MUSEUM OF THE ROCKIES

touch history

Ontogeny: Studying Growth and Development Using Growth Series

Created by Molly Ward, MOR Paleontology Educator and Technology Coordinator

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Grade Level: K-12 (specifically K-5)
Preparation Time: 5 minutes
Activity Duration: TBD

Background

One of the ways paleontologists can learn about dinosaurs is to study different ways dinosaurs changed as they grew. To do this, paleontologists have to create growth series of dinosaur fossils. For example, at the Museum of the Rockies, paleontologists have created a *Triceratops* skull growth series. They have taken all of the *Triceratops* skull fossils in the Museum's collection and lined them up in order from smallest to largest (presumably youngest to oldest). They then observe changes that happen to the animal's skull as it gets bigger and older.

To better understand what a growth series is and the type of information that can be gleaned from a growth series, this lesson starts out with an introduction to what a growth series is with individual human examples (*Part 1: What is a Growth Series*), followed by *Part 2: Human Growth Series* which looks at examples of several different humans at different growth stages (more like a dinosaur fossil growth series), and finally *Part 3: Dinosaur Growth Series* examines the actual *Triceratops* skull growth series from the Museum of the Rockies. Educators can choose which part of the lesson to begin with based on their students' background in the subject.

Vocabulary

- Growth series
- Ontogeny
- Ontogenetic series

Part 1: What is a Growth Series?

Concepts Addressed

- A growth series is a collection of specimens from the same kind of organism at different growth stages (or different ages).
- A growth series can provide evidence of how an organism changes as it matures.
- By comparing similarities and differences in observations of an organism at different stages of growth, it is possible to recognize trends and patterns in growth.

Objectives

The student will:

- Observe an example of a human growth series.
- Become familiar with the concept of a growth series.
- Identify trends and changes in human growth over time using a growth series.

Materials

- Individual Human Growth Series (1-5)—printed (and potentially laminated) or onscreen via PowerPoint or online

Procedure

Set-up

1. Prepare Individual Human Growth Series (1-5) (either print or display onscreen)

Activity

1. Discuss the idea of a growth series with your students.
    a. A growth series documents different growth stages (or ages) of an organism.
    b. For this activity, each growth series documents the different growth stages (or ages) of an individual.
    c. For this activity, each growth stage is represented by a photo of the individual at each growth stage (or age).
2. Discuss the idea that some human features can be changed externally, while others truly represent growth.
    a. For example, because we can cut, color and change our hair, it is not an accurate measure of change in this type of growth series.
    b. Skull shape is something that changes naturally, and can be observed to describe trends and changes in growth.
3. Display or give your students Individual Human Growth Series 1. *(Variation: Class could be divided into 5 groups at this point and each group could focus on one of the Individual Human Growth Series (1-5), discussing trends as a group when observation period is over)*.
4. Instruct students to observe the first two photos and make observations about the differences in physical features between the first photo of the child and the second photo of the child (*for example, the skull is less round in the second photo than the first, the mouth appears wider in the second photo*).
5. Repeat comparisons of physical characteristics between the second and third photos (growth stages). *Observations might include: the ears appear longer in the third photo than the second; the hair appears thicker in the third photo than the second).*
6. Repeat this observation process for each set of two photos (3 and 4, 4 and 5, etc.).
7. Discuss with the class trends in changes that occur over the entire growth series. *For example, the girl's head (skull) gets larger as she gets older, or, the girl's face gets longer and thinner as she gets older.* Make notes on the board, or have students keep notes about these trends.
8. Display or give your students Individual Human Growth Series 2.

9. Instruct students to observe this growth series in a similar manner to Individual Human Growth Series 1. Are the same trends evident here? Are there any new trend observations?

Extension

- With an advanced or older group of students, discuss the possible implications of the trends observed.

Part 2: Human Growth Series

Concepts Addressed

- A growth series can provide evidence of how an organism changes as it matures.
- By comparing similarities and differences in observations of an organism at different stages of growth, it is possible to recognize trends and patterns in growth.
- A dinosaur growth series is comprised of fossils from different individual dinosaurs that died at different stages of growth.

Objectives

The student will:

- Observe an example of a human growth series.
- Become familiar with the concept of a growth series.
- Identify trends and changes in human growth over time using a growth series.

Materials

- Human Growth Series with Five Individuals at Different Growth Stages-- printed (and potentially laminated) or onscreen via PowerPoint or online

Background

Growth series are important tools for helping scientists learn about how an organism changes as it grows. By using a camera, we can create a photo growth series for an individual human and learn about how they changed as they grew. However, if we were to create a human growth series using human skulls, we would have to use skulls from several individuals from different growth stages, because the characteristics of the human at the growth stage it was in when it died are recorded in its skull, but each person only dies once so we can't create growth series from one individual. This part of the activity gives students the opportunity to examine changes in humans throughout different growth stages using photos of several different humans at different ages.

Procedure

Set-up

1. Prepare Human Growth Series with Five Individuals at Different Growth Stages (either print or display onscreen)

Activity

1. Ensure that students are comfortable with the concepts addressed in the *What is a Growth Series?* activity.
2. Lead a class discussion about growth series.
    a. Review the idea that the Individual Human Growth Series from the prior activity show changes in a single individual over several years.
    b. Discuss as a class the idea that a *physical* (bone) growth series must come from more than one individual, such as with dinosaur fossils.
    c. Point out that to demonstrate a similar growth series in humans, we will be using photos of several individuals at different growth stages rather than skulls.
3. Now show the class the Human Growth Series with Five Individuals at Different Growth Stages.
4. Have the students observe this growth series and record observations of changes between each growth stage. Were students able to find evidence of the same kinds of trends that they found in the previous activity?

Part 3: Dinosaur Growth Series

Concepts Addressed

- A growth series can provide evidence of how an organism changes as it matures.
- By comparing similarities and differences in observations of an organism at different stages of growth, it is possible to recognize trends and patterns in growth.
- A dinosaur growth series is comprised of fossils from different individual dinosaurs that died at different stages of growth.

Objectives

The student will:

- Observe an example of a dinosaur growth series.
- Become familiar with the concept of a dinosaur growth series.
- Identify trends and changes in dinosaur growth over time using a growth series.

Materials

- Museum of the Rockies *Triceratops* Growth Series (photos)-- printed (and potentially laminated) or onscreen via PowerPoint or online

Background

Paleontologists cannot predict what dinosaur bones they will find, but they are excited to find as many skeletal parts as possible from the same kind of dinosaur (especially bones from the same part of the body, such as skulls). When this occurs, paleontologists can create an ontogenetic or growth series and can observe and describe trends in the animals growth and development. Paleontologists use these observations to infer dinosaur behavior.

Procedure

Set-up

1. Prepare Museum of the Rockies *Triceratops* Growth Series (either print or display onscreen)

Activity

1. Ensure that students are comfortable with the concepts addressed in Parts 1 and 2 of this activity.
2. Lead a class discussion about growth series.
    a. Discuss as a class the idea that a *physical* (bone) growth series must come from more than one individual.
3. Now show the class the Museum of the Rockies *Triceratops* Growth Series.
4. Have the students observe this growth series and record observations of changes between each growth stage. *For example, the horns of the Triceratops are longer/larger in the second photo than the first, or, the snout of the Triceratops is longer in the second photo than the first.*
5. As a group, summarize and discuss the trends seen in *Triceratops* throughout its growth. Some of the major trends students should identify include:
    a. The skull of the *Triceratops* got larger as it grew.
    b. The brow horns of the *Triceratops* got longer and larger as it grew.
    c. The brow horns of the *Triceratops* curve backward during its first several growth stages, and then began to curve forward as it got older.
    d. The triangular bones around the edge of the *Triceratops'* frill were not observed on the youngest growth stage, were very sharp on the next few growth stages and then appeared to be more and more rounded as the dinosaur got older.
    e. The frill of the *Triceratops* got longer and broader as it grew.

Assessment

- Provide each student with a printed copy of the Triceratops Growth Series.
- Instruct students to create a concept sketch describing changes they observe between stages on the growth series and to quantify trends they observe throughout the entire life span of the animal.

Extension

- Challenge your students to interpret the trends they have identified—what might *Triceratops* have used its horns for based on the trends seen? What about its frill?