EEOB 2250. Please find below the Panel's feedback for the course.

The Panel did not vote on the proposal as they would like the following points addressed:

- On the first page of the syllabus, the stated prerequisite for the course is different than that which appears on the curriculum.osu.edu form. The curriculum.osu.edu form designates "4 semester credit hours in Biological Sciences or Historical Geology," while page 1 of the syllabus states "there are no course prerequisites." The reviewing faculty ask that:
    - The course prerequisite(s) on the syllabus be amended to match what appears on curriculum.osu.edu (or vice versa).
    - The department provide a sample list of specific course numbers when designating prerequisites so it is clear what classes might fall under the category of "Historical Geology."

  We have updated the prerequisites on curriculum.osu.edu and the syllabus to "4 credit hours in biological sciences or earth sciences"

- The reviewing faculty ask that the most up-to-date, full and complete GEN Goals and ELOs for the Origins and Evolution theme be included in the course syllabus, per a requirement of General Education courses. The GEN Goals and ELOs can be found here on the ASC Curriculum and Assessment Services website: https://asccas.osu.edu/new-general-education-gen-goals-and-elos

  We have included the up-to-date GEN Goals and ELOs in the course syllabus and the submission form.

- The reviewing faculty note that the GEN submission form does not provide an explanation of how the course will address ELO 1.2, and asks that this information also be included.

  We have included the up-to-date GEN Goals and ELOs in the submission form, including ELO 1.2

- The reviewing faculty kindly request that the syllabus include a full bibliography of projected readings, more information on other anticipated assignments, and further detail on the topics listed on the course schedule, so that the committee might better evaluate if the level of the course is appropriate for the theme in question.

We have included required and recommended readings in the Syllabus (under Course Materials, Fees, and Technologies, and the course Schedule). We have included additional information on assignments under 'Description of Assignments' in the Syllabus. We have also included a supplemental document providing additional detail on assignments and the GEN ELOs addressed by each assignment.

- The reviewing faculty ask for a cover letter that details all changes made in response to this feedback.

Please let me know if you have any questions or require additional information.

Sincerely,

Ian Hamilton

Vice Chair of Undergraduate Studies, EEOB.

Dynamics of Dinosaurs Syllabus

EEOB2250 Autumn 2023

Course Information

- **Course times:** Lecture: 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

4 credit hours in biological sciences or earth sciences.

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. Engage in critical and logical thinking about the topic or idea of the theme.

1.2. Engage in an advanced, in-depth, scholarly exploration of the topic or idea of the theme.

2.1. Identify, describe, and synthesize approaches or experiences as they apply to the theme.

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 their knowledge of 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 their knowledge of how the universe, physical systems, life on Earth, humanity, or human culture have evolved over time.

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

EEOB 2250 addresses the Origins and Evolution theme, specifically the origins and evolution of life on earth. Evolution of life on earth is a central theme to this course. Students in this course examine the evolution of life on earth within the context of one very special group of organisms-the dinosaurs. Evolution is complex, but it is possible to survey the outcomes of evolution of life on earth by carefully investigating the major lineages of dinosaurs, and learning about how they arose and why they look and behave the ways they do. This course fulfills these learning outcomes by combining critical thinking and class discussion, examining case studies, using quantitative and predictive tools and analysis of real fossil data. The in-class assignments play central roles in achieving the ELOs for the Origins and Evolution theme and assessing those achievements. The in-class assignments allow for a hands-on approach to what it means to be a dinosaur biologist, as students critically examine real data, allowing them to engage in in-depth critical and logical thinking, synthesize information, and actively participate in advanced and scholarly exploration of these topics. 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. For example, the week 7 in class assignment will have students measure the size and distance of “fossil” trackways within the classroom. With these data, they will calculate the speed of the dinosaur that “deposited” them in the same way that biologists working in the field do. Additionally, students will be able to track how life has evolved over time. During the week 10 in class assignment, students will study how dinosaur phenotypes have changed over time in response to sexual selection; a powerful example of how evolution changes organisms over time. 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. The media assignment allows students to synthesize information and reflect on their knowledge as they critique popular media with what they know about dinosaurs from the course. Dynamics of dinosaurs offers a unique and interesting context in which to study and learn about origins and evolution

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
- Required readings will be posted on Carmen. Required readings for course activites are:

Baron et al. 2017. A new hypothesis of dinosaur relationships and early dinosaur evolution. *Nature* 543: 501-506

Brusatte et al., 2015. The extinction of the dinosaurs. *Biological Reviews* 90: 628-642

Recommended/Optional Materials and/or Technologies

The textbook is strongly recommended but not required **Dinosaurs: A Concise Natural History** by Fastovsky and Weishampel (4th edition, 2021)**:**

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.

Also strongly recommended is Brusatte, S. L. 2012. **Dinosaur Paleobiology**. Wiley-Blackwell, John Wiley & Sons, West Sussex, UK.

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)	270
Popular media assignment (30 points)	30
Total	400

See Course Schedule for due dates.

Description of assignments

In-class assignments

Description:
You will be completing weekly in class assignments. These assignments will vary from analyzing and interpreting current fossil data ((addressing Origins and Evolution ELO 1.1 1.2, 3.1 and 3.2) to debating current views around the K-T extinction (addressing Origins and Evolution ELO 3.3). You will provide a write up (this may include graphs, reflective essays, opinions and images) which will be turned in by the end of class for credit. These in class assignments may either be collaborative or performed alone, depending on the instructions from your instructor. Note: late in class assignments will not be accepted unless prior written approval has been given by your instructor or you have documentation of an excused absence (e.g. illness, family emergency)

Exams

Description:
There will be three (3) midterms for this course. These exams will be in-class. Students are allowed the use of a calculator and scrap paper. The exam will be multiple choice, matching and fill in the blank. Exams will address Origins and Evolution ELOs 1.1, 1.2, 2.1, 3.1, 3.2, 3.3, 4.1, and 4.2.

Exam Question Corrections

Description
You are able to earn points back on missed questions for exams if you choose (this is not a requirement). For this assignment, you must turn in the exam questions you missed (with a screenshot of the question) and explanation of which answer is correct and why. You can earn half (1/2) of the points back on the exams for a maximum total of 9 points (or 10%) of the exam grade (addresses Origins and Evolution ELO 2.2) This assignment allows you to reflect on yourself as a learner through self-assessment and adapt your studying methods to future exams.

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 and addresses Origins and Evolution ELOs 2.1 and 2.2)

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

Schedule

See next page

Week	Points	Topics, Readings, Assignments, Due Dates
1	5	**1. T Topic: Introduction and aims – Why study dinosaurs? The history of the study of dinosaurs (Chapters 2,15)** **2. 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)** In-class assignment: Constructing a geologic Time Scale
2	5	**3. T Topic: Fossil formation, excavation, and interpretation (contd) (Chs.1,2)** **4. 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** In-class assignment: Interpreting taphonomy of a fossil (case study)
3	5	**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** **6. H Topic: The evolutionary origin and radiation of the dinosaurs; dinosaurs as "revolutionary" organisms (Chs. 4, 5, and 14).** In-class assignment: Constructing a phylogenetic tree

4	5	**7. T Topic: The evolutionary origin and radiation of the dinosaurs; dinosaurs as "revolutionary" organisms cont (Chs. 4, 5, and 14)** **8. H Topic: The classification and phylogenetic relationships of dinosaurs; review of the Saurischian lineages (Chs. 5, 6, 7, and 9; Baron et al. 2017. A new hypothesis of dinosaur relationships and early dinosaur evolution. *Nature* 543: 501-506)** In-class assignment: Discussion: Old vs New View of Dinosaur phylogeny (What to believe?)
5	90	**9. T Topic: Review of the Ornithischian lineages (chapters 5, 10, 11, and 12)** **H: **MIDTERM I: Covers material from weeks 1-5 **** In-class assignment: NONE
6	5	**10. 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)** **11. H Topic: How big were the largest dinosaurs? – methods of estimating body weights; how fast could dinosaurs move? - biomechanical methods of estimating athletic abilities** In-class assignment: Estimating mass of dinosaurs: a comparison of methods
7	5	**12. T Topic: The formation and interpretation of fossil trackways; reconstructing dinosaur movements and calculating speeds from fossil trackways** **13. H Topic: Warm-blooded dinosaurs? Reconstructing the metabolic strategies of dinosaurs (Ch. 13)**

		In-class assignment: Estimating dinosaur speed (case study)
8	0	**14. T Topic: Warm-blooded dinosaurs? (contd) (Ch. 13)** **H: *Autumn break (no class)*** In-class assignment: NONE
9	5	**15. T Topic: Studying the social behavior of extinct animals - evidence of herding and parental behavior in dinosaurs** **16. H Topic: Sexual selection and dinosaurs (parts of chapters 11 and 12)** In-class assignment: Estimating Age a growth Rates from LAG data and discussion of parental care in dinosaurs
10	5	**17. T Topic: Sexual selection and dinosaurs (contd) (parts of chapters 11 and 12)** **18. H Topic: Biology of the largest terrestrial animals to ever exist - the sauropods** **(Ch.9)** In-class assignment: Interpreting cranial ornamentation: sexual selection, species recognition or growth?
11	90	**T: **MIDTERM II: Covers material from weeks 6-10**** **19. 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)** In-class assignment: NONE

12	5	**20. T Topic: The remarkable dromaeosaurids (aka "raptors") – the dinosaurs that launched the revolution in dinosaur biology (parts of chapters 6 and 7)** **21. H: *Veterans Day (no class)*** In-class assignment: What happened to all the big predators?
13	5	**22. T The Mesozoic battle tanks – biology of the Thyreophorans (Ch. 10)** **23. H The evolution and biology of the first and the largest flying vertebrates - the pterosaurs** In-class assignment: How many species are present?
14	30	**24. T The Mesozoic sea monsters - the ichthyosaurs, sauropterygians, and mosasaurs** **H THANKSGIVING HOLIDAY (traditional meal of dinosaur)** In-class assignment: NONE ***Popular Media Assignment: DUE***
15	5	**25. T Dinosaurs and the origin of birds (Ch 7)** **26. H The great Cretaceous extinction - hypotheses and evidence (Ch.16,** Brusatte et al., 2015. The extinction of the dinosaurs. *Biological Reviews* 90: 628-642) In-class assignment: The K-T Extinction-how rapid was it?
16	90	**T: *MIDTERM III: Covers material from weeks 11-15****

In class assignment details:

Week 1 In-class assignment: Constructing a geologic Time Scale (addresses ELO 3.1)

Students will reconstruct a geologic timescale using a variety of data with emphasis being on how old the earth is and how long dinosaurs dominated the biological landscape.

Week 2: n-class assignment: Interpreting taphonomy of a fossil (case study) (ELO 1.1 and 3.2)

Students will be presented with a case studying involving the discovery of a new fossil bed, and will be asked to reconstruct the likely cause of death and burial of these animals (with help from classmates). This exercise encourages them to engage in critical thinking and to understand how scientific methods used to reconstruct the history of dinosaurs

Week 3: In-class assignment: Constructing a phylogenetic tree (ELO 3.2)

Students will construct a simple phylogenetic tree. This allows them to understand how to interpret a tree, what a tree signifies and how the methods of constructing a tree accurately depicts the diversity of life (and in this case dinosaur diversity)

Week 4: In-class assignment: Discussion: Old vs New View of Dinosaur phylogeny (What to believe?) (ELOs 1.2 and 3.3)

Students will examine 2 "competing" phylogenetic trees. This allows them to apply their knowledge of trees from the week before, and engage in an advanced, in-depth, scholarly exploration of the topic of trees. In addition, this is an ongoing debate within paleontology and this in class assignment allows them to engage with a current controversy related to evolutionary questions.

Week 6: In-class assignment: Estimating mass of dinosaurs: a comparison of methods (ELO 1.1 and 1.2)

This in class assignment will examine real data of publish dinosaur size, and give students an opportunity to examine the outcomes of different methodology

Week 7: In-class assignment: Estimating dinosaur speed (case study) (ELO 1.2 and 1.2)

This in class assignment allows students to use carry out hands on data analysis when they will measure "fossil" trackways that are distributed within the classroom. They will use quantitative tools they have from lecture and determine the speed of the dinosaur that "deposited" the tracks.

Week 9 : In-class assignment: Estimating Age a growth Rates from LAG data and discussion of parental care in dinosaurs (ELO 1.2 and 1.2)

Students will graph real growth data (lines of arrested growth in bone) among different species and they will interpret what those difference mean and how they relate to parental care for some groups of dinosaurs

Week 10: In-class assignment: Interpreting cranial ornamentation: sexual selection, species recognition or growth? (ELO 4.1)

In this in class assignment students will look at ornamentation of lineages and see how (and in what ways) groups have evolved over time

Week 13: In-class assignment: How many species are present? (ELO 4.1)

This in class assignment has students looking at the data that exists on the number of dinosaur species present. This assignment will lead to a class discussion on how lineages diversify over time and how we catalog changes over time.

Week 15: In-class assignment: The K-T Extinction-how rapid was it? (ELO 3.3)

This in class assignment will have students read 2 papers that present opposing views on how long the KT extinction was (was the extinction fast or was it already occurring due to declining dinosaur diversity prior to the meteor strike). This is currently hotly debated topic within paleobiology and we will discuss the data in an in class discussion with different sides being presented

GE Theme course submission worksheet: Origins & Evolution

Overview

Courses in the GE Themes aim to provide students with opportunities to explore big picture ideas and problems within the specific practice and expertise of a discipline or department. Although many Theme courses serve within disciplinary majors or minors, by requesting inclusion in the General Education, programs are committing to the incorporation of the goals of the focal theme and the success and participation of students from outside of their program.

Each category of the GE has specific learning goals and Expected Learning Outcomes (ELOs) that connect to the big picture goals of the program. ELOs describe the knowledge or skills students should have by the end of the course. Courses in the GE Themes must meet the ELOs common for **all** GE Themes and those specific to the Theme, in addition to any ELOs the instructor has developed specific to that course. All courses in the GE must indicate that they are part of the GE and include the Goals and ELOs of their GE category on their syllabus.

The prompts in this form elicit information about how this course meets the expectations of the GE Themes. The form will be reviewed by a group of content experts (the Theme Advisory) and by a group of curriculum experts (the Theme Panel), with the latter having responsibility for the ELOs and Goals common to all themes (those things that make a course appropriate for the GE Themes) and the former having responsibility for the ELOs and Goals specific to the topic of **this** Theme.

Briefly describe how this course connects to or exemplifies the concept of this Theme (Origins & Evolution)

In a sentence or two, explain how this class "fits' within the focal Theme. This will help reviewers understand the intended frame of reference for the course-specific activities described below.

(enter text here)

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.

Connect this course to the Goals and ELOs shared by *all* Themes

Below are the Goals and ELOs common to all Themes. In the accompanying table, for each ELO, describe the activities (discussions, readings, lectures, assignments) that provide opportunities for students to achieve those outcomes. The answer should be concise and use language accessible to colleagues outside of the submitting department or discipline. The specifics of the activities matter—listing "readings" without a reference to the topic of those readings will not allow the reviewers to understand how the ELO will be met. However, the panel evaluating the fit of the course to the Theme will review this form in conjunction with the syllabus, so if

readings, lecture/discussion topics, or other specifics are provided on the syllabus, it is not necessary to reiterate them within this form. The ELOs are expected to vary in their "coverage" in terms of number of activities or emphasis within the course. Examples from successful courses are shared on the next page.

Goal 1: Successful students will analyze an important topic or idea at a more advanced and in-depth level than the foundations. In this context, "advanced" refers to courses that are e.g., synthetic, rely on research or cutting-edge findings, or deeply engage with the subject matter, among other possibilities.

Goal 2: Successful students will integrate approaches to the theme by making connections to out-of-classroom experiences with academic knowledge or across disciplines and/or to work they have done in previous classes and that they anticipate doing in future.

	Course activities and assignments to meet these ELOs
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. *Lecture examples*: 4 & 5 Taphonmy-students will learn how scientists use fossil data to reconstruct the deaths of dinosaurs 11. Estimating dinosaur size-students see how scientists use data and quantitative tools to estimate the sizes of dinosaurs 12. Using fossils to estimate dinosaur speed-students learn how biologists measure and estimate dinosaur speed with the use of fossils and mathematical tools *Activity examples:* 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 an advanced, in-depth, scholarly exploration of the topic or ideas within this theme	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, and discussion 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 *Activity examples:* Students will be analyzing "competing" phylogenetic trees describing the relationships among dinosaurs.

	These trees represent a current and ongoing debate among biologists regarding the relationships within dinosaurs and the students will be engaging in a discussion about how we interpret, construct and think about phylogenetic trees and the scientific process in general
ELO 2.1 Identify, describe, and synthesize approaches or experiences.	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 19th century provided a context for considering ancestor-descendent relationships among dinosaurs, whereas the cladistic revolution in the late twentieth century provided 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. *Lecture examples:* 1: History of paleontology examines how biological perspectives and scientific approaches has changed over time 8: In depth examination of the phylogenetic relationships among dinosaur lineages and how this has changed over time 13 and 14: Examining how the interpretation and examination of endothermy in dinosaurs has changed over time and how the current view synthesizes the work of previous biologists in the field

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. Additionally, we offer students an opportunity to learn from their incorrect exam scores by allowing them to turn in corrected responses. This *Activity examples:* Students complete a writing assignment in which they critically evaluate the presentation of dinosaurs in popular culture. This assignment allows students to reflect on their understanding of dinosaur biology and their experiences with popular portrayals Students can re submit any exam questions they got wrong with corrected responses and references to why the new answer is correct which allows them to reflect on their learning process, adapt and change how they study.

Goals and ELOs unique to Origins & Evolution

Below are the Goals and ELOs specific to this Theme. As above, in the accompanying Table, for each ELO, describe the activities (discussions, readings, lectures, assignments) that provide opportunities for students to achieve those outcomes. The answer should be concise and use language accessible to colleagues outside of the submitting department or discipline. The ELOs are expected to vary in their "coverage" in terms of number of activities or emphasis within the course. Examples from successful courses are shared on the next page.

GOAL 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.

GOAL 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.

	Course activities and assignments to meet these ELOs

ELO 3.1 Illustrate their knowledge of the time depth of the universe, physical systems, life on earth, humanity or human culture by providing examples or models.	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 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). *Lecture example*: 2. Examination of geological history of earth *Activity Examples*: Students will construct a geological time scale using data similar to those accessible to modern day scientists
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.

	4 & 5 Taphonmy-students will learn how scientists use fossil data to reconstruct the deaths of dinosaurs 8. Students examine the data scientists use to contruct phylogenetic trees 11. Estimating dinosaur size-students see how scientists use data and quantitative tools to estimate the sizes of dinosaurs 12. Using fossils to estimate dinosaur speed-students learn how biologists measure and estimate dinosaur speed with the use of fossils and mathematical tools *Activity examples:* Students will construct a phylogenetic tree using data, students will estimate dinosaur speed using fossil "trackways" created in the classroom
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 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. Lecture examples: 25. The relationship between dinosaurs and birds-students examine the current evidence (including controversial historical skepticism) regarding the relationships (and ultimately the inclusion of) birds and dinosaurs

	26. Exploring the K-T extinction- we explore the K-T extinction, including current data and the conflicting opinions and data about the K-T extinction and how quickly it occurred *Activity examples:* Students will examine real data (including species declines, fossil record data etc) around the time of the K-T extinction to personally scrutinize this current controversial subject
ELO 4.1 Describe their knowledge of 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. *Lecture examples:* 6. We examine how life changed and evolved over time and how the organismal diversity prior to dinosaurs “set the stage” for dinosaurs *Activity examples:* How many species are present?- here students will look at how we categorize species diversity and how that diversity has changed over time (and how do we catalog and categorize evolution over time) Interpreting cranial ornamentation: sexual selection, species recognition or growth? In this in class assignment students will look at ornamentation of lineages and see how (and in what ways) groups have evolved over time

ELO 4.2 Summarize current theories of the origins 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 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. *Lecture examples:* 25. Origin of birds and dinosaurs-this lecture examines in depth the current theories about how birds evolved, what data ties them to dinosaurs and why it is that it’s widely accepted that birds are dinosaurs