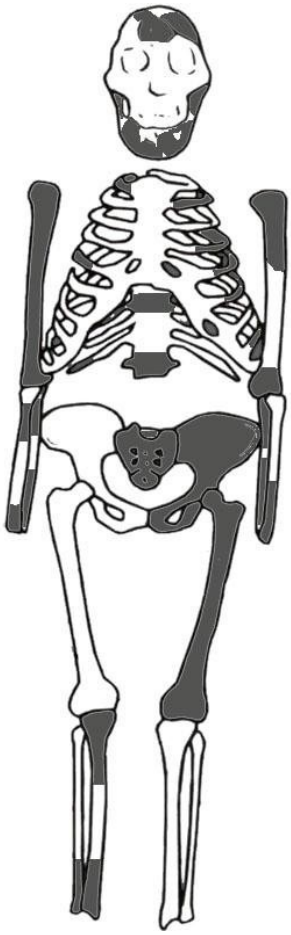
# Activity 1: Characters Chart

## Complete the following based on your reading:

**1. Fill out the chart (a) and answer the question (b).**

a. Identify the following features of Lucy's skeleton as either primitive (chimpanzee-like) or derived (human-like).

| | |
|---|---|
| Prognathic face | |
| Brain size | |
| Valgus knee | |
| Wide, short pelvis and sacrum | |



b. Using your answers from the chart above, how would you describe the overall anatomy of Lucy? On what do you base your conclusions?



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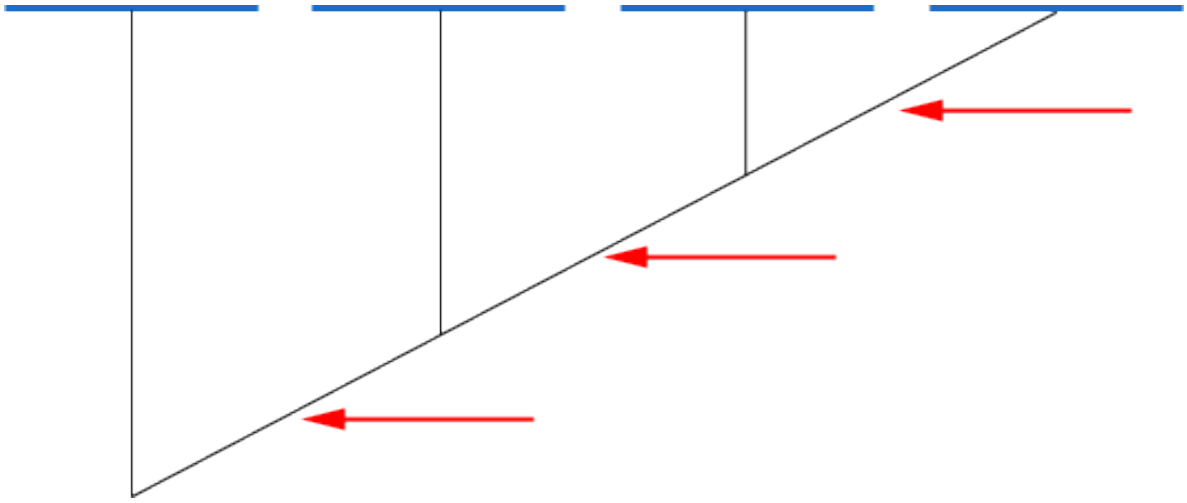
## Activity 2: Primate Relationships

1. Using the cladogram below, place the following labels on the blue lines to correctly depict the evolutionary relationships among these primates:

**Humans** **Monkeys** ***Australopithecus*** **Apes**

Now read the following clues. Identify when each of the derived traits listed in the box below evolved by writing it next to its corresponding arrow. When you are finished, answer the following questions.

Clue 1: All living apes lack tails.
Clue 2: The large human brain size is unique



| Derived Traits: | Bipedalism | Bigger Brains | Tail Loss |
|---|---|---|---|

a. What primates are characterized by bipedalism?

b. Did bipedal locomotion or bigger brain size evolve first?

## Activity 3: Relative Brain Size

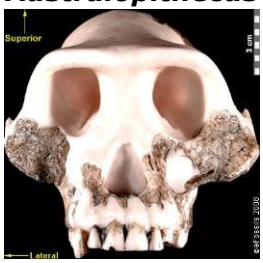
1. Plot the relative brain sizes in order to observe any trends in brain size as they relate to a body mass scale (from small-bodied to large-bodied). You will plot the logarithm of body mass (a proxy for body size) and cranial capacity (a proxy for brain size) on the chart found on the following page. Take a look at the numbers in the parentheses in the table below. Notice how wide-ranging the numbers are. The raw body mass (measured in kilograms) of chimpanzees is 35 kg, while the body mass of gorillas is 105 kg. That means a gorilla is 3 times the weight of a chimpanzee. We would need a really big chart to fit all of those raw numbers on one graph! By logging these numbers, we reduce these values to a smaller scope. Basically, we make it easier to plot these values on the chart.

| Taxon | **X**<br>Logged Body Mass (raw value in kilograms) | **Y**<br>Logged Cranial capacity (raw value in cubic centimeters) |
|---|---|---|
| Chimpanzee | 3.56 (35 kg) | 5.86 (350 $cm^3$) |
| Gorilla | 4.65 (105 kg) | 6.27 (530 $cm^3$) |
| Humans | 4.0 (57 kg) | 7.28 (1450 $cm^3$) |
| *Australopithecus* | 3.61 (37 kg) | 6.06 (430 $cm^3$) |

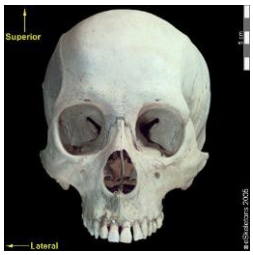
**Chimpanzee**


**Gorilla**


***Australopithecus***




**Human**

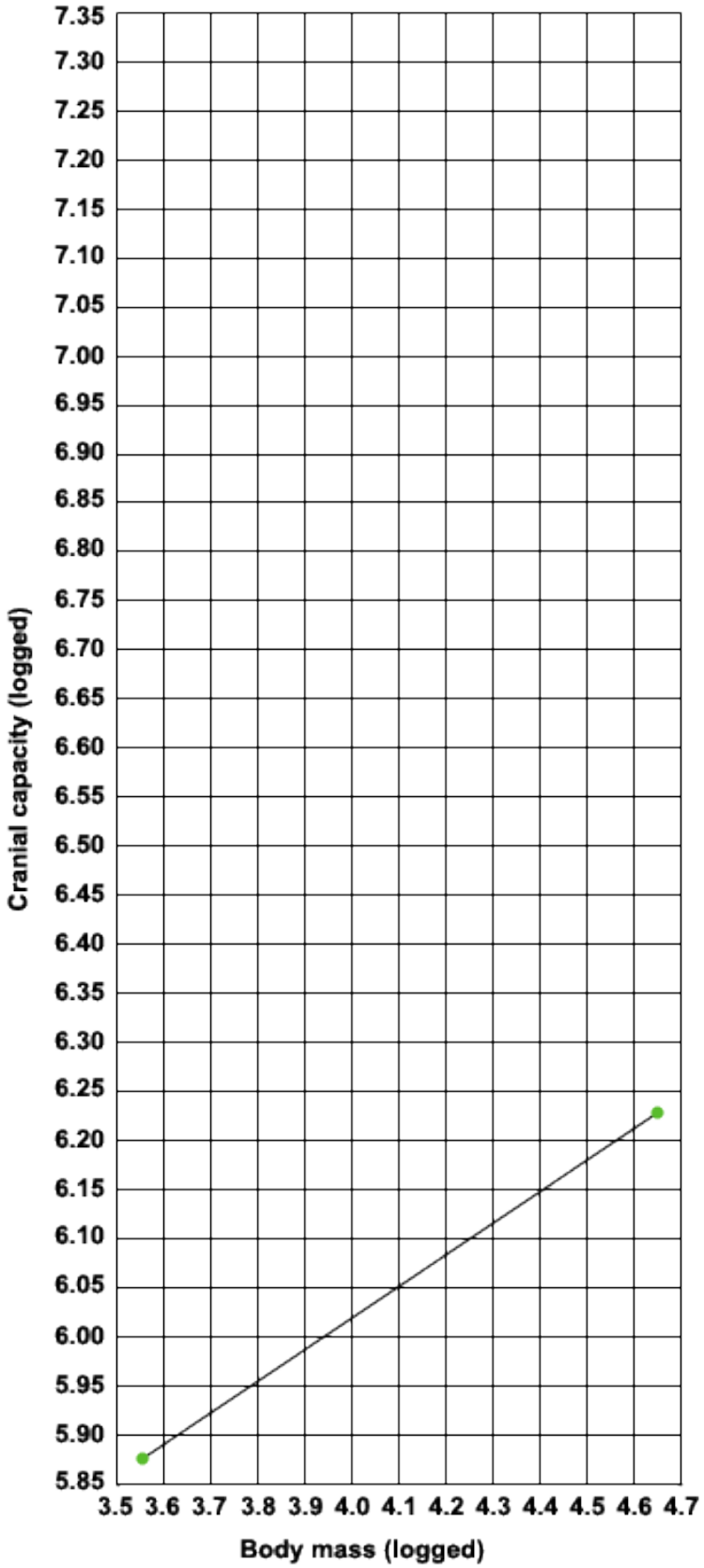



Have you ever plotted numbers on a graph before? It's easy! The table above tells us that the X value is going to be "body mass", and the Y value is going to be "cranial capacity." The X value is always plotted on the horizontal axis and the Y value is always plotted on the vertical axis.

Let's go over how we plotted our chimpanzee data point. First, find the X value for the chimpanzee body mass. It's 3.56. Find 3.56 along the X axis with your finger. Second, find the Y values for chimpanzee cranial capacity. It's 5.86. With your finger still on the 3.56 point along the horizontal axis, move your finger up the vertical axis until you reach 5.86. Plot your data point at the intersection of these two numbers.

Because we're interested in the brain sizes of humans and australopiths compared to those of living apes, we've gone ahead and plotted chimpanzees and gorillas for you. Then we drew a line connecting the chimpanzee and gorilla data points. This line is called a regression line, and illustrates any trends in the data. In this case, the regression line that we drew help us determine us what brain size we should expect in *A. afarensis* for any given body size, based on what we observe in living apes.

Let's plot human and *Australopithecus* brain sizes. Then, turn to the page to continue.



2. Take another look at the location of the human and *A. afarensis* data points. Are they above or below the trend line? If the data point falls below the trend line, then the observed brain size is relatively SMALL in comparison to living apes. If our data point falls above the trend line, then the observed brain size is relatively LARGE in comparison to living apes. Use this information, and the chart, to answer the following questions.

    a. Is the relative cranial capacity of *A. afarensis* larger or smaller than that of the living African apes? How did you come to this conclusion?

    b. How do humans compare to both the living African apes and *A. afarensis*?

## Activity 4: Bipedal Adaptations

1. Recall that the human pelvis (shown below right) looks very different from a chimpanzee pelvis (shown below left). Examine the pelves below. On the chimpanzee and *Australopithecus* pelves, trace the orientation of the iliac blades, their width and height, and the width of the sacrum. We have done this for you on the human pelvis, which you can use as a guide. Then, fill in the chart below and answer the questions.


| **Species** | **Iliac blade orientation** (Curved forward or Flat) | **Iliac blade width/height** (Broad/Short or Narrow/Tall) | **Sacrum Width** (Broad or Narrow) |
|---|---|---|---|
| Humans | *Curved forward* | *Broad/ Short* | *Broad* |
| Chimpanzees | | | |
| *Australopithecus* | | | |

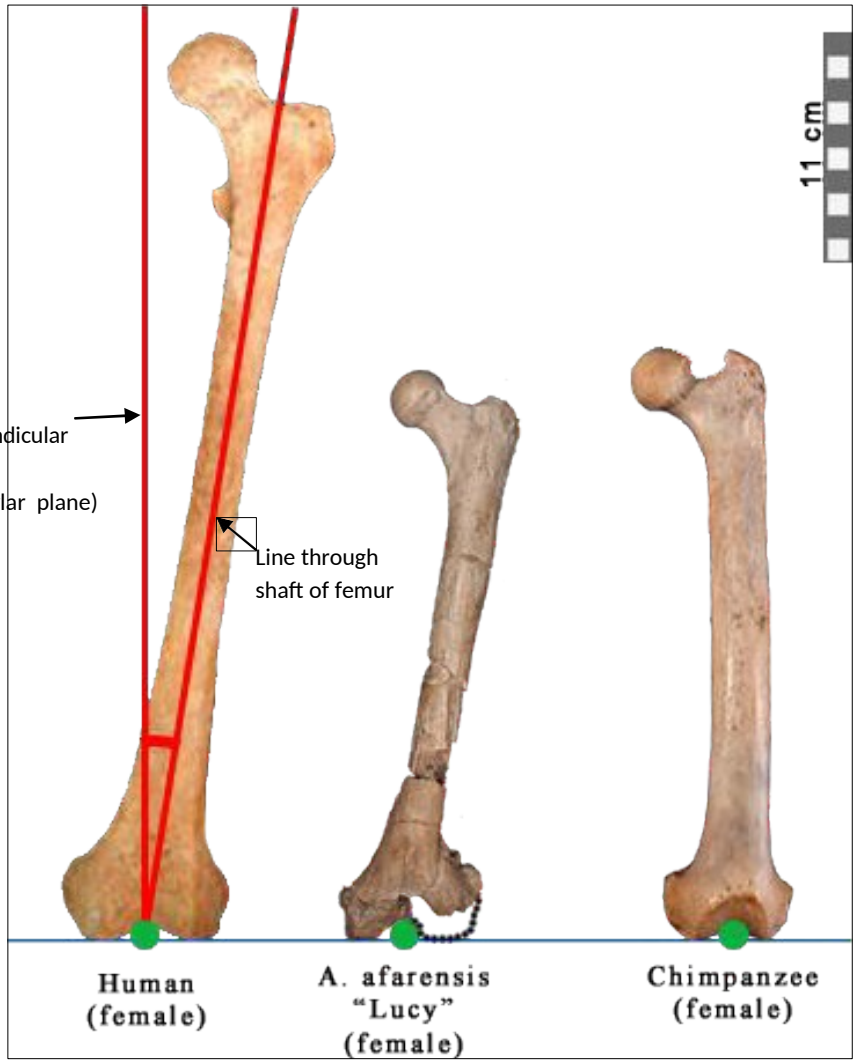
a. Does *Australopithecus* appear to have more chimpanzee-like or human-like pelvic morphology?

b. Based on your answer, what would you say about the locomotion of Lucy?

2. Recall that humans have a valgus knee as a result of a bicondylar angle that tilts the shaft of the femur toward the body's midline. We've drawn the human bicondylar angle on the image below to illustrate this point.

    a. Why is a bicondylar angle important for a biped?

    b. Draw the bicondylar angles for *A. afarensis* and a chimpanzee. To draw the angle, first draw a line perpendicular to the blue line, starting at the green dot. Then, draw a line through the middle of the femur's shaft.



c. Based on your drawing, does the *Australopithecus* femur exhibit a more human-like or more chimp-like bicondylar angle?

d. What can you conclude about the locomotion of Lucy based on your answer?

Based on your reading and the above exercise, answer the following questions:

1. Why was the discovery of Lucy so important?

2. What is a good way to determine Lucy's evolutionary relationship to humans and other living primates? Why? Hint: Think of a type of systematics discussed above using derived and primitive characters.

3. What happened to Lucy, after her death, that allows us to observer her as a fossil today? Describe the process(es)?

4. What did Lucy look like?

5. Lucy had a unique way of moving around in her environment. List and then describe the features of her skeletal anatomy that were discussed in the reading, and determine if this was a primitive or derived character for hominins. Remember hominins include human and other primates that walked bipedally.

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