



THE VISIBLE APE PROJECT

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Lesson Plan

Educator Introduction
Answer key
Student Worksheet

EDUCATOR GUIDE & ANSWER KEY

What can infant skeletons tell us about ape anatomy?

Active learning time: 15 to 20 minutes

Lesson introduction: Do you think you can be an anthropologist? Many anthropologists study the bones of primates. Bones change in shape and size as an animal grows from an infant into an adult. The skeleton of an infant will therefore look different from the skeleton of an adult. In this lesson, you will compare infant skeletons of three ape species to one another. You will then compare the skeletons of infants to skeletons of adults. Follow the instructions below and answer the questions to see if you can figure out how and why skeletons change during an animal's lifetime!

Learning objectives: The goal of this lesson is to have students explore the infant skeletons and compare them to one another, and to the available adult skeletons of the same species. The sizes and shapes of the bones in the infant skeletons are more similar to each other than they are different. As an ape grows, cartilage turns to bone. As the cartilaginous growth plates at the ends of bones develop, the bones articulate with each other at joints. Most differences that can be found among adult ape skeletons are not observed in the infants. This suggests that the way an animal lives as it grows up (diet, locomotion, habitat, etc.) has an influence on skeletal anatomy. Bones are shaped by the mechanical forces they endure during development. This exercise should foster a discussion about skeletal differences between infants and adults. An advanced discussion would include speculation about how bone responds to external influences, and how the adult skeleton reflects diet and locomotor behaviors.

Glossary definitions that will help you answer the questions below: Adult - Ape - Chimpanzee - Gorilla - Infant - Orangutan - Skeleton - Species - Three-Dimensional (3D) models

1. Open up the 3D models of the skeletons of three ape species (gorilla infant skeleton, chimpanzee infant skeleton, and orangutan infant skeleton) in their own browser tabs.
2. Explore the models by clicking around them. Rotate them, zoom in and zoom out.
3. How are the skeletons of all three specimens **similar** to one another? **List at least two similarities.**

Students will likely list one or more of the following answers:

- All of their bones look small
- All of the skeletons are the same color
- They all have bones that aren't connected to one another
- They all have cracks/gaps in their head/skulls
- They all have their mouths open
- Their hands and feet are in fists/fingers and toes are curled
- Their bones are very rounded/smoothed
- Other descriptions of differences in the sizes and shapes of specific bones

Best answer will incorporate at least two of the potential responses above, especially answers that acknowledge the fontanelles and that many infant bones are not yet connected to one another at joints.

More information on fontanelles: The "cracks" or gaps in the crania of the infant skeletons are fontanelles, which is a soft spot of connective tissue found in the gaps in between the cranial bones of an infant. Soft tissues are not visualized on the 3D models that result from CT scans, so they look like empty holes. Fontanelles allow for the postnatal growth of the brain, as the brain grows more rapidly than the surrounding bone does. In apes, fontanelles close sooner than in humans, since ape brains grow less than human brains do after birth.

4. Why might these **similarities** exist between gorilla, chimpanzee, and orangutan infants?

Students will likely provide one or more of the following answers:

- They are all babies and babies often look the same
- They are all apes/primates so their skeletons will be similar
- Ape species are closely related to one another so their skeletons will look similar

Best answer:

- Ape species are closely related to one another so their skeletons will look similar

5. How are the skeletons of all three specimens **different** from one another? **List at least two differences.**

Students will likely provide one or more of the following answers:

- The chimpanzee pelvis/hipbones are the most narrow while those in the gorilla are a bit wider
- Their ribcages have slightly different shapes
- The cracks/gaps/fontanelles in the crania of each specimen are different sizes
- The sacral vertebrae in the gorilla and orangutan infant skeletons are fused; etc.
- Other descriptions of differences in the sizes and shapes of specific bones

Best answer will incorporate any one of the potential responses above.

6. Why might these **differences** exist between gorilla, chimpanzee, and orangutan infants?

Students will likely provide one or more of the following answers:

- The specimens could be from individuals of slightly different infant ages
- They are different species so they are going to have different skeletons
- They are different individuals and don't have the same parents so they will look different

Best answer:

- They are different species so they are going to have different skeletons

7. In two new tabs, open up the 3D models of the gorilla adult skeleton and chimpanzee adult skeleton. There is not an adult orangutan skeleton available yet to share on the website.

8. Explore the models by clicking around them. Rotate them, zoom in and zoom out.

9. Can you find any **similarities** between the infant skeletons of each species and the adult skeletons of each species? **If so, list them.**

Students will likely provide one or more of the following answers:

- Infant skeletons/specific bones in the skeleton have a similar overall shape to the adult skeletons
- They are all made of bone
- All of the bones are the same colors
- They all have their mouths open
- Other descriptions of similarities in the sizes and shapes of specific bones

Best answer:

- Infant skeletons/specific bones in the skeleton have a similar overall shape to the adult skeletons

10. **Why** might the infant skeletons be **similar** to the adult skeletons of the same species?

Students will likely provide one or more of the following answers:

- Infants grow up to be adults so their skeletons are going to be similar.
- They are all apes/primates so their skeletons are similar.
- Other descriptions of changes in the sizes and shapes of specific bones

Best answer:

- Something along the lines of: Infants grow up to be adults so their skeletons are going to be similar.

11. Can you find any **differences** between the infant skeletons of each species and the adult skeletons of each species? If so, list them.

Students will likely provide one or more of the following answers:

- Adult bones are bigger/longer than infant bones
- Bones in the adult skeleton are all connected to each other
- Other descriptions of similarities in sizes and shapes of specific bones.

Best answer will incorporate any one of the potential responses above.

12. **Why** might the infant skeletons be **different** from the adult skeletons of the same species?

Students will likely provide one or more of the following answers:

- Bones change in size/shape/length over time as you grow up
- Adult skeletons reflect what an animal eats and how an animal moves during its lifetime
- They are different individuals so their skeletons are going to look different, etc.

Best answer:

- Adult skeletons reflect what an animal eats and how an animal moves during its lifetime

13. There isn't an adult orangutan available to compare to the orangutan infant. Reflect on the similarities and differences you observed between the gorilla infant & adult, and the chimpanzee infant & adult. **What would you predict an orangutan adult skeleton to look like?**

Students will likely provide one or more of the following answers:

- Limbs will get longer
- The body will be bigger
- The adult would have teeth
- The bones in the adult would all be connected together
- It would look similar to an adult chimpanzee or adult gorilla
- Other descriptions of changes in the sizes and shapes of specific bones

Best answer will incorporate at least two of the potential responses above, especially an answer acknowledging that in adult skeletons, bones are fused and connect with each other at joints.

Further reading for interested students and educators:

1. <https://carta.anthropogeny.org/moca/topics/age-fontanelles-cranial-sutures-closure>
2. <https://carta.anthropogeny.org/moca/topics/age-pelvic-bone-fusion>
3. <https://courses.lumenlearning.com/boundless-ap/chapter/development-of-the-skeleton/>
4. https://www.eva.mpg.de/documents/Wiley-Blackwell/Zihlman_Skeletal_JZool_2007_155_4778.pdf

WORKSHEET

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7. In two new tabs, open up the 3D models of the gorilla adult skeleton and chimpanzee adult skeleton. There is not an adult orangutan skeleton available yet to share on the website.
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All done? Check your answers with the answer key.