

Evolutionary Changes in Primates

Name: _____

Date: _____

Introduction:

When paleontologists discover fossils, they determine whether they have discovered fossils of recent or early organisms. They then determine to what kinds of organisms the fossils belong. If a skull were discovered and determined to be a primate skull, the next step would be to determine whether it is of an ape or a human. Because evolutionary change has occurred in both groups, the skull could be of early or modern ape or early or modern human. Because humans and apes evolved along separate lines, certain physical characteristics can be used in an attempt to classify the fossil skull as belonging to either ape (early or modern), early human, or modern human. Techniques similar to the ones used in this investigation are used by anthropologists, paleontologists, and archeologists.

In this investigation,, you will

- (a) examine gorilla, early human, and modern human skull models.
- (b) measure or observe and record specific skull structures and features.
- (c) evaluate evolutionary changes that have occurred in these organisms.

Materials

metric ruler	Protractor	<i>H. sapiens</i> skull model	Gorilla skull model	Chimpanzee skull model
• <i>A. afarensis</i> skull model		<i>A. boiesi</i> skull model	<i>H. erectus</i> skull model	<i>H. neandertalis</i> skull model

Procedure

Part A. Skull Characteristics

Brain Area Compared To Face Area:

The rectangles over the skulls in Figure 1 represent the area of the brain (upper rectangle). and face (lower rectangle) of each skull.

- Determine the area of each rectangle by measuring the length and width in centimeters and multiplying the two measurements together.
- Record data in Table 1 the brain and face areas for all the provided skulls.
- A comparison can be made as to whether the brain area is larger or smaller than the face area.
- Compare the brain and face areas and enter data into Table 1.

Cranial Capacity

- Measure the diameter in centimeters of the circle in each skull. The diameter is the distance across the exact center of each circle.

- Multiply the cranial diameters by 200cm^2 . This gives the cranial capacity (brain volume) in cubic centimeters.

- Record the cranial capacity for each skull in Table 1.

NOTE: This method of measuring cranial capacity differs from the method used when an intact skull is available.

Jaw Angle (Prognathism)

In front of each skull are two heavy lines, one running parallel to the slope of the upper jaw and one running through the nose. These two lines are to be used for measuring how far the jaw protrudes forward.

- With a protractor, measure the outside angle formed by the two lines in each skull (the angle toward the right). For example, the jaw angle in Figure 1 is 45° .
- Record the angles in Table 1. An angle of less than 90° means that the lower jaw sticks out in front of the nose. An angle of 90° means that the lower jaw does not stick out in front of the nose.

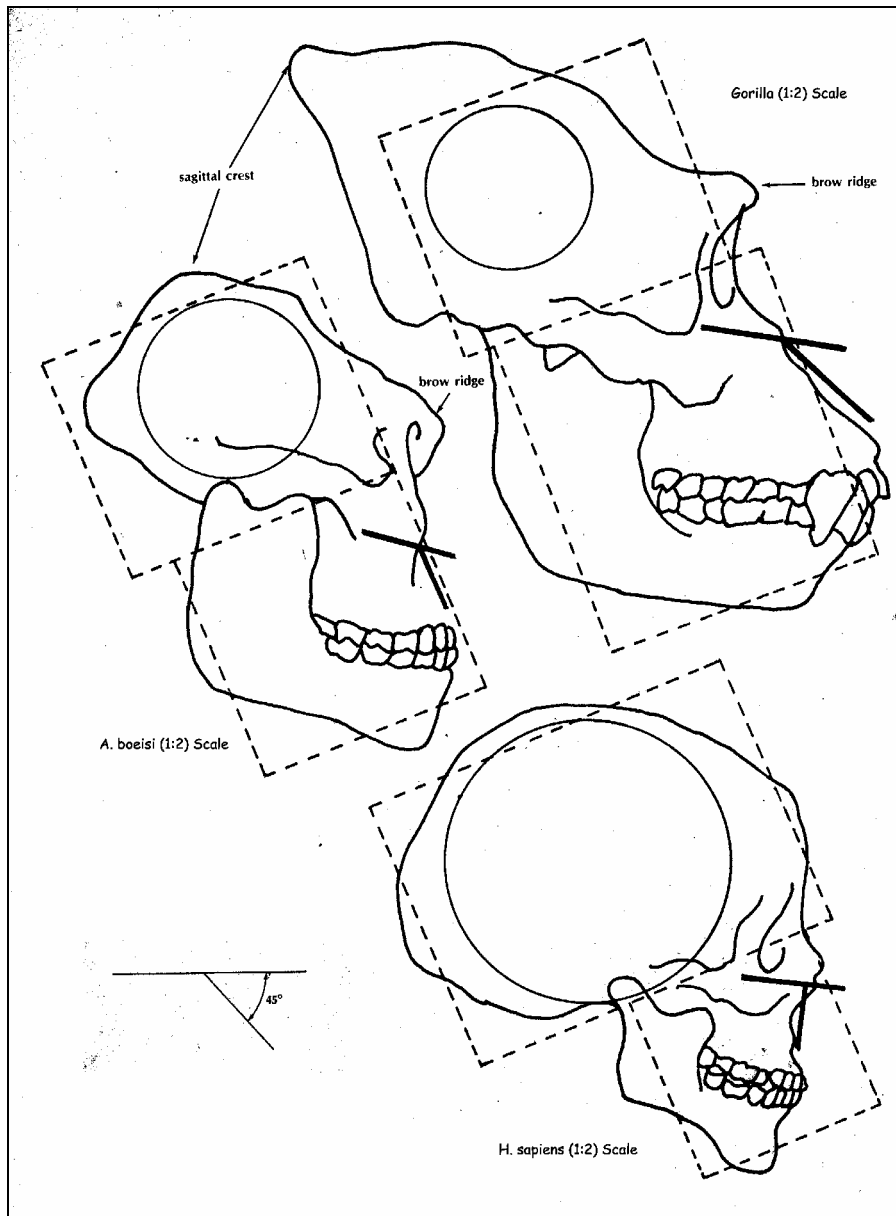


Figure 1

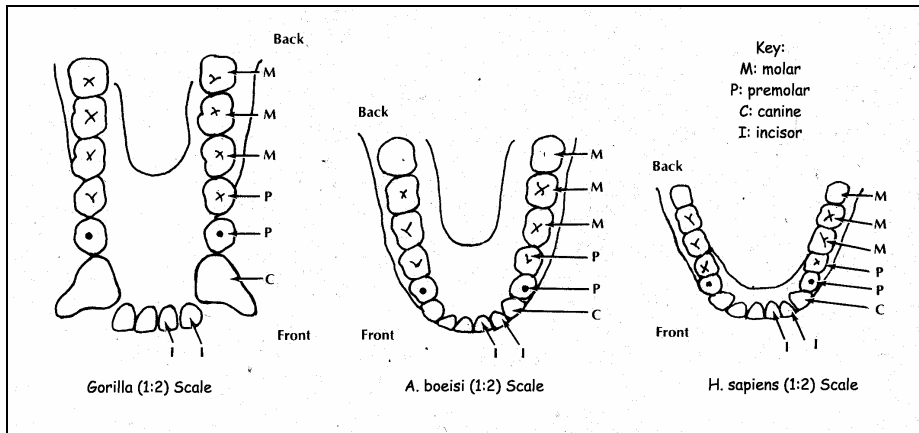


Figure 2

Sagittal Crest

A bony ridge running across the top of a skull for muscle attachment is called a sagittal crest.

- Indicate in table 1 whether a sagittal crest is absent or present in each skull. Refer to Figure 1.

Brow Ridge (Supraorbital Ridge)

Directly above the eye sockets is a thick bony ridge. This ridge may be absent or present in a skull.

- Indicate in table 1 whether or not a brow ridge is present.

Numbers and Types of Teeth

Use figure 2 for this part of the investigation.

- Count and record the number of teeth for each lower jaw in table 1.
- Count the number of each tooth type for each lower jaw. "M" on Figure 2 is for molar, "P" is for premolar, "C" is for canine, and "I" is for incisor.

Lower Jaw Shape

- The distance across the jaw backs compared to the distance across the jaw fronts can be used to determine jaw shapes of the six organisms. Record the shape into table 1.

Analysis:

1. What overall change in brain area has occurred during human evolution?
2. What overall change in facial area has occurred during human evolution?
3. Which animal in this investigation shows the largest brain area and smallest face area?

4. How does the cranial capacity of *A. afarensis* compare to that of the...

- Gorilla _____
- Boeisi _____
- *H. erectus* _____
- *H. neandertalis* _____
- *H. sapiens* _____

5. How do the lower jaws of these organisms compare in regard to -----

- Number of teeth? _____
- Number of molars? _____
- Number of premolars? _____
- Number of canines? _____
- Number of incisors? _____
- Jaw shape? _____















6. How many traits are similar when comparing

- *afarensis* to gorilla? _____
- *afarensis* to human? _____
- Human to gorilla? _____

7. Based on your answer above, and other data, does a modern human seem closer in evolutionary development to *A. afarensis* or a gorilla? Why?

Table 1

	<i>Gorilla</i>	<i>Chimp.</i>	<i>A. afarensis</i>	<i>A. boiesi</i>	<i>H. erectus</i>	<i>H. neand</i>	<i>H. sapiens</i>
Face Area							
Brain Area							
Is brain area smaller than face area?							
Is brain area 3X larger than face area?							
Cranial capacity in cm ³							
Jaw Angle							
Does lower jaw stick out in front of nose?							
Sagittal crest present?							
Brow Ridge present							
Number of teeth in lower jaw							
# Molars							
# Premolars							
# Canines							
# Incisors							
Lower Jaw "V" or "U" shaped?							

Species	Frontal View	Lateral view
<i>Gorilla</i>		
<i>Chimpanzee</i>		
<i>A. afarensis</i>		
<i>A. boeisi</i>		
<i>H. erectus</i>		
<i>H. neandertalis</i>		
<i>H. sapiens</i>		

INVESTIGATION 17-1 Change in Human Posture

Introduction

Erect posture is one of the most easily observed characteristics that separates humans from other primates. However, humans did not change from stooped posture to erect posture rapidly. The progress was slow, occurring over a period of approximately 3.6 million years. In this investigation you will determine the degree of uprightness of posture of six human ancestors and one primate ancestor in order to see the change in posture of humans.

Purpose

To determine the degree to which human posture has changed from stooped to upright

Objective

- *Observe* the change in human posture.

Materials

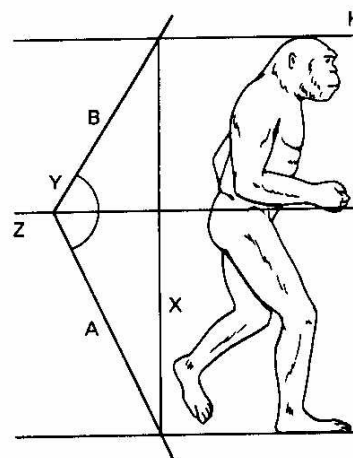
Centimeter ruler Protractor

Procedure

1. Construct a triangle for each picture in this investigation using the following method. Your triangle will be similar to the one shown in the example on the right.

Construct the triangle by doing the following:

- a. Draw a line parallel to the bottom of the paper and even with the feet of the subject. Label it F.
- b. Draw another line, parallel to the first line, F, even with the head of the subject. Label it H.
- c. Draw a line perpendicular to these two lines and extending from line F to line H. Label it X.
- d. Construct a line, Z, through the midpoint of the waist, and parallel to lines F and H. Extend line Z beyond line X.
- e. On line Z, at a point 3 cm from the intersection of lines X and Z, mark a point, Y.
- f. Extend a line from point Y to the intersection of lines F and X. Label it A.
- g. Extend a line from point Y to the intersection of lines H and X. Label it B.
- h. Measure the angle Y, the interior angle at the intersection of lines A and B.

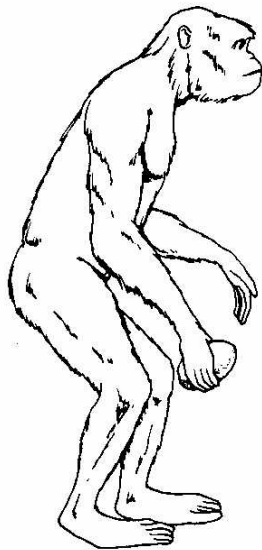


2. Using this method find angle Y for each picture. Record your findings.

Analyses and Conclusions

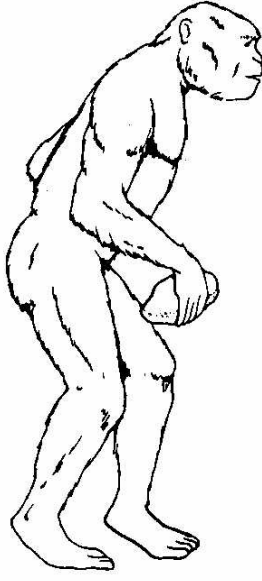
1. Look at the angle value for each picture. Does the angle increase or decrease? Explain the reason this occurs.

Ramapithecus



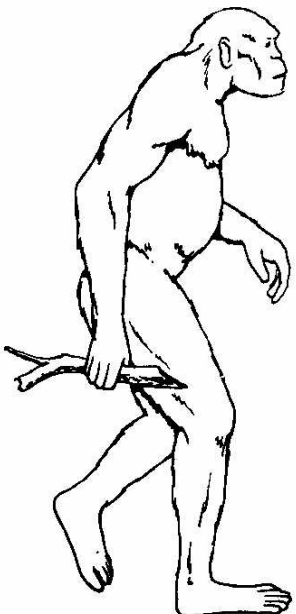
$\angle =$

Australopithecus africanus



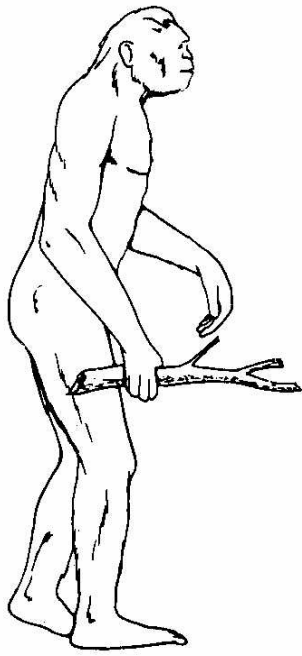
$\angle =$

Australopithecus robustus



$\angle =$

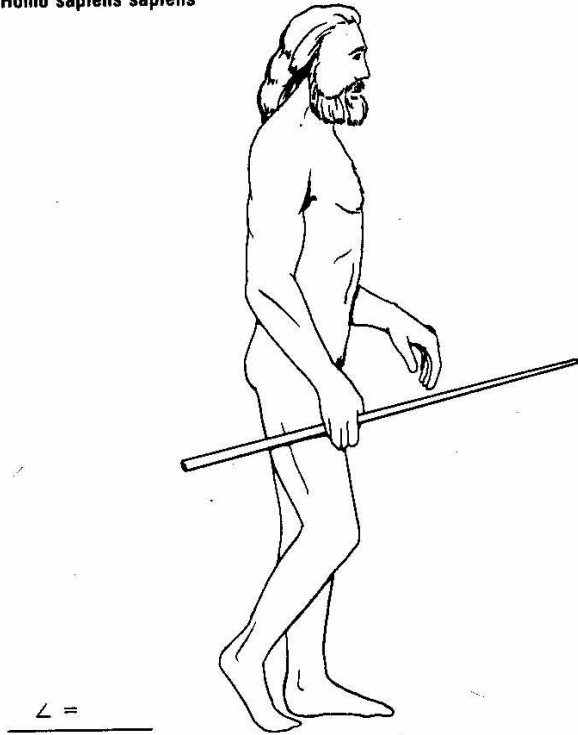
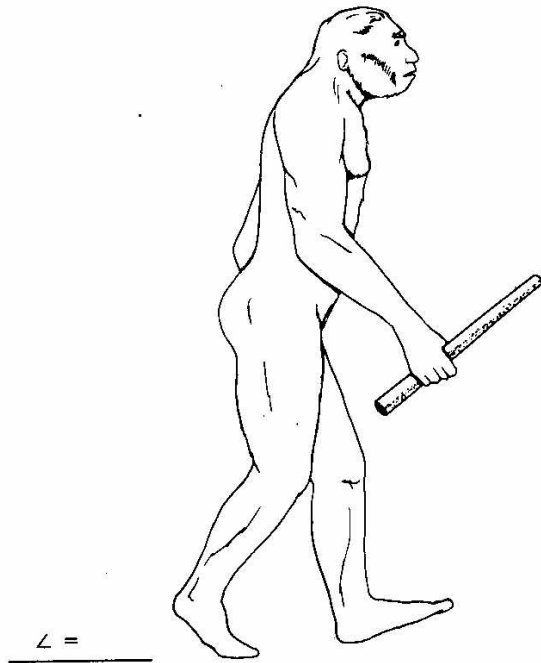
Homo erectus



$\angle =$

Homo sapien neanderthalis

Homo sapiens sapiens



2. What is the advantage of straight posture over stooped posture?

3. How would upright posture affect the stride of humans?

4. What do you think will happen to human posture in the future?

The measure of each angle will vary with the accuracy of student drawing and the equipment used. Any answer within two degrees should be accepted.

Going Further

Research facial development in humans. A series of pictures of the faces of each species will show a decrease in the size of the jaw. Trace this development and relate it to the change in human posture.

ADAPTATION OF THE HUMAN HAND

INTRODUCTION:

Living things have bodies that are adapted for the places they live and the things they do. Fish have gills so that they can remove oxygen that is dissolved in water. Most plants have green leaves which contain chlorophyll so that they can make food. Jellyfish have stinging cells to capture prey. Birds have hollow spongy bones so that they will be light enough to fly. Arctic animals have layers of fat and thick coats of fur to keep warm in the frigid Arctic climate. There are hundreds of examples of ways that organisms are adapted for a successful lifestyle.

Humans, too, are adapted for the things they do. One of our adaptations is our hand. Humans, as well as monkeys, gorillas, and other primates, have a hand that can grasp objects. In this lab exercise, you will perform several common actions. Then you will change your hand so that it resembles that of a non-primate animal. You will determine whether or not you can successfully perform the same actions. This will demonstrate how the human hand is adapted for the actions it performs. You will work with a partner to do this exercise.

PROCEDURE:

1. Do each of the following activities and have your partner time how long it takes you to do each one. Record the times in the data sheet.
 - A. Tie a knot in a piece of string.
 - B. Remove one shoe and replace it on your foot.
 - C. Unscrew a bottle cap or jar cover.
 - D. Unbutton two buttons and button them again.
 - E. Open a door.
 - F. Write your name on a piece of paper.
2. Using masking tape, have your partner tightly tape each of your thumbs to the palm of the hand.
3. After your thumbs are securely taped, try each of the activities listed in Procedure 1 again. Time each activity as you did before and record the time in the data chart. If an activity is not done in two minutes, record the word "unsuccessful."

DATA

FIGURE 1: Time Taken To Perform Various Actions

ACTION	Time to do it with	
	THUMBS FREE	THUMBS TAPED
Tie knot in string		
Remove and replace shoe		
Unscrew bottle cap		
Unbutton and rebutton		
Open door		
Write name		

CONCLUSIONS:

1. Explain why dog and cat paws are not adapted for doing the six actions you tested.

2. What are cat and dog paws adapted for?

3. Describe how your hand is adapted for doing the actions you tested.

4. You have an opposable thumb. Explain what you think this means.

5. Why do you feel that human hand adaptations have helped to make humans such a successful species on earth?
