The Human Evolution Teaching Materials Project

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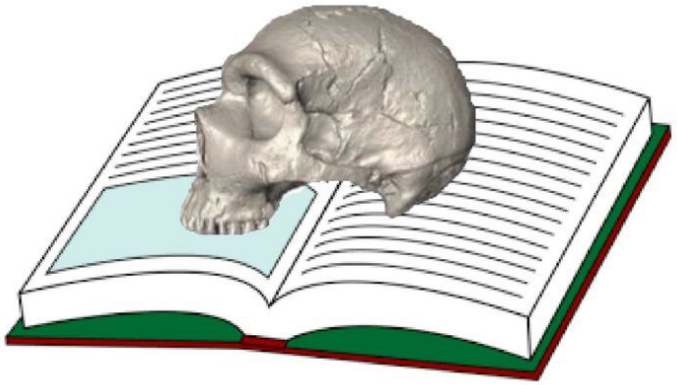
HUMAN EVOLUTION TEACHING MATERIALS PROJECT



HELPING EDUCATORS BRING 3D FOSSILS TO THE CLASSROOM

www.HETMP.com

What is HETMP?

The Human Evolution Teaching Materials Project (HETMP) provides resources for middle and high school educators to facilitate the inclusion of human evolution into existing science curricula. HETMP was designed to help teachers generate 3D models of hominin fossil crania and provide accompanying lesson plans, increasing access to 'hands-on' learning materials. Funding for this project is provided by the Society for the Study of Evolution.

Creation of HETMP

We identified several obstacles in the teaching of evolution at the middle school/high school level:

- The [perceived] conflict between evolution and religion
- The lack of resources available to middle school and high school teachers
- The “tangible” nature of the fossil record + the expensive cost of casts
- Difficulty with the integration of evolution into existing curricula (e.g. AP Bio)
- Lack of student interest

Why use HETMP to help teach evolution?

- Many high schools and middle schools don't teach evolution at all.
- Those that do teach evolution often don't have the most up-to-date information.
- Through the study of evolution, students can learn about ecology, the environment, paleoanthropology, biology, and what makes us human.
- Using HETMP, students are presented with the tangible evidence of evolution and are able to draw their own conclusions.

Goals and Objectives

The goal of this project is to increase access to three-dimensional (3D) models of fossils for the teaching of human evolution in middle and high school science curricula. Specific objectives include:

- Providing teaching materials that utilize 3D models of fossil hominins to reinforce students' understanding and awareness of evolutionary processes.
- Providing a database listing open-access 3D surface files of hominin crania curated for use by high school and middle school teachers.
- Providing resources for access to and creation of 3D models of fossil hominins.
- Providing support for using these files to create 3D printed models.

Au. africanus

Au. afarensis

Au. sediba

P. aethiopicus

P. boisei

H. naledi

H. erectus

H. rudolfensis

H. habilis

H. heidelbergensis

H. sapiens

H. neanderthalensis

And more!

Meet the cast and crew

How to implement HETMP

- Teachers go to www.HETMP.com to find all of the needed resources
- Teaching materials, 3D pdfs, .stl files, and more are kept up-to-date and are easy to download
- 3D prints can be generated either at the school or at a local institution with access to 3D printers (local libraries, universities, etc.). Schools without access to these resources can check out a pre-printed set of crania or can use 3D pdfs instead
- Teachers get continued support while they work to integrate the modules into their pre-existing curricula

Modules

HUMAN EVOLUTION TEACHING MATERIALS PROJECT

Resources For Teachers Who Want To Incorporate Human Evolution Into Their Science Curricula

MODULES 3D PDFS STL FILES ADDITIONAL RESOURCES HETMP IN ACTION CONTACT US

MODULES

Module 1: Paleoanthropological Methods

Module 2: Spitting and Lumping

Module 3: Cranial Capacity

Module 4: Tool Use

Module 5: Diet/Ecology

Module 6: Human Variation *NEW*

Module 7: Stratigraphy and Taphonomy *NEW*

Module 8: Bipedalism *NEW*

Module 2: Splitting and Lumping

SLOs:
- Students will define what it means to be a species.
- Students will understand the difference between inter and intragroup variation.
- Students will understand and interpret phylogenies.
- Students will demonstrate an understanding of the debate between splitting and lumping and be able to articulate their views on the subject matter.

Resources: http://evolution.berkeley.edu/evolibrary/news/131104_lumperssplitters
http://pages.ucsd.edu/~dkjordan/resources/clarifications/Th-Lumpers.html
http://highered.mheducation.com/sites/0767424263/student_view0/chapter8/lumpers_and_splitters.html#
http://medsocnet.ncsa.illinois.edu/MSSW/moodle/AuthTut/vpage_beta.php?tid=218&&pid=1055
http://evolution.berkeley.edu/evolibrary/article/phylogenetics_02

Curriculum Connections:
- **NGSS (2013)- LS3**
- **NGSS (2013)- LS4**
- **AP Biology (2012-2013)- 1, 6, 15**
- **IB Biology (2016)- 5**

Crania to highlight: *Paranthropus aethiopicus*, *Paranthropus boisei, Australopithecus africanus, Australopithecus sediba*

Teaching Materials Associated With Module 2

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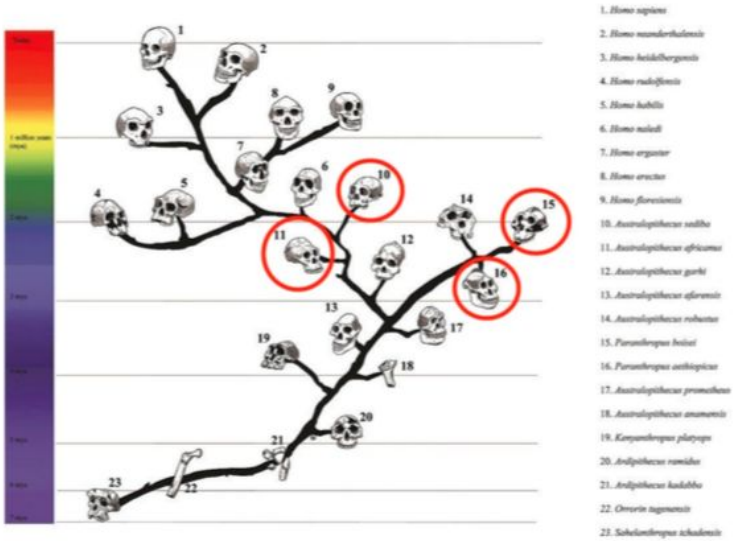
What is a species?
- According to Merriam-Webster: a category of biological classification ranking immediately below the genus or subgenus, comprising related organisms or populations potentially capable of interbreeding, and being designated by a binomial that consists of the name of a genus followed by a Latin or latinized uncapitalized noun or adjective agreeing grammatically with the genus name

Variation:
- Can be intergroup (between groups) or intragroup (within a group)
- Can impact where species distinctions are made
- Can change over time

Phylogenies:
- A phylogeny or a phylogenetic tree is a diagram that depicts the lines of evolutionary descent of different species, organisms, or genes from a common ancestor (Nature 2008)
- More closely related organisms are closer together on the tree
- The base of the tree is called the root and the offshoots are called branches
- A common ancestor of two species is present at their common node (i.e. point where the two branches converged)
- [See appendix for example of phylogeny. Courtesy of Francis Thackeray, University of Witwatersrand in Johannesburg: http://www.faz.net/aktuell/wissen/woher-kommt-der-mensch-1-unser-stammbaumim-mathe-style-14538823-p2.html?printPagedArticle=true#pageIndex_2]

Each module can function as a discrete unit or multiple modules can be taught together to provide a more holistic view of human evolution.

The teaching materials are kept up to date and are easy to integrate into existing science curricula!



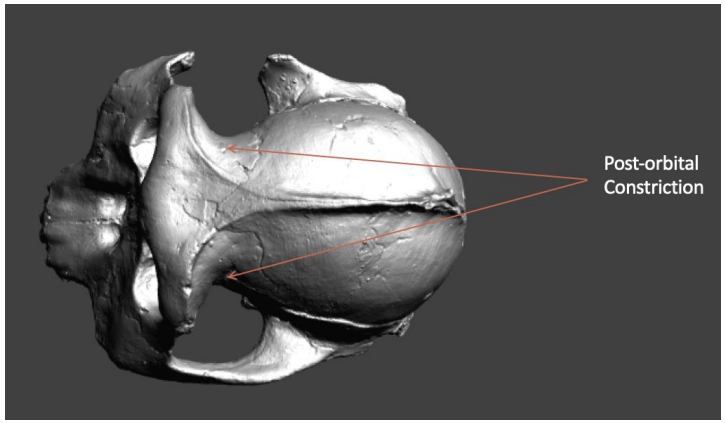
Originally grouped together (more of a "lumper" approach), *aethiopicus* and *boisei* were thought to be more robust forms of *Australopithecus*. Eventually, scientists recognized that the 'robust' forms were different enough to be in their own species. Using more of a "splitter" mentality, the fossils were recognized as being different enough from the other australopithecines - and similar enough to each other - to be placed into a separate genus. This new genus was called *Paranthropus*.

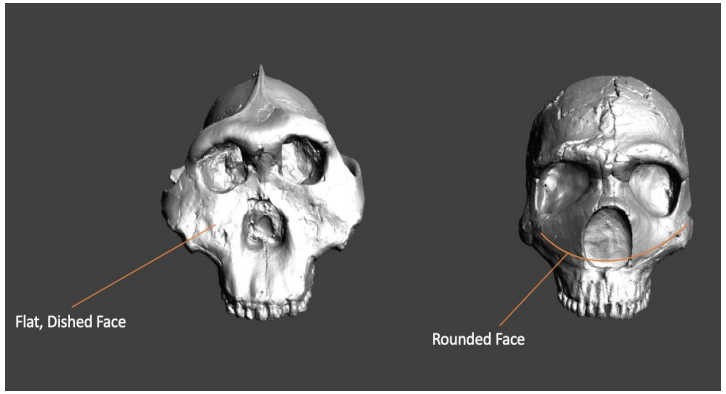
What are some similarities/differences between these four crania?

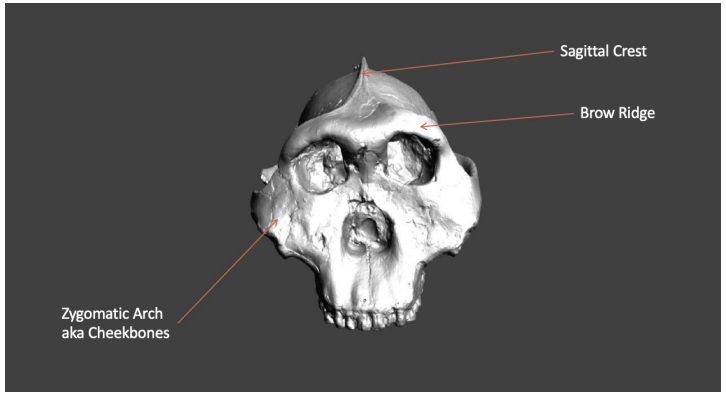
Part 1: Visual Analysis

Begin by visually assessing all four of the crania provided for you at the beginning of the lab for the provided traits. Write down your observations for each. Do not worry about the preservation of the fossil (i.e. missing pieces)—this varies based on the specimen and doesn't help you learn about the relationship between the various organisms. If you cannot observe a trait, write N/A. Refer to the osteology guide if you need help understanding what the various traits are.

Trait	A	B	C	D
Is the face flat/dished or more rounded like modern humans?				
Are the cheekbones big and flat or small and rounded?				
Is the brow ridge prominent or reduced?				
Is there post-orbital constriction present?				
How large are the teeth?				
Is the skull more prognathic or orthognathic?				
Is there a sagittal crest?				

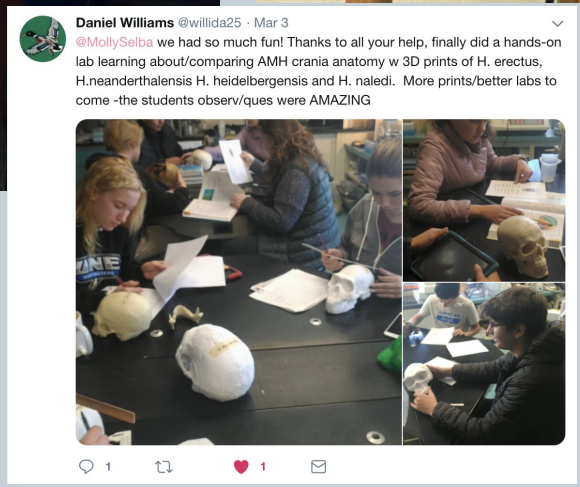






All of these crania (and more) are available to the public because they are all open-access!

Previous Implementation



Questions?

Acknowledgements

- 3D files: www.morphosource.org
  www.africanfossils.org

- Funding: Society for the Study of Evolution

- Collaborators:
  - Dr. Valerie DeLeon
  - Dr. John Krigbaum
  - Chi Klein