

H. C. Maddin, HP 2239  
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ERTH 5307  
**Evolutionary Developmental Paleobiology**

This course explores the role of development in the evolution of **organismal morphological diversity**, past and present. The content will be delivered primarily via student-led seminars on central concepts in evo-devo followed by discussion of recent research in the field.

**Course objectives:**

Learn details of vertebrate development that lead to understanding how the evolution of development has led to the **morphological** diversity of vertebrate life past and present.

**Learning outcomes:**

By the end of this course, students will be able to **apply** evolutionary concepts to vertebrate development.

By the end of this course, students will be able to **distinguish** between the different modes of developmental evolution.

By the end of this course, students will be able to **integrate** evolutionary developmental concepts to understand the origin of diversity.

**Recommended text:**

Wallace A. Evolution: a developmental approach. Wiley-Blackwell, West Sussex, UK.

**Lecture outline:**

Introductory lectures on Evo-devo, phylogenetics, homology, micro- and macro evo-devo  
Remaining lectures will be devoted to student presentations of key concepts in evo-devo:

Developmental System Drift	Developmental repatterning	Epigenetics	Atavism
Genetic assimilation	Evo-devo in the fossil record	Co-option	Heterotopy
Developmental plasticity	Modularity & integration	Hox genes	Heterochrony
Developmental constraint	Mutation	Heterotopy	Heterometry

**Marking scheme:**

50% Seminar presentation (including description of an experiment)  
20% Paper discussions  
20% Participation in all discussions  
10% Self-evaluation

**Presentation guidelines:**

You will be assigned a concept/topic in Evo-devo and will present your topic as it relates to the origin/evolution/maintenance of **morphological diversity**. You will create a **minimum** 30 min presentation/seminar on that topic that includes the following sections (roughly equal in time and value):

- Introduction to the concept

- Early history of the development of the idea, how concept was formalized, and what the concept seeks to understand and explain
- Describe at least three examples of the concept from the primary literature
- Show how this mechanism has influenced the origin and evolution of anatomical diversity

You will be marked for each section of your presentation based on the following: accuracy and thoroughness (60%), organization and clarity (30%), and visual presentation (10%).

\*TIP: Presentation should reflect research based on at least 10 papers from the primary literature.

You will also describe a novel experiment/analysis that could be conducted to test your evo-devo concept. You will have an extra 15 mins to present your experiment.

- Propose a study or experiment that explores the role of the concept in evo-devo. Specifically outline how this experiment would be conducted, and how you would interpret the different predicted outcomes.
  - Present background information
  - Ask a question
  - Present a hypothesis
  - Test the hypothesis
    - Describe the experimental precise design (what are the treatments, how many, group sizes, what are the controls, etc.). This should be described in sufficient detail to permit someone to actually perform the experiment
  - Describe how you would analyze and interpret different results

### **Paper discussion guidelines:**

Following your seminar presentation, you will lead a **minimum 30 min** discussion of two recent papers on your topic. You will be required to submit your papers to me a **minimum of one week** in advance so that I can upload them on cuLearn. You will choose and present the papers with the following things in mind:

- Relevance of the paper to your topic
- Give a clear explanation of the paper's contents
- Lead a discussion based on a short list of questions (~3/paper) you create for the class

You will be marked on the first two aspects for accuracy (60%) and clarity (40%), and for the quality of your questions (60%) and ability to answer those of your classmates (40%).

### **Participation:**

You are expected to contribute to discussions at each seminar. Your comments/questions need not be 'correct' every time. You are learning in the process. However, comments/questions should be relevant/appropriate where they contribute to discussion, rather than being said for the purpose of simply saying something. Because you are being evaluated on your participation, your attendance to each will be critical to be eligible for full marks. If you miss a class you will need to contact myself and provide an acceptable justification for your absence

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(i.e., doctor's note). In the event of an acceptable absence, your mark will be reweighted to the sessions attended.

### **Self-evaluation**

You will conduct a self-evaluation of your presentation and paper discussion. You will be provided with feedback from two classmates to assist in your evaluation. A rubric will be provided for you to fill out and return to myself and your TA.

### **Additional resources:**

Carroll S.B. 2005. Endless forms most beautiful: The new science of evo-devo and the making of animal kingdom. W.W. Norton & Company, New York, London.

Hall B. K. 1999. Evolutionary Developmental Biology. Kluwer Academic Publishers, Dordrecht, Boston, London.

<http://11e.devbio.com/>

<http://www.hhmi.org/biointeractive/evolution-collection>

### **Requests for Academic Accommodation**

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

#### **Pregnancy obligation**

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: [carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

#### **Religious obligation**

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: [carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

#### **Academic Accommodations for Students with Disabilities**

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made.  
[carleton.ca/pmc](http://carleton.ca/pmc)

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### **Survivors of Sexual Violence**

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and its survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: [carleton.ca/sexual-violence-support](https://carleton.ca/sexual-violence-support)

### **Accommodation for Student Activities**

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. <https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf>

For more information on academic accommodation, please contact the departmental administrator or visit: [students.carleton.ca/course-outline](https://students.carleton.ca/course-outline)