

3D Scanning...

A 3D scanner setup in a museum. A small dinosaur figurine is on a rotating platform. A monitor shows a 3D model of the object. A red laser line is visible on the platform.

and more.

*John Kappelman
Department of Anthropology
UT Austin*

Database vs Interactive Teaching and Learning Environment

- “Hands on” teaching and learning
- Scientific method
- Data collection
 - Skeletal elements
 - Assessing behaviors
- Quantification and hypothesis testing
- Instantaneous feedback



The Audience...



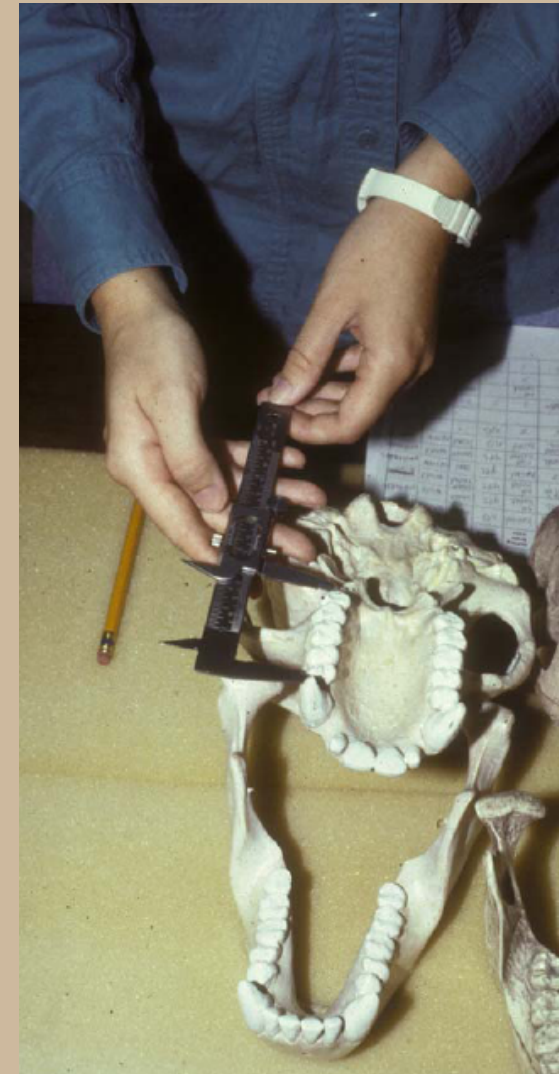
Population of diverse
learners,
from the K...




to the grey.

Digital Challenge: how to make the methods, data, and analysis process available and accessible

- Combine the best of the **traditional** teaching methods with the newest of the **technologies** and rethink the basic assumptions of knowledge discovery and transfer
- Transform what is perceived to be the “**impersonal**” computer interface into an interactive learning tool where the user is in the control seat



Learning Modules: 1980s...



LEVEL A

Average thickness of this layer: 85 cm

Carbon and/or ESR sample numbers: 3 & 4

Sample dates

LEVEL B

LEVEL XX

HELP!

IF YOU ARE TAKING AN EXAM YOU MUST LOG IN AT LEAST 15 MINUTES BEFORE THE LAB CLOSES

VExams ExamGiver

Developed by the Laboratory for Computer Imaging in Physical Anthropology

University of Texas at Austin

Click on 'Home' button to continue...

Dell

Home

Back

Home icon

Back icon

Help icon

Keyboard

Mouse

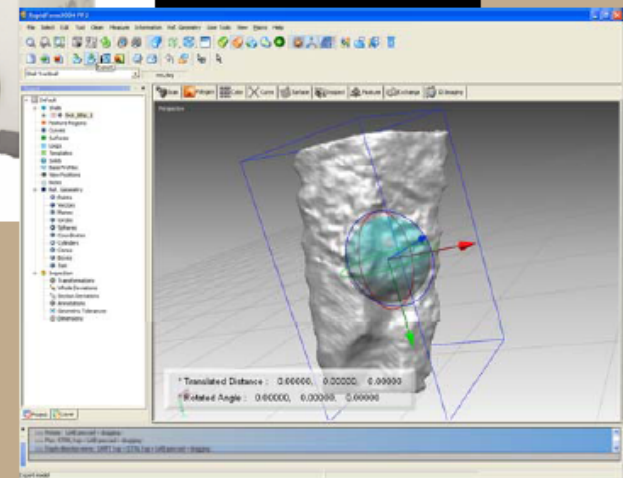
Computer tower

Monitor

Apple HyperCard: late 1980s

Development and Delivery

- 2-D and 3-D data capture and rendering
- *Learning modules*
 - *Virtual Laboratories*
 - *eSkeletons.org*
 - *eForensics.info*
 - *eFossils.org*
- *Repurposing basic data*
 - *Laptops and handhelds*
 - *eSkeletons kids' portal*
 - *3-D printouts at varying scales*
- *Evaluation*
 - *Vexams and testing lab*



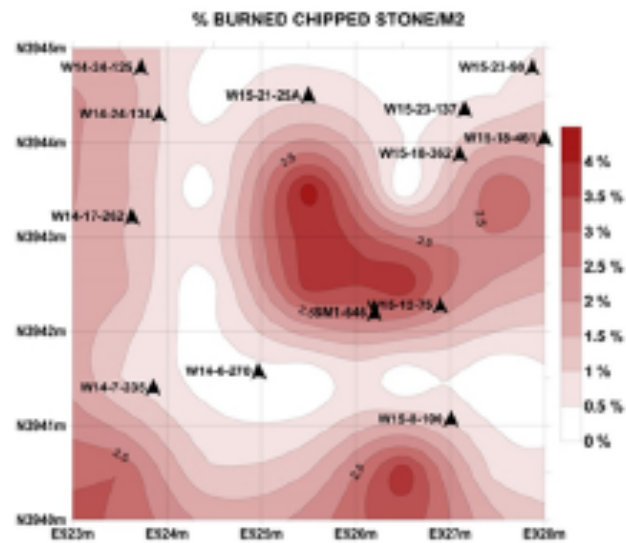
Data Acquisition

The University of Texas
High Resolution
X-Ray CT Facility



Minolta surface
scanning

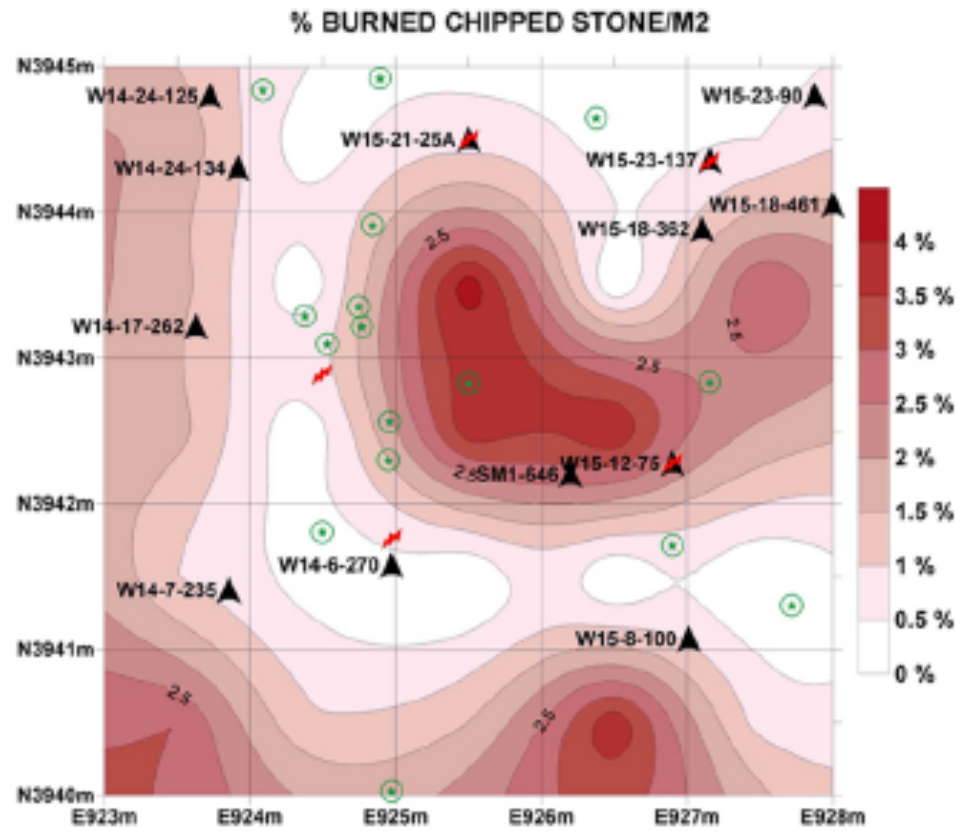




SM1 PRELIMINARY CHIPPED STONE DISTRIBUTION PATTERNS

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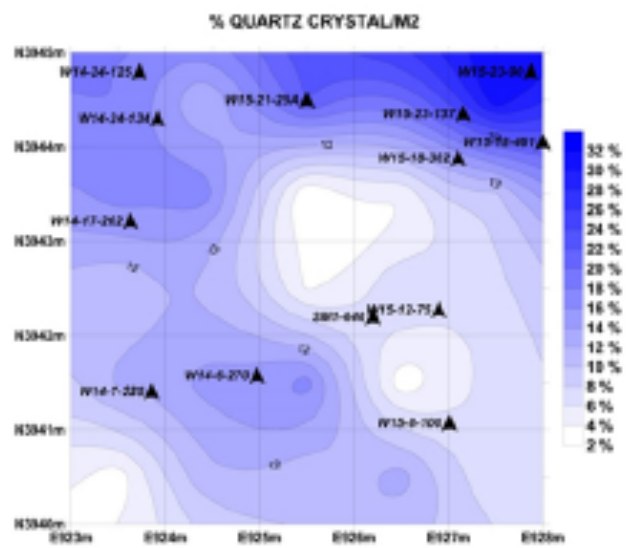
0 1 2 3 4 5
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MICROWEAR CATEGORY

- Extractive
- Maintenance

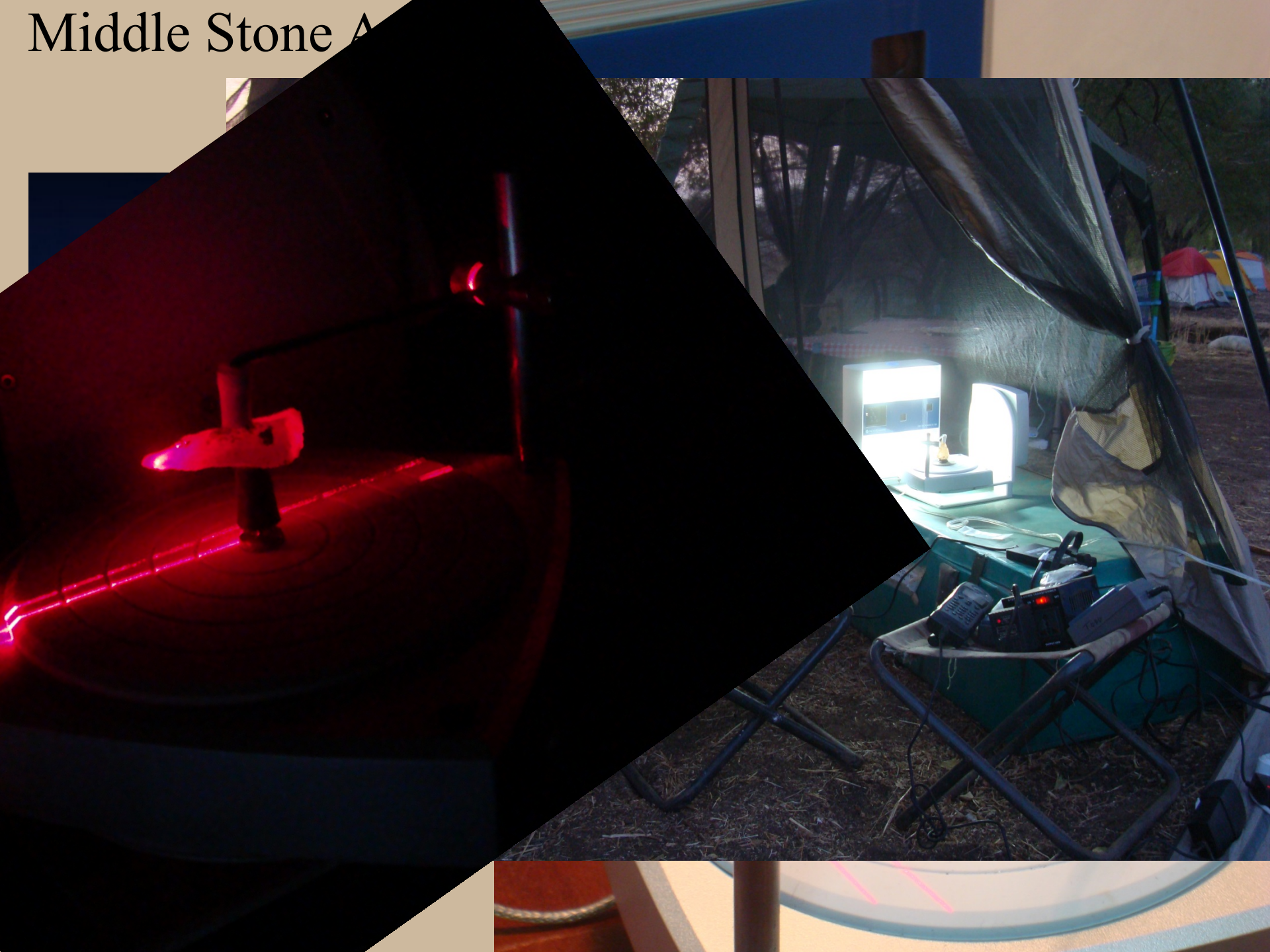
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**SM1 PRELIMINARY CHIPPED STONE DISTRIBUTION PATTERNS
MICROWEAR MASTER GROUP AND POINTS**

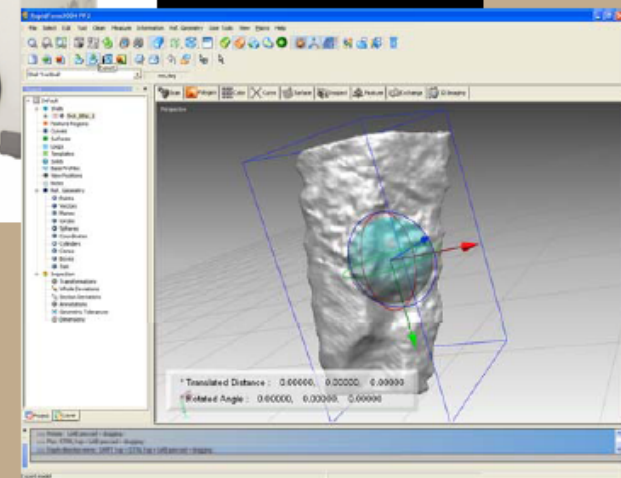
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meters

Middle Stone Age



Development and Delivery

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 - Laptops and handhelds
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- Evaluation
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Select a Lab here



Virtual Laboratories

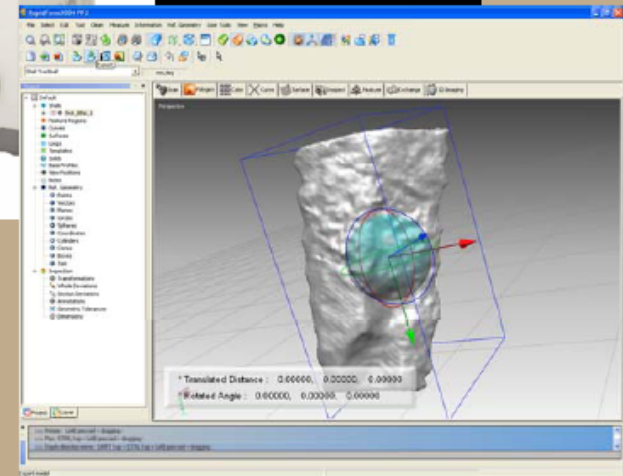
Copyright

EXIT

- Color images
- Movies
- 3D animations
- Interactive exercises
- Resources always available

Development and Delivery

- 2-D and 3-D data capture and rendering
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First launched 1998,
 with many updates...



Humans are unique among primates in that they alone practice obligatory bipedalism and their skeletons show distinctive adaptations for this form of locomotion. Humans' ability to regulate their body heat over long periods of heavy activity is also unique, as are their large brains that are highly developed organs that allow for technology, and diversity of culture and language. These qualities enable humans to travel over water, in the air, and into space. Humans live permanently in almost all terrestrial parts of the planet, and occupy inhospitable environments such as the Sahara and the Antarctic temporarily. *Homo sapiens* is the only extant human species.





eSKELETONS

[About eSkeletons](#) | [Glossary](#) | [FAQ](#) | [Legend](#) | [Resources](#)

TAXON COMPARATIVE ANATOMY TAXONOMIC TREE

[Baboon](#) [Chimpanzee](#) [Common Marmoset](#) [Gibbon](#) [Gorilla](#) [Human](#) [Lesser Bushbaby](#) [Mouse Lemur](#) [Orangutan](#) [Ruffed Lemur](#) [Slow Loris](#) [Squirrel Monkey](#) [Tarsier](#)

Human: Femur



Please select a bone for viewing:

- Femur
- Fibula
- Os Coxa
- Patella
- Tibia



[MORPHOLOGY](#) | [ORIGINS](#) | [INSERTIONS](#) | [ARTICULATIONS](#) | [MOVIE](#) | [PROVENIENCE](#)

↑ Superior

← Lateral



© eSkeletons 2006



meet Lucy



eLucy is a website that will help you to learn about the world's most famous fossil, Lucy, a member of the species *Australopithecus afarensis*, who lived 3.2 million years ago. Lucy was discovered in 1974 in Ethiopia, and she is unique because over 40% of her skeleton was recovered, making her one of the most complete australopithecine fossils ever found. This website provides activities and lessons that will help you to learn about Lucy's place within the history of human evolution. Some activities are online, but others can be completed offline. After studying Lucy, you can investigate other aspects of human evolution at eFossils.org. You can learn more about the human and primate skeleton at eSkeletons.org.

Lucy began her public tour of the United States in 2007 in the exhibit, "Lucy's Legacy: the Hidden Treasures of Ethiopia."

COMPARE LUCY

Visitors can view individual bones from Lucy and compare her bone morphology with the anatomy of chimpanzees and modern humans. Just select an element to get started.

STUDENTS > Activities

This section contains crosswords, puzzles, life-size printouts and other activities to help students learn more about Lucy and human origins.

TEACHERS > Lessons

This section is a collection of lessons and suggested activities that may be used to supplement science classes focusing on human evolution and human origins.

First launched
2011

eFossils.org
a collaborative
website and
community
database for the
study of human
evolution

The screenshot shows the eFOSSILS website with a dark header containing the logo and navigation links: Sites, Species, Comparative Anatomy, Catalog, Resources, Forums. The main content area features three news items: 'Old Feet. New Site.' with an image of foot bones, 'Red Deer Cave Fossils' with a skull image, and 'Denisovan DNA' with a DNA helix image. To the right is a 'Lucy' section with a grid of fossil images and a 'Past News' button. Below is an 'Open Map' section with a timeline from 6 Ma to 1 Ma and a satellite map of Africa and Asia with location markers. The map is powered by Google and includes a 'Terms of Use' link.

eFOSSILS Sites Species Comparative Anatomy Catalog Resources Forums

Old Feet. New Site.
Foot bones from Burtele suggest a hominin with an opposable big toe lived in Ethiopia 3.4 Ma. Image ©The Cleveland Museum of Natural History via LiveScience.

Red Deer Cave Fossils
Descriptions of fossils from Southwest China have sparked new debate about human evolution in Asia. Photo by Darren Cunroe (via LiveScience).

Denisovan DNA
From a finger bone and a molar, researchers have mapped the genome of newly discovered extinct hominins who lived 30,000 years ago. View the results [here](#).

Explore Lucy
Learn more about one of the most famous fossils ever found: the 3.2 million year old fossil of "Lucy", a nearly complete fossilized skeleton from the species *Australopithecus afarensis*. View more of her morphology in the **Bone Viewer**, or visit **eLucy** to compare her anatomy with that of a modern human and a modern chimpanzee.

Past News

Open Map

Timeline: 6 Ma, 5 Ma, 4 Ma, 3 Ma, 2 Ma, 1 Ma. Geological periods: Pliocene, Pleistocene, Holocene.

Locations: Middle Awash, Hadar, Olduvai, Zhoukoudian, Atapuerca.

Map | Satellite | Terrain

POWERED BY Google

Imagery ©2011 - Terms of Use

Navigation

- *In The News* link
- Time line
- Map
- Pull-down menus
- e.g.: Sites
 - Hominins
 - Archaeology
 - Fauna
 - Paleoecology
 - Bibliography and links

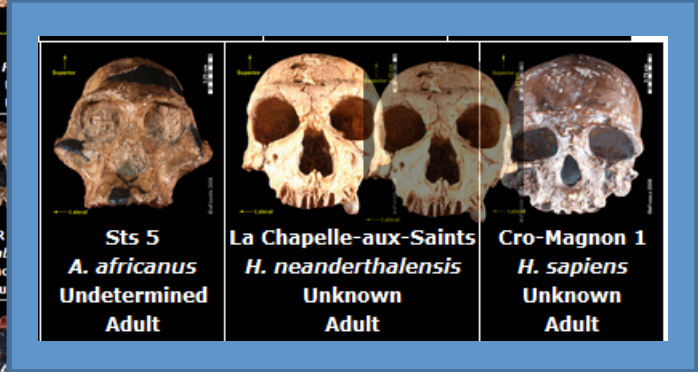
The screenshot displays the eFOSSILS website with a dark header. The main navigation bar includes 'Sites', 'Species', 'Comparative Anatomy', 'Catalog', and 'Resources'. A pull-down menu is open under 'Species', listing 'Atapuerca', 'Hadar', 'Middle Awash', 'Olduvai', and 'Zhoukoudian'. Below the navigation, there are three article previews: 'Global Footprint D...', 'New hominin species?', and 'New talk about an old fossil'. To the right is a 'Bone Viewer' section for 'Explore Lucy' with a grid of fossil images. Below these is an 'Open Map' section showing a timeline from 6 Ma to 1 Ma with colored bars for 'Middle Awash', 'Hadar', 'Olduvai', 'Atapuerca', and 'Zhoukoudian'. The footer contains 'eFossils Production Credits' from the University of Texas at Austin, 'eFossils is a collaborative website...' text, and 'eAnthro Digital Libraries List' with icons for 'ANTHRO LABS', 'FORENSICS', 'FOSSILS', 'LUCY', and 'SKELETONS'.

Comparative Anatomy

Bones	View	Hominins	Specimen Number
Cranium	Anterior	<i>Australopithecus africanus</i>	Bodo
Femur	Inferior	<i>Homo erectus</i>	Broken Hill 1
Fibula	Lateral Left	<i>Homo ergaster</i>	Cro-Magnon 1
Humerus	Lateral Right	<i>Homo habilis</i>	KNM ER 1470
Lumbar Vertebra	Posterior	<i>Homo heidelbergensis</i>	KNM ER 1813
Mandible	Proximal	<i>Homo neanderthalensis</i>	KNM ER 3733
Maxilla	Superior	<i>Homo rudolfensis</i>	KNM ER 3883
Os Coxae		<i>Homo sapiens</i>	KNM WT 15000
Os Coxae		<i>Kenyanthropus platyops</i>	KNM WT 17000
Patella		<i>Paranthropus aethiopicus</i>	KNM WT 40000
Pelvis		<i>Paranthropus boisei</i>	La Chapelle-aux-Saints
Radius		<i>Paranthropus robustus</i>	La Ferrassie 1

+ image size

Reset

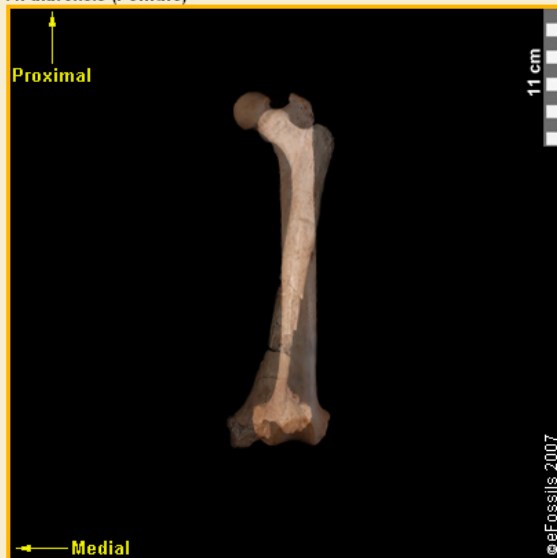


COMPARE LUCY: Femur - Ventral / Anterior

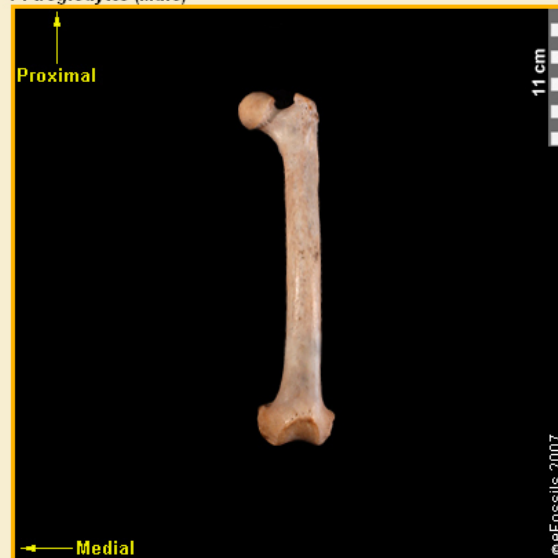
Femur Ventral / Anterior

H. sapiens 1 *P. troglodytes* 1

A. afarensis (Female)



P. troglodytes (Male)





When held in the anatomical position, the femur of an ape will stand almost vertical within a horizontal plane. In humans, the femur will form a bicondylar angle (i.e. the angle at which the femur lies to the midline of the body), and brings the knees closer together (**valgus knee**). Because of this angle, the feet fall directly below the center of gravity, balancing the body over the stance leg during the stride cycle, thereby stabilizing bipedal locomotion. Lucy's femur exhibits a bicondylar angle.

The size of the femoral head is related to body mass. The large femoral head of modern humans reflects their larger body size. Comparing Lucy with modern humans, Lucy has a smaller femoral head and a relatively longer femoral neck. Reduction of the femoral neck length increased the amount of stress the femur was able to support, and may have been a specialization due to a change in bipedal posture or an adaptation for the larger body size of later humans.

Bone
viewer

Community website: add a site

Sites ▾ Species ▾ Comparative Anatomy Catalog Resources ▾

Contribute

Efossils is a collaborative website where users can contribute their own site reports. Please fill out the following form to request a user account.

After your request for access has been received, you will receive an email with a link to the online submission form. Follow the instructions in the pdf form to contribute a site report.

Name: *



Affiliation: *

Email Address: *

Site Description: *

CAPTCHA

This question is for testing whether you are a human visitor and to prevent automated spam submissions.



stop spam.
read books.

Submit

eFOSSILS

Phong ▾

Skull 0 ▾

Default ▾

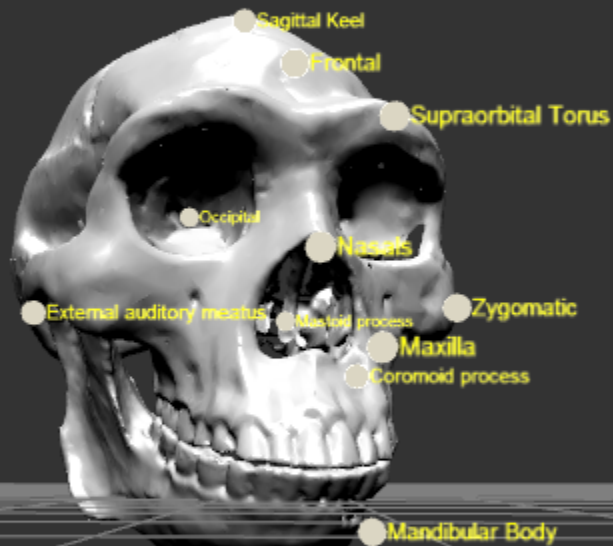
Instructions

Shader

Scene

Points

Canvas



Ambient Amount

Ambient Red

Ambient Green

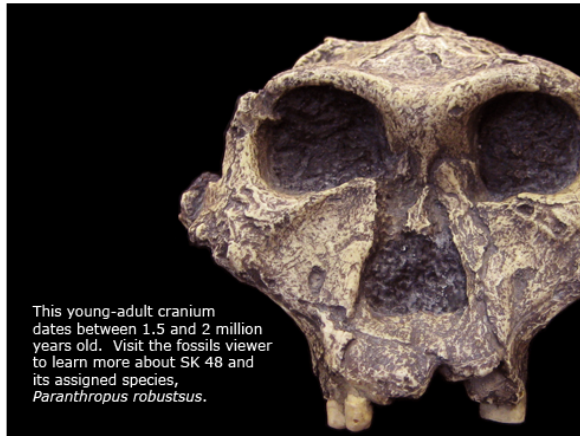
Ambient Blue

Diffuse

Specular

Shininess

Camera Cam Mode Rotate Morphology



This young-adult cranium dates between 1.5 and 2 million years old. Visit the fossils viewer to learn more about SK 48 and its assigned species, *Paranthropus robustus*.

Recent News

13 March 2013: Key differences in the brains of Neanderthals and modern humans... (Proceedings of the Royal Society B)

15 Nov 2012: As reported in **Science**, Neanderthals and *Homo sapiens* may have inherited use of spear points from an earlier ancestry...

3 Oct 2012: A recently discovered juvenile skull may hold clues as to when early humans began including meat as a regular part of their diet. Read the article in **PLOS**.

Discussions

Australopithecus sediba was recently suggested as a possible ancestor to early Homo (4 replies).

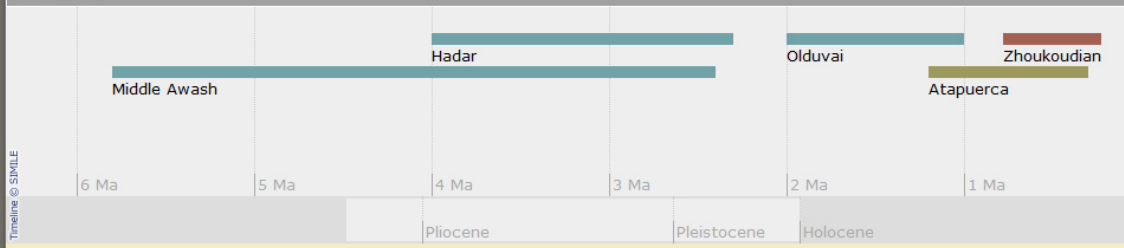
AL666 should not be assigned to *Homo habilis* as the majority of the traits used to identify the specimen as *Homo habilis* are also seen in australopithecids.

Early human ancestors radiated out of Africa a little less than 2 Ma, according to the most recent data. However, little is known as to what affected these prehistoric migrations...

[past news](#)

[more discussions](#)

Open Map



eFossils Production Credits

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Liberal Arts
Instructional Technology Services

THE UNIVERSITY OF TEXAS AT AUSTIN

eFossils is a collaborative website in which users can explore important fossil localities and browse the fossil digital library. If you have any problems using this site or have any other questions, please feel free to contact us.

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eAnthro Digital Libraries List

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e SKELETONS

e FORENSICS

e FOSSILS

e LUCY

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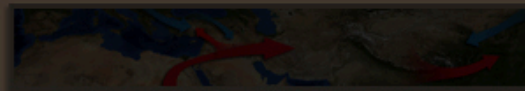


eAnthro Labs: A collection of labs with step-by-step instructions

On the Track of Prehistoric Humans



Temperate Migrations



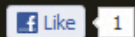
Got an idea for a new eAnthro Lab?



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eAnthro Labs is a digital database of community run laboratory exercises. Anyone interested in a particular hypothesis may contribute to an existing lab or propose one of their own.

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eAnthro Digital Libraries

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On the Track of Prehistoric Humans: Learn how to collect data and apply correlations to the fossils record. Plot your data with others from around the world.

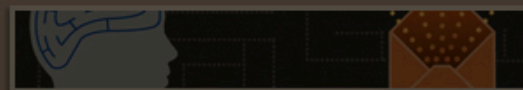
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The Trackways Lab

On the Track of Prehistoric Humans



FOOTPRINTS FOUND at Laetoli, Tanzania, in 1976 that date to 3.7 million years ago are among the most spectacular fossil discoveries because they record a moment in time when many different animals walked through wet volcanic ash leaving behind their tracks. Among these animals were several prehistoric humans who belonged to the species *Australopithecus afarensis*, a small brained, bipedal hominin that lived in East Africa from about 4 to 2.8 million years ago. Their footprints were preserved when the ash dried and hardened, and was covered by another layer of volcanic ash.

The Laetoli Trackways offer a unique opportunity to explore how scientists study the behaviors of fossil organisms because the tracks, quite literally, record a snapshot of how *Au. afarensis* walked. The trackways also permit us to take measurements of both foot length and stride length of these individuals; however, other interesting information about this species, its height for example, is unknown.

Can we use the relationship between foot length and stride length versus height in living humans to estimate the stature of these fossil humans? If you look at the people around you, you'll note that there is a general relationship between foot length, stride length, and height: shorter people generally have shorter feet and take shorter strides, while taller people have longer feet and take long strides. This general relationship can be evaluated by measuring a large sample of people and, if the relationship (or correlation) is strong, it can be used to estimate or predict the height of *Au. afarensis*.

Try it yourself. You can measure and evaluate the correlation between foot length and stride length versus body height, and then use these data to estimate the height of the Laetoli hominins.

e-Fossils Production Credits

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eAnthro Labs

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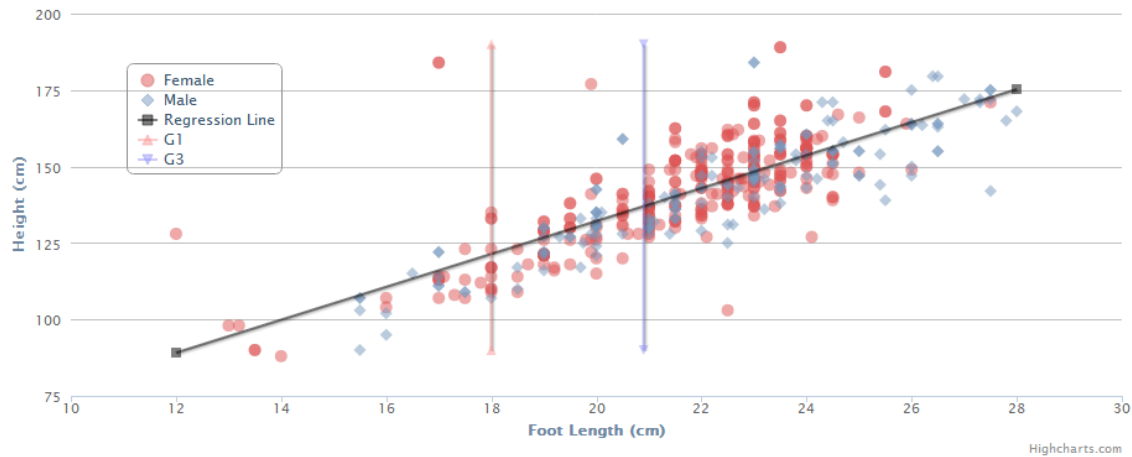
e LUCY

Trackways Exercise *On the Track of Prehistoric Humans*

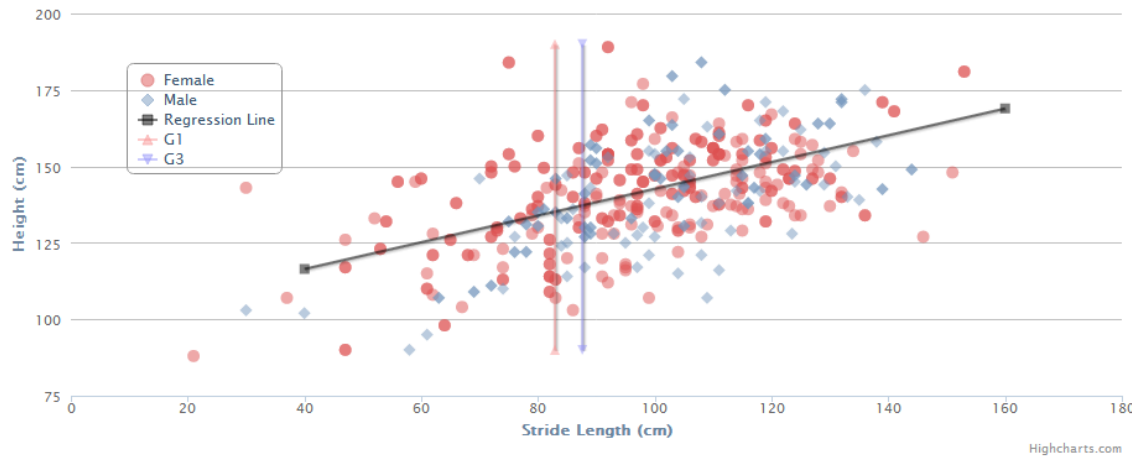
When the measurements are graphed, you will see a trend in the data that correlates the relationship between foot length and height, and stride length and height. Note that individuals with longer strides and longer feet appear to be taller than those individuals with shorter feet and shorter strides. The foot length and stride length of the Laetoli footprints can be measured and plotted as well. From this data, an estimate can be made for the height of the individuals who made the tracks at Laetoli, answering the question, "How tall were the australopiths?"

[view ALL published data sets](#) |
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Foot Length Versus Height by Gender



Stride Length Versus Height by Gender





Temperate Migrations: Collaborate with others to track climatically-mediate hominin movements through time and space.

On the Track of Prehistoric Humans



Temperate Migrations



Got an idea for a new eAnthro Lab?



Collaboratorium: some problems require participation of the field

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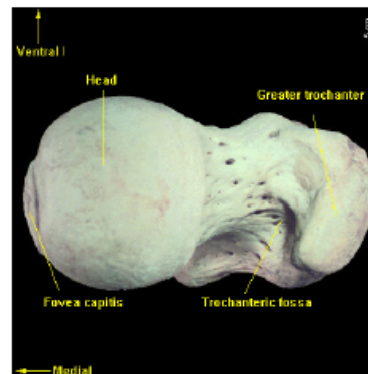
Human Osteology Guide, mastered in Adobe Acrobat Pro Extended with 3D embedded objects

The femur is the proximal bone of the hindlimb. It is the largest bone in the human body. The femur articulates proximally with the acetabulum of the os coxa to form the hip joint. Distally, the femur articulates with the tibial condyles to form the knee joint. Click on the bone at right to enable the interactive 3D viewer. Use your mouse and the toolbar to rotate, zoom, and pan the image.



Proximal Femur

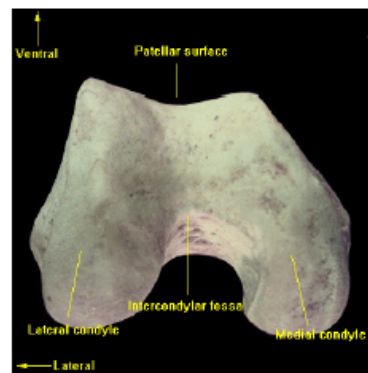
The proximal femur is dominated by its massive, nearly spherical head. The articular surface of the femoral head is disrupted by the fovea capitis, an excavated depression in the otherwise smooth surface. The head is connected to the rest of the femur by its neck. Two roughed trochanters on the proximal femur provide important muscle attachment sites. The greater trochanter projects superiorly from the dorsal surface of the proximal femur. The *gluteus medius* and *gluteus minimus* muscles take origin here and serve as critical hip stabilizers during walking. Further distally, several major hip flexors take origin from the lesser trochanter. The two trochanters are united by an intertrochanteric crest on the dorsal surface of the proximal femur and an intertrochanteric line on the ventral surface.



Proximal View

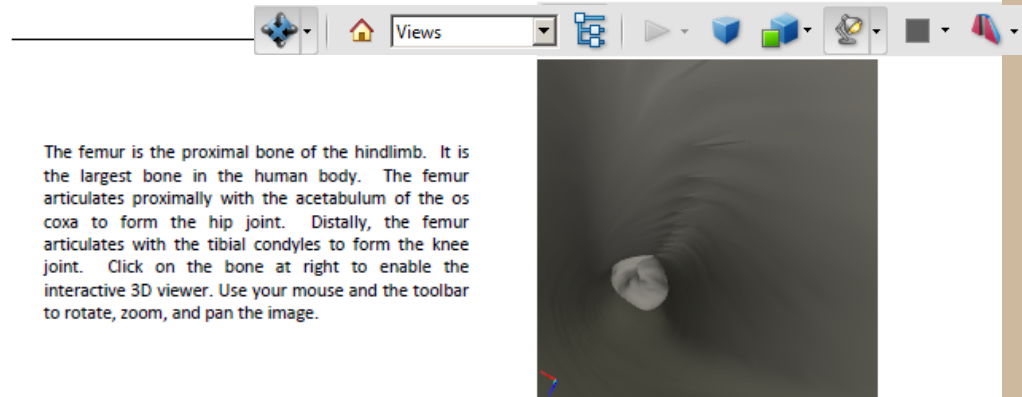
Distal Femur

The distal femur bears two large articular condyles which rest on the corresponding condyles of the tibial plateau. The broader lateral condyle is separated from the narrower, more curved (in distal view), medial condyle by a broad depression known as the intercondylar fossa. The medial condyle projects further distally such that the shaft tilts laterally when the condyles are set upon a flat surface (e.g. the tibial plateau). The two condyles merge ventrally as the patellar surface, an articular facet for the patella. The medial epicondyle and lateral epicondyle sit just proximal to the condyles, where they provide attachment sites for the collateral knee ligaments. The lateral epicondyle is separated from the lateral condyle by the popliteal groove.

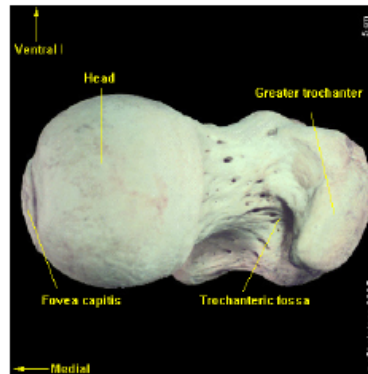


Distal View

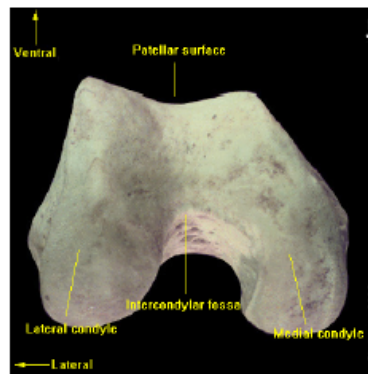
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Proximal View



Distal View

Proximal Femur

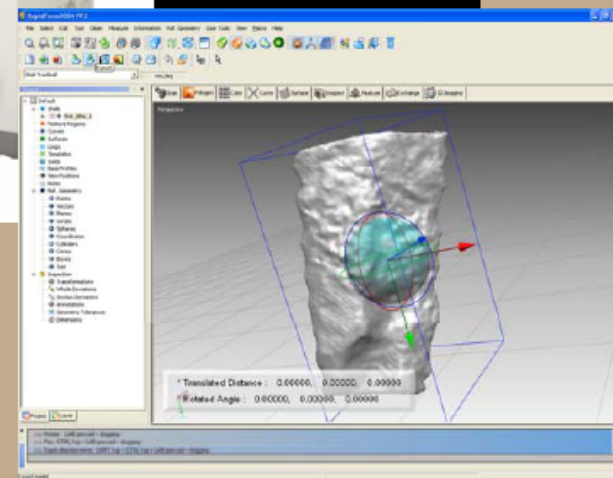
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Distal Femur

The distal femur bears two large articular condyles which rest on the corresponding condyles of the tibial plateau. The broader lateral condyle is separated from the narrower, more curved (in distal view), medial condyle by a broad depression known as the intercondylar fossa. The medial condyle projects further distally such that the shaft tilts laterally when the condyles are set upon a flat surface (e.g. the tibial plateau). The two condyles merge ventrally as the patellar surface, an articular facet for the patella. The medial epicondyle and lateral epicondyle sit just proximal to the condyles, where they provide attachment sites for the collateral knee ligaments. The lateral epicondyle is separated from the lateral condyle by the popliteal groove.

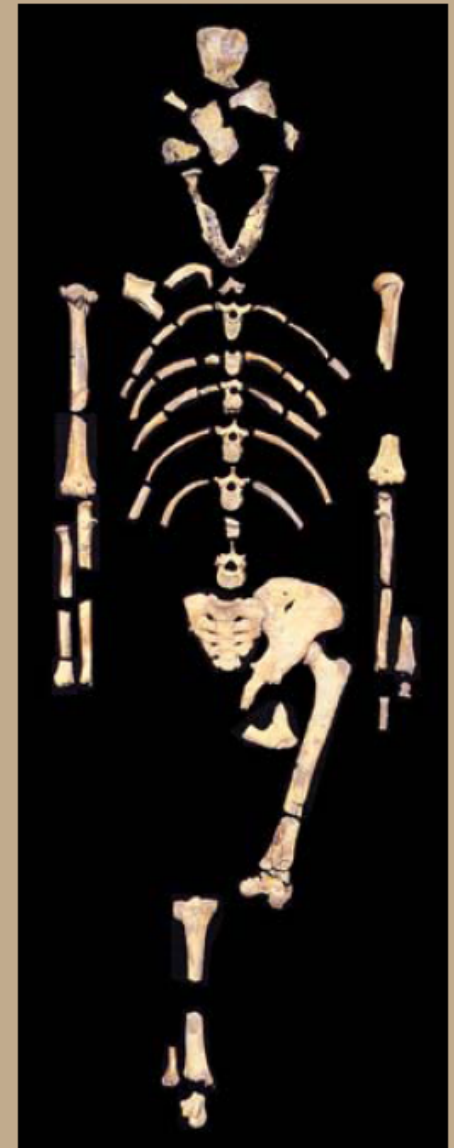
Development and Delivery

- *2-D and 3-D data capture and rendering*
- *Learning modules*
 - *Virtual Laboratories*
 - *eSkeletons.org*
 - *eForensics.info*
 - *eFossils.org*
- **Repurposing basic data**
 - Laptops and handhelds
 - eSkeletons kids' portal
 - 3-D printouts at varying scales
- *Evaluation*
 - *Vexams and testing lab*



3-D printouts at varying scales

- Files of 3-D scans available for downloading by users
 - Engineering modeling
 - Health care professionals and students
- eFossils and the Lucy Exhibit
 - Lucy's tour of the U.S.



Possibilities of New Technology



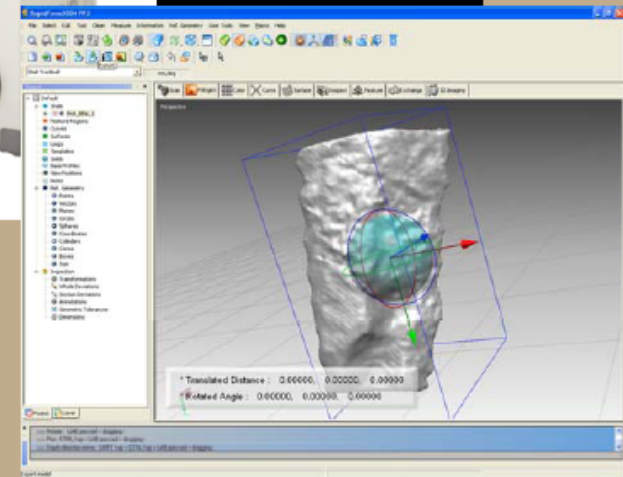
Human hand study set
- Create more resilient
print-outs of carpal bones
for osteology students

- Allows for 3D Rendering of Internal Structures:
- Sagittal cross-section of human cranium

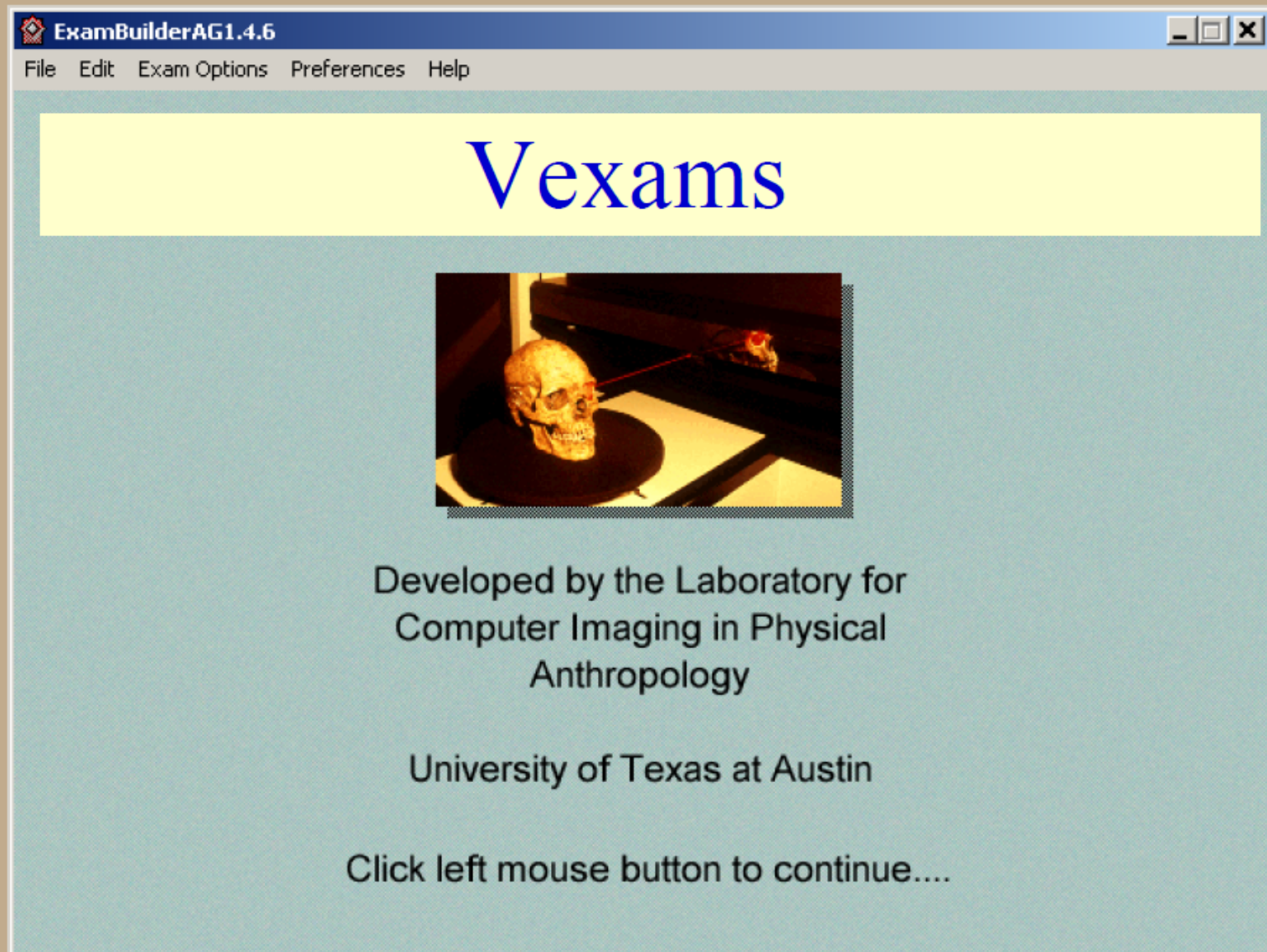


Development and Delivery

- 2-D and 3-D data capture and rendering
- Learning modules
 - Virtual Laboratories
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 - Vexams and testing lab



Vexams: an interactive multimedia computer-based evaluation program




VExams

- Integrate media
- Content drawn from full range of course content
- Integrate content with
 - Multiple choice
 - Matching
 - T/F
 - Fill-in
 - Interactive questions

ExamGiverAG2.3.2

File About Instructions and Information

Welcome to East Africa! The project is located in a remote region near Lake Naivasha in western Kenya. The new group of primate that you are studying, Primate X, is clearly closely related to the olive baboons, *Papio anubis* (shown at right), that also lives in the general region. The new group is well-habituated to humans because the local people do not hunt it.



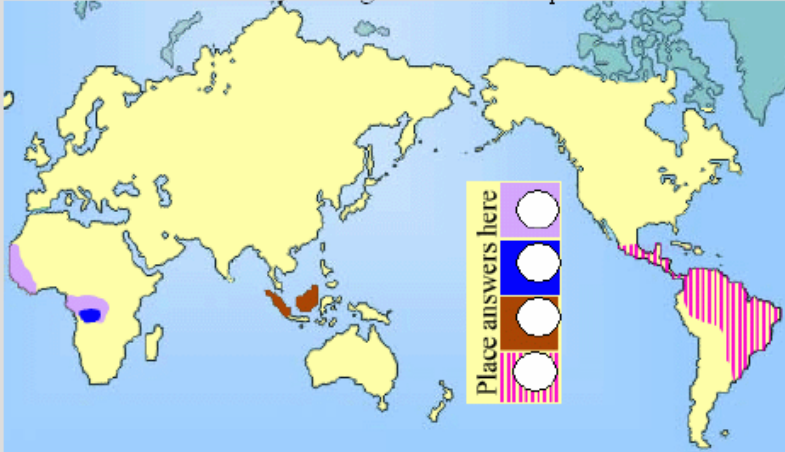
Select the best answer choice:

A

ExamGiverAG2.3.2

File About Instructions and Information

Identify the region where each primate lives:



Place answers here


A. New World monkeys
B. *Pongo pygmaeus*
C. *Pan paniscus*
D. *Pan troglodytes*
E. Old World monkeys

- Fixed number of questions
 - Random
 - Fixed
 - Unique but uniform exam
- Grade calculated automatically at end of exam
- Exam review
- 24/7 testing
- Centralized testing facility
 - Fill-in
 - Interactive

ExamReviewer 1.3.3

File About Information About This Question

After you have collected and reviewed your field data, it is fairly obvious that the new primate is unusual. How did it become this way? After a discussion with one of the local villagers, she reminds you that they have been keeping records on primate X for a very long time. You trade in your field notebook and binoculars for your laptop and head to the village archives to review their data. Villagers have collected measurements on the tooth morphology of the primates that



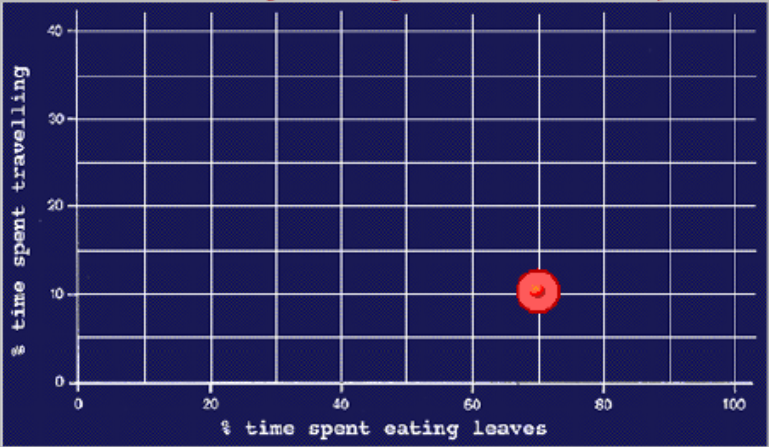
Good job!!

A B C D E

ExamRev

File About Information About This Question

Good job!! You plotted this one correctly.



% time spent travelling

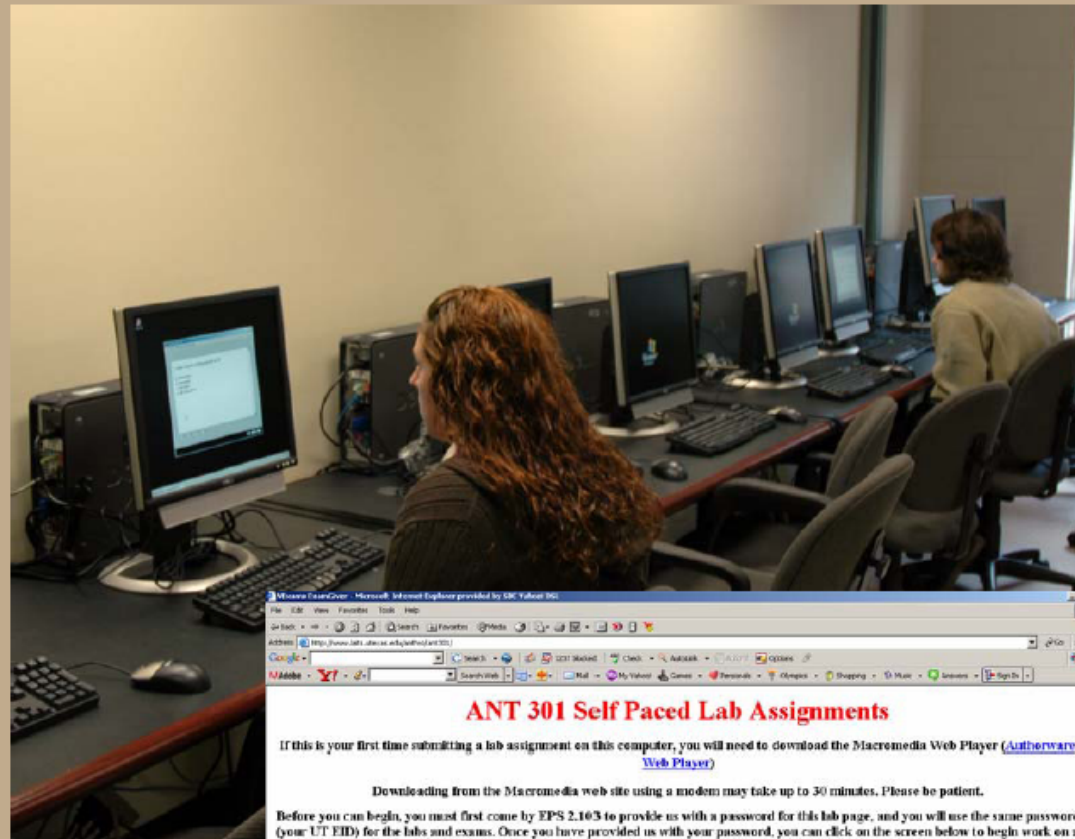
% time spent eating leaves

After several weeks you have obtained some interesting data about the new primate. Your observations show that your

New primate: 70% leaves and 10% travel time

Testing Facility

- ID checked and proctored exams
- One time or many times for highest score, better understanding
- Timed, or not
- Web-based for low or no (review) credit
- Initial support from Intel and Microsoft



ANT 301 Self Paced Lab Assignments

If this is your first time submitting a lab assignment on this computer, you will need to download the Macromedia Web Player ([Authorware Web Player](#))

Downloading from the Macromedia web site using a modem may take up to 30 minutes. Please be patient.

Before you can begin, you must first come by EPS 2.163 to provide us with a password for this lab page, and you will use the same password (your UT EID) for the labs and exams. Once you have provided us with your password, you can click on the screen below to begin work on the lab assignment.

When the screen opens, click the left-hand mouse button, type in your password and press Enter. After verifying that your information is correct, use the slider bar to scroll through the labs and choose the assignment that you would like to complete. You may work on any of the labs listed, but you may submit each lab only once. Follow the instructions. It may take a moment for some of the media to load so be patient. You can save the completed assignment to your desktop, hard drive, or a floppy. Be sure to e-mail your completed lab file as an attachment to the course email address, and be sure to keep a backup copy for yourself.

Use the slider bar to show all of the lab assignments.

1. The small-brained Pli-Pleistocene hominids are generally referred to as the _____. This genus is divided further into two groups, the _____ and the robust forms. Many scientists prefer to separate the robust forms even further into their own genus and/or subgenus, _____.

a. Neanderthal; small; Australopithecus

Select the best answer choice
A B C D E

Use the slider bar to show all of the lab assignments.

Acknowledgments

- Thanks to Ann Molineux for today's invitation
- Funding from National Science Foundation and UT (College of Liberal Arts, Longhorn Technology Fund), Intel, and Microsoft
- LA ITS staff including especially Adrienne Witzel
- Undergraduate and graduate students

ExamBuilderAG1.4.6

File Edit Exam Options Preferences Help

VExams

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TAXON COMPARATIVE AN

THE UNIVERSITY OF TEXAS AT AUSTIN DEPARTMENT OF ANTHROPOLOGY

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anthropology

Select a Lab here

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apply correlations to
around the world.

On the Track of Prehistoric Hominids

Virtual Laboratories for Physical Anthropology, Version 4.0

John Kappelman, Editor
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THOMSON
WADSWORTH

EXIT