

# The Missing Link: Inferring Function from Structure

by

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## Introduction

You will be working with some skulls today in order to learn some basic skull anatomy and how we can make inferences about other parts of the body based on the skull. You are going to do this so that you can figure out the diet of the skull that the “hero” of our story finds and where it fits among the various skulls set on the lab tables in front of you. Our purpose today is to see connections and relations and not to learn scientific names or terminology; those will be for another day.

So, today our learning objectives are:

- Knowledge of skull anatomy
- Functions of skull components
- Knowledge of relationship of teeth and diet
- Relationship between skull anatomy and mode of locomotion
- Knowledge of some differences between apes and humans

In each group, we will need four individuals to serve specific roles:

- A *moderator*, whose job is to moderate the group process to make sure all members’ views are heard and valued, and to keep the group focused on task.
- A *time-keeper* to make sure you don’t run out of time before the objective of each task is completed.
- A *recorder* to write down the answers to each part of the case.
- A *reporter* to present to the class the findings of the group that were recorded by the recorder.

There are five parts to this case. The case takes about 45 minutes to complete. We’ll distribute our time as follows among the different parts:

- Part I     15 minutes
- Part II    10 minutes
- Part III    5 minutes
- Part IV    10 minutes
- Part V     5 minutes

## Part I – Liza Looks for Lucy

Dr. Liza Street is a paleoanthropologist at the American Museum of Natural History in New York City. She's been in the field for two and a half grueling months collecting fossils in the Turkana District of northwest Kenya, East Africa. She has an excellent team in the field, made up of experienced local Kikuyu fossil hunters, plus several graduate and undergraduate students from a variety of American universities. The team has been scouring the badlands daily, with only a day each week to rest, bathe, catch up with mail, reading, laundry, etc. While everyone on the team knows that paleontological fieldwork is a daily routine of finding crocodiles, turtles, rodents, horses, etc., the feeling of disappointment is nevertheless palpable. After all, they are there to find human ancestors.

One day at lunch, two weeks before the Americans are due to return to the States, Sam (an especially eager undergraduate) arrives breathlessly at the agreed upon lunch-spot. He rushes to Liza with the news that he has found some pieces of an ancestral human skull. While munching her peanut butter and jelly sandwich, Liza encourages Sam to report what he has found. As Sam hurriedly begins recounting the find and the circumstances surrounding it, Liza's mind wanders to her first experiences in paleoanthropology.

At that time, Liza was a sophomore in college filled with the desire to make a contribution to science and to be famous. But, first she had to learn the tools of her profession. Her advisor, Professor Jeff Black, knew that the only way to learn anatomy was to spend time with specimens, examining them in detail. He set Liza in a room with dozens of skulls and instructed her to figure out the various parts of the skulls.

You should each have a skull to work with. As a group, make a list below of the major parts of the skull that you can identify (not all the lines need to be filled in).

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What might be the functions of the various major parts of the skull? (Write your answer below.)

## Part II – We Are What We Eat

Liza shakes her head and re-focuses on Sam. He is saying that in his comparative anatomy class the previous term he had learned to associate differences in teeth with diet by comparing the teeth of carnivores (meat-eaters), herbivores (grass/leaf-eaters), and frugivores (fruit-eaters). He is sure that the specimen he has found had a similar diet to one of those groups.

At the end of your benches are three skulls. As a group, examine them to determine what sort of food they are adapted for. Give the reason(s) for your determination.

Reason(s):

Skull 1: \_\_\_\_\_

Skull 2: \_\_\_\_\_

Skull 3: \_\_\_\_\_

Once you have an idea of the relationship between teeth and food, look at the skulls you originally worked with and determine their diets(s).

Diet(s) of original skulls:

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### Part III – A Hole in One

Sam insists that his specimen is a human ancestor and not an ape because it is bipedal. Liza reminds him that his specimen is of a skull and asks him how he knows that it comes from a bipedal creature. Sam confidently tells her how he knows.

Can you tell if an animal is a quadruped (4 feet) or a biped (2 feet) by looking at the skull? How? (write your answer below.)

## Part IV – Climbing the Family Tree

Liza is convinced that Sam has found an early human. She and the team accompany Sam back to the spot where his specimens lay. Sam had made a pile of stones to mark the spot so it could be easily found again. As Liza carefully examines each piece and fits them together, she realizes that Sam has made the find of the season, if not the decade! Images of reporters surrounding her upon their return to New York fill her mind, but first she has to decide exactly where the find fits in the known fossil record.

As a group, agree upon a family tree (phylogeny) for the skulls and list below the criterion or criteria that you used (not all the lines need to be filled in).

Criterion(a):

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## Part V – Skullduggery

Where does Sam's find fit in the arrangement of skulls? (Write your answer below.)

The image that illustrates the case is a frontal view of a cast restoration of “Olduvai Hominid 5.” The Olduvai Hominid 5, also known as OH5, is one of the most important specimens discovered of *Paranthropus boisei* (formerly called *Australopithecus boisei*), and is known as its type specimen. OH5 was discovered by Mary Leakey at Olduvai Gorge in northern Tanzania in 1959. (Photo by Nicolas Guérin and used in accordance with the Creative Commons Attribution-Share Alike 3.0 Unported license.)

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