Dinosaur Family Tree

3rd - 5th Grade
NGSS: 3-LS3-1

Background

Lesson Description

Students examine dinosaur forms to identify similarities and differences in their features. Students construct a system of classification based on their observations and then revise that system with a small group of their peers. Finally students test their classification system with additional dinosaurs.

Driving Phenomenon

There are so many living things that now live or once lived on the Earth, and new organisms are being discovered all of the time. Currently scientists know of over 1.5 million species of organisms living on the Earth, and new species are discovered every day. Scientists who study organisms that once lived on Earth but are no longer living estimate that over 99% of species that ever lived have gone extinct. In order to study the extant (still living) as well as the extinct (no longer living) organisms on Earth, biologists need a common language to talk about all of these things and how they are related to one another. Biologists have developed a system for how to organize and keep track of all living things.

Dinosaurs are a group of organisms that lived on Earth between 230-66 million years ago. Compared to humans' existence on Earth, this is a very long time. During their time on Earth, dinosaurs spread across all areas of land, and evolved into many different forms. To organize this clade, or related group of organisms, is a challenge that scientists must reevaluate with each new fossil discovery. **When new dinosaurs were discovered on Antarctica, how did scientists determine that they were in fact dinosaurs and which dinosaurs they were most closely related to?**

Driving Questions

- How are dinosaurs related?

Learning Objectives

- Students will demonstrate an understanding of Students will show an understanding of classification and organization techniques when they analyze a set of dinosaur body forms to recognize patterns and differences.
- Students will demonstrate a knowledge of organization by incorporating the data into a graphical display that illustrates the patterns and differences identified.
- Students will deepen their understanding by reviewing and refining the organizational system by incorporating input from peers and additional organisms.

Time Requirements

- Three 60 minutes work sessions

Prerequisite Knowledge

- Living things are found in many different forms and this range of variation is called diversity of life.
- Some organisms that once lived on Earth are no longer living.

Student Resources

1. Strategies for Grouping and Organizing Objects
2. Dinosaur Cards
3. Strategies for Classifying and Organizing Dinosaurs
4. Presentation of Ideas
5. Traits Graphic Organizer
6. New Dinosaur Discoveries
7. Affinity Map Rubric

How are Dinosaurs related?

Full lesson procedures begin on the next page

Engage | 20 minutes	
Practice classification by looking for patterns of similarities and differences in objects. Watch a video where biologists discuss how they would classify candy.	Notes
Student Resource 1.0 and/or Brain Scoop Video	
Explore | 40 minutes	
Students work individually to organize and classify dinosaurs by their anatomically features by creating affinity maps with dinosaur cards.	Notes
Student Resource 2.0 and 3.0	
Explain | 50 minutes	
Students present their affinity maps to a small group of their peers and work together to make a consensus map for their group.	Notes
Student Resource 4.0 and 5.0	
Elaborate | 30 minutes	
Students utilize their organizational structure to classify three new dinosaur discoveries.	Notes
Student Resource 6.0	
Evaluate | 25 minutes	
Students share and evaluate the group affinity maps using the rubric provided.	Notes
Student Resource 7.0	

Pre-lesson Preparation and Enrichment

Materials

- A collection of buttons, craft supplies, or other types of materials that can be categorized and organized.
- Copies of the Student Resources (1 per student)

Notes

Lesson Enrichment Ideas

DO

Plan a trip to explore the history of life on Earth in the Griffin Halls of Evolving Planet, and see fossil specimens from all over the world up close at the Field Museum in Chicago.

Rent real specimens, and bring them to your classroom. If you live in the Chicago area, the *N. W. Harris Learning Collection* at the Field Museum offers numerous specimens that can be rented for study in the classroom.

- Paleontology Practice
- Dinosaurs in the Jurassic
- Dinosaurs in the Cretaceous

READ

Day of the Dinosaurs
by Dr. Steve Brusatte and Daniel Chestert
Admittedly, this book includes many Dino-NOTS! However, it full of examples explaining and illustrating dinosaurs' most essential body features in an way appropriate for 3rd through 5th grade students.
http://worldcat.org/oclc/935196639

Boy Were We Wrong About Dinosaurs
by Kathleen Kudlinski
An engaging introduction to the nature of science through the lens of dinosaur discoveries.
http://worldcat.org/oclc/221152330

WATCH

Apatosaurus: Wrong Name
Learn how even scientists can encounter challenges and have to revise their thinking throughout the course of studying how to classify and name species.
https://vimeo.com/203208318

Brain Scoop Episode: The Taxonomy of Candy
This video introduces what scientists think about the process of classification.
https://youtu.be/-tdVPiyVDsQ

How are Dinosaurs related?

Engage

1 Introduce the idea of classifying objects by giving each student an opportunity to sort a group small objects like old buttons, different varieties of candy, or a mixture of craft supplies (for example - pom-poms, feathers, and stickers) at their desk. If this activity is not a good fit for your classroom environment consider starting the lesson with the Brain Scoop video in the alternate activity.

2 Provide each student 15-20 of the small objects, and allow time for them to sort the objects into groups.

3 Next have students think-pair-share about the exercise and compare the grouping strategies that they used.

4 As a follow up to the organization activity or video, work with the students to build an affinity map of living things. An affinity map is a way of organizing and grouping a collection of ideas quickly. Items or ideas are evaluated rather quickly and like things are grouped together.

5 First pass out two cards or sticky notes to each student.

6 Have them write the name of a specific (for example - not just tree but Oak tree) living thing that they know well on each card, legibly with a marker.

7 Collect the cards and put them up, or have the students put them up on a board where everyone can see them. Combine any duplicates.

8 Take a moment here to notice with the students how many living things that you were able to brainstorm in just a few minutes. Highlight that there are over 1 million species of organisms that scientists have described on Earth that need to be organized.

9 Allow the students to organize all of the living things on the board. If necessary, engage students with the prompts below.

10 Can we break this big mass of living organisms into groupings of similar things?

Alternative to Activity

Engage | Steps 1-3

If you are unable to gather materials for the sorting activity, watch the Taxonomy of Candy episode of the Brain Scoop hosted by the Field Museum's Chief Curiosity Correspondent, Emily Graslie available at https://www.fieldmuseum.org/blog/taxonomy-candy

In the Student Resource

Engage | Step 3

- Describe your groupings to your partner, and listen to the types of groupings that they made.
- What was the first thing you did to sort the objects?
- Did any objects stand out from the others? What did you do with those?
- How did your grouping differ from your partner's groupings? What similar choices did you make?

11 Start with a binary trait like mobile / non-mobile or symmetrical / asymmetrical. Encourage the students to offer up an idea of how to categorize, or have them say whether or not each organism has or doesn't have the trait.

12 Now choose one of the two groups and do that same process again to create smaller categories.

13 Finally, ask the students how they can use the skills that they just practiced to classify a different group of organisms that they are less familiar with like dinosaurs.

Explore

1 Each student receives Student Resource 2.0 which includes a set of 12 dinosaur cards. They will cut them apart and lay them out on their desk so they can see them all clearly.

2 Explain that one of the key ways that biologists classify organisms is to compare their body structures and shapes. This may be an opportunity to use an example from the group affinity map done in the previous activity.

3 Encourage the students to spend some time examining the cards and familiarizing themselves with the similarities and differences in the dinosaurs. The only information on the cards are illustrations of the dinosaurs and a scale that illustrates their size, so students will be making decisions based upon the external body features of the dinosaurs, only. They will not receive the name of the dinosaurs, so their interpretations will be based upon the illustrations in front of them, not their past experience or prior knowledge of dinosaurs.

4 As students examine the dinosaur cards, invite them to consider the questions in Student Resource 3.0 to help them identify patterns in the dinosaurs' body forms and features. Write the observations they share on the board to serve as a visual reminder of criteria that can be used to sort the dinosaurs.

5 Now invite the students to arrange and rearrange the dinosaurs on their desk into groups using similarities of features that they identified in the probes in the previous step.

In the Student Resource

Explore | Step 4

- What interesting, surprising, or unique features do you observe on the dinosaurs' bodies?
- What body features do all the dinosaurs have in common? (four limbs, tails, symmetrical bodies, legs straight under their bodies)
- What features only appear in just one or two of the dinosaurs? (armored plates, particular skull shapes, teeth and claw shapes or arrangements).
- What features allow you to see that some dinosaurs are more alike than other dinosaurs?
- Show how groupings can be further categorized.

6 Once they have organized the cards into groups, students will record their groupings as a hub/spoke map. See Student Resource 4.0 for an example and blank paper on which to create the map.
   - Each grouping will be represented as spokes of a common hub.
   - The student will write the description or common feature that unites all of dinosaurs in that group in a center oval, and then place the dinosaur cards for that group evenly around the outside of the circle.?

7 Once they have created a map that groups the dinosaurs logically, they can glue the cards to a backing sheet.

8 Finally they will draw spokes connecting each box to the central circles.

Explain

1. Assign students to groups of three to four. The groups will share their maps with each other and go through the process of creating a consensus model of the maps for the entire group.

2. Students will begin by presenting the map they created to their peers. The person to their right will complete the Student Resource 5.0: Traits Graphic Organizer recording their ideas as they present to create a group summary.

3. As each person presents their map they can use the questions in Student Resource 4.0 to organize their thoughts.

4. Sentence stems are provided in Student Resource 4.0 to support students as they explain why they made the choices that they did on their grouping maps/diagrams.

5. What is something you realized for the first time by creating the map?

6. Once each person in the group has presented their map, have students look at the Traits Graphic Organizer that was filled out during the presentations. Identify "Grouping Features" that the majority of people identified. These features will help students start to develop their group map.

7. Next, have students locate the "Differentiating Features" that correspond with the groups they created to further develop the detailed groupings on their map.

8. Instruct students to continue working together to build a group affinity map combining elements and ideas from members of the group to make a map on which they all agree.

In the Student Resource

Engage | Step 3

- What are the traits used to create the big groupings or main hubs of your map. Recorder: write those in the Grouping Features column.
- Which traits helped you differentiate the dinosaurs into small groups or individuals? Recorder: place this in the Differentiating Features column.
- Which traits seemed to be present in all of the dinosaurs? Recorder: write this in the Common Features column.
- What evidence did you find on the dinosaur cards that led you to categorize them in this way?

Elaborate

1. Now that the students have created group maps, have them test the organizational structure that they have developed by trying to incorporate newly discovered dinosaurs.

2. Provide each group with three "newly discovered" dinosaurs.

3. First they should observe whether or not these new organisms have the common features that they previously identified.

4. If they do, they will find a place in their maps to sort these new dinosaurs.

5. Make final adjustments and revisions to the group maps to prepare it for presentation to the full class.

Evaluate

1. Two members of each group present their group map to the class.

2. Present students with the following guidelines about what information to include in their presentation. It should be between one to three minutes.
   - What are the primary grouping features that you identified? Explain why these were a logical choice.
   - What are the lower level grouping features that your group used and why? What evidence in the forms of the dinosaurs led you to organize them in that way?
   - Were there any inconsistencies or organisms that seemed to be outliers in the hierarchy? How did you address them and where did they end up in the map?
   - How did your map work when challenged with adding in new organisms??

3. During other groups' presentations students will use the rubric in Student Resource 7.0: Affinity Map Rubric to analyze the maps presented by other groups.

Strategies for Grouping and Organizing Objects

Student Resource 1.0

Describe your groupings to your partner, and listen to the types of groupings that they made.

What was the first thing you did to sort the objects?

Did any objects stand out from the others? What did you do with those?

How did your grouping strategy differ from your partner's grouping? What similar choices did you make?

Student Resource

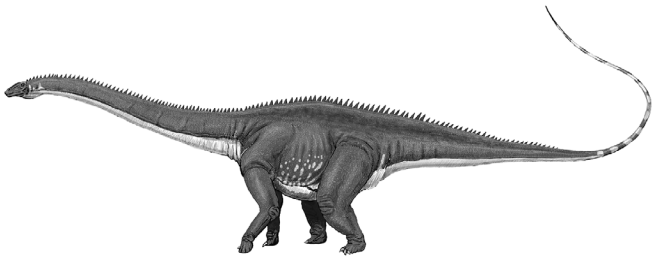
Dinosaur Cards Dinosaur Cards

Student Resource 2.0

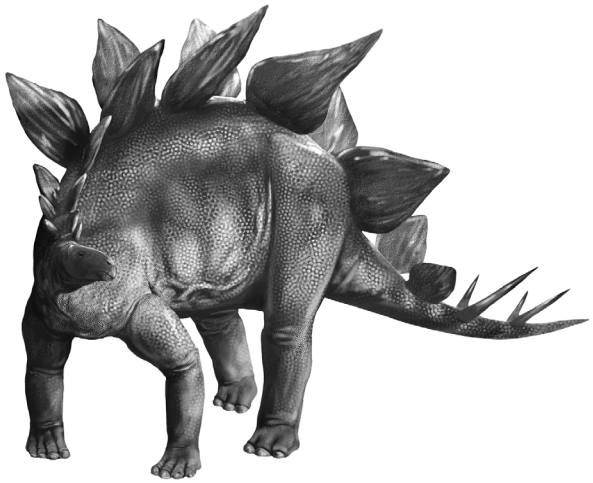
Parasaurolophus | (PAIR-uh-sor-oh-laf-us)
length: 33 feet

Triceratops | (TRI-sair-uh-tops)
length: 30 feet

Diplodocus | (di-PLAH-di-KUS)
length: 87 feet

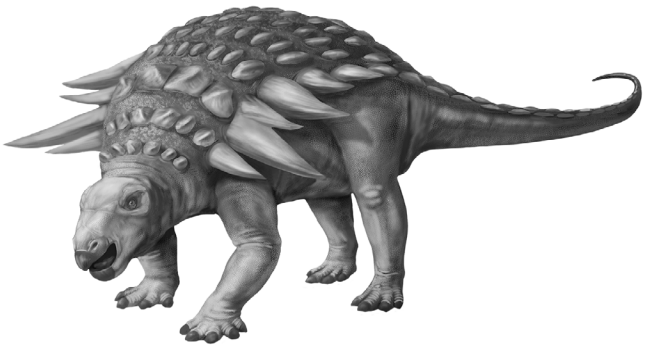


Stegasaurus | (stay-guh-SOR-us)
length: 20 feet



Student Resource

Edmontonia | (ed-mon-TON-nee-ah)
length: 20 feet

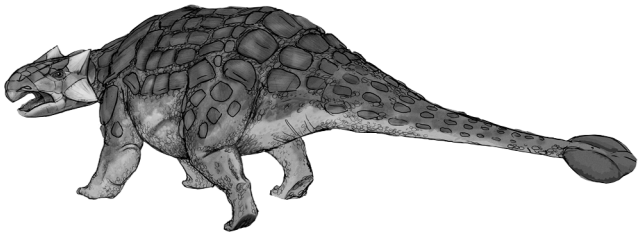


Deinonychus | (die-NON-ick-us)
length: 11 feet

Daspletosaurus | (duh-SPLEE-tuh-SOR-us)
length: 28 feet

Brachiosaurus | (BRACK-ee-oh-SOR-us)
length: 85 feet

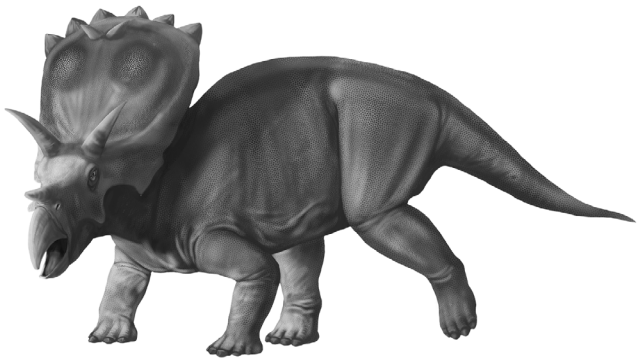
Ankylosaurus | (an-KIE-loh-sor-us)
length: 30 feet



Apatosaurus | (uh-PAT-uh-SOR-us)
length: 70 feet

Tyrannosaurus | (tie-RAN-uh-SOR-us)
length: 40 feet

Anchiceratops | (an-KEE-sair-uh-tops)
length: 15 feet



Strategies for Classifying and Organizing Dinosaurs

Student Resource 3.0

What interesting, surprising, and/or unique features do you observe on the dinosaurs' bodies?

What body features do all the dinosaurs have in common?

What features only appear in just one or two of the dinosaurs?

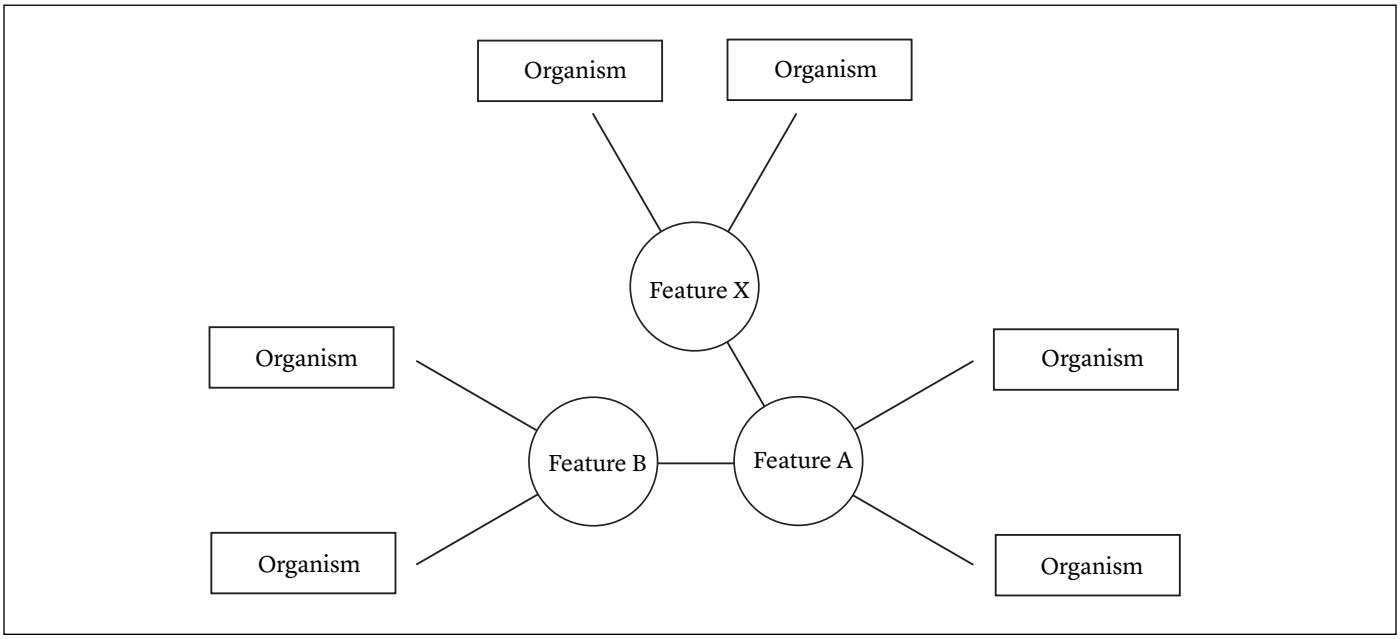
Student Resource 1.3 Strategies for Classifying and Organizing Dinosaurs

What features allow you to see that some dinosaurs are more alike than other dinosaurs?

Show how groupings can be categorized further.

Presentation of Ideas

Student Resource 4.0



Student Resource

1 Take a few minutes to think and prepare before presenting to your small group.

2 Use the following questions to organize what and how to present to your group:

- What are the traits used to create the big groupings or main hubs of your map.
- Which traits helped you differentiate the dinosaurs into small groups or individuals?
- Which traits seemed to be present in all of the dinosaurs?
- What evidence did you find on the dinosaur cards that led you to categorize them in this way? Use the following sentence stems if you are finding it difficult to describe the evidence.
- What is something you realized for the first time by creating the map?

English	Español
The image showed_____ body feature.	La imagen mostraba un rasgo corporal _____.
This grouping of dinosaurs all exhibited the _____ feature.	En esta clasificación de dinosaurios, todos tenían el siguiente rasgo: _____.
This grouping of dinosaurs all lacked a _____.	A todos los dinosaurios agrupados aquí les faltaba _____.
This dinosaur had/didn't have _____ making it unlike any of the others.	Este dinosaurio (no) tenía _____, lo que lo hace diferente de todos los demás.

3 As each person presents their map, have someone in the group record the ideas being presented in Student Resource 1.5: Traits Graphic Organizer

Traits Graphic Organizer

Student Resource 5.0

Complete this graphic organizer as each person presents to the small group to create a summary of all your group members' organizing strategies.

Common features (all dinosaurs had trait)	Grouping features (main hubs of the maps)	Differentiating features (small groups or individuals only)

New Dinosaur Discoveries

Student Resource 6.0

After incorporating the newly discovered species, choose two members of the group to present your revised map to the class.

Plan your presentation to cover the following information. It should be between one to three minutes.

What are the primary grouping features that you identified? Explain why these were a logical choice.

What are the lower level grouping features that your group used and why? What evidence in the forms of the dinosaurs led you to organize them in that way?

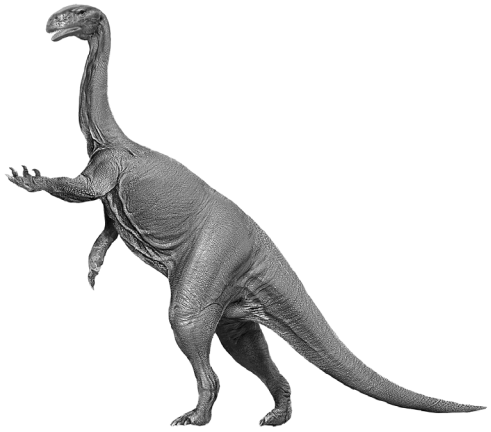
Were there any issues or organisms that didn't seem to fit anywhere in the groupings? How did you solve that challenge and where did they end up in the map?

How did your map work when you were asked to add new organisms?

Student Resource 6.0 New Dinosaur Discoveries

Cryolophosaurus | CRY-oh-lof-uh-SOR-us
length: 25 feet

Glacialisaurus | (GLAY-see-AL-ee-SOR-us)
length: 35 feet



Patagotitan | (PAH-tuh-go-TIE-tan)
length: 122 feet

Student Resource

Patagotitan by © Museum of Paleontology Edigio Feruglio (MEF)
Cryolophosaurus and Glacialisaurs by Velizar Simeonovski © Field Museum

Affinity Map Rubric

Student Resource 7.0

Use the rubric to evaluate your classmates' maps.

Criteria	Exceptional	Adequate	Inadequate
Hierarchy-Complexity	Map includes three levels of organization. Organisms are evenly distributed throughout the levels.	Map includes two levels of organization. Only one to two organisms are by themselves.	Map does not have groups within groups.
Learning-Cooperation	Team showed flexibility in working through problems together to create the map and present their process.	Team was able to produce a map together, but they did not work through any detail problems or map is incomplete.	Team could not work together to create a map.
Logic-Evidence	The evidence about how body forms were grouped was logical and matched the organization of the map.	Body feature evidence was used and the organization of the map was partly logical.	No evidence or logical reasoning was used or presented.

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