

**Anth 305**  
**Human Evolutionary Developmental Biology**  
Fall 2017



Professor: Zachary Cofran  
Meetings: Blodgett Hall 101, M 3:10-6:10 pm  
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Office: Blodgett Hall 323  
Lab: Blodgett Hall 030  
Office hours: T 4:45-6:00 pm, W 1:00-2:15 pm, or by appointment

What literally makes us human? This class examines how growth and development were modified over the course of human evolution, to create the animals that we are today. Human anatomy is placed in an evolutionary context by comparison with living primates and the human fossil record. The first half of the course focuses on theory, namely evolution, genetics and life history. The second half examines evidence for the development and evolution of specific parts of the body, from head to toe. Through lab activities and a term project, students draw on different types of data to test hypotheses about evolution and development.

### **Course objectives**

- Understand evolutionary theory
- Appreciate the interrelationship between ontogeny and phylogeny
- Become familiar with the human fossil record
- Learn to set up a testable research question
- Collect anatomical data in order to test a hypothesis
- Conduct original study about human evolution and development

### **Readings**

Bibliographic information for weekly readings is posted to Moodle, and it is students'

responsibility to obtain the readings (unless otherwise noted). All readings should be completed for the week in which they are posted/assigned, before coming to class.

## Assignments and Grading

### Participation = 15%

You will get the most out of the class if you actively participate, and there will be many instances when you will be expected to contribute to a class discussion and/or participate in small-group exercises. In addition, each session you are expected to bring in (at least) one discussion question about the week's readings, which we may discuss in class.

The assessment of Participation is as follows: missing two (2) or more class sessions = 0%; regularly present but inactive = 5%; regularly present and sporadically active = 10%; present and highly active = 15%.

### Lab = 10%

Nearly all class sessions will have a laboratory component in which we examine skeletal remains, with activities related to the week's readings. You will record your observations, results, etc. for each lab activity on a handout and submit it when you come to class the following week. Be sure to complete all activities in a session and record all requested information.

Each missed lab entry will cost 1% percentage point, and incomplete entries will cost 0.5%.

### #FossilFriday = 5%

Using Twitter, *before 5 pm on each Friday of the semester* (including Fall Break!) you will show and tell the world something interesting about a specific, non-adult hominin fossil, which tells us something about the evolution of development. The purpose of this assignment is to practice extremely concise writing and dissemination of paleontological data.

Your post must state the specimen's ID number (e.g., SKW 5) and species (e.g., *Australopithecus robustus*), and include either a picture from a) a peer-reviewed journal article, or b) a physical or virtual specimen and some kind of ontogenetic information. Be sure to use the hashtag *#FossilFriday*. Students must write about different specimens.

You may miss/skip/forget one *#FossilFriday* without penalty. From there, each missed post will cost 1/5 points; missing 6 or more results in a grade of 0 for the *#FossilFriday* series.

### Virtual Endocast = 20%

Assignment given 25 September  
Due Friday 20 October

You will acquaint yourself with the ‘joys’ of CT data by creating an endocast of a chimpanzee in the KUPRI database (<http://bit.ly/2hpZkWQ>). You will then compare your model with homologous data from MH 1, an *Australopithecus sediba* adolescent. Students must select separate specimens.

**“Wolff’s Law” presentation = 10%**

Article summary due 08 November on Moodle  
Presentations on Monday 13 November in class

Toward the end of the semester we will discuss bone functional adaptation (often colloquially “Wolff’s Law”), as reviewed in the reading by Ruff et al. (2006). For this session, each student is required to 1) find a peer-reviewed journal article relating bone functional adaptation to hominin evolution; 2) write a short (~one single spaced page) summarizing the article and situating it within the context of the human evo-devo material we have covered this semester; 3) posting their summary to Moodle for the rest of the class to read by midnight 08 November; 4) briefly presenting their article summary with images using Powerpoint in class on 13 November; 5) Reading the other students’ summaries and being ready to discuss them.

**Project = 40%**

Your course project will be an original study in which you address a research question about ontogeny and phylogeny, gather and analyze data to test a hypothesis, and write up the results in the style of an article for [Journal of Human Evolution](#). This cumulative project involves several parts:

- Brainstorming meeting (5%)  
Before the end of week 4 you must meet with me to discuss potential topics.
- Project proposal (5%)  
Before investing completely in a research project, you must write a brief (<2 pages) proposal including the following: 1) research question(s), 2) significance statement, 3) data that address the research question and where the data will come from, 4) specific hypothesis/-es to be tested, 5) potential method(s) to analyze data and the test hypothesis.  
Due in class 30 October
- Presentation (10%)  
You will present your preliminary findings to the class at the end of the semester, and I will provide any last comments and suggestions for your write-up. Talks will be in the style of podium presentations at the annual meetings of the American Association of Physical Anthropologists, lasting for 15 minutes each with time for questions after.  
Presentations will be done in class on 27 November
- Write-up / final paper (20%)  
You will present your research in a ~10 page paper, which must be uploaded to Moodle no later than 10 December. A 100-200 word abstract must be included but does not contribute to the ~10 pages.

There will be no opportunities for extra credit.

### **Attendance**

If you miss class you cannot participate, which in turn can affect your grade. However, you are allowed up to three excused, penalty-free, no-questions-asked absences throughout the semester. The exception to this is that you must be in attendance for the exams and infographic presentations; failure to attend on these important dates will result in your failure of those assignments. Exceptions to this rule can only be made with appropriate documentation from Health Services or the Dean of Students.

### **Assignment submission and late work policy**

I expect you to submit your work in a timely manner, as directed on assignment prompts. Late work will be reduced by 10% for each day that it is late. The only time I will accept late work without penalty is if it is accompanied by documentation from Health Services or the Dean of Students.

### **Disability accommodation**

Academic accommodations are available for students registered with the Office for Accessibility and Educational Opportunity (AEO). Students in need of disability (ADA/504) accommodations should schedule an appointment with me early in the semester to discuss any accommodations for this course that have been approved by the Office for Accessibility and Educational Opportunity, as indicated in your AEO accommodation letter.

### **Academic Integrity**

All work you submit must be your own. You may discuss assignments with colleagues, but you may not turn in the same work. When you use references, other people's ideas, and especially other people's direct words, you absolutely must cite them. For more information, see page 133 of the Vassar College Regulations (<http://bit.ly/2bMuogv>) and "Going to the Source" (<http://bit.ly/2bMuNQ8>). Plagiarism and other academic misconduct will result in a grade of 0 on the assignment and referral to the College's Academic Panel.

## Schedule of topics, readings & assignments\*

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\* Schedule and content subject to change at professor's discretion.

### **Week 1 (28 August): Humans; skeletal anatomy**

#### Readings

Dart 1925. *Australopithecus africanus*: The man-ape of South Africa. *Nature* 115: 195–199.

Schultz 1960. Age changes in Primates and their modification in man. In JM Tanner, (Ed.), *Human Growth*. Pergamon Press, Oxford, pp. 1–20.

### **Week 2 (04 September): Labor Day – no regular class**

**Handout relating to film and reading, due in class next week!**

Film: *What Darwin Never Knew*

#### Reading

Gould & Lewontin, 1979. The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme. *Proceedings of the Royal Society of London. Series B* 205: 581.

### **Week 3 (11 September): Evolution; Virtual methods**

2<sup>nd</sup> half of class in Library 160 (computer classroom)

#### Readings

Gould & Lewontin, 1979. The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme. *Proceedings of the Royal Society of London. Series B* 205: 581.

Pontzer, 2012. Overview of hominin evolution. *Nature Education Knowledge* 3: 8. (<http://bit.ly/homevol>).

### **Week 4 (18 September): Development**

**Term project brainstorm meeting deadline**

#### Readings

Rolian and Boughner 2016. Introduction to Evo-Devo-Anthro. In Boughner and Rolian (eds). *Developmental Approaches to Human Evolution*. Wiley Blackwell, Hoboken, pp. 1–15.

Cofran 2018. Ontogeny. In *The International Encyclopedia of Biological Anthropology*, Wenda Trevathan (ed). John Wiley and Sons, Inc.

### **Week 5 (25 September): Brain**

Virtual endocast assignment given

#### Readings

Hrvoj-Mihic et al. 2013. Evolution, development and plasticity of the human brain: from molecules to bones. *Frontiers in Human Neuroscience* 7: 1–18.

Gunz 2016. A uniquely modern human pattern of brain development. In Boughner and Rolian (eds). *Developmental Approaches to Human Evolution*. Wiley Blackwell, Hoboken, pp. 261–283.

## Syllabus – Anth 305 – Fall 2017

Carlson et al. 2011. The Endocast of MH1, *Australopithecus sediba*. *Science* 333:1402–1407.

### **Week 6 (02 October):** Teeth 1: Histology & Life History

Bromage and Dean 1985. Re-evaluation of the age at death of immature fossil hominids. *Nature* 317: 525–527.

Smith et al. 2015. Dental ontogeny in Pliocene and Early Pleistocene hominins. *PLoS One*: 10: e0118118.

Smith 2013. Teeth and human life-history evolution. *Annual Review of Anthropology* 42: 191–208.

## October Break – no classes!

### **Week 7 (16 October):** Teeth 2: Pattern formation

Wednesday 25 October– Amitov Ghosh, 5:30 pm

Friday – Virtual Endocast Assignment due

#### Readings

Boughner 2016. The tooth of the matter: The evo-devo of coordinated phenotypic change. In Boughner and Rolian (eds). *Developmental Approaches to Human Evolution*. Wiley Blackwell, Hoboken, pp. 35–60.

Kavanagh et al. 2007. Predicting evolutionary patterns of mammalian teeth development. *Nature* 449: 427–432.

Evans et al. 2016. A simple rule governs the evolution and development of hominin tooth size. *Nature* 530: 477–480.

### **Week 8 (23 October):** Skull & face

McCollum 2008. Nasomaxillary remodeling and facial form in robust *Australopithecus*: a reassessment. *Journal of Human Evolution* 54: 2–14.

Lacruz et al. 2015. Distinct growth of the nasomaxillary complex in *Au. sediba*. *Scientific Reports* 5: 15175.

Kimbel and Rak 2017. *Australopithecus sediba* and the emergence of *Homo*: Questionable evidence from the cranium of the juvenile holotype MH 1. *Journal of Human Evolution* 107: 94–106.

### **Week 9 (30 October):** Spine & Pelvis

Monday – Term project proposal due

Young et al. 2015. Shared rules of development predict patterns of evolution in vertebrate segmentation. *Nature Communications* 6:6690.

Williams and Orban 2007. Ontogeny and phylogeny of the pelvis in *Gorilla*, *Pongo*, *Pan*, *Australopithecus* and *Homo*. *Folia Primatologica* 78: 99–17.

### **Week 10 (06 November):** Limbs

Wolff's Law article summary must be posted to Moodle by midnight 08 November

#### Readings

Rolian 2014. Genes, development, and evolvability in primate evolution. *Evolutionary Anthropology* 23: 93–104.

## Syllabus – Anth 305 – Fall 2017

Pietak et al. 2013. Fundamental ratios and logarithmic periodicity in human limb bones. *Journal of Anatomy* 222: 526–537.

**Week 11 (13 November):** Wolff's law

Student presentations & discussion-leading

Readings

Ruff et al. 2006. Who's afraid of the big bad Wolff? "Wolff's Law" and bone functional adaptation. *American Journal of Physical Anthropology* 129: 484–498.

Student article summaries posted to Moodle

**Week 12 (20 November):** Project work day

In-class project activity

**Week 13 (27 November):** Student Presentations

**Week 14 (04 December):** Heterochrony & Human Evolution

Reading

Gould 1977. Chapter 10: Retardation and Neoteny in Human Evolution. In *Ontogeny and Phylogeny*. Belknap, Cambridge, pp. 352–404.