Human Feet Are Strange

hhmi | BioInteractive

Activity
Student Handout

INTRODUCTION

Humans, along with familiar species such as orangutans, gorillas, lemurs, baboons, and chimpanzees, are primates**.** Among living primates, modern humans are most closely related to chimpanzees. The two species shared a common ancestor that lived about 6–7 million years ago. One of the traits that distinguish humans from all other primates, including chimpanzees, is the way we walk. Chimpanzees are primarily **quadrupedal**, which means that they walk on four limbs. Chimpanzees move with their hands turned under so that their knuckles make contact with the ground, which is why they are also described as knuckle-walkers. Humans, on the other hand, are **bipedal**, meaning that we walk on two legs.

We walk with our feet close together and directly underneath our hips, enabling us to balance on one leg while the other leg swings forward. Chimpanzees can walk on two legs only for short distances. Because their feet are not directly under their hips, they sway side to side to help maintain balance when walking on two legs.

Because humans are the only primate to walk on two legs, bipedality most likely evolved in the lineage that led to humans. When did this human trait first evolve? The "Human Feet Are Strange" activity will help answer that question. Part 1 focuses on observing modern human footprints and what we can infer from them. In Part 2, you will make observations and inferences from a portion of the Laetoli trackway, a trail of footprints that were made in what is now East Africa about 3.6 million years ago! You will compare human feet and chimpanzee feet to the footprints in the Laetoli trackway, to determine whether those footprints were more human-like or chimp-like.

PROCEDURE

PART 1: Classroom Trackway

1. In the film *Great Transitions: The Origin of Humans*, paleoanthropologist Dr. Tim White says that human feet are "strange." Discuss as a class what he means by that. Record your ideas below.

2. To see what human footprints look like, you or your classmates will make two sets of footprints using paint. Your instructor will explain the procedure for doing this safely.
3. Carefully analyze the two sets of footprints made in class. Consider the following questions when making your observations:
    - Is the big toe pointed in the same direction as the stride?
    - How far apart are the left and right feet?
    - How long is the stride?
    - Where was most of the weight placed on the foot? How can you tell?

Write your notes below.

4. What are the similarities and differences between the two sets of footprints?

Similarities	**Differences**

5. If you hadn't seen the footprints as they were being made, what could you infer about how they were made or who made them? What observations did you base your inferences on? What couldn't you infer?

   List below the observations and inferences.

Observations	**Inferences**

6. List below some things you could not infer without actually seeing the footprints being made.

PART 2: Laetoli Trackway

The Laetoli trackway is a trail of footprints left in soft volcanic ash about 3.6 million years ago that quickly hardened into a cement-like surface after it was rained on. Unlike the fossils of bones, which are referred to simply as fossils, fossil footprints are referred to as trace fossils. They provide indirect evidence of past life.

Fossils of *Australopithecus afarensis*, the same species as the famous "Lucy" fossil, have been found near the Laetoli footprints. Had *A. afarensis* made the footprints at Laetoli?

7. Your instructor has shown you an illustration of a small portion of the Laetoli trackway to analyze. Take a few moments to familiarize yourself with the image. There are two sets of prints in the trackway; one set is labeled G.1 and the other G.2/3. In each footprint, the outermost lines outline the size of the foot and each line within represents 1 millimeter of additional depth. The more lines there are encircling an area, the deeper that part of the footprint was in the ash.
8. What do you observe about the footprints?
    a. Is the big toe pointed in the same direction as the stride?

    b. Where was most of the weight placed?

9. What can you infer from your observations? For each of the questions below, list the observations and inferences.
    a. How many individuals were walking?

    Observation **Inference**

    b. What were their relative sizes—that is, how big were they compared with one another?

    Observation **Inference**

c. Were they walking together at the same time?

Observation **Inference**

10. Compare the Laetoli footprints to the classroom footprints.
    a. What characteristics do they have in common?

    b. How are they structurally different from each other?

PART 3: Chimpanzee and Human Footprint Comparison

There are many differences between chimpanzee footprints and human footprints. Chimpanzees and other nonhuman primates, like gorillas, have feet that are specialized for climbing, not walking. Use the information in Table 1 to help answer the questions that follow.

Table 1. Footprint Characteristics.

Modern Chimpanzee	**Modern Human**
Tracks may include knuckle prints. 	Tracks do not have knuckle prints. 
The big toe is not in line with the stride.  A chimp's big toe points in a different direction from the rest of the foot.	The big toe is in line with the stride.  Our big toes point in the same direction as the rest of the foot.

The feet lack arches. 	The feet display prominent arches.  Our foot arches function as shock absorbers and are the part of the foot that doesn't touch the ground when we stand upright and walk.
There is no push-off from the big toe.  When chimps walk on two legs, most of their weight passes along the outside of their foot from the heel forward, as shown in the illustration. The big toe is not a push-off point.	There is push-off from the big toe.  When we walk, most of our weight passes from the heel, along the outside of the foot, then across the ball of the foot, and to the big toe. The big toe is a push-off point for the next stride.

11. Using information from Table 1, did the individuals who made the Laetoli footprints millions of years ago have feet more like a human or a chimpanzee? Did they walk more like a human or a chimpanzee? Provide evidence to support your claims.

12. Do you agree or disagree with this statement:

    "It is possible to determine when bipedalism evolved by looking only at the Laetoli footprint."

    Explain your answer.