HUMAN EVOLUTION: A HANDS-ON INVESTIGATION USING HOMINOID SKULLS

Introduction: This lab will allow students to investigate and evaluate evolutionary relationships by examining skulls of living and extinct human relatives. It is a direct, hands-on way of studying human evolution. Working and presenting interpretations in groups will simulate the process of paleo-archeology study that characterizes this scientific field and will tie into a discussion of the various competing theories of human evolution that are currently debated.

Obj ectives:

1. To become familiar with the different tools and techniques used in paleoanthropological studies;
2. To analyze important structural features and to determine their importance in determining evolutionary relationships;
3. To collect data by measuring and observing primate skulls;
4. To use the data gathered to analyze various phylogenetic trees showing evolutionary relationships between fossil and living specimens of hominoids.

Materials: 9 hominoid skulls (including gorilla, chimp, and *Australopithecus* and *Homo* species), protractors, rulers, calipers

Procedure:

1. The teacher will introduce the morphological characteristics that will be used to examine the evolutionaary relationships among primates that can be learned from a study of their skulls.

2. Students will work in groups of four to collect data and observations to complete the "Human Evolution Data Chart". Each group will take approximately 5-7 minutes at each station and will rotate through each station. Each group will complete a data chart which includes at least 11 traits for each skull. The "Hominoid Skull Comparison Checklist" should be consulted for an explanation of the possible variations in each of the 11 traits. The description of the data in each group should be arrived at by consensus, with everyone in the group agreeing on the final description of each characteristic. Any characteristic for which data cannot be obtained (for example, a jaw with uncountable teeth) should be marked N/A for "not available" so as to avoid confusion with a descriptor such as "none". At the conclusion of the observations each student will have a completed data chart with written descriptions for each skull studied.

3. After the data chart is completed, the teacher will read off the age of each of the skulls and the students will fill in the data on the chart.

4. Students should then turn the data chart over and make a list of the trends they have observed in hominoid evolution as they completed the lab. For example, the forehead went from almost nonexistent in early hominoids to large in modern humans. The groups should work together on compiling their lists.

5. As a follow-up to the lab, the students will read and analyze currently accepted and competing theories of human evolution either from their textbooks or from articles. A class discussion will involve being prepared to defend one of the theories based on what has been read and also on the observations make in the laboratory.

HOMINOID SKULL COMPARISON CHECKLIST

First fill in the name of each skull on your data chart. Then follow the checklist below to fill in the characteristics of each skull on the data chart. Record all measurements in millimeters.

1. Forehead: Does the skull extend above the eyes? Is the forehead **large**, **small**, or **medium**?

2. Chin: How pronounced is the chin? Does it **stick out** like yours or **slope back**?

3. Sagittal crest: This is the bony ridge along the top of the skull to which large chewing muscles attach. Is there a saggital crest? How pronounced is it? Is it **large**, **small**, or **medium**?

4. Prognathism: Examine the skull for existence of a "muzzle" or snout - a protrusion of parts of the face below the eyes. Gorillas (and dogs) have pronounced prognathism. Humans do not.

5. Facial slope: Use a ruler and protractor to measure the **angle** of the face as shown in diagram below.

6. Supraorbital browridge: Look for a bony ridge protruding above the eyes. **Large**, **small**, or **medium**?

7. Dental arcade: The arch, or shape of the jaw will be either boxshaped (sides parallel), **"U"-shaped** (parabolic sides), **" V " -shaped**, or **intermediate**.

8. Canines: The canine is the third tooth from the center of the top and bottom jaw. Describe them. Are they **long**, or **short?; sharp**, or **dull**? Is there a **diastema** present (a gap between the upper incisors and canines)?

9. Foramen magnum: This is the large opening in the base of the skull through which the spinal cord passes. The position of this hole reflects the body posture (and indirectly the locomotor pattern) of a hominoid. Is the foramen magnum located **toward the rear** or **more forward**?

10. Number of teeth--Top/Bottom: Count the number of teeth in the upper and lower jaw. Record number of incisors: canine: premolars: molars in one-half of the upper jaw as the numerator and the same count for one-half of the lower jaw as the denominator.

11. Cranial Module: Calculating the cranial module provides a rough numerical value for the size of the cranium. Measure the maximum **length** by placing one end of a caliper on the most forward projecting point of the forehead and the other end on the most posterior point at the back of the skull. The maximum **width** is determined with the calipers on the sides (temples) of the skull at the widest point. The maximum **height** is measured by putting the skull on its side; then hold one end of the calipers on the midpoint of the anterior of the foramen magnum and the other end at the intersection of the coronal and sagittal sutures on top, in the midline. Add these and divide by 3:

FACIAL SLOPE

CRANIAL MODULE