ANTH 3412 'Hominin Evolution'

Course time and location
Course: ANTH 3412 'Hominin Evolution'
Semester: Fall 2017
Lectures (section 3412.10): Tuesdays and Thursdays, 9.35am–10.50am. Monroe Hall, room 114.
Labs (sections 3412.30 and 3412.31): Tuesdays. Lisner Hall, room 130.

Instructor
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Course description
The study of human evolution involves:

- understanding the evolutionary context and the circumstances surrounding the origin of the clade (group) that includes modern humans and their closest fossil relatives (i.e., hominins)
- identifying species in the fossil record that belong in that clade
- reconstructing the morphology and behavior of those species
- determining how they are related to each other and to modern humans
- investigating the factors and influences (e.g., genetic, environmental) that shaped their evolution
- reconstructing the origin(s) of modern human anatomy and behavior

The study of the fossil evidence for human evolution is traditionally referred to as hominid paleontology. The word 'hominid' comes from 'Hominidae' the name of the Linnaean family within which modern humans (and the other extinct members of the human clade) have traditionally been placed. However, because nearly all of the molecular data support a particularly close relationship between *Homo sapiens* (the formal Linnaean name for modern humans) and the species of living chimpanzees and bonobos included within the genus *Pan*, this traditional terminology has been changed. Some researchers have suggested that the term Hominidae, and its informal version hominid, should be made more inclusive and be extended to embrace the great apes (i.e., the *Gorilla*, *Pan*, and *Pongo* clades) plus the *Homo* clade. Thus, another name needs to be found for *H. sapiens* and for the fossil species more closely related to it than to other great ape species. The solution used for this class (although there could be others) is that if hominid is to be used as suggested above, then the species and genera more closely related to modern humans than to any other great ape should be recognized as a tribe (this is a taxonomic category below the level of the family and above the level of the genus) called the Hominini (the equivalent informal name is 'hominin').

Thus, if researchers are confident a species is in the clade whose only living representatives are modern humans, then it should be referred to as a *hominin*, not as a *hominid*. Therefore, in the 'new' terminology (see Table 1 for the 'old' and 'new' taxonomies) this course concentrates on *hominin paleontology*, with a prologue summarizing the fossil apes that preceded the origins of the hominin clade. The study of the artifacts (e.g., stone and bone tools, drawn and carved images, early structures, evidence of decoration, etc.) made in prehistoric times is called prehistoric archeology. In the US the combined study of hominin paleontology and prehistoric archaeology is called *paleoanthropology*, human prehistory, or just prehistory.

This course concentrates on the fossil and to a lesser extent the molecular evidence, but it will refer to the archeological record when the latter can provide insights into hominin behavior. Because it will emphasize the importance of trying to reconstruct as much biology as possible from the fossil record it is most aptly described as a course in hominin paleobiology (HPb).

Aims

The course HOMININ EVOLUTION aims to do the following:

- set out the scope of HPb (see the paragraph above)
- provide an introduction to the main analytical and research methods used in HPb
- introduce the relevant fossil evidence and set out, as appropriate, its context (e.g., its geological age, paleoenvironmental context, etc.)
- review interpretations of the hominin fossil record, including a discussion of their strengths and weaknesses
- provide a sound foundation for more advanced study and independent research within the area of HPb

Learning outcomes

Through attendance at lectures and laboratory sessions, plus participation in discussions at both lectures and laboratory sessions, together with appropriate reading and independent study, diligent students should:

- be able to identify the important research questions within HPb
- become familiar with the classes of evidence available to hominin paleobiologists
- understand the limitations and inherent uncertainties of a historical science such as HPb
- be able to discriminate between evidence and the interpretations placed on that evidence
- be sufficiently familiar with the anatomy of modern humans and with anatomical terminology so as to be able to understand and comprehend simple descriptions of hominin fossils
- be sufficiently familiar with the paleontological evidence and the relevant research methods to follow the arguments set out in reviews of the primary research literature
- be aware of the strengths and limitations of the main quantitative methods used in HPb research

Online Access

This syllabus and other resources for the classes (e.g., readings) will be available on Blackboard at http://blackboard.gwu.edu

Course prerequisites
Background on Biological Anthropology is necessary (ANTH 1001, or equivalent). Otherwise, it is important that you contact your TA at the very start of the course. Getting help early will ensure that you can keep up with the pace of lecture and lab, and are well prepared for the first MCQ assessment.

Recommended textbook
The course does not follow the sequence in any specific textbook, but these are three well-regarded textbooks.

The first of the three is *Reconstructing Human Origins* by Glenn C. Conroy and Herman Pontzer (3rd pbk. edition 2012, Norton: New York and London) (ISBN 0-393-92590-0) hereafter referred to as 'C'. Glenn Conroy is a Professor at Washington University in St. Louis and a very experienced teacher and researcher. Herman Pontzer is researcher at Hunter College in New York. This is a sound presentation of the fossil evidence and its context. The new edition is more up-to-date than 'K' or 'L&F' (see below) and it is probably the book of choice for those students who are mainly interested in the hominin fossil record.

The second book is the *Principles of Human Evolution* by Roger Lewin and Robert Foley (2nd edition 2004, Blackwell: Malden, MA and Oxford) (ISBN: 0-632-04704-6), hereafter referred to as 'L&F'. Rob Foley is a Professor of Anthropology at The University of Cambridge and Roger Lewin is an experienced and knowledgeable science writer. This is an up-to-date survey of human evolution that stresses the theory and the comparative context.

The third option is the *The Human Career* by Richard Klein (3rd edition 2009, The University of Chicago Press: Chicago) (ISBN: 978-0-226-43965-5), hereafter referred to as 'K'. Richard Klein is a Professor at Stanford University. He specializes in archeology, but he is very well-informed about the hominin fossil record. As you will see when you go to the library or bookstore 'K' is a large book and some sections contain more than you need. At the time of its publication, 'K' was commendably up to date, but it does not deal with several recent important discoveries and re-interpretations. If you are as interested in archeology as you are in hominin paleobiology, then this is the book for you, but if you decide to use this book you will have to pay particular attention to the readings for each class.

Other non-textbooks students might consider looking at are:

An Introduction to Human Evolutionary Anatomy by Leslie Aiello and Christopher Dean (1990, Academic Press: London) (ISBN 0-12-04559-9). This is more detailed than you need, but despite its age it will be indispensable if you continue with more advanced human evolution courses.

Encyclopedia of Human Evolution (2nd Ed.) edited by Eric Delson, Ian Tattersall, John Van Couvering and Alison Brooks (2000, Garland Publishing: New York) (ISBN 0-8153-1696-8). Well-worth getting if you intend to continue with human evolution.

The Fossil Trail: How we know what we think we know about human evolution by Ian Tattersall (2008, Oxford University Press: New York) (ISBN-13: 978-0195367669). This is a history of fossil discoveries. It is well written, and Ian Tattersall's acute observations of, and experience with, the hominin fossil record make the book more authoritative than most popular summaries of hominin evolution.

Other readings
In addition to the relevant sections of the three textbooks, for many classes students will be directed to specific reading assignments. These are class notes written by Bernard Wood (BW; the University Professor of Human Origins) that have been carefully selected so as not to burden you with impossibly long reading lists. You **will be expected to have read and be familiar with these class notes** and other specific readings (e.g., research articles) that are prescribed. **Your examinations will assume you have read them.** Lists of 'further reading' will be provided for those who wish to read about topics in more depth.

Average minimum amount of out-of-class or independent learning expected per week:
A 3-credit course should include 2.5 hours of direct instruction and a minimum of 5 hours of independent learning or 7.5 hours per week. More information about GW's credit hour policy can be found at:
provost.gwu.edu/policies- forms (webpage)
or
provost.gwu.edu/files/downloads/Resources/Assignment-Credit-Hours-7-2016.pdf (form)

Structure of the class
Each class will consist of approximately 60 minutes of lecture on the topic of the day accompanied by some pop quizzes. Theses quizzes will be the basis of some exercises that will be performed by the class as a whole. The remaining 15 minutes of class will be used to wrap up the lecture of the day with a general discussion. The last classes will be used for student presentations.

A PowerPoint presentation summarizing the content of each class will be available on the Blackboard site **after each lecture**.

*** This structure is subject to change (e.g., pending final student enrollment)

Use of electronics in the classroom
There is a growing body of research demonstrating conclusively that laptops and cellphones in the classroom are damaging the classroom experience and undermining learning. For example, it is now established that students learn more from taking hand-written notes than notes on laptops. Thus, **students may not use electronic devices (e.g., laptops, cell phones, tablets) in the classroom without written consent of the professor**. If you have special needs for which use of electronics is an appropriate accommodation you must either 1) deliver a request from Disability Support Services or 2) send the professor and your TA a one-page explanation justifying the request.

If you want to know more, read these articles:
http://www.insidehighered.com/news/2011/05/18/professors_spy_on_students_to_see_how_they_are_using_laptops_in_class
http://www.newyorker.com/online/blogs/elements/2014/06/the-case-for-banning-laptops-in-the-classroom.html?mobify=0
http://msutoday.msu.edu/news/2014/surfing-the-web-in-class-bad-idea/
http://chronicle.com/blogs/linguafranca/2014/08/25/why-im-asking-you-not-to-use-laptops/

Assignments and grading
The components of the final grade for the class are summarized below:

- First MCQ assessment 10%
- Anatomy quiz 10%
- Class presentation 10%
- Second MCQ assessment 20%
- Topic summary 25%
- Lab reports 25%

MCQ/SAs
Two of the components are Multiple-Choice/Short Answer examinations; one will be held during class time (10%) and the second will be in place of the 'final exam' (20%). The first one is designed to help students judge whether they are making progress with the goals of the class, and to give them examples of the types of factual information they will be expected to be familiar with. The first will cover Classes 1-7; the second will concentrate on Classes 10-22, but may include material from Classes 1-7.

Anatomy quiz
The third component of the assessment is the Anatomy Quiz (10%) (which is Lab 6), which will test your knowledge of the skeletal anatomy that is relevant to hominin evolution.

Topic summary
Over the length of the course, students will develop a written summary (25% of the overall grade for the course) of one of these three topics in hominin evolution: (1) a hominin species taxon, (2) a method in hominin paleobiology, or (3) a paleontological site. You may work with no more than two other students to do this, but if you do so you should clearly identify the contributions of your collaborators. You should write as if you were preparing notes for your classmates and it should be written at the same level as the notes for the course. The main text should not exceed 3000 words (plus title, author list and references written in the style of a scientific paper published in the *Journal of Human Evolution*).

It is very important that you follow these instructions: You must let your instructor know which topic you have selected **by 5pm on 9/28 at the latest**; it will be 'first come, first served' in the sense that the earlier you do this the greater choice of topic you will have (arrange an appointment *before the due date*). You must send SA an electronic double-spaced draft (doc/docx format, in Times New Roman 12 pt font) of your summary (around half page) **by 5pm on 10/5 at the latest**; SA will provide you preliminary feedback. A double-spaced copy of the final version for grading (again, in Times New Roman 12 pt font and doc/docx format) must be sent electronically to SA **one week after your class presentation** (see below). Make sure that your final summary addresses the feedback given to your during the class presentation (see below).

Please note that the submission email must be headed 'ANTH 3412 Fall 2017: [Topic]_Summary_by_[your names/s].' **Submissions in any other format and/or submitted after the deadline described above will not be graded.**

Class presentation

At the end of the course, students will present their Topic Summaries to the rest class (10% of the final grade). Your peers and the instructors will provide some feedback on the aspects that could be improved and you will need to incorporate this feedback in your final written summaries.

Lab reports

These are done throughout the semester, and contribute 25% of the overall grade for the course. During each lab session students will work in small groups to complete exercises on worksheets. Students will be responsible for printing out these worksheets (available on Blackboard) prior to each lab session. DW will check for worksheet completion as evidence of student participation in each respective lab session. Students will then complete a report for each lab, following the template provided. Reports will be sent to DW electronically, and will be **due 5pm one week after the respective the lab session**. Students will receive a grade for each lab report, and near the end of the semester SA will confer with DW and decide on a final holistic letter grade for this component.

*Attendance and participation

SA in collaboration with DW will moderate the overall grade on the basis of attendance and the contribution each student has made to discussion in the lectures and in the laboratory sessions. Usually this will be used to increase a student's grade (i.e., rounding up borderline grades *for students with good attendance*); only in exceptional circumstances will it be used to reduce a grade. **Notes and recommended papers will be provided before each class. Students are expected to have read and digested these *before* the class.**

The correspondence between percent scores and letter grades followed in the course is:
(the grades will not be curved)

A	92.5 – 100
A-	89.5 – 92.4
B+	86.5 – 89.4
B	82.5 – 86.4
B-	79.5 – 82.4
C+	76.5 – 79.4
C	72.5 – 76.4
C-	69.5 – 72.4
D+	66.5 – 69.4
D	62.5 – 66.4
D-	59.5 – 62.4
F	59.4 and below

Tentative schedule
*** All schedule dates are subject to change. See below for a 'teaser' of each class content.

Date	Day	Lecture topics
Aug 29th	Tues	Class 1. Syllabus, course content, introduction to 'Hominin Evolution'
		Lab 1. Taxonomy and nomenclature
		Section 1. Hominin Evolution: Context
Aug 31st	Thurs	Class 2. Evolutionary context of *Homo sapiens*: comparative studies.
Sep 5th	Tues	Class 3. Names and what they mean: I. Taxonomy and systematics.
		Lab 2. Alpha taxonomy and cladistic analysis
Sep 7th	Thurs	Class 4. Names and what they mean: II. Terminology of human evolutionary anatomy.
Sep 12th	Tues	Class 5. Overview of the hominin fossil record.
		Lab 3. Anatomical terminology
Sep 14th	Thurs	Class 6. Reconstructing the past: I. Time and context.
Sep 19th	Tues	Class 7. Reconstructing the past: II. Phylogeny.
		Lab 4. Intra vs interspecific variation, scaling and allometry
Sep 21st	Thurs	Class 8. **MCQ ASSESSMENT OF SECTION 1**
Sep 26th	Tues	Class 9. REVIEW OF ANATOMY
		Lab 5. Comparative morphology: Modern humans vs chimpanzees
		Section 2. Hominin Evolution: Fossil and Molecular Record
Sep 28th	Thurs	Class 10. Evolutionary history of the apes: Hominoid origins
Oct 3rd	Tues	Class 11. The Miocene antecedents of the earliest hominins: Hominid origins
		Lab 6. Anatomical accuracy and precision [**ANATOMY QUIZ**]
Oct 5th	Thurs	Class 12. Hominin origins: contenders for the title of 'earliest' hominin.
Oct 10th	Tues	**GW Fall Break (no classes)**
Oct 12th	Thurs	Class 13. Archaic hominins: early evidence from East and Central Africa
Oct 17th	Tues	Class 14. Archaic hominins: evidence from southern Africa.
		Lab 7. Fossil apes
Oct 19th	Thurs	Class 15. Hyper-megadont and megadont archaic hominins.
Oct 24th	Tues	Class 16. Transitional hominins: the discovery of *Homo habilis.*
		Lab 8. Early hominins
Oct 26th	Thurs	Class 17. Pre-modern *Homo*: early African *Homo erectus* – origins and dispersal beyond Africa
Oct 31st	Tues	Class 18. Pre-modern *Homo*: *Homo erectus sensu stricto*.
		Lab 9. Australopiths vs *Homo*
Nov 2nd	Thurs	Class 19. Pre-modern *Homo*: later archaic *Homo.*
Nov 7th	Tues	Class 20. Pre-modern *Homo*: focus on Neanderthals
		Lab 10. Anatomy of *Homo*
Nov 9th	Thurs	Class 21. Anatomically modern *Homo*: Modern human origins: I. The fossil evidence.
Nov 14th	Tues	Class 22. Anatomically modern *Homo*: Modern human origins: II. The molecular evidence.
		Lab 11. Neanderthal characteristics
Nov 16th	Thurs	Class presentations
Nov 21st	Tues	**No class**
		No lab
Nov 23rd	Thurs	**Thanksgiving (no classes)**

Nov 28th	Tues	Class presentations
		Lab 12. Modern human origins
Nov 30th	Thurs	Class presentations
Dec 5th	Tues	Class presentations
Dec 7th	Thurs	REVIEW OF THE COURSE: TOPICS CHOSEN BY THE CLASS
Dec 13th-21st		**Final Examinations**

GW's Academic Schedule – Fall Semester 2017

Classes Begin	Monday, August 28
Labor Day (no classes)	Monday, September 4
Fall Break (no classes)	Monday, October 9 – Tuesday, October 10
Thanksgiving Break	Wednesday, November 22 – Saturday, November 25
Last Day of Classes	Monday, December 11
Makeup/Reading Day	Tuesday, December 12
Final Examinations	Wednesday, December 13 – Thursday, December 21

Table 1: 'Old' and 'New' Taxonomies

A traditional pre-molecular hominoid taxonomy. Extinct-only taxa are in bold.

Superfamily Hominoidea (hominoids)
- Family Hylobatidae (hylobatids)
  - Genus *Hylobates*
- Family Pongidae (pongids)
  - Genus *Pongo*
  - Genus *Gorilla*
  - Genus *Pan*
- Family Hominidae (hominids)
  - **Subfamily Australopithecinae (australopithecines)**
    - **Genus *Ardipithecus***
    - **Genus *Australopithecus***
    - **Genus *Kenyanthropus***
    - **Genus *Orrorin***
    - **Genus *Paranthropus***
    - **Genus *Sahelanthropus***
  - Subfamily Homininae (hominines)
    - Genus *Homo*

A currently common hominoid taxonomy recognizing modern molecular studies. There are several variations of the same. Extinct-only taxa are in bold type.

Superfamily Hominoidea (hominoids)
- Family Hylobatidae (hylobatids)
  - Genus *Hylobates*
  - Genus *Symphalangus*
  - Genus *Hoolock*
  - Genus *Nomascus*
- Family Hominidae (hominids)
  - Subfamily Ponginae
    - Genus *Pongo* (pongines)
  - Subfamily Gorillinae
    - Genus *Gorilla* (gorillines)
  - Subfamily Homininae (hominines)
    - Tribe Panini
      - Genus *Pan* (panins)
    - Tribe Hominini (hominins)
      - **Subtribe Australopithecina (possible or archaic hominins)**
        - **Genus *Ardipithecus***
        - **Genus *Australopithecus***
        - **Genus *Kenyanthropus***
        - **Genus *Orrorin***
        - **Genus *Paranthropus***
        - **Genus *Sahelanthropus***
      - Subtribe Hominina (hominans)
        - Genus *Homo*

Brief class descriptions

Class 1. Syllabus, course content, introduction to 'Hominin Evolution
This session will explain what 'hominin evolution' means, and how it can be investigated using fossil evidence. This class will provide some examples of paleobiological and evolutionary questions that can be answered using the hominin fossil record.

SECTION 1: HOMININ EVOLUTION: CONTEXT

Class 2. Evolutionary context of *Homo sapiens*: comparative studies
What evidence is available to determine which, if any, of the living primates is more closely related to modern humans than any other? This class will explore the classes of evidence that can be used to explore the relationships among living organisms and especially among humans and other primates. We will also discuss what implications this evidence has for using classical morphology as an indicator of phylogenetic relationships within the hominin clade.

Class 3. Names and what they mean: I. Taxonomy and systematics
Systems and conventions are essential for any science. Think of how difficult physics and chemistry would be if there were no conventions about notation and there was no periodic table, or how difficult it would be if your local supermarket had no system for displaying the goods for sale; corn flour stacked next to grapefruit juice, and wine next to kitchen cleaners?

The convention we use to classify living things is the one devised by Linnaeus. However, when he devised the scheme the only organisms he had in mind were living ones. How easily can it be applied to extinct animals, when all we know about them comes from the sparse fossil record? Can a fossil species be recognized and defined in the same way as a living species? What criteria should be used to identify species in the fossil record?

Class 4. Names and what they mean: II. Terminology of human evolutionary anatomy
In order to study human evolution students must acquire a working knowledge of both anatomical terminology and the reference points used in studies that involve measuring fossils and comparative collections. This class will review the history of anatomical research and will explain the origin of the terms used in anatomy and hominin paleobiology. Learning human evolutionary anatomy requires one to be able to recognize anatomical elements and understand, and be able to use, a precise anatomical vocabulary.

Class 5. Overview of the hominin fossil record
The hominin fossil record can be broken up finely into many exclusive categories, or more coarsely into inclusive taxa or even more inclusive grades. This class sets out the case for recognizing six grades around and within the hominin clade.

Class 6. Reconstructing the past I: Time and context
Many aspects of the context of the hominin fossil record are important for its interpretation. How are fossils dated? What can be inferred about the habitats the early hominins lived in? What roles, if any, did changes in global and regional climates play in determining the course of hominin evolution? How do

scientists obtain information about past climates? What other animal groups co-existed with fossil hominins? Can the changes and trends observed in their evolution help interpret the hominin fossil record?

What do fossils consist of? Why are some parts of the skeleton better represented in the fossil record than others? Are fossils an unbiased, or a biased, sample of past populations and faunas? How can an irregular object, such as a tooth or a skull, be converted into qualitative or quantitative data suitable for scientific analysis?

Class 7. Reconstructing the past: II. Phylogeny
Once the fossil record has been resolved into species the next task is to understand how those species are related. Was there just a single hominin lineage, or did it break up into several lineages, each with its own particular morphological signature? This problem has been addressed, apparently successfully, at higher taxonomic levels (i.e., the relationships between major groupings such as birds and reptiles) by a method called cladistics, or phylogenetic analysis. But how successful is cladistics at determining the phylogenetic significance of the relatively subtle differences between hominin species, especially when the early hominin fossil record is sparse and dominated by skulls and teeth?

Class 8. MCQ/SA ASSESSMENT OF SECTION 1.

SECTION 2: HOMININ EVOLUTION: FOSSIL RECORD AND MOLECULAR EVIDENCE

Class 9. REVIEW OF ANATOMY

Class 10. Evolutionary history of the apes: Hominoid origins
and
Class 11. The Miocene antecedents of the earliest hominins

Extant apes and humans constitute a relict of a once highly diversified group. During the Miocene (2~3 Ma to 5.3 Ma) in Africa, Europe and Asia there was a greater diversity of apes that did not resemble or move around like any primates alive today. Thus, current debates in paleoanthropology focus on elucidating the functional morphology and shape affinities of these fossil forms. It is from some of these Miocene apes that both modern great apes and earliest hominins evolved. Thus, only by studying the evolution of fossil apes in combination with available early hominins we will be able to provide realistic models of ape and human evolution and thus understand human origins.

Class 12: Hominin origins: contenders for the title of earliest hominin
When the principles of neutral mutation are applied to the molecular differences between modern humans and chimpanzees, they suggest that the common ancestor of these two groups would have been living between about 12 and 5 Ma, with most estimates tending to be closer to the younger end of the range (i.e., 7-5 Ma). The common ancestor of later hominins was almost certainly more ape-like than modern human-like, but it was unlikely to have been exactly like any modern ape. Discoveries made at Aramis in Ethiopia in the 1990s, that are ~4.4 Ma and which display an intriguing mixture of features that formerly had been regarded as peculiar to *Australopithecus* or as ape-like, were allocated to a novel species in placed in a new genus as *Ardipithecus ramidus*. Subsequent discoveries at localities older than Aramis in Ethiopia were referred to a second species of *Ardipithecus*, as *Ardipithecus kadabba* (~5–7 Ma), and at the Kenyan site of Lukeino hominin-like fossils dated to ~6 Ma were placed into yet another new species in a different genus

as *Orrorin tugenensis*. Fossils dating to ~7 Ma discovered at a site called Toros-Menalla in Central Africa were assigned to yet another new species and genus as *Sahelanthropus tchadensis*. All of these taxa have at one time, or another, been put forward as the likely ancestor of all later hominins. But, how certain can we be that *any* of these discoveries sample taxa that are more closely related to modern humans than to chimpanzees or any other great ape? Could they be ancestors of living chimpanzees, or belong to an archaic 'proto-hominin' group with no direct link to either living chimpanzees or modern humans? Have recent additional discoveries and analyses of these taxa provided any clarification?

Class 13: Archaic hominins: early evidence from East and Central Africa
Discoveries in East Africa, most of them made over the past two decades, together with material from a site in Central Africa, make up the evidence for at least one, and perhaps several, species of *Australopithecus*. The best known of these is *Australopithecus afarensis*. There is as good a fossil record for this species as for any early hominin and thus it offers an opportunity to investigate it according to the principles set out earlier in the course. How well is it dated? How well can it be characterized in terms of its functional capabilities? How different are males and females? Does it display any evolutionary trends through time? Can its paleohabitat be determined with any precision? How do the other East and Central African archaic hominins, *Australopithecus anamensis* and *Australopithecus garhi*, and *Australopithecus bahrelghazali* respectively, differ from *Au. afarensis*? Why did researchers decide to erect a new genus, *Kenyanthropus*, to accommodate recent discoveries from Kenya? How does the new taxon differ from taxa included in *Australopithecus*? What are the relationships of *Au. garhi*?

Class 14. Archaic hominins: evidence from southern Africa
The first archaic hominin was not discovered in East Africa, but at the Taungs (now called Taung) Limeworks, 75 miles north of Kimberley, in what is now part of South Africa, in 1924. In the following year in a letter to the journal *Nature* Raymond Dart attributed the child's skull from Taung to a new species and genus, *Australopithecus africanus.* Comparable finds at Sterkfontein and at Makapansgat were initially attributed to different genera and species, but they were later included within *Au. africanus,* as were hominins more recently recovered from Gladysvale Cave. Fossils with slightly larger postcanine (i.e., the premolar and molar teeth), more robust jaws, and with flatter faces, were found at Kromdraai and Swartkrans, and more recently in caves at Drimolen, Gondolin and Coopers. This more megadont (the technical term for 'large teeth') material was originally assigned to a second genus, *Paranthropus*, as *Paranthropus robustus* (some workers also recognize the Swartkrans material as a separate species, *Paranthropus crassidens*); it is conventional to treat these latter fossils as at least a separate species and in these notes they are treated as a separate genus. The *Paranthropus* remains are sometimes referred to as the 'robust' australopiths because of their large faces and jaws, but in this class they will be referred to as paranthrops. Some researchers believe that fossil hominin remains from a relatively unexplored lower part of the Sterkfontein cave complex (Member 2 and the Jacovec Cavern) push the southern African fossil record back to 4 Ma, and perhaps beyond, but this old date has been challenged. Even more recently two associated skeletons found at a site called Malapa have been assigned to a separate species of *Australopithecus*, as *Au. sediba*. In the case of the Jacovec fossils it has been claimed that they may sample a more primitive hominin species than *Au. africanus*, and in the case of the Malapa fossil remains it is claimed that they sample a taxon that links *Au. africanus* with *Homo*. But they may both be variants of *Au. africanus.* How are these hominin taxa recovered in southern Africa related to the evidence recovered from East African sites?

Class 15. Hyper-megadont and megadont archaic hominins

The OH 5 cranium was discovered by Mary Leakey at Olduvai Gorge in 1959. It was designated as the type specimen of *Zinjanthropus*, later to be called *Australopithecus (Zinjanthropus) boisei*. Subsequent discoveries at Olduvai and other sites, notably from Shungura, Koobi Fora and West Turkana, all located in the Omo region, and Konso in Ethiopia, have confirmed the existence of a species that was distinct from, and more derived than, *Paranthropus robustus*. Some researchers consider that the East African evidence belongs to the same clade as *P. robustus* and that both enough from species attributed to *Australopithecus* that the genus name *Paranthropus* should be revived to accommodate them, and in this class we will refer to this East African megadont archaic hominin as *Paranthropus boisei*. *Paranthropus boisei* is one of the best-known fossil hominin taxa (at least craniodentally). Its massive, wide, flat face, large mandible, diminutive anterior and very large-crowned (hyper-megadont) and thick-enameled premolar and molar teeth are among its diagnostic features. Similar, but morphologically distinctive and temporally earlier (>2.3 Ma) material from West Turkana has been assigned to a separate species, *P. aethiopicus*. The two East African taxa, *P. boisei* and *P. aethiopicus*, are sometimes referred to as 'hyper-robust' to distinguish them from the 'robust' forms from southern Africa.

The morphological similarities shared by the southern African 'robust' and East African 'hyper-robust' forms may either be the result of similar adaptations affecting separate, regionally-distinct, hominin lineages (i.e., convergent evolution), making the grouping polyphyletic), or they may reflect the fact that the two regional variants shared a recent common ancestor not shared with *Au. africanus* and thus form a morphologically coherent and distinctive monophyletic group (i.e., they are a grade and clade of fossil hominins). If there is support for the latter proposition (i.e., they are a clade) then this would provide further justification for the reintroduction of the genus *Paranthropus.*

Class 16. Transitional hominins: the discovery of *Homo habilis*

In the early 1960s Louis and Mary Leakey made a series of discoveries at Olduvai Gorge of a type of hominin that was clearly distinct from *P. boisei*. This prompted Louis Leakey, Phillip Tobias and John Napier to propose in 1964 that the remains represented a new, more primitive, species of the genus *Homo* that they named *Homo habilis* (literally 'handy man'). Their critics considered the new taxon to be unjustified. Some claimed that the new material was indistinguishable from *Au. africanus*, while others regarded it as being more closely-related to *Homo erectus* (see below). *Homo habilis* was the subject of intense discussion and debate in the 1960s and the debate continues today. This class will review the history of the early discoveries of *H. habilis*, summarize the debate about the justification of the new species, review the fossils attributed to *H. habilis* since 1964, and present the background to contemporary interpretations of that evidence.

Since 1964 *Homo*-like fossil material found at Olduvai Gorge has been added to the *H. habilis* hypodigm. However, it was discoveries made at Koobi Fora that proved to be decisive in prompting researchers to reassess the hominin remains from that site (as well as those from Olduvai) that were being referred to an informal taxonomic group called 'early *Homo*'. Some researchers claimed that the extent and nature of the variation in this catch-all grouping was excessive for a single species and it was proposed that the material in early *Homo* should be allocated to two species. One widely adopted scheme recognizes *Homo habilis sensu stricto*, with OH 7 as its type specimen, which is known from both Olduvai Gorge and the Omo region and perhaps from sites elsewhere. The other, *Homo rudolfensis*, of which KNM-ER 1470 is the type specimen, is, as yet, known only from sites in the Omo region, and from a site in Malawi. Recently, researchers have gone even further and questioned whether it is appropriate to include these taxa in *Homo*. What criteria should be used to decide whether taxa deserve their own genus? When these criteria are

applied to early *Homo* species, what is the outcome? How do recent discoveries in the Turkana Basin and Dmanisi (Georgia) affect these discussions?

Class 17. Pre-modern *Homo*: early African *Homo erectus* – origins and dispersal beyond Africa
By perhaps 2.0 Ma, and certainly by 1.8 Ma, the remains of a new form of hominin, *Homo ergaster* or early African *Homo erectus*, appear in sites in the Omo region of East Africa. What distinguishes it from all the hominin taxa that have been referred to in earlier classes is a reduction in the relative and absolute size of the face, jaws and chewing teeth, perhaps a reduction in sexual dimorphism (but the discovery of small-brained *H. erectus* challenges this hypothesis) together with a postcranial skeleton that clearly demonstrates it is an obligate biped. Cranial specimens similar to those of *Homo erectus* from the Far East (see below) are also found in East Africa, but these (e.g., OH 9) postdate the remains attributed to *H. ergaster*. Similar fossils have been recovered from a ~1.8 Ma site in Georgia called Dmanisi. Some researchers imply, the latter remains bridge the morphological gap between *H. habilis* and *H. ergaster*/early African *H. erectus*. New fossil evidence from the Dinaledi Chamber in the Rising Star cave system adds further complication to our understanding of the origins of *Homo*.

Class 18: Pre-modern *Homo*: *Homo erectus sensu stricto*
Despite claims that archaic hominins were among the hominin fossils recovered from Indonesia there has never been any convincing evidence that hominins belonging to *Au. africanus* or *Au. afarensis* have been recovered from sites beyond Africa. The earliest hominin fossil evidence outside of Africa is from Indonesia, where absolute dates of ~1.8 Ma have been claimed for *H. erectus* remains and from Dmanisi, Georgia, where crania in some ways resemble *H. ergaster* and in others, *H. habilis* have been recovered. Other than these sites and an archaeological site in the Near East called Ubeidiya the evidence for hominin occupation much beyond 1 Ma is weakened either by unreliable dating or by the inconclusive nature of the paleontological or archeological evidence. However, the ~1.3 Ma sites of Orce and the Sima del Elefante (one of the caves at Atapuerca), both in Spain, are the exception. Were the first hominins to leave Africa *H. ergaster*-like, or were they more primitive, *H. habilis*-like hominins? There is evidence that *H. erectus* persisted in Asia for well over a million years (~1.8 – ~0.2 Ma) so *H. erectus* in Asia overlapped temporally with *Homo sapiens* in Africa (see below). Did *H. erectus sensu stricto* ever penetrate Europe? Where does the ~100-60 Ka (or even 700 Ka) *Homo floresiensis* fit into all this?

Class 19. Pre-modern *Homo*: later archaic *Homo*
The distinctive morphology of *H. erectus* gives way to hominins with a less specialized but still quite 'robust' (i.e., relatively wide mandibular body and ectocranial features in the skull, and thick cortex and relatively thick long-bone shafts in the postcranial skeleton) skull and postcranial skeleton. There is an ongoing debate about the degree of regional distinctiveness of these remains, which include fossil crania from sites such as Kabwe in Africa, Petralona and Mauer in Europe and Jinnuishan in China. There is no consensus about the most appropriate taxonomy for this material. Some researchers support species-level distinctions (e.g., *H. heidelbergensis*, *H. rhodesiensis, H. antecessor*), while others are content to recognize the variability as no more than an expression of polytypic, intraspecific, variation within an interpretation of *Homo sapiens* that would see it subsume all of *Homo* post-*H. erectus*.

Class 20. Pre-modern *Homo*: focus on the Neanderthals:
Homo neanderthalensis, or Neanderthals for short, are a group of pre-modern *Homo* that has what many, but not all, researchers interpret as a particularly distinctive morphology. The group is found in sites which are spread across Europe, the Near East and western Asia, and the remains date from > 200-30 Ka (this date would be ~450 Ka if the Sima de los Huesos material is included). Their distinctive facial shape,

robust long-bones and large joints have been interpreted as being a phenotypic consequence of their occupying cold and 'marginal' environments armed with relatively unrefined tools. However, this simplistic interpretation is being challenged. The second of the two classes will review evidence from Neanderthal DNA. These data provide important new evidence about whether Neanderthals are a separate species, and thus about the relationship between Neanderthals and modern humans.

Class 21: Anatomically modern *Homo*: Modern human origins: I. The fossil evidence
and
Class 22: 'Anatomically modern *Homo*: Modern human origins: II. The molecular evidence'
The origin of modern humans is a topic that has dominated human evolutionary studies for the past decade or more. However, despite this degree of attention there has been little substantial progress. The crux of the debate is whether, or not, anatomically-modern humans originate from a series of migrations of hominins 'Out of Africa'. The successive migrations each took their gene pools with them so that modern humans everywhere have a genome that is mainly made up of genes that originated in Africa at different times. The competing hypothesis is that modern humans arose by a series of regional transitions from archaic to anatomically modern humans with, or without, significant admixture with immigrants from Africa. The latter hypothesis allows for genes to be transferred *between* regions (by either migration of interbreeding), but it also implies there was substantial morphological continuity *within* each major region through time.

We will examine whether, and in what ways, the paleontological and archeological evidence can be reconciled with the molecular evidence from individuals sampled from modern human populations. Each of the three lines of evidence, *molecular*, *anatomical* and *behavioral*, has its strengths and weaknesses, and these will be discussed. This class will also focus on the implications of the ~170 Ka modern human-like crania from Herto, in the Middle Awash, Ethiopia, and dates for the Omo crania that suggest they are ~190 Ka.

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