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Lucy in the Sky with Diamonds: Hands-On Miniworkshop Comparing and Contrasting Hominids and Other Primates

Kathleen Nolan

St. Francis College, 180 Remsen St., Brooklyn NY 11201 USA
(**knolan@sfc.edu**)

The Australopithecan skeleton"Lucy" was discovered while the song in the title, written by the Beetles, was playing on the radio in the background. In this workshop participants will: 1. Draw and color in bones that are "missing" on a poster of a Lucy skeleton (by comparison with a human skeleton) 2. Discuss sexual dimorphism in primates, make a graph from height and weight data of males and females of various primate species and explore how these differences may have helped the primates survive. 3. Calculate and compare size and volume of various skull models and discuss the implications of this. This hands-on exercise has been received well by Baruch College Honors, Regional Honors Collegial Council student members at a creative faculty workshop, and St. Francis College biology and nursing classes. It has been lauded as a way to help the students grasp differences among hominids and primates.

Keywords: *Australopithecus afarensis*; Lucy; human evolution; hominid; primate

Introduction

Who is not fascinated by the discoveries that are reported of early humans and other primates such as in Johanson *et al*. (1981)? However, all the difficult Latin names and geologic time frames can bog down efforts to learn this material and turn students off to taxonomy in general. This lab exercise slows down the learning process and requires that the students learn about hominids through the kinesthetic processes of drawing, graphing, measuring, and writing on a white board or smart board in a cooperative way. This type of learning involves the tactile senses, and allows the students to see things in three dimensions. This should help to improve interest in hominids and primates and the retention of this material by the student. Some of the information about early hominids, including that of sexual dimorphism, conjectured tool use, and other hypothesized life style information, is provided by Szpak (2007).

Students might want to present additional research to the class or add to their lab reports information about topics such as skull shape as presented by Cobb (2008), bipedalism (Preuschoft, 2004),and genetic control of anatomy (Martínez-Abadías *et al*., 2012).Senter (2010) offers additional educational exercises that instructors and students alike could consider that would make learning about hominids and primates more appealing

Student Outline

Materials

- Picture of Lucy skeleton—blown up to 11" by 17" poster
- Picture of human skeleton (use your textbook or lab manual)
- Pencils, including colored pencils
- Graph paper
- Human skulls—adult and infant
- Cro-Magnon skull
- Gorilla skulls—male and female
- Chimpanzee skull
- Other primate skulls that might be available
- Split peas (to fill skulls for volume measurements)
- Beakers or pitchers to measure volume
- Funnels
- Cotton balls to plug foramina in skulls

Methods

1. Draw in bones that are missing from the Lucy skeleton on the poster given to you (based on Fig. 1). Label the bones. How do you know that Lucy is a female? How do you know that she was bipedal?
2. What is sexual dimorphism? What is evidence of it in humans? Other animals? How have societies evolved around this?
3. Graph the sexual dimorphism data given to you in Table 1 for seven primate species. First graph on the graph paper given to you, and then on Excel.
4. Then set up the data in columns in Excel as shown in Table 2. You will need to plot mass on the X axis and height on the Y axis for both males and females. What is your analysis of this data?

Table 1. Relative Body Mass and Height of Selected Australopithecines and Extant Taxa

Species	Male Mass (kg)	Female Mass (kg)	Male Height (m)	Female Height (m)
Australopithecus africanus	41.0	30.0	1.40	1.10
Australopithecus afarensis	45.0	29.0	1.50	1.10
Paranthropus boisei	49.0	34.0	1.40	1.20
Paranthropus robustus	40.0	32.0	1.30	1.10
Homo sapiens	68.2	50.0	1.75	1.61
Pan troglodytes	56.6	40.1	0.85	0.75
Gorilla gorilla	164.3	75.5	1.70	1.50

Set up the data in Excel as shown in Table 2:

Figure 1. Lucy skeleton (*Australopithecus afarensis*) AL 288-1. (Original image: http://commons.wikimedia.org/wiki/File:Lucy.jpg)

Table 2. Set-up for mass versus height data in Table 1 for seven primate species

Mass	Height A afri	Height A afar	Height Para b	Height Para r	Height Homo s	Height Pan t	Height Gorilla
30	1.1						
41	1.4						
29		1.1					
45		1.5					
34			1.2				
49			1.4				
32				1.1			
40				1.3			
50					1.61		
68.2					1.7		
40.1						0.75	
56.6						0.85	
75.5							1.5
164.3							1.7

Click on “Chart”, then “Scatter”, then “Straight Marked Scatter” and you should generate a graph that should resemble that in Fig. 2.

5. Observe the human male and female skulls and skeleton. Observe the male and female gorilla skulls, the Cro-Magnon, and the dolphin skulls. What are some similarities and differences that you note?

6. Measure the volume of the skulls by first plugging orifices with a cotton ball or napkin, and then filling with split peas and measuring the volume that the peas took up in the skull. Put the measurements on the board.

7. Compare your results to Fig. 34.46, p. 729 in Reece et al. (2011), or with the evograms at one of these URLs:

   http://evolution.berkeley.edu/evolibrary/article/evograms_07,

   http://www.pbs.org/wgbh/nova/evolution/whos-who-human-evolution.html.

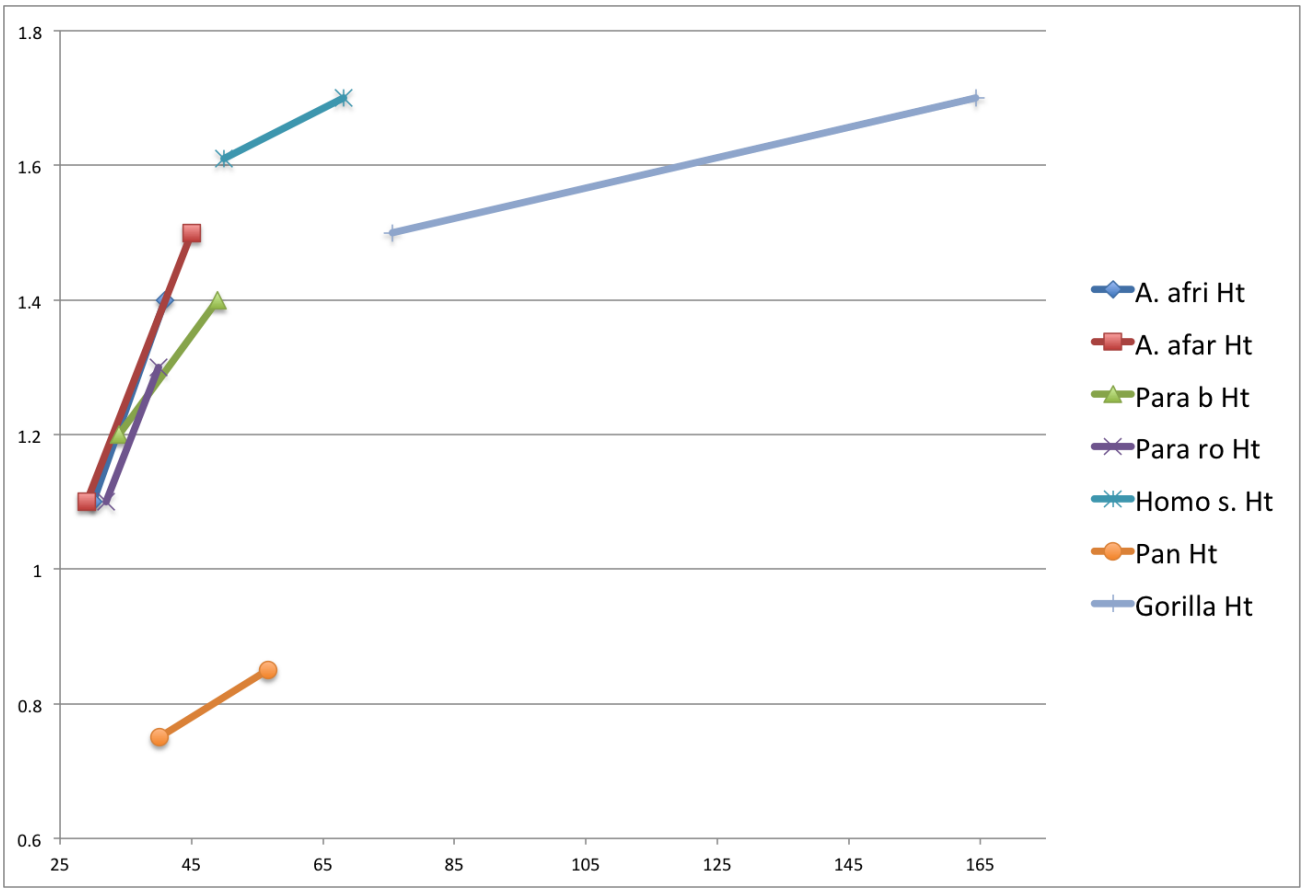

Figure 2. Graph of mass versus height of seven primate species.

Notes for the Instructor

After completing these exercises, the students should be able to answer the following questions:

1. Would the time at which a species evolved be a good character for differentiating that species from others? Why or why not?
2. Is size a good trait for differentiating species? Why or why not?
3. What is sexual dimorphism and what does it tell you about life history strategies? Which extant species has the highest degree of sexual dimorphism, and how is it outwardly manifested?
4. Why is it hard to estimate body size of early hominids?
5. What are characteristics of bipedalism?
6. Why might bipedalism have evolved?
7. What is a pre-adaptation?
8. What can determine body size?
9. Does brain capacity differentiate species?

Materials

The skulls (and definitely the disarticulated Lucy skeleton) can be quite pricey as noted below. In the University of Calgary workshop we were able to borrow the disarticulated Lucy skeleton from the Anthropology Department, but I cannot justify buying it for St. Francis College as we have a relatively small biology department only (no anthropology).

Skulls---human, gorilla, (male and female), chimpanzee, dolphin, Cro-Magnon---can be obtained from Bone Clones (**boneclones.com**), Skulls Unlimited (**skullsunlimited.com**) or the Evolution Store (**theevolutionstore.com)**.

For example, *Gorilla gorilla* (female) from Bone Clones (BC-035) costs $230; *Gorilla gorilla* male (BC-001) is $270; and the disarticulated Lucy skeleton (SC 036D) is $2100.

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Web sites

BBC - The Incredible Human Journey -1 of 5 -Out of Africa_arc.avi
Donald Johnson—How Lucy Got her Name
http://www.youtube.com/watch?v=SKYjpetqYWI&feature=player_detailpage

The Real Eve
http://www.youtube.com/watch?v=oAXt2AUwPm0&feature=player_detailpage

More info about bones
http://www.youtube.com/watch?v=ZRoSy1Hwouo
http://www.youtube.com/watch?v=k86w0zlzY54&feature=related

An excellent video on skeleton preparation "Taboo" can be viewed on the Skulls Unlimited website
http://www.skullsunlimited.com

About the Authors

Kathleen A. Nolan, Ph.D. is a professor of biology and Chair of the Biology, Health Promotion and Health Care Management Department at St. Francis College. She has been a long-time ABLE member and has presented numerous major and mini-workshops at ABLE conferences. She is interested in a wide variety topics, including fish population genetics and biology laboratory education.

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