Biological Anthropology: Laboratory Activities

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Wenatchee Valley College

Contents:

Please note: These activities are meant to be used in connection with a full Biological Anthropology Course and full textbook. The instructor is expected to present the base material that students will need to complete each activity. This allows the instructor to mold the activities to their own approach. Students will need an assigned text to assist with these activities, identify bone and features, understand the proper use of Hardy-Weinberg Equilibrium, significance of primate taxonomy, and specific information about various early human forms. These activities are presented in the sequence they might be used if teaching with Introduction to Physical Anthropology by Robert Jurmain et al.[1] These activities do not need to be used in the order presented and are meant to allow an instructor to have lab activities for students that do not require the students to purchase a separate lab manual. The contents of this manuscript are available by means of Creative Commons. They may be used free of charge as long as this author and all other copyright holders are given credit for their work. Should you have any activities you wish to add to this manual, and make available under creative commons to other instructors, please notify this author.

These are the only lab quizzes in this book. On the first week I introduce the students to the 206 bones of the typical adult human. Week two, the students are provided with blank copies of the images in these activities. I then point to ten or twenty specific bones and the student must locate and name the bone on their sheets. After the quiz, I then introduce them to the major features and landmarks of the bones. Week 3, the students receive the same blank versions of these images, and again I point to 10 to 20 different features or landmarks on various bones. They are expected to locate these on the correct image, location, and name them correctly. We then continue onto lab 3.

This is an introduction into the application of the Hardy-Weinberg Equilibrium. It is expected that the presenter will explain the assumptions required for Hardy Weinberg equilibrium to function. The first four questions require the students to place the assigned percentages into the provided equations. The second page asks to interpret what might happen given certain situations. The goal with these activities is for students to understand that just because a trait is not "dominant" does not mean it will quickly be removed from the gene pool of a population. Sometimes, recessive traits have a better possibility for long term survival. I usually collect this lab at the start of week 4.

This activity takes last week's introduction of the Hardy-Weinberg Equilibrium and applies it to monogenetic traits within your class's population. Students are expected to solve the equations to find the expected population with a heterozygous genotype for the trait in question. They are then asked to compare their results to that of the population at large through internet research. The web address for: OMIM ® - Online Mendelian Inheritance in Man, ® is provided at the end of the activity. I collect this assignment at the beginning of week 5

Lab 5 & 6 Pages 17-24

Primate geography, social systems and diet are the focus of these activities. The class is broken into groups of 2-4 students. Each group selects on primate based on the images provided. At week 6 each group presents to the class information about the location, social behaviors, diet and physical characteristics of the primate they selected. I grade each group on their research, effort and presentation. After the presentations, each group is expected to complete the rest of the worksheet for the primates that were not presented by other groups. The students are provided with two web links that can assist them in collecting the required information. The final group worksheet is due at the beginning of week 7.

Week 7 Pages 25-28

Students will focus on modern Human bone interpretation. In my classroom we have a real skeleton that was collected prior to 1960. The students are asked to study this skeleton and find the sex, age at death, pre-mortem injuries and post-mortem damage. Students are asked to examine a collection of fetal skull casts and describe the major changes in skull development prior to birth. Finally, students are expected to go to the library and do internet/library research on two recent cases of historic bone analysis.

Lab 8,9, & 10 Pages 29-38

The class will again split into groups of 2-4 students. Each group will start to examine a cast of various fossil or modern human skulls. In week 8, I provide casts of *Salelanthropus tchadensis*, *Artipithicus ramidus* (Ardi), *Australopithecus africanus* (Mrs. Plies) and *Australopithecus afarensis* (Lucy or similar). The students are provided with calipers, rulers and magnifying lenses. In week 9, the students receive casts of *Homo habilis, Homo erectus, Archaic Homo sapiens and Homo sapiens neanderthalensis* (my bias). In week 10 I provide the class with 4 different modern human casts. Students are then asked to compare the differences from week 10 with the earlier two activities.

Chart: Possible Early Humans Ancestors…or not Page 39

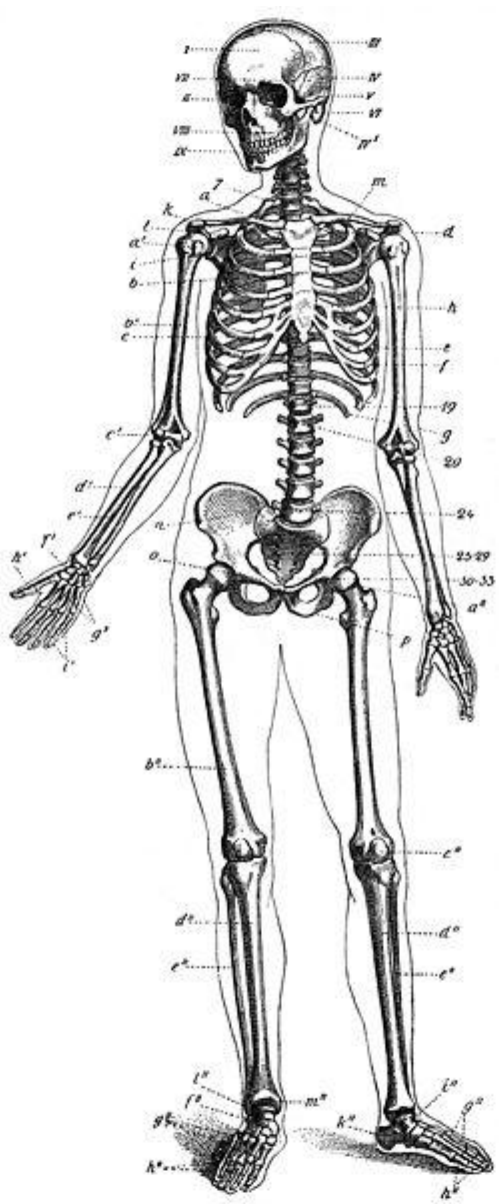
Works Cited for chart Page 40

Dedication and Thanks:

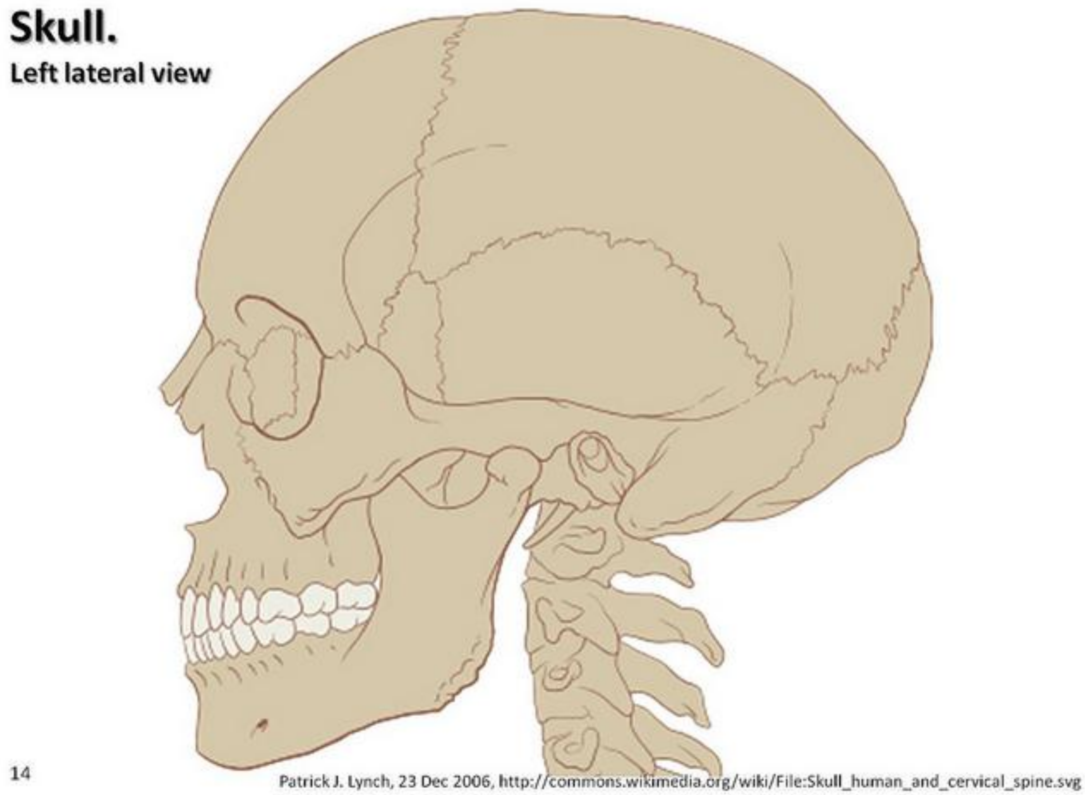
First I would like to thank Dr. John Asoszatia-Petheo, Ph. D. my first Biological Anthropology instructor who had the courage to teach us and take risks. I wish to thank Professor Barbara Oldham for her assistance collecting the creative commons and copyright free images needed to make this work possible. Thanks should also go to the students (test subjects) who have helped me refine these assignments over the past few years. This work would not be available to others without the technical assistance and persistence of Dr. Claver Hategekimana, Ph.D. Many people contributed their work and photography free of charge or with a creative commons usage. Frans de Waal and Anne Zeller both agreed to allow their copyrighted primate images to be used in this effortt. Others permitted their images to be used under creative commons, and are credited next to their work and I wish to thank them for their generosity. I need to thank Dr. Karl Polivka, Ph.D, for assisting with the proofreading. Finally, all thanks should go to Amanda H. S. Taub, my wife and domestic financial sponsor for allowing me to research, teach and do my various creative follies without demanding that I find a “real job.”

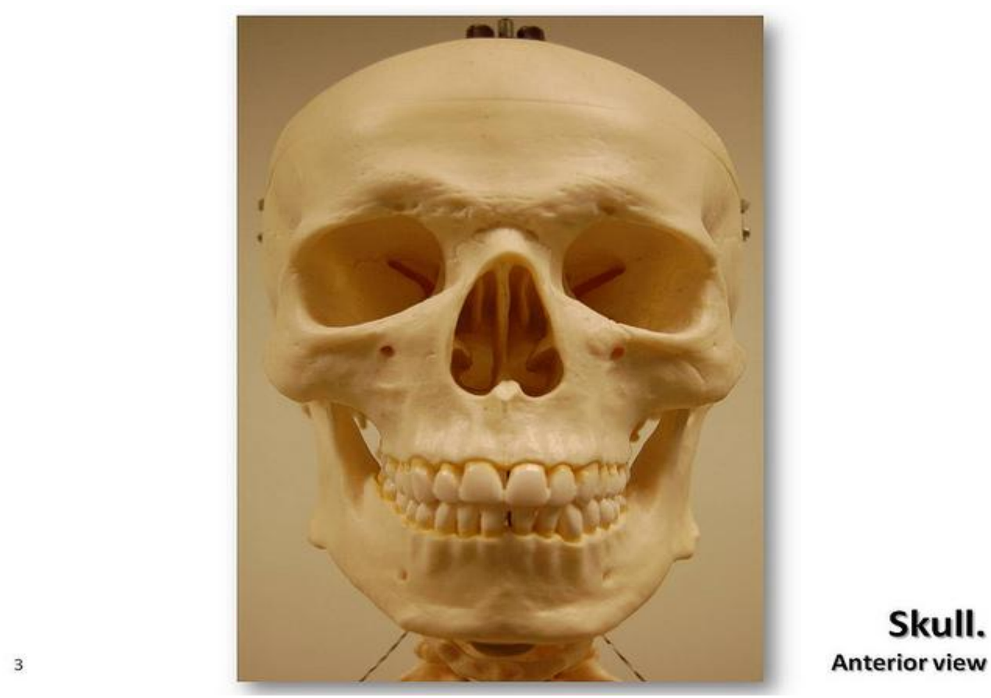
NAME____ Lab 1
DATE________________________________

Your instructor will provide you with the names of all 206 bones of the modern human body. You will need to remember these and be prepared for a quiz on these bones, their location and function by the next time your lab group meets.



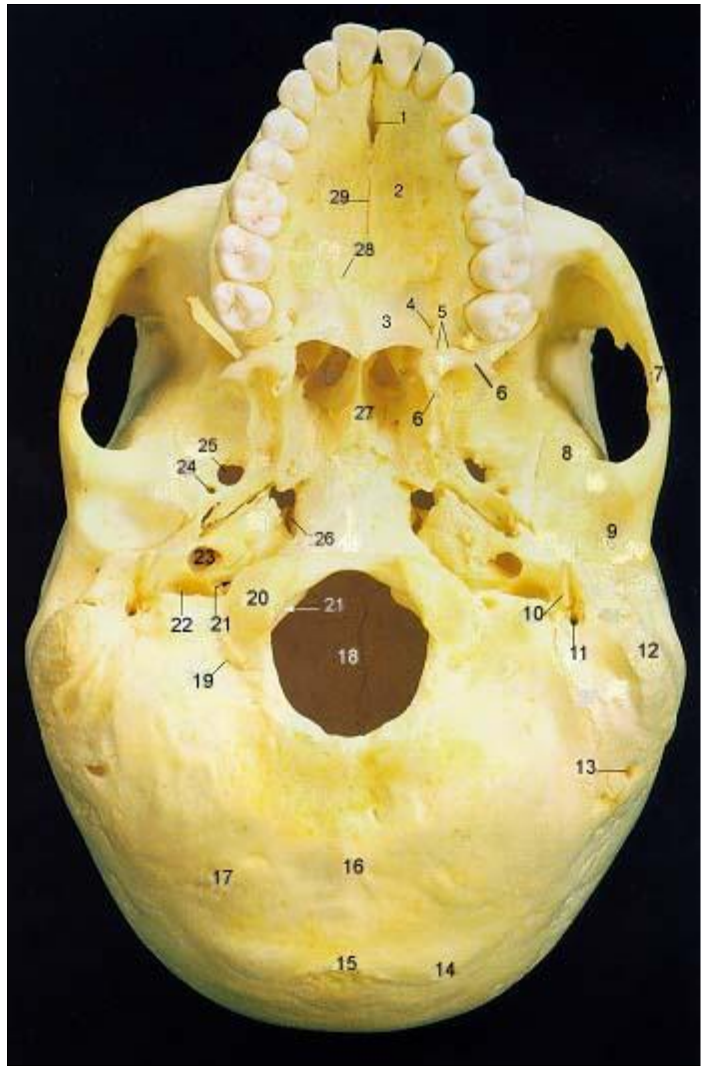
Copyright free from Wikipedia





http://www.flickr.com/photos/rswatski/4843867357/sizes/z/in/photostream/

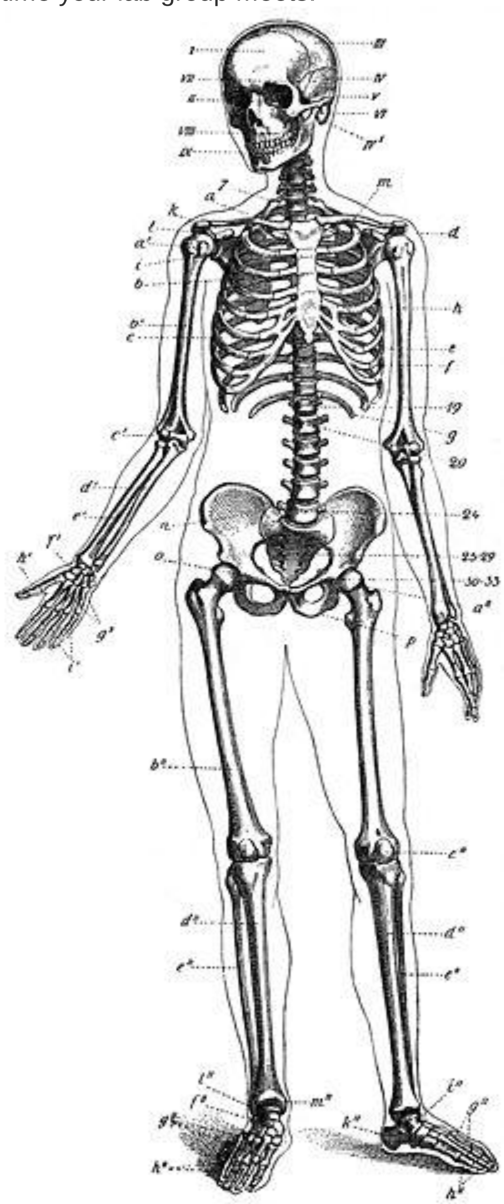
Source:
http://www.bio.psu.edu/people/faculty/strauss/anatomy/skel/inferior2.htm



NAME____ Lab 2

DATE__________________________________

Your instructor will provide you with the names of the bone features you will need to learn. You will need to remember these and be prepared for a quiz on these features, their location and function by the next time your lab group meets.



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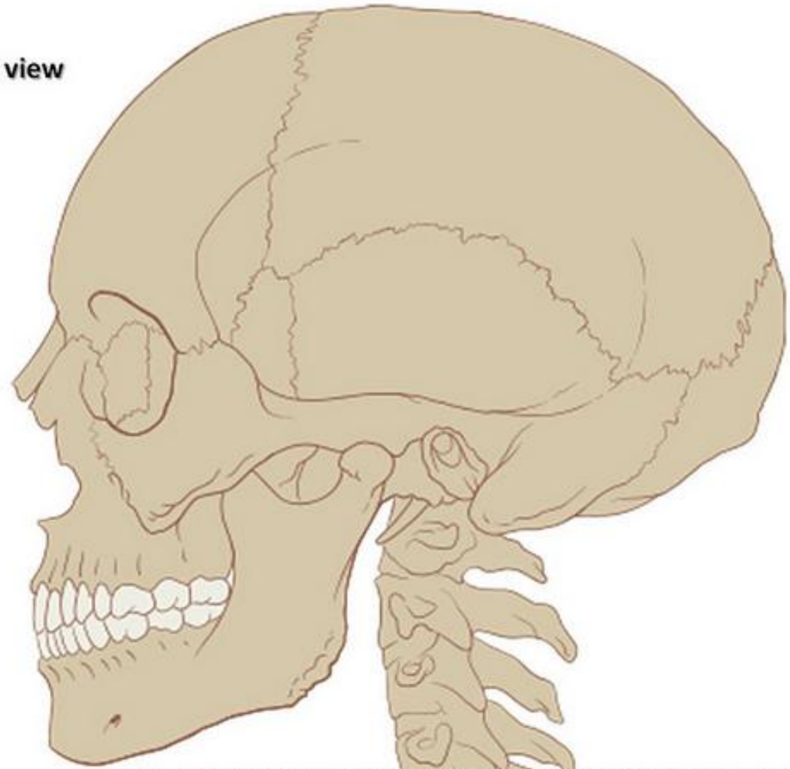
Skull.
Left lateral view



14

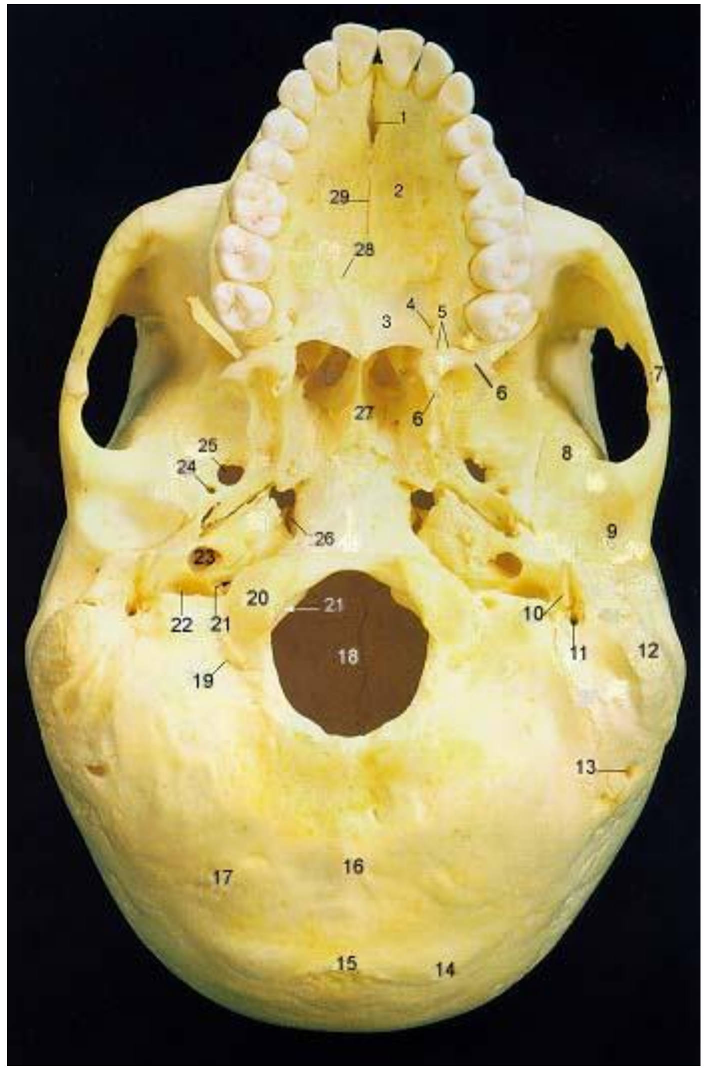
Patrick J. Lynch, 23 Dec 2006, http://commons.wikimedia.org/wiki/File:Skull_human_and_cervical_spine.svg

3

Skull.
Anterior view

http://www.flickr.com/photos/rswatski/4843867357/sizes/z/in/photostream/

Source:
http://www.bio.psu.edu/people/faculty/strauss/anatomy/skel/inferior2.htm



NAME____ Lab 3

LAB #3 Hardy-Weinberg Equilibrium

Please read the section of your assigned textbook that covers this equation (check the index of the assigned text for the specific pages). It will explain how this equation is used to determine the percent of a population that carries heterozygous traits, and how these unexpressed traits can appear in future generations.

q= Dominant Trait r=Recessive Trait p=Subordinate Dominant Trait

These formulae assume stability in population:

$(q+r)^2 = q^2+2qr+r^2$ if $q=.5$ & $r=.5$, then $q^2=.25$, $r^2=.25$ & $2qr=.50$
If $q=.4$ & $r=.6$, then $q^2=.16$, $r^2=.36$ & $2qr=.48$

$(q+p+r)^2 = q^2+p^2+r^2+2pq+2pr+2qr$
If $q=.3$, $p=.3$, & $r=.4$ then next generation will show
$q^2=.09$, $p^2=.09$, $r^2=.16$, $2pq=.18$, $2pr=.24$, & $2qr=.24$
or $q=.51$, $p=.33$, & $r=.16$

1) What will your distributions be in the second generation if q=.69 & r=.31:

2) What will your distributions be in the second generation if q=.31 & r=.69:

3) What if q=.33, p=.34, & r=.33, what will be your populations and their expression in the next generation?

4) What if q=.9 p=.05, & r=.05, what will be your populations and their expression in the next generation?

5)a) In the current generation, q=.9 & r=.1. If q is completely selected against, what will the distributions be in the next generation? (equation)

b) What will these distributions be if r is completely selected against? (essay)

6) What is the relationship between the dominance of a trait, and its rate of survival if it is selected against by either natural or artificial selection? (essay)

7) In the current generation the distribution of traits is q=.4, p=.4 & r=.2. What will the distributions be in the next generation? (equation)

b) Given your answer to 7, what would you expect if during the second generation q is completely selected against, what will the third generation's distribution look like? (essay)

c) Given your answer to 7, what would you expect if during the second generation p is completely selected against, what will the third generation's distribution look like? (essay)

d) Given your answer to 7, what would you expect if during the second generation r is completely selected against, what will the third generation's distribution look like? (essay)

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Name(s)____ Lab 4

Lab #4 Class genealogy

For each trait below, figure out the q, r, q^2, r^2 and 2qr for this class. In order to do this you will need to know the total number of students who take part in this activity, and the number that possess each trait. The only other equipment you will need is an ear swab, calculator and sense of humor:

1) Ear Lobes: Unattached or free is dominant, attached is recessive.

2) Darwin's point: a projection on either or both ears at about the 10-11 o'clock position.

Present is dominant, while absent is recessive.

3) Ear wax: Sticky yellow wax is dominant, while dry flaky and grey is recessive.

4) Tongue rolling: The ability to roll your tongue into a 'U' shape is dominant, while the inability to do so is recessive.

5) Tongue folding: The ability to fold your tongue over itself is recessive trait.

6) Wrist tendons: The presence of 2 wrist tendons is dominant, while the presence of three is recessive.

7) Mid-digit hair: the presence of hair on the middle segment of one's fingers is dominant and the absence of this hair is recessive. (Please note: pulling these hairs out does not change your genotype, but may confuse the rest of the class.)

8) What do these answers say about your class and how it fits within the population at large? The following is a useful website to answer this question: http://www.ncbi.nlm.nih.gov/omim

9) Review the following links:
http://www.pbs.org/wnet/secrets/previous_seasons/case_plague/index.html
http://www.pbs.org/wnet/secrets/previous_seasons/case_plague/clues.html
http://www.pbs.org/wnet/secrets/previous_seasons/case_plague/interview.html
Can monogenetic traits have an evolutionary impact? Why or why not?

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Names: ____ Lab 5 & 6

Your group will be assigned one primate from below. You will research your primate and give a presentation next week to the class. In this presentation you must provide your classmates with the proper classification of your primate (from kingdom to species), its natural geography (no, not including zoos and private collections), its natural diet (not what it will eat if you feed it), natural group behaviors, specific diagnostic physical features, and any other traits you find interesting. The presentation is worth 10 points and should last around ten minutes. During the presentations, you will fill out the same information for the rest of the primates listed on this sheet. This sheet will be due the following week and will need all primates described as above (including those not presented). This group activity is worth 10 points, and ALL MEMBERS OF THE GROUP MUST PARTICIPATE. Should a group find that one or more of its members should be "voted extinct," please notify the instructor immediately.

Two Collared Lemurs

http://www.flickr.com/photos/joshbousel/2622755480/

Copyright: Josh Bousel

Ring Tail Lemur

http://www.flickr.com/photos/davidden/2269694846/

Copyright: David Dennis

Red Bellied Lemur

http://www.flickr.com/photos/biggles621/2097775935/

Copyright: Steve Johnson

Crested Black Macaque

http://www.flickr.com/photos/lipkee/616650100/

Bolivian Red Howler

http://www.flickr.com/photos/24932721@N04/2481039816/

Black Spider Monkeys

http://www.flickr.com/photos/wwarby/3209802292/

Copyright: William Warby

Baboon

(Primate Research Center, University of Wisconsin)

Copyright: Anne Zeller

Common Marmosets

http://www.flickr.com/photos/mcwetboy/3607506156/

Copyright: Jonathan Crowe

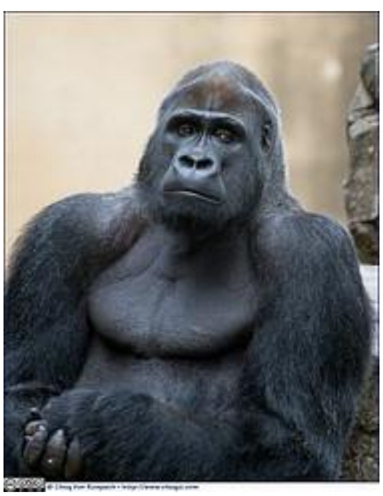
Vervet

http://www.flickr.com/photos/mejymejy/2982075048/

Copyright: Mark Johnston

Orangutan

http://www.flickr.com/photos/jamiedfw/503804320/



Gorilla

http://www.flickr.com/photos/chuqui/4737709648/

Chimpanzee

(Primate Research Center, University of Wisconsin)

Copyright: Frans de Waal

Bonobo

http://www.flickr.com/photos/douglas-fisher/773973665/

Copyright: Douglas Fisher

Information Sources:

Lemur Center: Duke University: http://lemur.duke.edu/

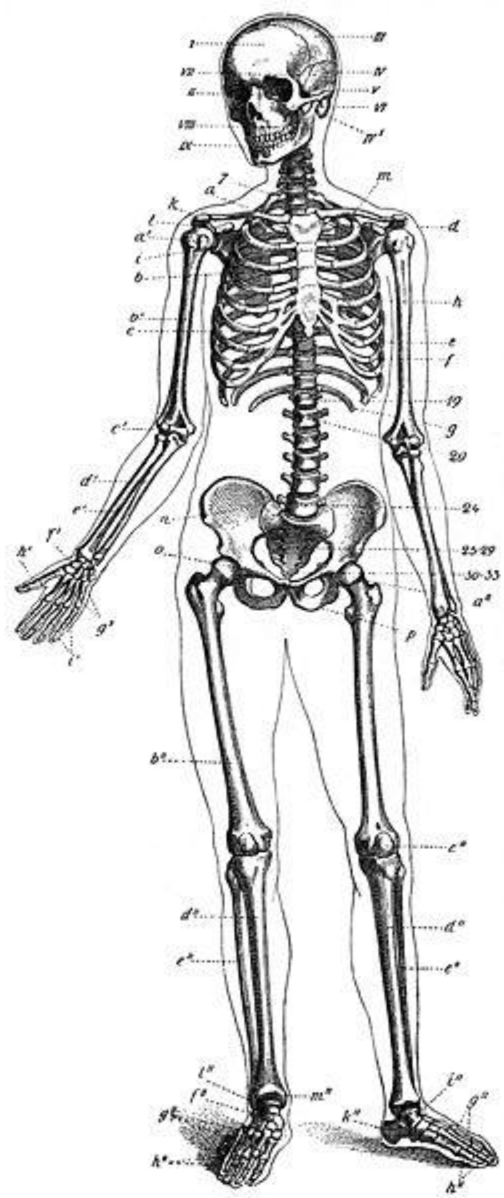
Primate Research Center, University of Wisconsin http://pin.primate.wisc.edu/:

3 Points of extra credit: Taxonomically completely classify the two primates below and defending your answer:

http://www.flickr.com/photos/acplinfo/4548285021/

Names____ Lab 7

1) In your groups, examine our complete lab skeleton and locate all bone abnormalities on the charts blow. Indicate if these 'injuries' are pre or post-mortem. Also, attempt to age, sex and race this individual.



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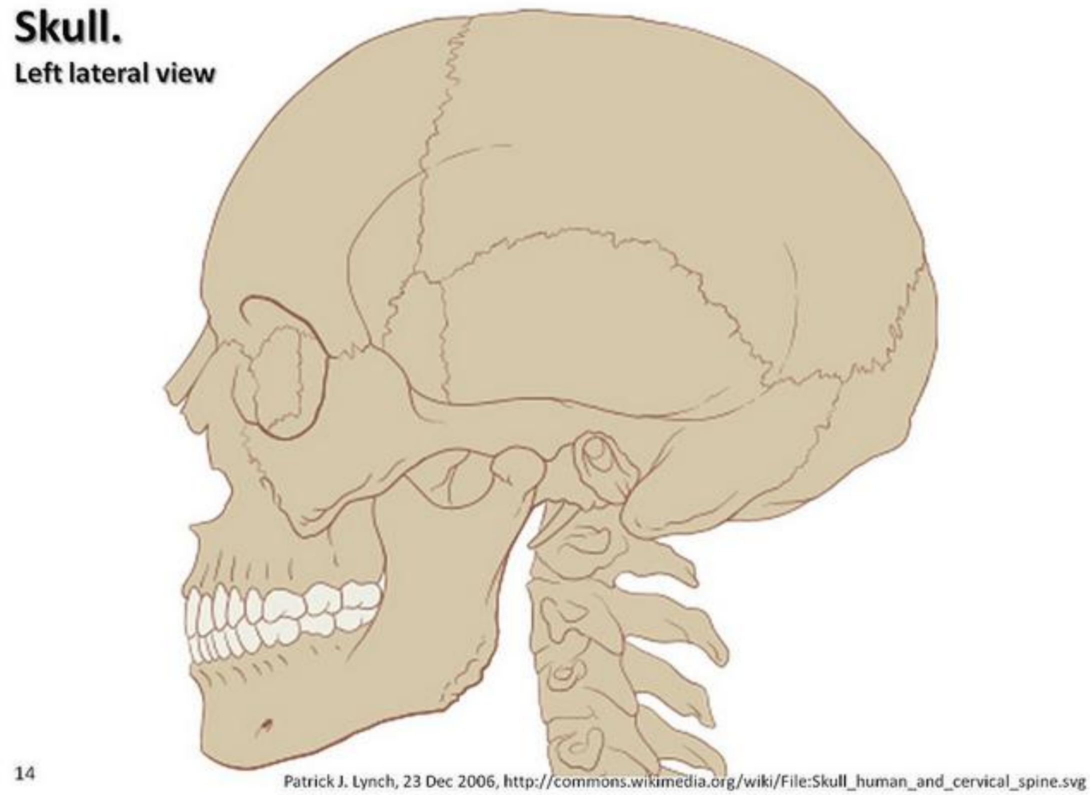

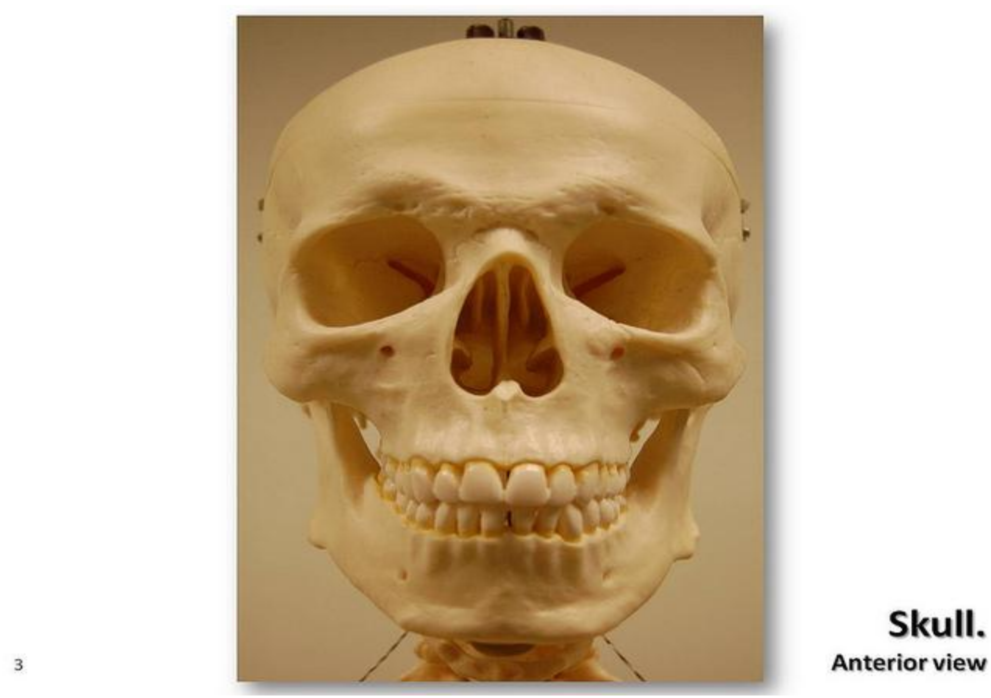

http://www.flickr.com/photos/rswatski/4843867357/sizes/z/in/photostream/The Human Skull: side view

2) Examine the five fetal human skull casts on display. Using correct bone nomenclature, described the differences at the various stages of development.

3) In 1991 the “Iceman” or “Ötzi” was found in the Alps. Research this find and document what his bones tell us about his life and his death.

4) The Body of Tutankhamen was scanned a few different times. Research these scans and document how the different scans lead to different conclusions. (Hint: Dr. Bob Brier looked at the early x-rays)

Last modified at 12/16/2010 by [Taub, Alex]

Names ____ Labs 8

EARLY HOMINID CRANIUM COMPARISON CHECKLIST

Martin Nickels

PLEASE READ THESE 5 STATEMENTS BEFORE BEGINNING THIS ACTIVITY:

1. Work in groups of 3-4 students so that everyone can be involved in the activity.

2. BE SURE (!) TO TAKE TURNS doing different measurements and observations.

3. When taking a measurement, use the SLIDING CALIPERS (except for #11 & #12 which may require the HINGE calipers) and remember to...

4. ALWAYS MEASURE IN MILLIMETERS [mm] and round off to whole numbers.

5. PLEASE DO NOT ADD ANY PENCIL OR PEN MARK "TATTOOS" TO THESE CRANIA, OR STICK YOUR FINGERS IN THEIR EYE ORBITS OR NOSES!

I. BRAINCASE: (7 items #1-7)

1. Does the FOREHEAD (frontal bone) look more vertical OR flatter when the skull is held in normal anatomical position [NAP] (i.e., with the eyes oriented forward)?

2. Is a SUPRAORBITAL BROWRIDGE present?

3. If present, is the BROWRIDGE DIVIDED in the middle, or CONTINUOUS?

4. What is the SHAPE OF THE BRAINCASE (front to back) when viewed from above?

5. Is a SAGITTAL CREST present?

6. In NAP, is the FORAMEN MAGNUM oriented more downward OR more to the rear?

7. Is the MASTOID process relatively flat OR does it noticeably protrude (project)?

II. FACE: (5 items: #8-12)

8. Are the NASAL BONES raised (arched) OR flat?

9. Measure the MAXIMUM BREADTH (width) of the NASAL OPENING [mm].

10. Measure the MAXIMUM HEIGHT of the NASAL OPENING [mm].

11. Measure the LENGTH of the MAXILLA (the upper jaw) [mm]. (Measure down the middle of the palate from the front edge of the foramen magnum to either between or just in front of the two central incisors to determine how much the face projects forward.)

12. Measure the BIZYGOMATIC BREADTH using the hinge caliper if necessary [mm]. (This is the width or breadth of the face from the widest part of one zygomatic arch to the widest part of the other zygomatic arch.)

III. DENTITION: (6 items #13-18)

13. SHAPE OF THE DENTAL ARCADE: Do the tooth rows diverge towards the back OR are they more straight-sided and parallel to one another?

14. When viewed from the side, are the INCISORS angled out OR are they vertical?

15. Measure the COMBINED WIDTH or BREADTH of the 4 INCISORS together.

16. Does the CANINE tooth project above the chewing surfaces of the other teeth?

17. Is a CANINE DIASTEMA present?

18. Measure the COMBINED LENGTH of the LEFT 2 PREMOLARS and 3 MOLARS together by measuring from the back of the last molar to the front of the first premolar to determine the length of the chewing surface of the "cheek teeth". [mm]. (NOTE: Measure the right side if the left side is missing any of these 5 teeth.)

Source:
http://www.indiana.edu/~ensiweb/lessons/hom.cran.html

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19) What trends do you notice? What are the major differences between these skulls?

Names ____ Labs 9

MIDDLE HOMINID CRANIUM COMPARISON CHECKLIST

Martin Nickels

PLEASE READ THESE 5 STATEMENTS BEFORE BEGINNING THIS ACTIVITY:

1. Work in groups of 3-4 students so that everyone can be involved in the activity.

2. BE SURE (!) TO TAKE TURNS doing different measurements and observations.

3. When taking a measurement, use the SLIDING CALIPERS (except for #11 & #12 which may require the HINGE calipers) and remember to...

4. ALWAYS MEASURE IN MILLIMETERS [mm] and round off to whole numbers.

5. PLEASE DO NOT ADD ANY PENCIL OR PEN MARK "TATTOOS" TO THESE CRANIA, OR STICK YOUR FINGERS IN THEIR EYE ORBITS OR NOSES!

I. BRAINCASE: (7 items #1-7)

1. Does the FOREHEAD (frontal bone) look more vertical OR flatter when the skull is held in normal anatomical position [NAP] (i.e., with the eyes oriented forward)?

2. Is a SUPRAORBITAL BROWRIDGE present?

3. If present, is the BROWRIDGE DIVIDED in the middle, or CONTINUOUS?

4. What is the SHAPE OF THE BRAINCASE (front to back) when viewed from above?

5. Is a SAGITTAL CREST present?

6. In NAP, is the FORAMEN MAGNUM oriented more downward OR more to the rear?

7. Is the MASTOID process relatively flat OR does it noticeably protrude (project)?

II. FACE: (5 items: #8-12)

8. Are the NASAL BONES raised (arched) OR flat?

9. Measure the MAXIMUM BREADTH (width) of the NASAL OPENING [mm].

10. Measure the MAXIMUM HEIGHT of the NASAL OPENING [mm].

11. Measure the LENGTH of the MAXILLA (the upper jaw) [mm]. (Measure down the middle of the palate from the front edge of the foramen magnum to either between or just in front of the two central incisors to determine how much the face projects forward.)

12. Measure the BIZYGOMATIC BREADTH using the hinge caliper if necessary [mm]. (This is the width or breadth of the face from the widest part of one zygomatic arch to the widest part of the other zygomatic arch.)

III. DENTITION: (6 items #13-18)

13. SHAPE OF THE DENTAL ARCADE: Do the tooth rows diverge towards the back OR are they more straight-sided and parallel to one another?

14. When viewed from the side, are the INCISORS angled out OR are they vertical?

15. Measure the COMBINED WIDTH or BREADTH of the 4 INCISORS together.

16. Does the CANINE tooth project above the chewing surfaces of the other teeth?

17. Is a CANINE DIASTEMA present?

18. Measure the COMBINED LENGTH of the LEFT 2 PREMOLARS and 3 MOLARS together by measuring from the back of the last molar to the front of the first premolar to determine the length of the chewing surface of the "cheek teeth". [mm]. (NOTE: Measure the right side if the left side is missing any of these 5 teeth.)

Source:
http://www.indiana.edu/~ensiweb/lessons/hom.cran.html

	Skull #1	Skull #2	Skull #3	Skull#4
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19) What trends do you notice? What are the major differences between these skulls?

Names ____ Labs 10

RECENT HOMINID CRANIUM COMPARISON CHECKLIST

Martin Nickels

PLEASE READ THESE 5 STATEMENTS BEFORE BEGINNING THIS ACTIVITY:

1. Work in groups of 3-4 students so that everyone can be involved in the activity.

2. BE SURE (!) TO TAKE TURNS doing different measurements and observations.

3. When taking a measurement, use the SLIDING CALIPERS (except for #11 & #12 which may require the HINGE calipers) and remember to...

4. ALWAYS MEASURE IN MILLIMETERS [mm] and round off to whole numbers.

5. PLEASE DO NOT ADD ANY PENCIL OR PEN MARK "TATTOOS" TO THESE CRANIA, OR STICK YOUR FINGERS IN THEIR EYE ORBITS OR NOSES!

I. BRAINCASE: (7 items #1-7)

1. Does the FOREHEAD (frontal bone) look more vertical OR flatter when the skull is held in normal anatomical position [NAP] (i.e., with the eyes oriented forward)?

2. Is a SUPRAORBITAL BROWRIDGE present?

3. If present, is the BROWRIDGE DIVIDED in the middle, or CONTINUOUS?

4. What is the SHAPE OF THE BRAINCASE (front to back) when viewed from above?

5. Is a SAGITTAL CREST present?

6. In NAP, is the FORAMEN MAGNUM oriented more downward OR more to the rear?

7. Is the MASTOID process relatively flat OR does it noticeably protrude (project)?

II. FACE: (5 items: #8-12)

8. Are the NASAL BONES raised (arched) OR flat?

9. Measure the MAXIMUM BREADTH (width) of the NASAL OPENING [mm].

10. Measure the MAXIMUM HEIGHT of the NASAL OPENING [mm].

11. Measure the LENGTH of the MAXILLA (the upper jaw) [mm]. (Measure down the middle of

the palate from the front edge of the foramen magnum to either between or just in front of the two central incisors to determine how much the face projects forward.) 12. Measure the BIZYGOMATIC BREADTH using the hinge caliper if necessary [mm]. (This is the width or breadth of the face from the widest part of one zygomatic arch to the widest part of the other zygomatic arch.) -- III. DENTITION: (6 items #13-18) 13. SHAPE OF THE DENTAL ARCADE: Do the tooth rows diverge towards the back OR are they more straight-sided and parallel to one another? 14. When viewed from the side, are the INCISORS angled out OR are they vertical? 15. Measure the COMBINED WIDTH or BREADTH of the 4 INCISORS together. 16. Does the CANINE tooth project above the chewing surfaces of the other teeth? 17. Is a CANINE DIASTEMA present? 18. Measure the COMBINED LENGTH of the LEFT 2 PREMOLARS and 3 MOLARS together by measuring from the back of the last molar to the front of the first premolar to determine the length of the chewing surface of the "cheek teeth". [mm]. (NOTE: Measure the right side if the left side is missing any of these 5 teeth.)

Source:
http://www.indiana.edu/~ensiweb/lessons/hom.cran.html

	Skull #1	Skull #2	Skull #3	Skull#4
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19) What trends do you notice? What are the major differences between these skulls?

20) How wide is the variety in Modern Skulls? Compare this to the historical differences you saw in weeks 8 and 9. Can bones be used to define membership in a past species? Why or why not?

Last modified at 12/16/2010 1:13 PM by Taub, Alex

Possible Early Humans Ancestors…or not	appr. Weight	appr. Height	appr. Cranial Capacity	Age	Samples/Location	Major Differences
Sahelanthropus tchadensis	?	?	320-370 cc	7.0-6.0 MYA	Toumai: Chad, Central Africa 6+individuals	Possible common ancestor with chimpanzee[1]
Ardipithecus ramidus	50 kg	120 cm	320-380 cc	5.7-4.0 MYA	Ardi: Ethiopia, 38 +individuals	Walking up-right, elongated phalanges[2]
Austrolopithicus aforensis	35 kg	105 cm	410 cc	3.9-2.9 MYA	Lucy: Hadar Ethiopia 200+individuals	Walking up-right without grasping feet[1] + tool use?[3]
Austrolopithicus africanus	40.8-50 kg	110-137 cm	440 cc	3.0-2 MYA	Taung Child: South Africa	Walking up-right without grasping feet + tool use?
Paranthropus boisii	34-49 kg	122.5-135 cm	510 cc	2.6-1.3 MYA	Olduvai & Lake Turkana	Sexual dimorphism in sagital crest?[4 &5]
Paranthropus robustus	32-39 kg	107.5-130 cm	510 cc	2.0-1.2 MYA	Swartkrans, South Africa	Large jaw and strong muscles[4 & 5]
Homo habilis	32-37 kg	115-147.5 cm	750 cc	2.5-1.6 MYA	Olduvai & Lake Turkana	Tools, fire? start to spread out of Africa[1]
Homo erectus	53-63 kg	157-175 cm	800 cc	1.8-150,000 YA	Turkana Boy: Lake Turkana & Pekin Man: China	Elongated legs & control of Fire[1]
Homo sapiens archaic	51-62 kg	155-172 cm	1100 cc	800,000-100,000	Asia, Africa & Europe	First evidence of created shelter[1]
Homo sapiens neanerthalensis	80-84 kg	152.5-162.5 cm	1000-1350 cc	250,000-20,000	Europe	Cave paintings and burials[1 & 5]
Homo sapiens sapien	54-64 kg	157.5-172.5 cm	1250 cc ish	100,000-present	World Over	70,000 first evidence of people in Australia[1]

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