



UF College of Education  
UNIVERSITY of FLORIDA

FLORIDA  
MUSEUM

Engaging K-12 Students in  
Integrated STEM via  
3D Digitization, 3D Printing  
and Paleontology



## **AUTHOR (S)**

Shawn McCarty @ Hoover Elementary School - Stockton Unified School District, CA

## **LESSON TITLE**

Titanoboa: Giant Snake From Earth's Past

## **GRADE LEVEL**

5th-6th Grades

## **TIME FRAME**

Four ninety-minute lessons with enrichment art homework.

## **DRIVING QUESTIONS**

What Similarities/Differences are there between ancient Titanoboa & modern Anaconda?

## **LEARNING GOALS**

Learning goals are for students to inspect, sort, and analyze different 3D printed snake fossils. Students will be able to understand anatomical similarities and differences between the two sets of bones, from Titanoboa and modern anacondas. They will be able to explain and give scientific explanations to real-world phenomena as well as present cause-and-effect relationships with ancient ecosystems compared to present day.

## ANCHORING EVENT

Have students to work in groups and sort the 3D printed Titanoboa and Anaconda vertebrae and rib bones by any characteristics they notice. These would be best to be printed in white filament. After they have finished, give them a hint, that there are two different species of animal bones in their set. Notice if students have changed their thinking or approach. Students will document their findings in a printed graphic organizer. Their goal is to successfully sort the Titanoboa fossils from the anaconda ones.

## COLLABORATIONS

Students will utilize our classroom's tables that seat four students each. Every table has a colored chair that will correspond to a particular group job. The group jobs include;

Red = Secretary, they will take notes and observations from the sorting anchoring event.

Blue = Artist, they will be drawing a model of one fossil from Titanoboa and one from Anaconda.

Yellow =Technology, they will be creating a brief multimedia presentation of their findings.

Green = Activity Captain, they will organize materials and help all group members stay on task, and speak to the class when presenting as a group.

Once students have collaborated with their own tables, students will share and present their multimedia presentations, then they will present to our fellow 5th and 6th grade classrooms next door. Effective 5th-grade collaborators will post at least two supportive comments on each group's threaded post. Students presented their posters on the wall outside of our classroom. Students from other classrooms can walk by and see them outside of the room, without disrupting your class.

## STEM INTEGRATION

Describe the science, math, engineering, and technology knowledge and skills this activity helps develop.

**Science:** Students will be interacting with 3D printed snake fossils to compare/contrast evolutionary traits.

**Technology:** Students will be helping to print 3D fossils to be used on our life-size Titanoboa 3D printed bulletin board. Students will collaborate and work with their colored 'jobs' classmates, and will help print bones in the color filament that matches their colored jobs.

**Engineering:** Students will use TinkerCad to include their individual name on one of the fossils that we will be using for the bulletin board. At the end of the unit/lesson, students will get to take their named fossil home as a keepsake.

**Math:** Students will be measuring 48 feet around a single bulletin board, and spacing our fossils in equal distances apart. We will also work on converting units from yards, feet, inches, etc.

## ASSESSMENT

Another post will include an embedded link to their individual Titanoboa 3D fossil that that they have manipulated in Meshmaker and now contains their individual name to be printed into their fossil (and

will be taken home after the Unit). IF STUDENTS ARE UNABLE TO UPLOAD/DOWNLOAD THEIR FILES BECAUSE OF THE SIZE, SIMPLY PRINT THE SAME VERTEBRAE FOR ALL STUDENTS BUT LET THEM SELECT THE COLOR OR TEXTURE OF THE FILAMENT. Finally, students will complete a summative assessment that I will link using Google Forms, that assesses their understanding of anatomical similarities between the snake species. Between the formative and summative assessments above, students will have successfully incorporated all three dimensions of learning from the standard taught.

Pre Assessment:

<https://goo.gl/forms/RTCBE2jnm6wLvTDX2>

Post Assessment:

<https://goo.gl/forms/RmRCTUTpqvRWCPH3>

## PROCEDURE

In 5th-grade we will be having year-long discussions on evolution of animals and characteristics that have changed over time. We discuss the environmental changes that might cause animals to have to change to survive, e.g. giraffes' long necks, reptiles to breathe air, etc.

My students would not have prior knowledge on what specific fossil functions are, but they will be able to compare and contrast similarities, some might require further research on Chromebooks.

Day/Lesson 1:

### **Engagement: Anchoring Event:**

Students will complete the anchoring event listed above with the four people that are sitting with them at their tables. Note: The same students who are working together on Day/Lesson 1, will need to work in the same group for days/lessons 2 and 3 as well. (20 minutes)

Students will then record their final Similarities and Differences on a Venn Diagram, that will be posted into the class' Google Classroom. This Venn Diagram:

([https://drive.google.com/file/d/1BGI0hEEfH\\_TZ6kp4vU83P9amxo4zDbOO/view?usp=sharing](https://drive.google.com/file/d/1BGI0hEEfH_TZ6kp4vU83P9amxo4zDbOO/view?usp=sharing))

will be used, and the original file(s) should be downloaded from here:

(<https://www.teacherspayteachers.com/Product/Venn-Diagram-Blank-FREEBIE-1862924>) will help students to record their data and take notes from their group collaborations. (20 minutes)

Name: \_\_\_\_\_ Date: \_\_\_\_\_

This Venn Diagram helps me to compare and contrast  
 \_\_\_\_\_ & \_\_\_\_\_

Both

© 2017 Love Believe Teach

**Explore:**

As a class we will then debrief on what the students learned, how they sorted their fossils, and what they wrote down after group and whole class discussions. (15 minutes)

We will use what we noticed, inferred, and discussed about the vertebrae, and explore as a class the new App that Mr. Aaron Wood created, at [https://wood-idigfossils.shinyapps.io/snake\\_length/](https://wood-idigfossils.shinyapps.io/snake_length/)

Students will watch, Titanoboa: A Monster Snake - Teaser  
<https://www.youtube.com/watch?v=SI14qp4KvGo> (3 minutes)

Students will then discuss with their Tablemates their thoughts, 'Ahh Ha's, and remaining questions about the video. (5 minutes)

They will now work with their tablemates to select AND write down 20 unique facts that they have found during internet exploration time. Each student in the group should find five facts, then discuss/inform their group members to make sure that no one has already selected their research

fact. Students will record their facts on the following document that will also be posted into our Google Classroom. The link for that graphic organizer is here: <http://freeology.com/wp-content/files/blank4column.pdf> (27 minutes)

**Title:**



**Day 2:**

**Explain**

First, we will briefly review what we learned from the Day/Lesson 1 activities, especially if any students were absent during that time. (10 minutes).

Students will have five minutes to ‘skim’ through the three websites. They will decide as a group which one they would like to explore together, then explain to the class by creating a poster presentation. (5 minutes)

1. <https://www.floridamuseum.ufl.edu/science/at-45-feet-long-titanoboa-snake-ruled-the-amazon/>
2. <http://www.scholastic.com/browse/article.jsp?id=3757615>

Collaborating with their group, they will now create a 4-page poster from their research. The teacher will hand out one large piece of white construction paper to EACH student in the class. The students are to design a collaborative poster where their final product will be the four posters taped together

to make one large group poster. They will need to plan where everything will go, who is doing what, explaining what, and what pictures will get drawn. Students will use this rubric to guide their collaborative group posters ([https://drive.google.com/file/d/1doYK4CNxlqNDc1-gLYQbGpzFmUUf\\_OZ2/view?usp=sharing](https://drive.google.com/file/d/1doYK4CNxlqNDc1-gLYQbGpzFmUUf_OZ2/view?usp=sharing)) (45 minutes)

**Making A Collage : Titanoboa**

Teacher Name: **Mr. McCarty**

Student Name: \_\_\_\_\_

CATEGORY	4	3	2	1
<b>Collaborative Pieces</b>	The poster includes 4 pieces, each different, and created by the students in your group.	The poster includes 3 pieces, each different, and created by the students in your group.	The poster includes 2 pieces, each different, and created by the students in your group.	The poster includes 1 or no pieces, each different, and created by the students in your group.
<b>Design</b>	The poster contains 20 facts about Titanoboa in a creative, artistic, and easy to read manner.	The poster contains at least 15 facts about Titanoboa in a creative, artistic manner, some of the writing may be hard to read.	The poster contains at least 10 facts about Titanoboa but might have some incorrect data, sloppy, or was not assembled together correctly. Low effort.	The poster contains less than 10 facts about Titanoboa and had difficulties with creativity, collaboration, and workmanship. Not 5th-6th grade effort.
<b>Time and Effort</b>	Class time was used wisely. Much time and effort went into the planning and design of the poster. It is clear the student worked at home as well as at school.	Class time was used wisely. Student could have put in more time and effort at home.	Class time was not always used wisely, but student did do some additional work at home.	Class time was not used wisely and the student put in no additional effort.

The teacher will be available for assistance for small group instruction, or reviewing the article that the group has decided to research. Students will be taking their individual posters home today at the end of the lesson for completion. Review the rubric from above with the class prior to ending Day 2 (30 minutes).

**Day 3**

**Extend/Elaborate:**

Students will start Day 3 with five brief minutes to assemble their individual posters (This was their art homework from the night before) to make one group poster with research from one of the three websites that they selected. (5 minutes)

Student groups will then present their final posters to the class. They can answer any follow-up questions from other classmates, or describe the work that each student contributed to. This is a great time to make sure students understand the environmental differences between Titanoboa and Anaconda (40 minutes).

The final two portions of this Titanoboa project will involve the students using computer assisted drafting (CAD) software, such as TinkerCad or MeshLab, to alter the Titanoboa vertebrae to include their initials or full name and then display their 3D printed creations and poster(s) on a classroom bulletin board. The CAD should take about 20 minutes, but may take more time depending on students' abilities. Advanced or early finishing students may walk around and help their neighbors if they finish early. (30 minutes) The template for the Titanoboa fossil was found here: [https://www.morphosource.org/Detail/SpecimenDetail/show/specimen\\_id/1838](https://www.morphosource.org/Detail/SpecimenDetail/show/specimen_id/1838) and teachers will need to register and then request (free) access to the file from Morphosource.

Once complete, the students will share their .STL file with the teacher to then be printed on the 3D printer. Some teachers might only be able to print a few each day, so the bulletin board might take a few weeks to fully create.

There is also the possibility here to add in math standards as well. Teachers can remind students that the Titanoboa was about 40-50 ft long. There is a lot that can be done in mathematics dealing with measurement and units. Converting from feet to yards, inches, centimeters, etc. can be beneficial for 5th-6th graders to review.

Once their vertebrae are printed (10 or so a week for a month long bulletin board), the vertebrae can be taped or velcroed to the wall. The idea is to place a vertebra a certain distance apart, say one foot each, along the perimeter of the bulletin board, as a border. Each time they go around the board, have the fossils go inwards towards the middle. The final product, depending on the size of the bulletin board, may have one, two, or even three 'rows' all the way around of multicolored Titanoboa vertebrae. (15 minutes)

**Evaluate (and Reflect):**

**Day 4**

Students will evaluate the lesson plan through authentic reflections on Google Sites and an digital assessment on Google Forms. They will use their knowledge gained to document their progress throughout the three day lesson. We will demonstrate how to quickly create a Google Site, and then each group will be responsible for creating sections and titles that we can then share their site with our other 5th-grade classroom and even the school as a whole. (45 minutes)

**STANDARDS**

**NEXT GENERATION SCIENCE STANDARDS (NGSS)**

Students will be able to correctly explain that energy in animals' food, was once energy from the sun (5-PS3-1). <http://www.nextgenscience.org/pe/5-ps3-1-energy>

Science Practices	Connection to the Lesson
Using models to express ideas and data.	Students will learn while using graphic organizers in several of the lessons.
Disciplinary Core Ideas	Connection to the Lesson

<b>Organization for matter and energy flow in organisms</b>	This will connect the fact that snakes get their own energy from prey, who got their energy from the sun.
<b>Crosscutting Concepts</b>	<b>Connection to the Lesson</b>
<b>Energy and Matter</b>	Energy can be transferred in various ways and between objects.

### CCSS STANDARDS

List relevant CCSS state standards for the intended grade level for math and/or language arts.

[5.NBT.1.a](#)

[ELA-Literacy.RI.5.3](#)

### OTHER STANDARDS

(optional – examples are ISTE standards, 21<sup>st</sup> century skills and 4C's etc.)

### 21st century skills:

3. Information, Media and Technology Skills

## RESOURCES & MATERIALS

<https://www.smithsonianchannel.com/shows/titanoboa-monster-snake/0/140671>

<https://m.youtube.com/watch?v=KF8gVABzIdI>

<https://www.teacherspayteachers.com/Browse/Search:Titanoboa>

<http://idahoptv.org/sciencetrek/topics/snakes/teachers.cfm>

[https://wood-idigfossils.shinyapps.io/snake\\_length/](https://wood-idigfossils.shinyapps.io/snake_length/) by Aaron Wood

## KEY ACADEMIC AND/OR SCIENTIFIC LANGUAGE

List the terms used in the lesson and definitions (e.g., deep time, brachiopod etc.).

Some of the many paleontology glossaries:

<http://palaeos.com/paleontology/glossary.html>

<http://www.fossilmall.com/Science/Glossary.htm>

Titanoboa

Paleocene

Constrictor

Humidity

Temperature



## **PRIOR KNOWLEDGE**

Students should know that snakes are reptiles. They should understand the differences of being warm blooded and cold blooded. The food chain, or food web connections will be expanded to include prehistoric connections. Students should understand what vertebrate and invertebrate animals are.