Name Period Date

CHAPTER 12 | ADDITIONAL INVESTIGATION

Comparing Indexes Among Primates

Background

Humans have the largest brains of all primates. In order to accommodate this large brain, the skull of a human has a vertical forehead, providing a large brain capacity. Humans belong to the *Hominid* family, which shares a common ancestor with apes. Knowledge of human ancestry is based on fossil remains. The oldest hominid fossils are about 3.8 million years old, and the oldest human fossils about 100,000 years old. The degree to which a fossil has human characteristics can be measured by the use of indexes. An *index* is a comparison of two measured quantities. An index can be calculated to show the proportion of skull that is above the eyes. This index, called the *supraorbital* height, provides information about the size of the braincase. In this investigation, you will determine indexes of skulls and hands for a modern human, a fossil hominid, and a gorilla.

MATERIALS

- metric ruler
- scissors
- adhesive tape
- posterboard

PROCESS SKILLS

- Observing
- Collecting Data
- Analyzing Data
- Drawing Conclusions

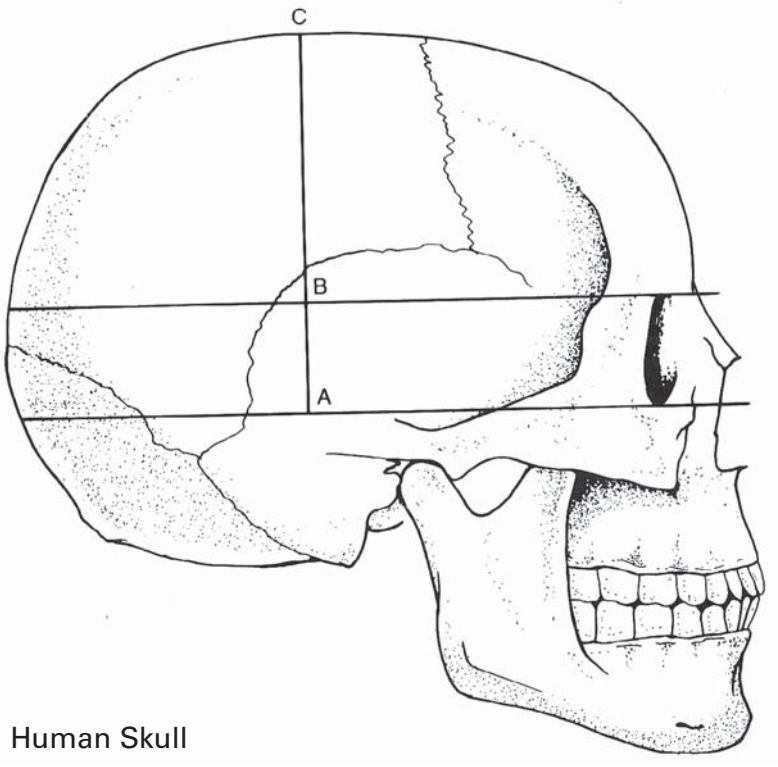
Problem

How do primate indexes compare to one another?

Procedure

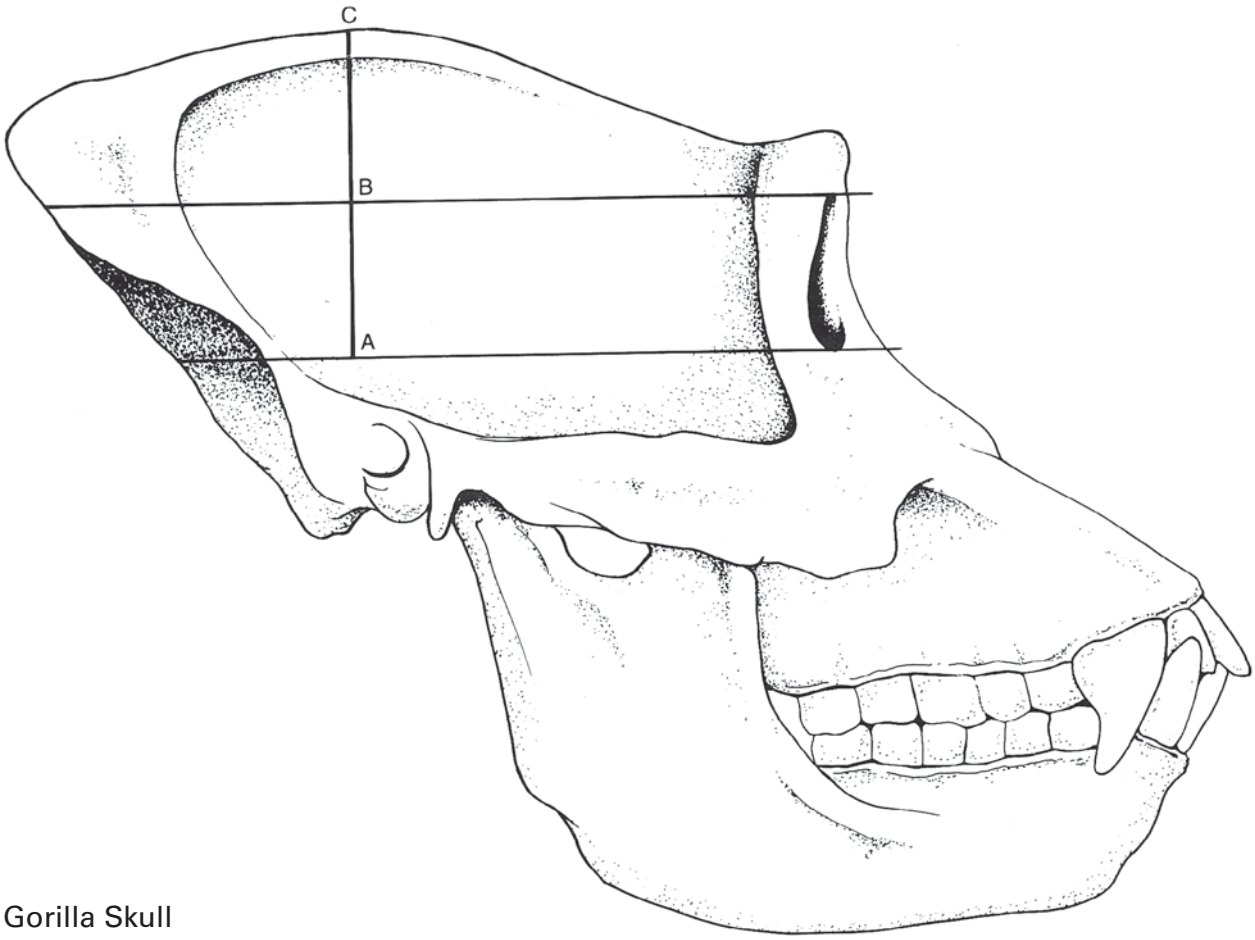
Part A: Comparing Indexes of a Human, Gorilla, and Fossil Hominid

1. The first illustration depicts a human skull. The second illustration is of a gorilla skull. The third illustration is a skull of a fossil hominid, *Australopithecus africanus*. Determine the supraorbital height of each of these skulls. With a metric ruler measure the distances AC and BC in centimeters, as shown for each skull. Record these in Table 1.

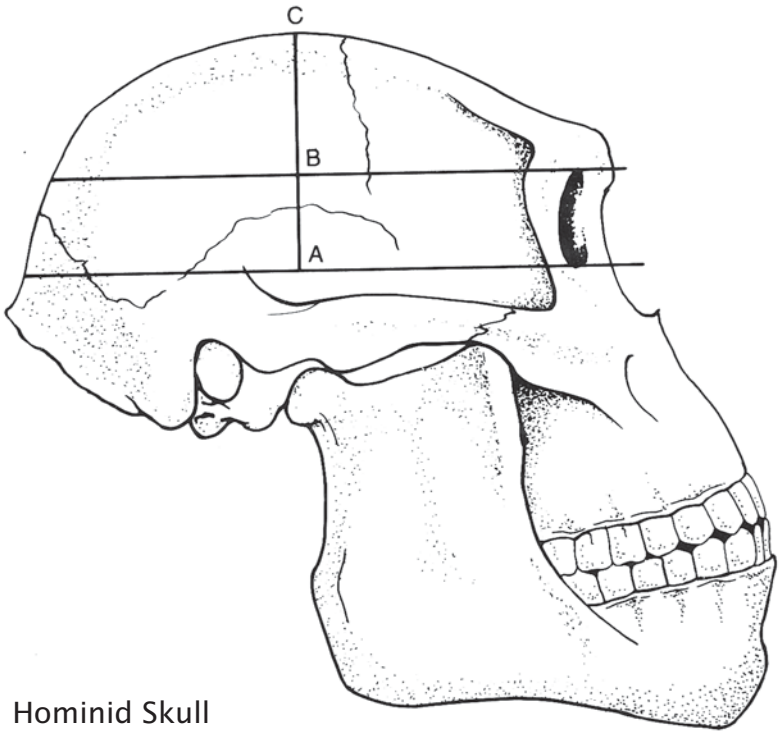


Human Skull

Name Period Date



Gorilla Skull



Hominid Skull

2. Multiply the value of BC by 100 and divide the result by AC. Round off the answer to the nearest whole number to obtain the supraorbital index. Record this value in Table 1. Which of the primates has the smallest supraorbital height? Which has the largest?

Part B: Constructing a Measuring Square

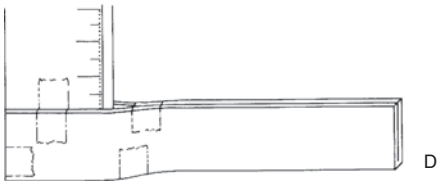
1. Using scissors, carefully cut a piece of posterboard 30 cm × 4.5 cm.

2. Measure and mark a distance of 2 cm from the long edge of the posterboard and then draw the line along the entire length of the piece. Fold the posterboard lengthwise as shown below.

3. Put the posterboard over the end of a metric ruler so it comes up to the 2-cm mark at one edge, as shown below. Then tape the piece of posterboard to the end of the ruler.

4. Fold the piece of posterboard again, 1 to 2 cm from the original fold, so it fits over the end of the ruler as shown below. If it comes up past the 2-cm mark, trim the excess. Tape the second side of the posterboard to the end of the ruler.

5. Make sure that the ruler and piece of posterboard are at right angles to each other. If they are not, remove the tape and adjust the posterboard. Then tape loose ends together as shown below. Before continuing with the investigation, clean up your materials.



Name **Period** **Date**

Part C: Measuring Your Own Supraorbital Height

1. Work with a partner to make the following measurements using the measuring square you have constructed. Stand in profile to your partner so he or she is facing your right side. Place the unruled end of your measuring square on top of your head and have the ruler hang down in front of you as shown below.

2. Slide your finger along the top of the socket of one of your eyes. You will feel a v-shaped indentation near the nose. This is the highest point of the socket.

3. Keep your finger at the highest point of your eye socket while your partner measures in centimeters BC, the distance from the top of your eye socket to the highest point of your skull. Be sure the measuring square is held straight across the top of your head as the measurement is made.

4. Subtract 2 cm from the measurement of BC, adjusting for the width of the horizontal bar on your head. Record the adjusted value of BC in Table 1.

5. Locate the lowest point on your eye socket with your finger. Using the same techniques as above, have your partner measure in centimeters the distance AC. Subtract 2 cm from the measurement of AC and record the adjusted value in Table 1.

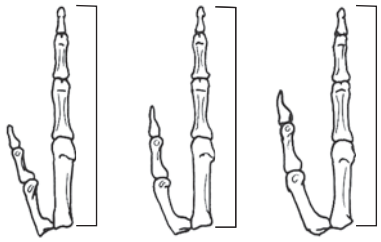
6. Calculate your supraorbital height index as you did in Part A. Record the result in Table 1. Note how your supraorbital height differs from the human index in Table 1.

7. Change places with your partner and measure the distances BC and AC on your partner's skull using his or her own measuring square. Do not use your measuring square.

Part D: Thumb Index

1. The thumb index compares the length of the thumb to the length of the hand. The illustration below shows the thumb and index fingers of a gorilla, *Australopithecus africanus,* and a modern human. Using a metric ruler, measure in centimeters the length of the thumb and index finger in each illustration from the tip of the finger to the base of the palm (the heel of the hand). Record the measurement in Table 1. Measure the length of your own thumb and index finger in the same way. Record these lengths in Table 1.

Name Period Date



Hand bones of (a) gorilla, (b) *Australopithecus africanus*, and (c) modern human

❷ Determine the thumb index for each by multiplying the length of the thumb by 100 and dividing the result by the length of the index finger. Round off the answer to the nearest whole number. Record the thumb index in the data table.

Which of the primates that you measured has the smallest thumb index? Which has the largest?

Observations

TABLE 1. INDEXES OF A GORILLA, FOSSIL HOMINID, AND HUMANS

		Gorilla	*Australo-pithecus*	Human	You
Supraorbital height	BC (in cm)				
	AC (in cm)				
	Index				
Thumb index	Thumb length (in cm)				
	Index finger length (cm)				
	Index				

Analyze and Conclude

1. **Infer** Why are the supraorbital height and thumb indexes important measurements in comparing primates?

Name Period Date

2. **Analyze** One unique human adaptation is the grip between the thumb and forefinger. Why are other primates incapable of holding objects in this manner?

3. **Conclude** Based on data regarding the supraorbital height and thumb indexes, which primate is more closely related to humans, the gorilla or *Australopithecus africanus*? Support your conclusions.

4. **Connect** Scientists explain that the great similarity between apes and humans is because of their common ancestry. If this explanation is correct, then there should be fossil forms with characteristics indeterminate to those of apes and humans. Do data from this lab support the explanation or refute it?

5. **Connect** The indexes you have measured are indicators of proportion, not absolute size. On occasion, measurements of brain size have been incorrectly assumed to indicate the superiority of one person to another. Explain why this assumption is incorrect.

6. **Connect** Although the indexes you have measured are indicators of proportion, relative proportions of an animal change during growth. Therefore, indexes taken from immature animals can be misleading. How can you explain differences between some of your classmates' supraorbital heights and that of the human skull on your data table?