**Hominoid Skulls Lab-CER (Claim-Evidence-Reasoning)**

**Introduction:** In this lab, you will play the role of a paleo-anthropologist. You will be provided with scale drawings of actual hominid skulls. Like a paleo-archeologist, you will describe, measure and compare skull drawings from contemporary apes (gorillas and chimpanzees) and fossil hominids (erect and bipedal forms evolutionarily separated from the apes). Hominoid is the collective term for apes and humans.

**Purpose**: You, as the paleo-archaeologist, will independently discover some of the similarities and differences that exist between these forms. You will then research, share and debate this information with your “colleagues” and collectively, try to identify and arrange the hominid skulls based on age and morphological characteristics.

**Objectives:**

* Handle and read measuring instruments
* Identify specific dental and skeletal features of hominoids
* Describe these features as either similar to, different from, or the same as those present in other hominoid forms.
* Construct and justify a taxonomic classification (Cladogram)

**Background:** Paleo-anthropology is the intersection of the disciplines of paleontology (the study of ancient life forms) and anthropology (the study of humans). Through these activities you will analyze important morphological (form and structural) features of hominoids, and determine their importance in determining evolutionary relationships.

The fossil record is a primary source of information for evaluating the history of life on Earth. The fossil record documents the presence of life for over 80% of Earth’s history. The first fossil records of bacterial cells (cells without a nucleus) were found in rocks dated about 3 Billion years ago. Cells with a nucleus date back to 1.5 billion years ago, and multicellular organisms first appear in the fossil record about 1 billion years ago. These organisms first appeared in the sea. Approximately 500 million years ago, plants appeared on land, while the first land animals appeared about 150 million years later. The first land animals were amphibians, which later evolved into reptiles and subsequently into birds and mammals. One group of mammals evolved into tree-dwelling primates.

More than 10 million years ago, the African climate was changing, and grassland was replacing dense forest cover. In this new environment, some early apes” (a type of tree-dwelling primate) started to spend more time on the ground. Later, some of these forms also began to stand upright more frequently and easily, which led them to look over the tall grasses and freed their hands for other uses. Gradually, over a period of perhaps 1-2 million years, the first fully erect and bipedal (able to stand on two feed) hominoids appeared—the hominids).

The word “hominid” refers to members of the taxonomic family of humans. Hominids are included with the superfamily Hominoidea. Hominoid is the collective term for apes and humans. The term “hominid” (derived from the Latin *homo,* for man) is defined as all species on the human evolutionary branch. *Homo sapiens* are the only living representatives from hominid family.

Though the hominid fossil record is far from complete, and the evidence is usually fragmentary, there is more than enough to give an excellent outline of the evolutionary history of humans.

**Question:** What is the phylogenetic relationship of this group of hominids: *A. boisei, Homo neanderthalensis, Homo habilis, Homo erectis, Pan troglodytes, A. africanus, Gorilla, gorilla, Homo sapiens sapiens?*

**Procedure/Research Part I:**

1. With your “colleagues”, examine scale drawings of eight different hominid skulls.

*(A. boisei, Homo neanderthalensis, Homo habilis, Homo erectis, A. africanus, Homo sapiens sapiens, Pan troglodytes, Gorilla, gorilla)*

* 1. You will have 3 scale drawings of each hominid skull (frontal, profile, and basilar views)
  2. Use your checklist to help you describe, measure, calculate, and record the morphological characteristics of each hominid skull.
     1. Your description should be arrived at by mutual consensus of all group members. Because some of the data asked is subjective and/or open to interpretation, you may end up discussing and debating some of the answers with the members of your group. You must **double check all measurements**.
  3. Record all of the requested data for your numbered scale drawings of each hominid in the spaces for the corresponding number on your Hominid Skull Chart.
     1. Any necessary calculations may be done immediately after measurements are taken or after the lab is completed.
  4. **DO NOT WRITE on the MASTER DRAWINGS!** The only drawings you may write on are the copies of any profiles provided for that purpose.
  5. Once your group has completed its measurements and recorded the data for a set of skull drawings, wait for the other groups to finish their measuring and recording. When all the other groups are done, each group will pass their drawings on to another group according to instructor’s instructions.
  6. Each time your group receives a new set of scale drawings, repeat your measurements and data recording. By the end of the activity, your group should have viewed and measured **all eight sets** of drawings.

**Evidence and Reasoning: Part II: REPORT**

* 1. After you have measured and described all of the skulls, this is your **EVIDENCE!** You will include all evidence in a **REPORT** titled **Hominid Phylogenetic Relationships of Change Over Time** as indicated below.
  2. In your report, **determine** and **describe** the phylogenetic relationships represented by your **EVIDENCE** as follows:
     1. **List the features** that all the skulls have in common.
     2. **Identify the features** most useful for distinguishing between **each** of the skulls.
     3. **Determine** which fossil skull belongs to which hominid.
     4. **Research and record the ages** of each hominid fossil.
     5. **Describe the changes** that occur in each hominid cranium over time, and possible reasons for those changes. Consult references, if necessary.
     6. As a group, **discuss** your data and **write your REASONING** on where each skull would be placed in an evolutionary time scale according to the **EVIDENCE** collected in Part I. You must be able to **EXPLAIN YOUR REASONING BASED ON YOUR EVIDENCE** of the evolutionary phylogenetic relationships you are using to determine where the skull would be placed in a cladogram (below).
     7. You will use this information above to construct your **CLAIM**: **Phylogenetic Relationships of Hominids Cladogram.** On this cladogram, you will illustrate evolutionary phylogenetic relationships of hominids based on your **EVIDENCE** and place the skulls in what your group determines is correct evolutionary order (**CLAIM).** You must use the **EVIDENCE** presented in your report above to demonstrate these relationships. In other words, you must be prepared to give your **REASONING** as to why (**CLAIM**) you placed a skull in a particular place on the cladogram using the **EVIDENCE** your group collected
     8. As a **group**, be prepared to **explain and defend** the **REASONING** and **CLAIM** regarding the placement and phylogenetic relationships of various species listed on your hominid cladogram. Remember, hominid evolution is still being debated by paleo-anthropologists. There are no right or wrong answers; however, your **CLAIM** (represented by Cladogram) should be backed up by sound and logical **REASONING**. If your **REASONING** is not logical and based on **EVIDENCE**, you will not gain full credit for the assignment/project.
     9. State your **CLAIM** based on your **REASONING** and **EVIDENCE.**

**Multimedia Project Part III: PRESENTATION**

* + - 1. Using an application on your phone, such as **Stop Motion Studio**, you will prepare a multimedia presentation of your **EVIDENCE (Cladogram) and REASONING**.
         1. You will need to **state** where each skull is placed in the cladogram and **explain** your **REASONING** in terms of phylogenetic relationships of hominids as to why you placed each skull where you did. In other words, you will have to present your **EVIDENCE, STATE YOUR CLAIM** (Cladogram) and explain your **REASONING** for the phylogenetic placements for **each** skull.

1. You will need to **create a story board** prior to using **Stop Motion Studio** so that you know which skull in your cladogram you will present in what order and what information you will use to **explain** your **REASONING** behind your placement.
   1. Next, you will create your Stop Motion Video and follow up with a voice over; which is why you need to plan it out. You may use other apps such as **IMovie** to further enhance your presentation if you choose to.
2. You will upload your **Stop Motion Video** to **You tube** **and send an email with the link to your teacher**. Your teacher will upload it to your class channel. Videos will be viewed and evaluated by the teacher and your peers. You will need to be present on the day of the viewing to answer questions and participate in the peer review. Everyone in your group is responsible for knowing the EVIDENCE, REASONING, and CLAIM!!! You will be questioned and evaluated for your participation, knowledge, and ability to answer questions. Your grade may be different than the rest of your team based on your contributions and knowledge demonstrated during peer review.

**Supplies available Include:**  smaller copies of skulls for video purposes, white boards, markers

**Note:** You are **REQUIRED** to be present every day and fully participate in this activity to earn credit. You will be evaluated by your peers and your teacher. Any student not doing so, will be given an alternative assignment (individual research project on hominids including research paper and multimedia presentation) to complete on their own and turn in no later than the deadline given to them by their teacher (which is the same day project is due for everyone else). **No extensions** will be given. **Anything more than 1 day of excused absences** for duration of project may result in completion of alternative assignment.

**Hominid Cranium Comparisons Check List**

**Instructions:**

**\***Everyone **must participate** and be involved. **Take turns** taking measurements

\*Always measure to the nearest **millimeter**

\*Record your info in the **proper spaces** of the Hominoid Skull Data Chart

\*Do **NOT** write on master drawings.

\***Note the numbers** listed on the bottom right-hand corner of each set of drawings.

\***Record all the data** for the numbered specimen in the **proper column** of the data chart.

\*You will have to **look up any terms or images** for terms and structures you don’t know

**Note:** Do **NOT** abuse the ability to use your phone for research **or** you will be **denied** the privilege.

**BRAINCASE:**

1. Does the forehead (frontal bone) look more **V**ertical (up and down) or more **H**orizontal **(**flatter)? (V for vertical, H for horizontal)
2. Look at both the frontal and profile views of the specimen. Is the supraorbital brow ridge for this specimen **S**mall, **M**edium, or **L**arge (S, M, L)
3. IS there a sagittal crest? **Y**es, or **N**o (Y or N)
4. You will not be able to measure cranial capacity from the drawings. However, you will be able to measure and compare some cranial sizes. Locate the frontal drawing. Measure the maximum cranial breadth (width) (mm) at the widest point of the braincase. Some drawings have dashed lines to help you if the large orbital bones hide the width.
5. Look at the profile drawing. What is the shape and size of the braincase? Measure the approximate maximum braincase length (mm). **Do not include the area of the sagittal crest.**
6. Observe the skull from the basilar view. Is the foramen magnum oriented downward (**C**entered), more towards the **R**ear of the skull, or somewhat **I**n between/ (C, R, I)

**FACE**

1. Are the nasal bones raised (**A**rched), **F**lat, or somewhat **I**n between? (A, F or I)
2. Measure the maximum breadth (width) of the nasal opening (mm).
3. Measure the maximum height of the nasal opening (mm).
4. Observe the skull from the basilar view. Measure the length of the maxilla (upper jaw) (mm).
5. Is there a chin? **Y**es, **N**o, or somewhat **I**n between? (Y, N, I)
6. Is the facial prognathism **M**inor, **P**ronounced, or somewhat **I**n between (M, P, I)
7. Find the **photocopy** of the profile view of this specimen. Draw a line from the **x** on the supraorbital brow ridge to the point where the incisor meets the mandible (lower jaw). Draw another line vertically through the same point in the lower jaw. With a protractor measure the facial slope, in degrees (o).

**DENTITION**

1. What is the dental arcade shape? Is it **S**traight sided or **D**iverging (getting wider toward the back)? (S or D)
2. When viewed from the side, are the incisors **S**lanted (sticking out), **V**ertical (straight up and down, or somewhat **I**n between? (S, V, I)
3. Measure the canine length (mm).
4. Do the canines jut above and below the chewing surface of the other teeth? **Y**es, **N**o, or somewhat **I**n between? (Y, N, I)
5. Is the canine diastema (gap) present? **Y**es, **N**o, or somewhat **I**n between? (Y, N, I)
6. Determine the area of the combined chewing surface (in mm2) as follows:
   1. Determine the average width of the two pre-molars and three molars.
   2. Measure the total length of the two pre-molars and the three molars.
   3. Multiply the total length of the chewing surface by the average width of the five teeth, (mm2)

**Hominid Skull Data Chart**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Specimen Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Forehead (frontal bone) V/H |  |  |  |  |  |  |  |  |
| Supraorbital Brow Ridge (S, M, L) |  |  |  |  |  |  |  |  |
| Sagittal Crest  (Y, N) |  |  |  |  |  |  |  |  |
| Maximum Cranial Breadth (mm) |  |  |  |  |  |  |  |  |
| Shape of braincase & meas. mm |  |  |  |  |  |  |  |  |
| Foramen Magnum  (C, R, I) |  |  |  |  |  |  |  |  |
| Nasal Bones  (A, F, I) |  |  |  |  |  |  |  |  |
| Maximum breadth of nasal openings (mm) |  |  |  |  |  |  |  |  |
| Maximum height of nasal openings (mm) |  |  |  |  |  |  |  |  |
| Length of maxilla (mm) |  |  |  |  |  |  |  |  |
| Chin  (Y, N, I) |  |  |  |  |  |  |  |  |
| Facial Prognathism (M, P, I) |  |  |  |  |  |  |  |  |
| Facial slope in degrees (0) |  |  |  |  |  |  |  |  |
| Dental Arcade  (S, D) |  |  |  |  |  |  |  |  |
| Incisors  (S, V, I) |  |  |  |  |  |  |  |  |
| Canine length (mm) |  |  |  |  |  |  |  |  |
| Canines Jut (Y, N, I) |  |  |  |  |  |  |  |  |
| Canine diastema (gap) (Y, N, I) |  |  |  |  |  |  |  |  |
| Combined chewing surface (mm2) |  |  |  |  |  |  |  |  |
| Specimen Name |  |  |  |  |  |  |  |  |
| Geologic Age |  |  |  |  |  |  |  |  |