

BASIS Lesson Plan

Lesson Name:

Prehistoric Puzzles: Understanding the formation of fossils

Grade Level Connection(s)

NGSS Standards: 3rd grade - Fossils provide evidence of past life

FOSS CA Edition:

[CRS will identify standards connections & communicate with BASIS team about these]

**Note to teachers: Detailed standards connections can be found at the end of this lesson plan.*

Teaser/Overview

Advertise your lesson to teachers with a fun and interesting overview! In 2-3 sentences, what is your lesson about? (This will be sent to teachers when your lesson is advertised to them).

- *What are fossils and how do they form? There are different types of fossils and we can use them to learn things about the past. In this lesson your students will learn to tell stories about the past, and make a "fossil" of their own.*

Lesson Objectives

*What **meaningful scientific experiences** will students gain from your lesson? If possible, think about what questions students will be figuring out (as opposed to topics they will be "learning about"), and what scientific practices they will use to figure it out.*

- Students will create trace fossils to observe potential conditions under which fossils can form
- Students will explore the effects of different environments and sediment types on preservation in the fossil record
- Students will practice inferring information about past life based on fossil evidence

Vocabulary Words

- Fossil
- Sediment
- Paleontologist
- Body Fossil
- Trace Fossil
- Cast



Materials

Scientist Volunteers will bring:

What will you bring with you? (Include a detailed list so that interested teachers can use this lesson plan to teach the lesson on their own, too!)

- Diorama
 - Terrarium/tray (4)
 - Play-doh
 - Sand
 - Toy dinosaurs (quadrupedal herbivores and bipedal carnivores, 4 of each)
 - Laminated cards with story for making footprints (4)
- Fossil/cast specimens
 - Footprint cast
 - Carnivorous dinosaur tooth x2 (*Tyrannosaurus*)
 - Herbivorous dinosaur tooth x2 (*Camarasaurus*, *Corythosaurus*)
 - Carnivorous dinosaur claw x2 (*Saurophaganax*, *Allosaurus*)
 - Herbivorous dinosaur claw x2 (ungual, ornithopod foot)
- Tooth and Claw Worksheet (1 per student)

Materials teachers should provide:

What basic materials, if any, should students have ready when you arrive (pencils, paper, scissors, etc.)?

- Will need sink

Classroom Set-Up

Share anything the teacher should know about how the classroom should be set up prior to this lesson (this info is shared with the teachers in their confirmation email).

- Class will be split into two activities on each side of the classroom, with one further subdivided into 4 groups

Classroom Visit

1. Introduction (10 minutes)

Introduce that we're scientists from UC Berkeley – do the students know where that is? Also nice to explain that we're students, just like them! Science is all about asking questions and learning new things.

Role Model Introduction:

Every team member should take a moment to explain who they are and what they study/do as a

scientist. A bonus will be to tell your “story,” as if giving an elevator pitch to 8-year-olds: Why did you become a scientist? What made you interested in your topic? Why should students relate to you, or be interested in you?

Topic Introduction:

How many of you have heard of fossils? [pause for answers] Do you know what a fossil is? [pause for answers] A fossil is something left behind by past life, like a bone or a leaf impression or a footprint.

Fossils let us learn about what life was like a long time ago, before there were any people around to see it. In some ways things were really different then (there were strange animals like dinosaurs and woolly mammoth, different climate) and in other ways things were a lot like today (many animals and plants living today have similar ancestors that lived far in the past, ecosystems and food webs, non-living elements like the water cycle, sun and moon, seasons, mountains and oceans and rivers). By understanding what the past was like, we can get a better idea of how the Earth and the life on it got to be how it is today, and how it might keep changing in the future.

There are two types of fossils, **body fossils** and **trace fossils**. Body fossils are the remains of the actual plant or animal, like bones. [Show the students a cast of a fossil] Sometimes animals leave traces of their behavior that get turned into fossils, we call these trace fossils.

2. Learning Experience (40 minutes - ~18 min for each activity, ~3 min changeover)

Describe the hands-on portion of the lesson. Now that you’ve introduced the topic, how will students go about exploring it? Make sure it’s clear WHY students are doing these activities, and how each activity connects to the question they’re trying to figure out.

Activity 1 – Trace Fossils:

Students split up into 4 groups (~3 students per group). Each group gets a toy carnivore and herbivore, a tray with either dry sand, slightly wet sand, very wet mucky sand, or play-doh (analog for mud). Introduce the word “sediment”: it’s things like mud, sand, dirt, clay, etc. that preserve the fossils we find. Before the groups start the activity, point out the 4 different kinds of sediments they have. Ask the class: which kind of *sediment* will be best for making footprints?

Each of the groups also receives a laminated card with instructions to act out a “story” with their dinosaurs. Unbeknownst to the students, all 4 cards have the same instructions. We help the students make footprints with their dinosaurs by making up a story (predation, feeding, migration, etc). Try and make sure the students move the dinosaurs through the substrate in a feasible manner--so no flying or teleporting, quadrupedal dinos should stay on 4 feet). **Have the students practice on the table before acting out the story in sediment.**

Once the footprints are made, have the groups switch places to see the other dioramas (around 4 minutes per station). Try to make sure students don’t disturb the sediment they’re looking at—simply observe. You can point out that millions of years have passed, so they should imagine that the sand or play-doh is now stone. Ask each group what they think happened to form the footprints in the diorama they moved to--how many dinosaurs were there, and what kind (how many toes do their feet have, how many legs do they stand on, how do those things compare to your dinos?) Once members of each group have written down their ideas, the groups can convene to describe how they made their footprints—all the same way! Ask the students which kind of ground made for the best prints. How did water affect the sand’s ability to make prints?

Potential questions:

- Which kind of sediment made the best footprints?

- Play doh, then wet sand, then dry sand or muck
 - Importance of water for making sediment “squishy”—but just the right amount
 - Importance of grain size: play doh preserves more detail because it’s not made up of relatively large chunks like the sand.
- What information could you get from the footprints? How could you tell?
 - Need to know what dino feet looked like, how many legs each kind walks on
 - Another important thing is thinking about how the footprints are made (in pairs, make trails)

Activity 2 – Body Fossils:

In this activity, students will move between two stations, one containing fossils of dinosaur claws and the other containing fossils of dinosaur teeth. At each station, students will try to determine which specimen belongs to which type of dinosaur. Students will have to think about how animals’ bodies are adapted for different lifestyles, and how that allows us to interpret the lifestyles of dinosaurs. What traits do carnivore teeth and claws have, versus the traits that herbivore teeth and claws have? Before starting, explain that the fossils we’re handing around are *casts*, rather than the original fossils taken from the ground. Briefly explain how casts are near-perfect replicas of the original specimens, and are useful not just for teaching and display, but also for research! (maybe make the connection between artificial casts and the fact that many fossils themselves are natural casts or molds, like the footprints—so it’s not really fair to say they’re “fake”)

At each station, ask students what they would expect the teeth (or claws) of a carnivore to look like vs those of a herbivore, and why. Have students think of examples of modern-day carnivores and herbivores for comparison. Then show them the representative fossils and have them predict which belongs to a carnivore and which belongs to a herbivore. Show them the features of each fossil that paleontologists use to make their diagnosis. After students have looked at both teeth and claws, give out the worksheet and have them draw in the tooth shapes that they predict for *Allosaurus* and *Brachiosaurus*.

- *Allosaurus* should have sharp teeth, *Brachiosaurus* should have blunt or peg-shaped teeth.

3. Wrap Up: Review and Discuss the Learning Experience (5 minutes)

Briefly remind students what they did in the two stations. Ask a few wrap-up questions, especially if there wasn’t time at the end of the stations.

- What did you learn today?
- Have students share their drawings – what do teeth and claws look like in carnivores versus herbivores?
- What could you learn from footprints?
- Ask class which kind of sediment was the best for making footprints (does anyone remember what ‘sediment’ means?)

4. Connections & Close (5 minutes)

Connections to the real world around students:

Why should students care about the phenomenon they've been exploring? How does their exploration fit into the bigger picture of why scientists study it? What connections can students draw to their own lives? How can they learn more?

- In real life, paleontologists usually can't check their guesses (hypotheses)
 - But they can observe modern animals and study other remains (e.g. fossil bones) to see whether their ideas make sense
 - many different lines of evidence to try to understand how past animals lived
- Once a footprint is formed, how does it get preserved? Needs to dry, then be covered in sediment from a flood or something like that [potentially can bring in footprint casts from our lab to show an example of cast/mold]
 - Emphasize that the sediment turns into rock if it's buried under lots of other sediments for a long, long time, so paleontologists find trace fossils in hard rock
- What other kinds of fossils might form in this way besides footprints?

Close:

Wrap up as a role model by leaving a few minutes for students to ask questions about science, about being a scientist, and about becoming a scientist.

Follow Up: After the Presentation

Teachers who wish to extend the impact of this lesson may find the following CRS web pages useful:

- <http://www.crscience.org/educators/helpfulreports>
- <http://www.crscience.org/educators/treasuretrove>

Standards Connections

[CRS will identify standards connections & discuss them with your BASIS team]