Rise of Dinosaurs

3rd -5th Grade
NGSS: 3-LS4-1

Background

Read Pre-Lesson Preparation Before Class

Lesson Description

Students organize and graph fossil data so that it can be shared with their peers. Together students analyze the data to determine the differences and similarities between multiple fossil dig sites. Students then draw conclusions about what the differences can tell them about the relationship between the dig sites.

Driving Phenomenon

Scientists called paleontologists search for and study fossils that can provide evidence for organisms and environments that lived long before humans. Using fossil evidence, paleontologists have been able to reconstruct many details of Earth's history. Learning to read what fossils can tell us has been a long, difficult process for humans. It was not until the 20th century that geologists and paleontologists were able to decode the ages and mysteries in Earth's rocks. Now we are beginning understand the vast history of life on Earth and how it has been affected by changes in the geological history of Earth. **For instance, on Antarctica we find fossils of numerous types of organisms that would not be able to live there today and have not been alive for millions of years.** As students organize, analyze, and interpret data from dig sites that are similar in geographic location, they will discover that the changes and differences in living things in a region can be related to a differences in geological forms over time.

Driving Questions

- How did life in Antarctica change over time?
- What was Antarctica like long ago?

Learning Objectives

- Students will demonstrate understanding of appearance and disappearance of organisms over time by constructing a timeline of the fossil record in a particular place.
- Students will demonstrate an understanding of obtaining, evaluating, and presenting data by developing graphs depicting data that they collected.

Time Requirements

- Three 45-60 minute sessions

Prerequisite Knowledge

- Some organisms that once lived on Earth are no longer living.
- Antarctica is near the South Pole and is a cold and barren landscape.

Teacher Resources

1. Lystrosaurus Reproduction Illustration
2. Photographs of Lystrosaurus Fossils
3. Fossil Cards Sites 1-5
4. Class Bar Chart
5. Line Plot Sites 1-5

Student Resources

1. Research Group Roles
2. Species Record
3. Graphing Group Data
4. Environmental Claim, Evidence, Reasoning

How did Antarctica change over time?

Full lesson procedures begin on the next page

Engage | 15 minutes	
Introduce an extinct organism, and allow the students some time to wonder about this organism, its life, and the environment in which it lived.	Notes
Teacher Resources 1.1 and 1.2: Lystrosaurus Illustration and Fossil Photographs	
Explore | 30 minutes	
Review chart T.A.I.L.S. as a class. Students work in groups to "excavate" the fossils at their sites.	Notes
Fossil Cards Printable and Class Bar Chart Layout, Student Resources: 1.0 - 3.0	
Explain | 45 minutes	
Students work as a group to prepare the data they collected presentation for the class symposium.	Notes
Student Resources: 1.0 - 4.0	
Elaborate | 25 minutes	
Class symposium: groups share data that is presented as a class-wide chart as well as charts prepared in their individual groups. The class will analyze and interpret all the data brought together to explain the findings.	Notes
Student Resources 3.0 - 4.0	
Evaluate | 20 minutes	
Class discussion to explore the information that can be gathered from the class timeline, and determine what is still unknown.	Notes

Pre-lesson Preparation

1. Break students into five or six groups with three to four students each.
2. Set-up one "dig site" for each group of students ahead of time.
3. Gather the appropriate number of buckets or bins.
4. Gather the filler material (e.g. newspaper ripped into strips, shredded copy paper, scraps of paper, packing peanuts poly-fil, etc.) and fill the bins half to the top.
5. Print and cut the fossil cards found in Teacher Resource 1.3. Each sheet is labeled for a different site, so keep track the site where they belong as you cut them out.
6. Embed the fossil cards throughout the the filler material for each site.
7. Print the background for the class bar graph. This is a two-page document that you will tape together to make an 11"x17" chart.

Materials

- Five buckets or trays
- "Filler" material
- Copy of "fossil cards"
- Copies of the student resources for each student
- Markers - one color for each group, preferably bright colors easily scene from across the room

Lesson Enrichment Ideas

DO

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. Recommended experience boxes that pair with this lesson:

- *Paleontology Practice*
- *Fossils*

READ

When Fish Got Feet, When Bugs Were Big, and When Dinos Dawned: A Cartoon Prehistory of Life on Earth
by Hannah Bonner
An illustration-rich journey through the late Paleozoic and early Mesozoic eras.
https://worldcat.org/oclc/896980857

Older Than Dirt: A Wild But True History of Earth
by Don Brown and Dr. Mike Perfit
Two dirt-loving animals explore major events in the history of the Earth in a graphic novel format.
http://worldcat.org/oclc/949922830

WATCH

Excavating Triassic Fossils in Antarctica
Antarctica expedition team members excavate Triassic fossils. This video is part of a series of video reports documenting daily life and fieldwork on an expedition to Antarctica.
https://youtu.be/PCp3sMvW1pU

How did Antarctica change over time?

Engage

1 Show the students the illustration of a reproduction of Lystrosaurus (Teacher Resource 1.0), and ask them if they've ever seen anything like this walking around.

2 Then show images of the Lystrosaurus fossils (Teacher Resource 1.2) and explain that they haven't seen one because this is an organism that went extinct approximately 200 million years ago.

Lystrosaurus fossils have been found all over the world, from North America to Antarctica and everywhere in between. It is the most prevalent fossil of a land animal from its time period of the late Permian through the early Triassic periods (290-206 million years ago). Paleontologists estimate that 95% of land animals during this time were Lystrosauri! Lystrosaurus also survived the largest extinction event in the history of the world when 70% of land animals and 95% of sea animals went extinct.

3 Ask students what they wonder about this animal and its world. Give them an opportunity to think and write before sharing their questions. Write the questions on the board or chart paper.

4 Tell students that scientists, called paleontologists, ask similar questions when they find fossils. These questions lead them to study the fossils in many different ways to find clues about the past. These questions also drive them to continue looking for more fossils.

Explore

1 Explain that paleontologists have ways of finding places that are likely to have fossils, but there are no guarantees of which fossils will be exposed at the time they are there. Also, because very few of the organisms that have ever lived become fossilized, when paleontologists look for fossils they can't always depend on finding a particular species.

2 Share that today the class is going to go fossil hunting here in the classroom. Whatever fossil organisms you find at your site will tell you something and allow you to make discoveries about the prehistoric world. All of our sites are from a place called the Transantarctic Mountains, this is one of the few sites in Antarctica where paleontologists can find fossils because it is one of the only areas where rocks rise above the thick glaciers.

3 Let students know that each team has a different site where they will be searching for fossils. Once they have gathered and analyzed the fossil data, everyone will come together for a paleontology symposium to combine the data and get an even better impression of what was happening millions of years ago. As part of the symposium everyone will be contributing charts that you'll make in your groups and contribute data to a class chart.

4 Take the opportunity to review chart TAILS and point them out on the Class Bar Graph (Teacher Resource 4.0) which should be displayed on the board or elsewhere in the classroom. TAILS are the five elements to focus on when creating a graph to ensure that it accurately and effectively communicates the data. These elements have been pre-determined for the class graph to serve as an example, but the students will have to make sure to create them for their group's graphs.

5 Place the students in their groups and assign them a color from the markers you gathered ahead time. Allow them to gather with their research teams and agree upon who will take on the various roles. Descriptions of the roles can be found on cut-out cards in Student Resource 1.0. The roles are:

- Field Scientist
- Collection Manager/Recorder
- Science Communicator/Presenter

6 Field scientists will take turns searching their site looking for specimens. Once they find one, they pass it along to the collections manager/recorder who will be assisted in this first step by the science communicator.

T.A.I.L.S. Stands For:

Explore | Step 4

- **Title:** a statement that describes what was being studied when collecting this data
- **Axes:** two straight lines at right angles to one another; X is horizontal, Y is vertical
- **Intervals:** as you move up or left on an axis each number should increase at an equal amount
- **Labels:** are titles for each axis describing the variable measured and always include the unit of measurement in parentheses
- **Scale:** the overall number range for each axis should be selected so that the data fills the chart field

7 The collection manager will record the data found on the fossil cards and tally the occurences of each organism at their site by type as they are found in the two graphic organizers found in Student Resource 2.0.

8 Once the group has found and recorded all the specimens from the site, the group will use the data to create two graphs. There are instructions and a template in Student Resource 3.0 to guide the students in creating their group charts. However, if your students are less experienced with graphing this may work better as a full class activity guided by you.

9 The bar graph should show the number of fossil occurrences of each organism at the site. A template for this graph can be found in Student Resource 3.0.

10 The line plot will show the frequency of organisms over time at that site. Each site has an individual line plot template due to its different range, so the templates for these graphs are found in the Teacher Resource 5.0: Line Plot Templates. If your students already have extensive experience with line plots, you can have simply provide the blank template.

Explain

Preparation for the class symposium.

1 The science communicator will refer to the group's bar graph to determine if it has organisms that are being tracked on the class bar graph (Teacher Resource 4.0). If so, they will contribute that data to the class bar graph.

2 Each group should help the science communicator prepare a one to three minute presentation for the symposium. In the presentation each group will make a claim about the prehistoric environment at their site using evidence from the dig. A claim, evidence, reasoning (CER) graphic organiser is provided in Student Resource 4.0 along with the following prompts to help them focus their thinking.

- Were different organisms found in equal amounts, or did a single organism dominate the environment?
- Were the organisms consumers or producers?
- Were the consumers mainly herbivores (plant eaters) or carnivores (meat eaters)?
- Were they all close in size, or were there big differences across organisms?
- Looking at the data on the line plot, were the number of organisms increasing or decreasing over time?

Elaborate

Paleontology Symposium

1. First discuss the completed class bar graph. Students will discover that the class bar graph is actually a confusing group of data. Help them begin to make sense of the data with the following prompts.
   - What can we determine about the sites based upon this data?
   - What questions does this data bring up for us?

2. The main thing to note from this graph is that not all organisms were represented at all of the sites. Students could have a number of different questions after reviewing this graph, but one question they definitely should be asking is -why are there different organisms at each site? Record all of the questions that students ask on the board.

3. Next each group presents their Claim-Evidence-Reasoning chart for their site. If presentations cite the graphed data from the group charts or line plots, have students post their charts up on the board.
   - Ask students if any of the claims or evidence help the class make sense of the questions that we were asking after reviewing the class graph.
   - Note that now that the class has learned more about the different sites, we can try to compare and contrast the similarities and differences.
   - Ask students if there any patterns across the different sites that are starting to emerge.

4. After comparing and contrasting the sites, have groups post any line plots that have not been shared.
   - Allow students to come up to the board and carefully examine all of the line plots. Compare and contrast the differences between each line plot.
   - Did everyone have the same ideas about how to write titles, axis labels, etc.?
   - How do the intervals and axes compare to one another?
   - Invite the students to arrange the plots in a way that makes logical sense. Guide students to notice that the intervals and scale of the X-axes are different on each chart, and that they could be arranged in numerical order.

5. Once the line plots are arranged in order reassess what the similarities and differences between the sites are, and guide students towards the recognition that there is a sort of timeline arranged on the board.

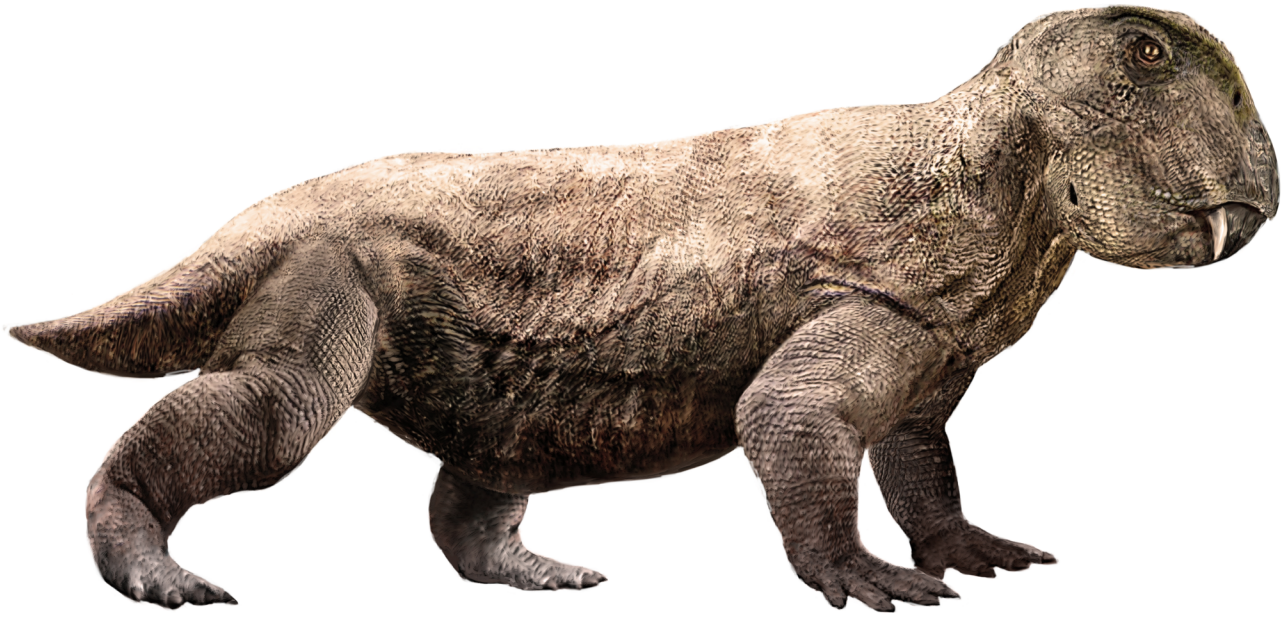
Evaluate

1 Reflect with students about the patterns that were noted and how they play out over the timeline created by the line plots.

2 Ask: Were there points in time when many organisms seemed to disappear? If we were going to make recommendations about how paleontologists should continue this investigation, where would you suggest they focus their efforts?

Lystrosaurus Reproduction Illustration

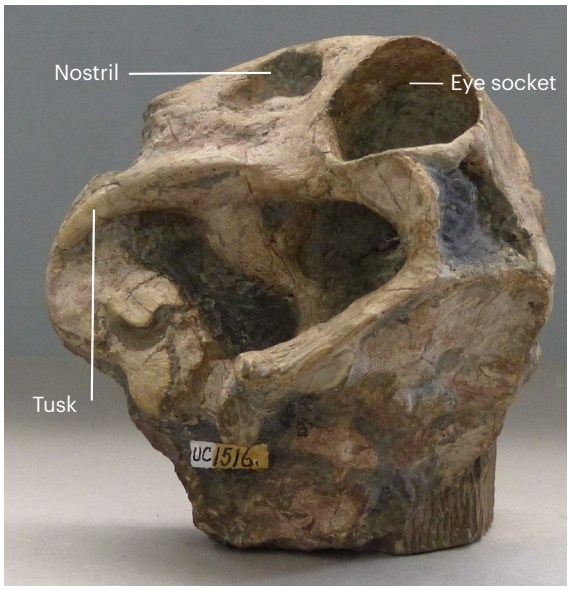
Teacher Resource 1.0

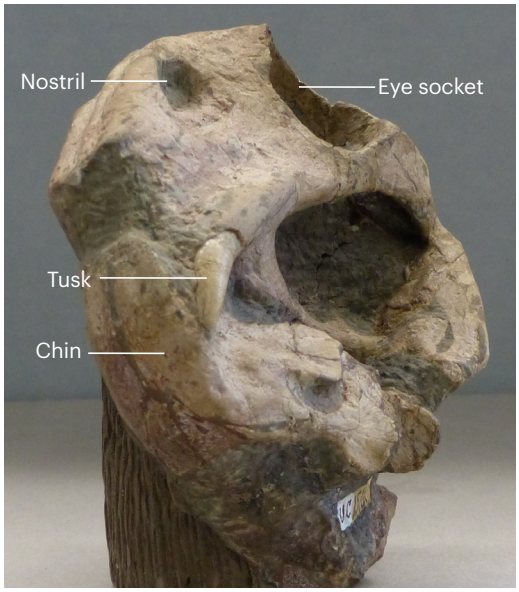


Teacher Resource

Photographs of Lystrosaurus Fossils

Teacher Resource 2.0

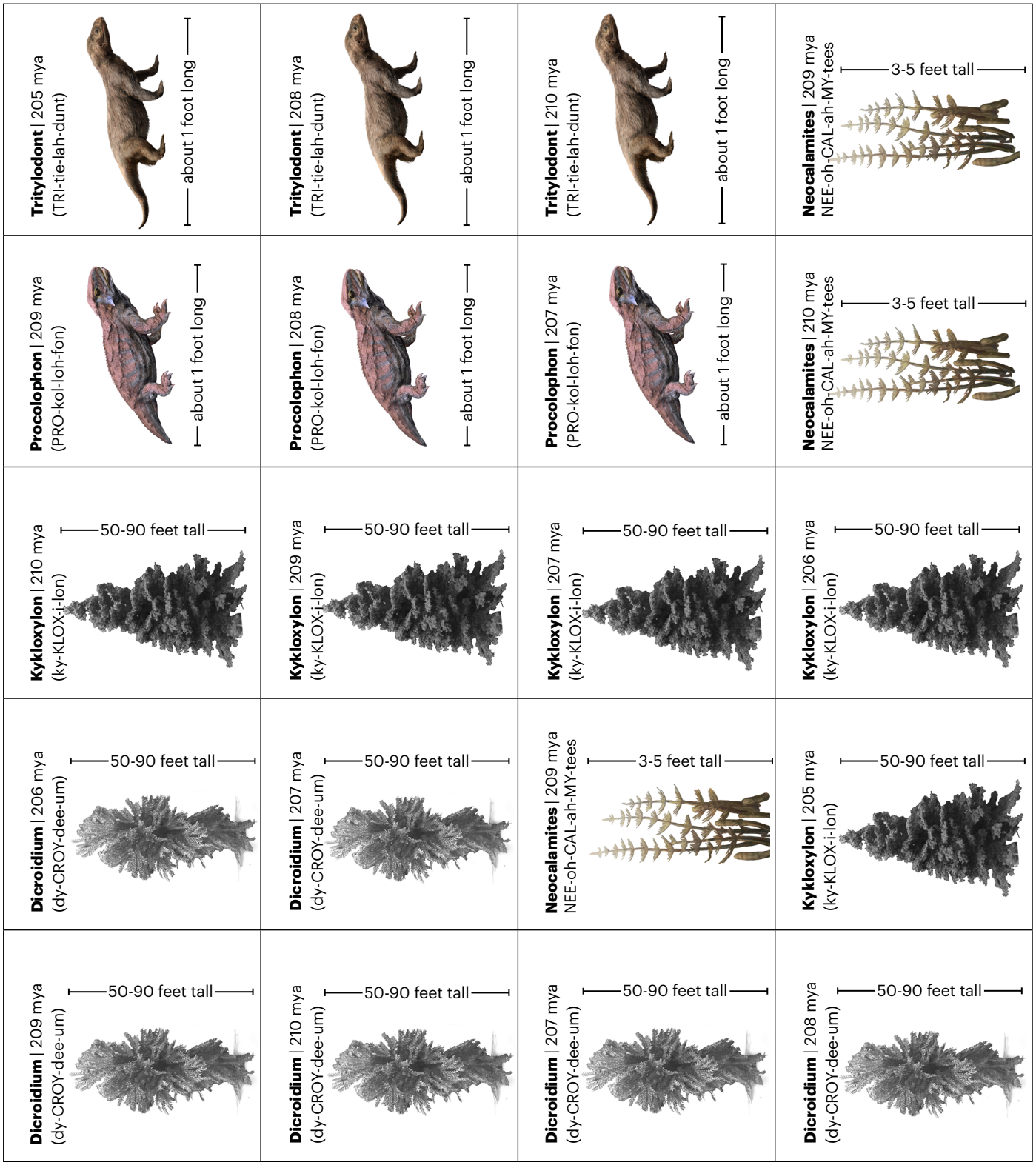




Teacher Resource

Fossil Cards — Site 1

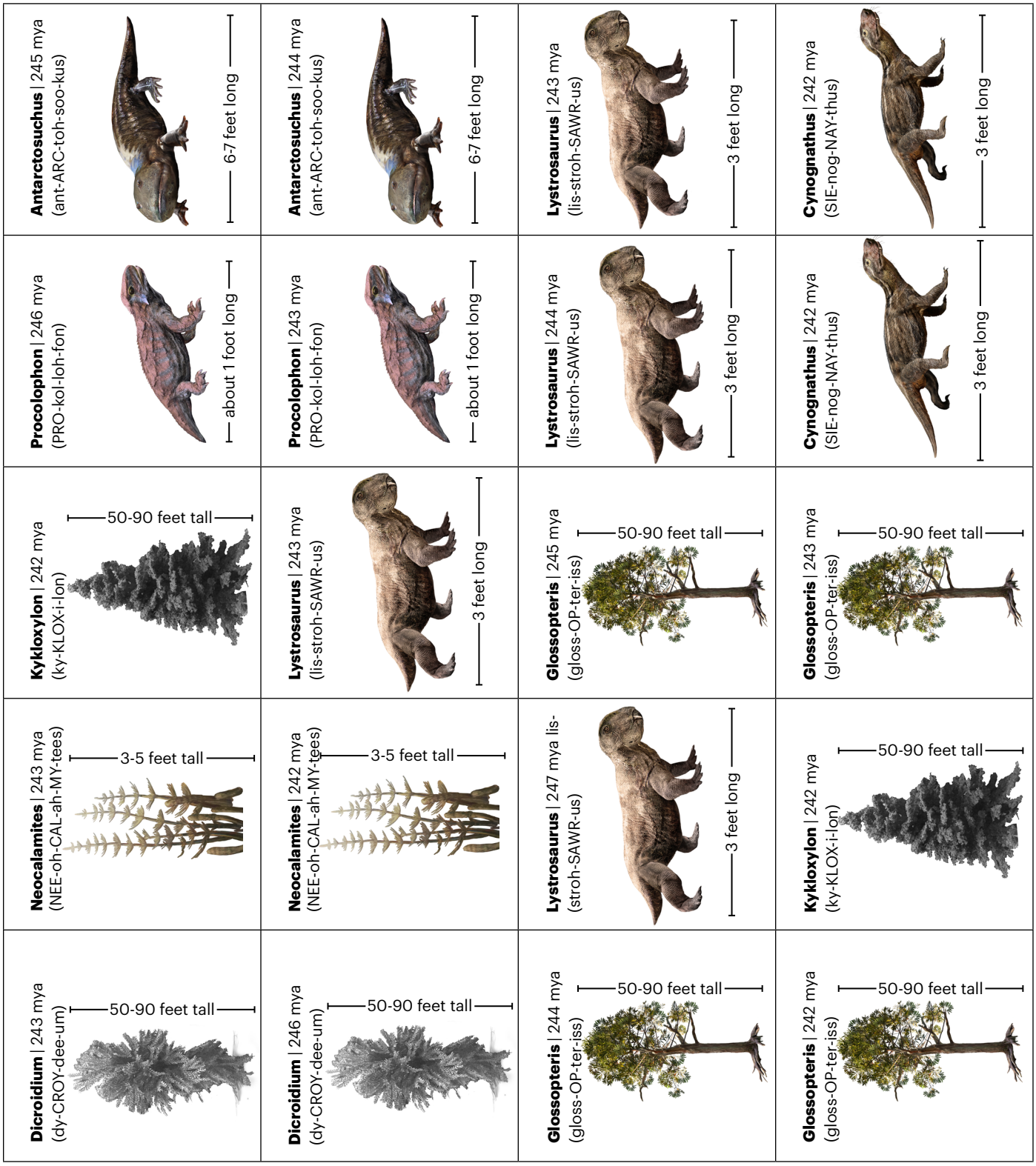
Teacher Resource 3.0



Teacher Resource

Fossil Cards — Site 2

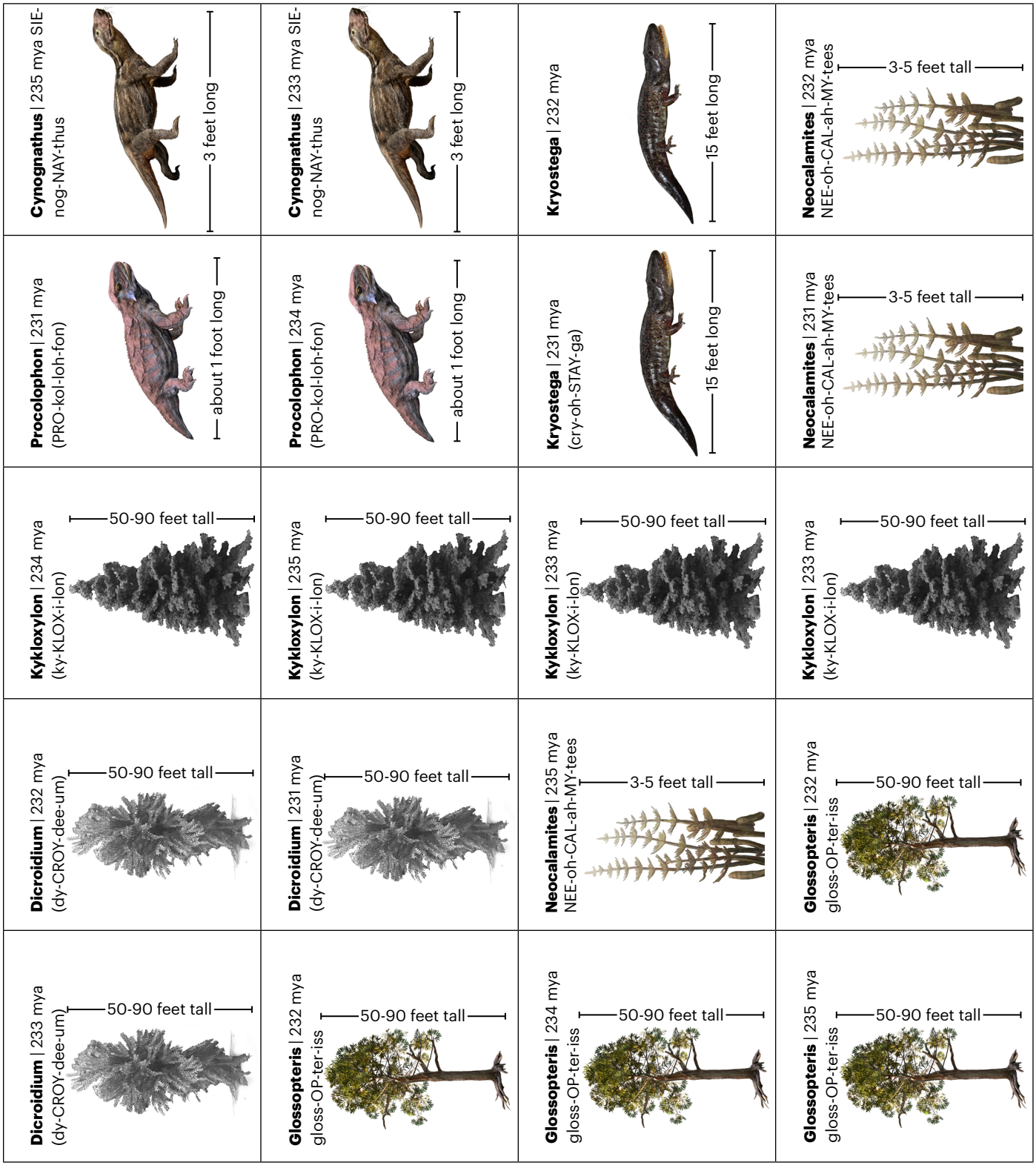
Teacher Resource 3.0



Teacher Resource

Fossil Cards — Site 3

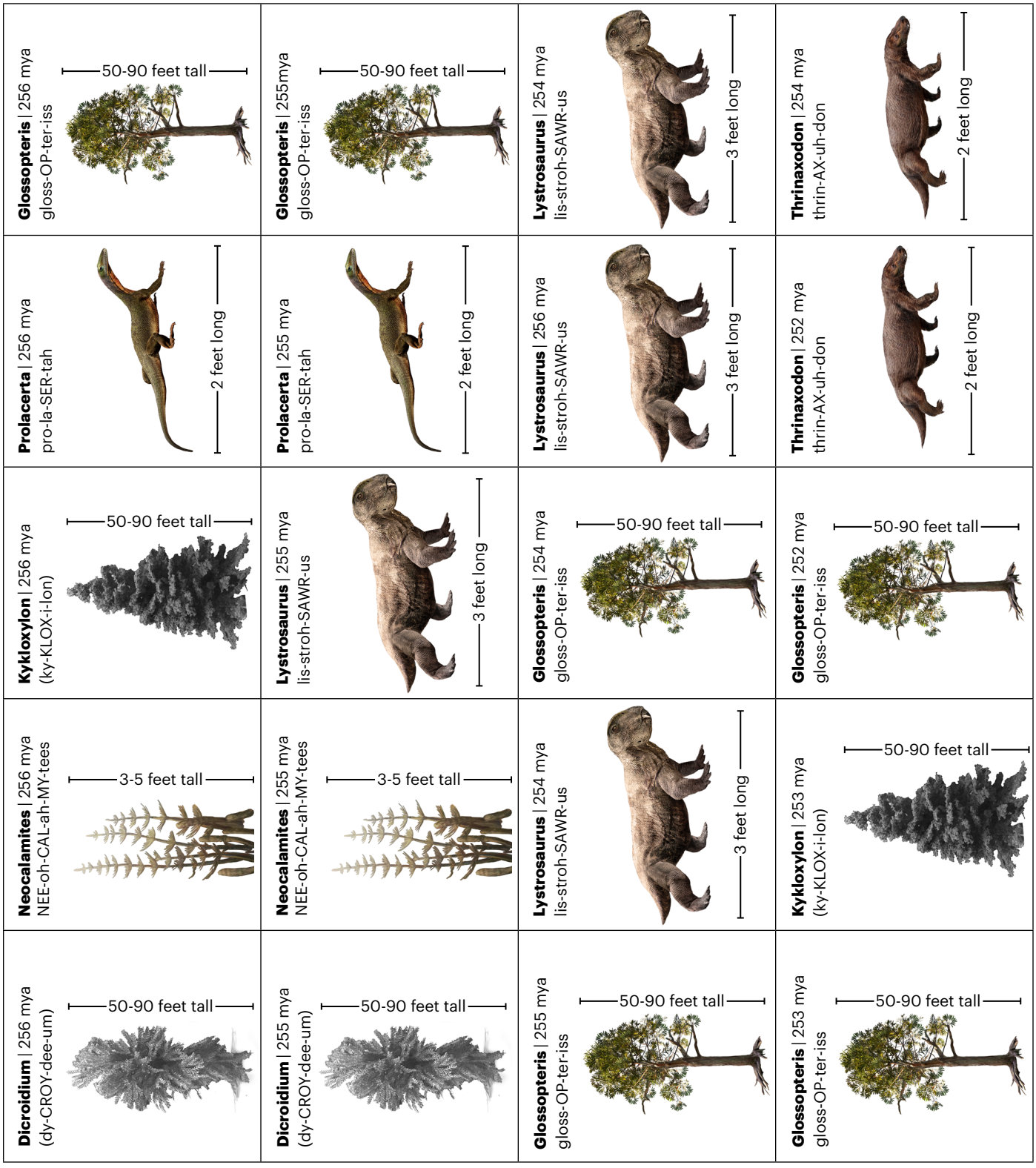
Teacher Resource 3.0



Teacher Resource

Fossil Cards — Site 4

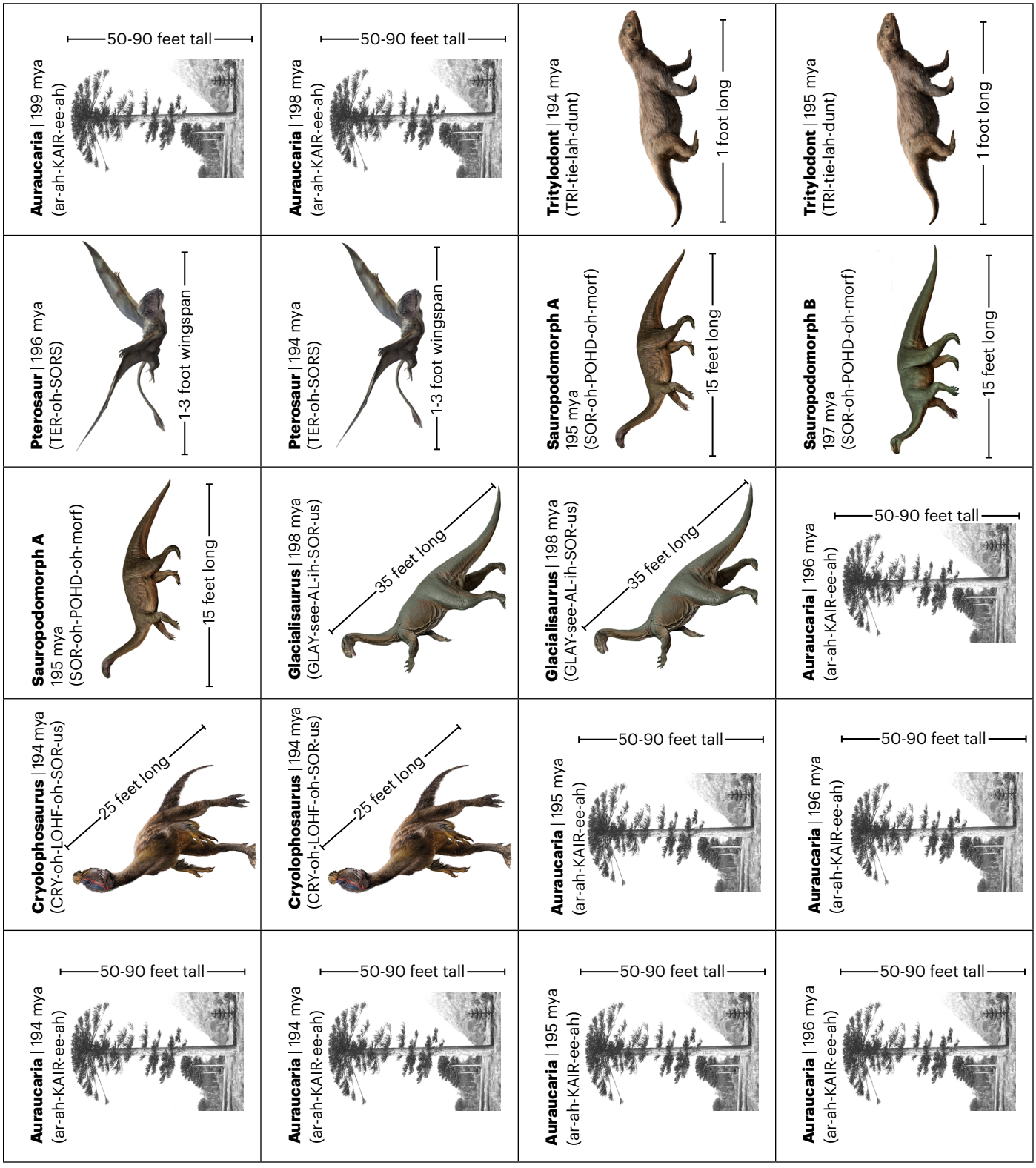
Teacher Resource 3.0



Teacher Resource

Fossil Cards — Site 5

Teacher Resource 3.0

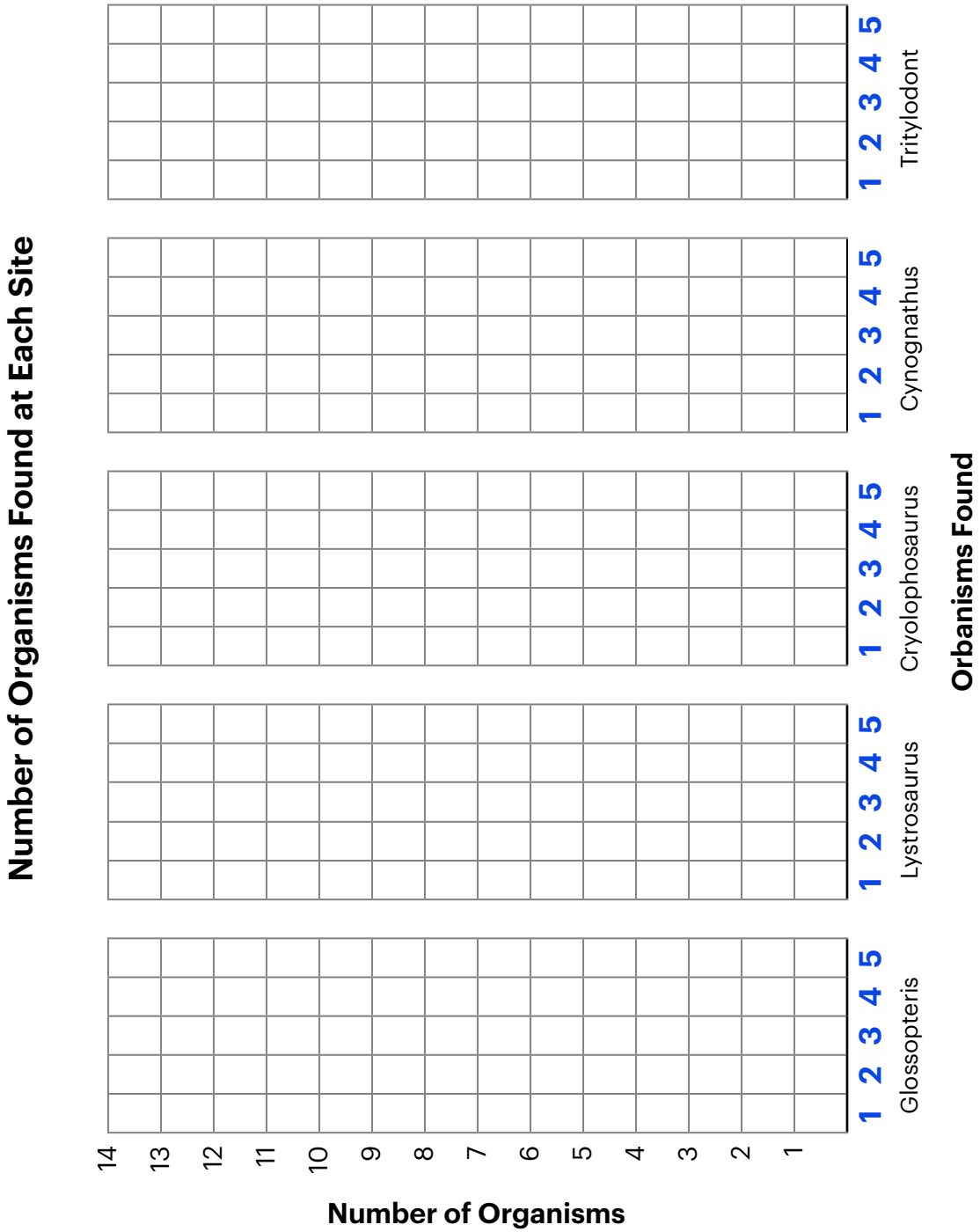


Teacher Resource

Class Bar Chart

Teacher Resource 4.0

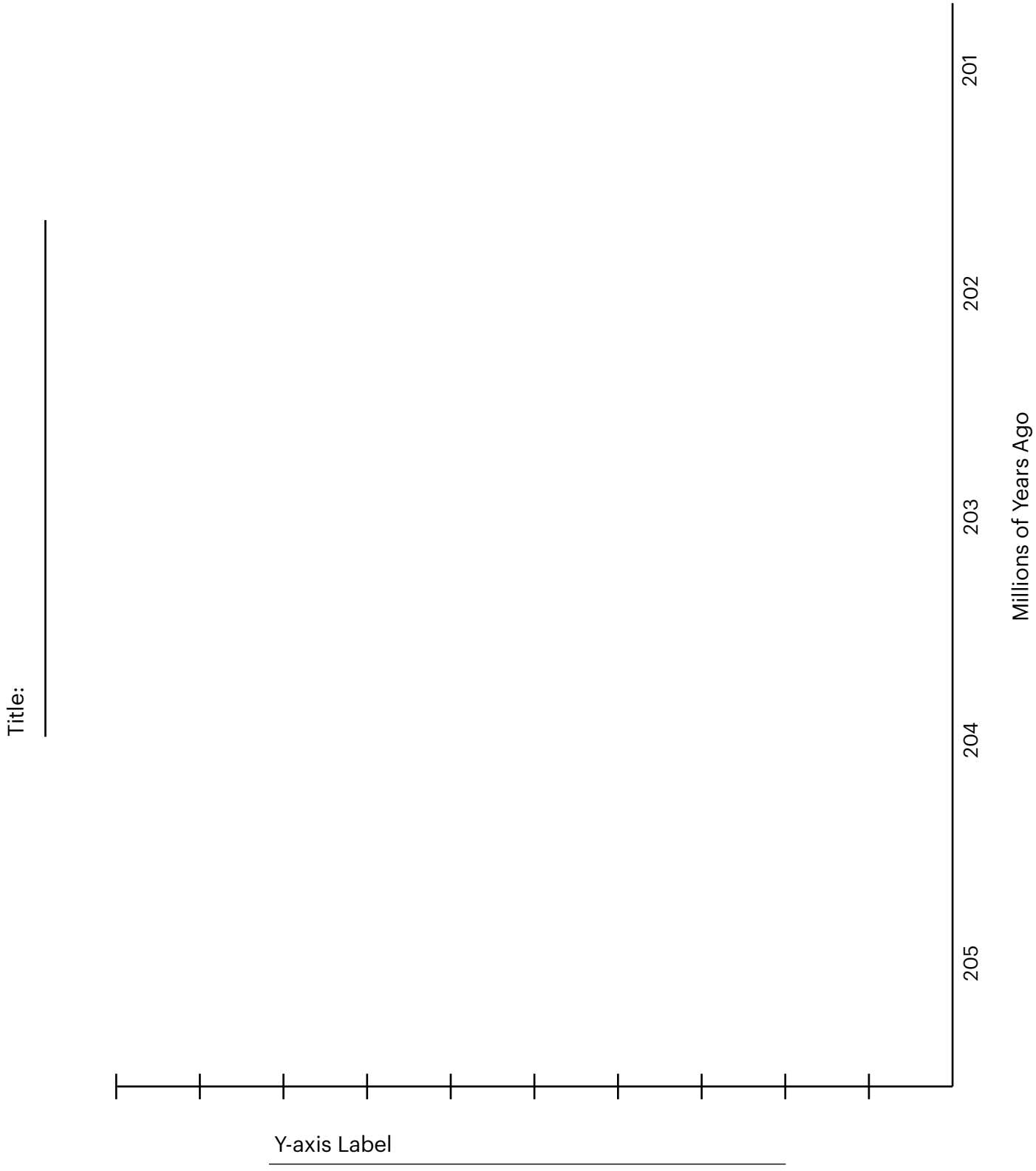
Copy onto a large piece of chart paper or print as a poster and laminate for reuse.



Names

Line Plot Site 1

Teacher Resource 5.0

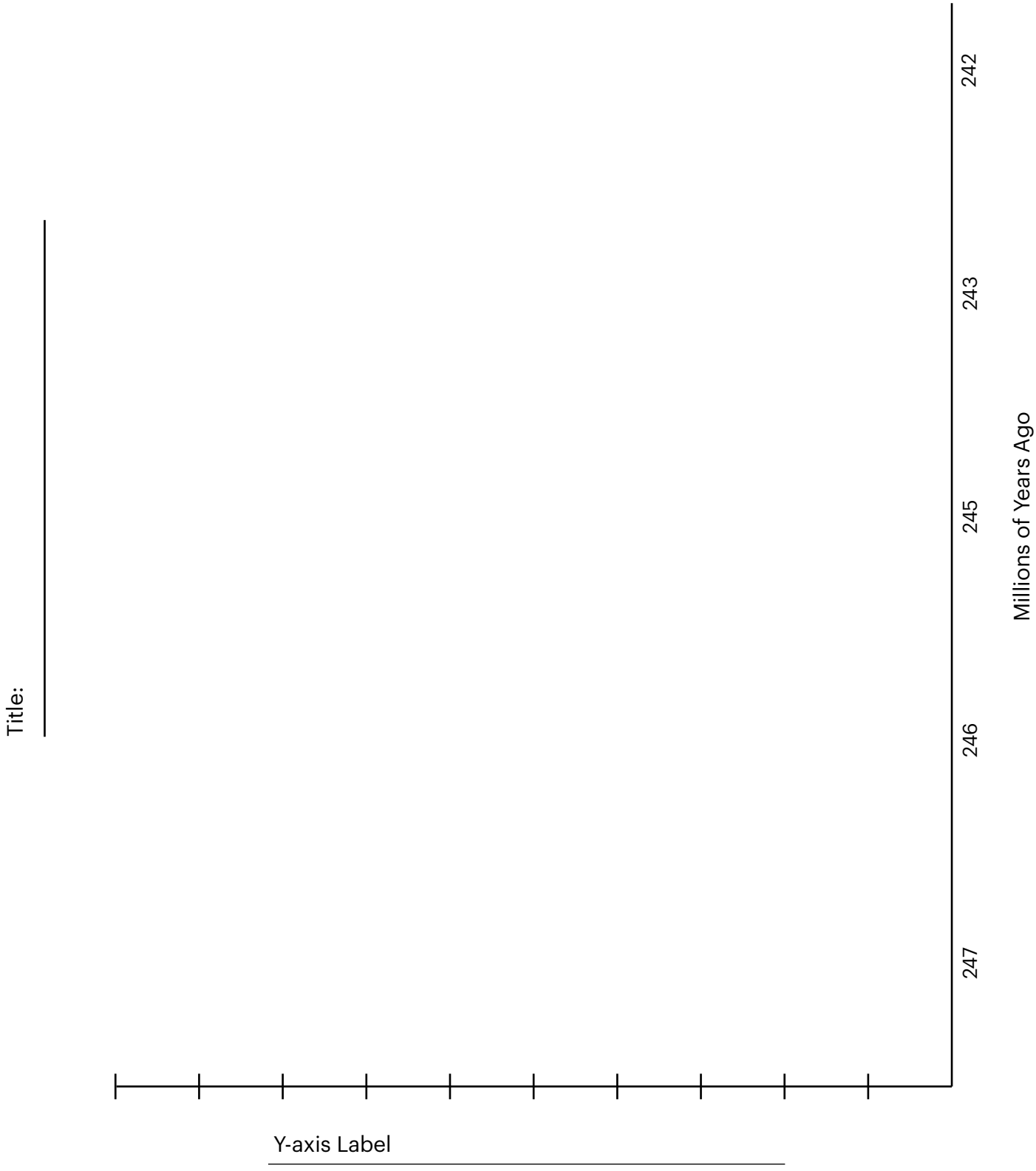


Teacher Resource

Names

Line Plot Site 2

Teacher Resource 5.0

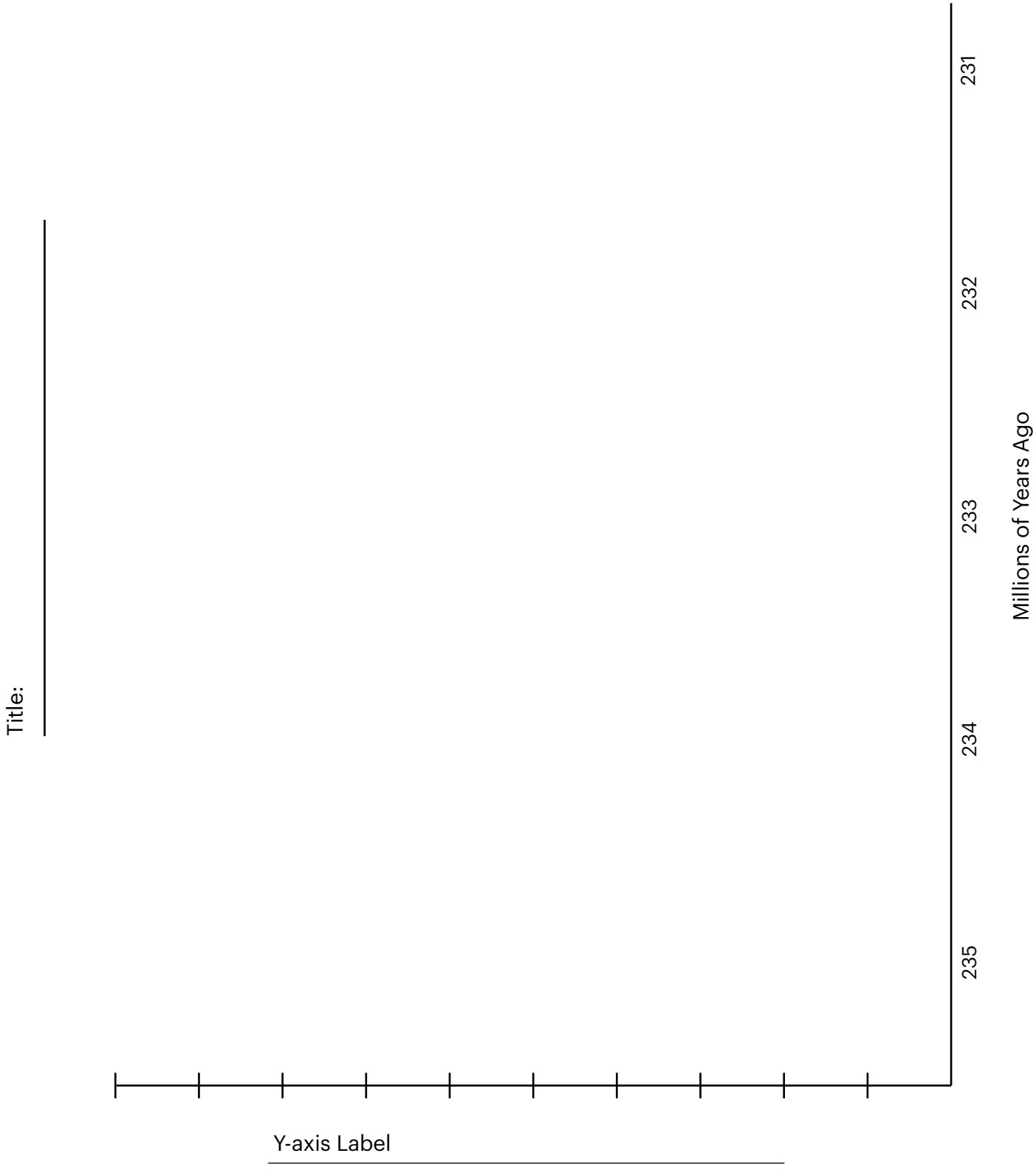


Teacher Resource

Names

Line Plot Site 3

Teacher Resource 5.0

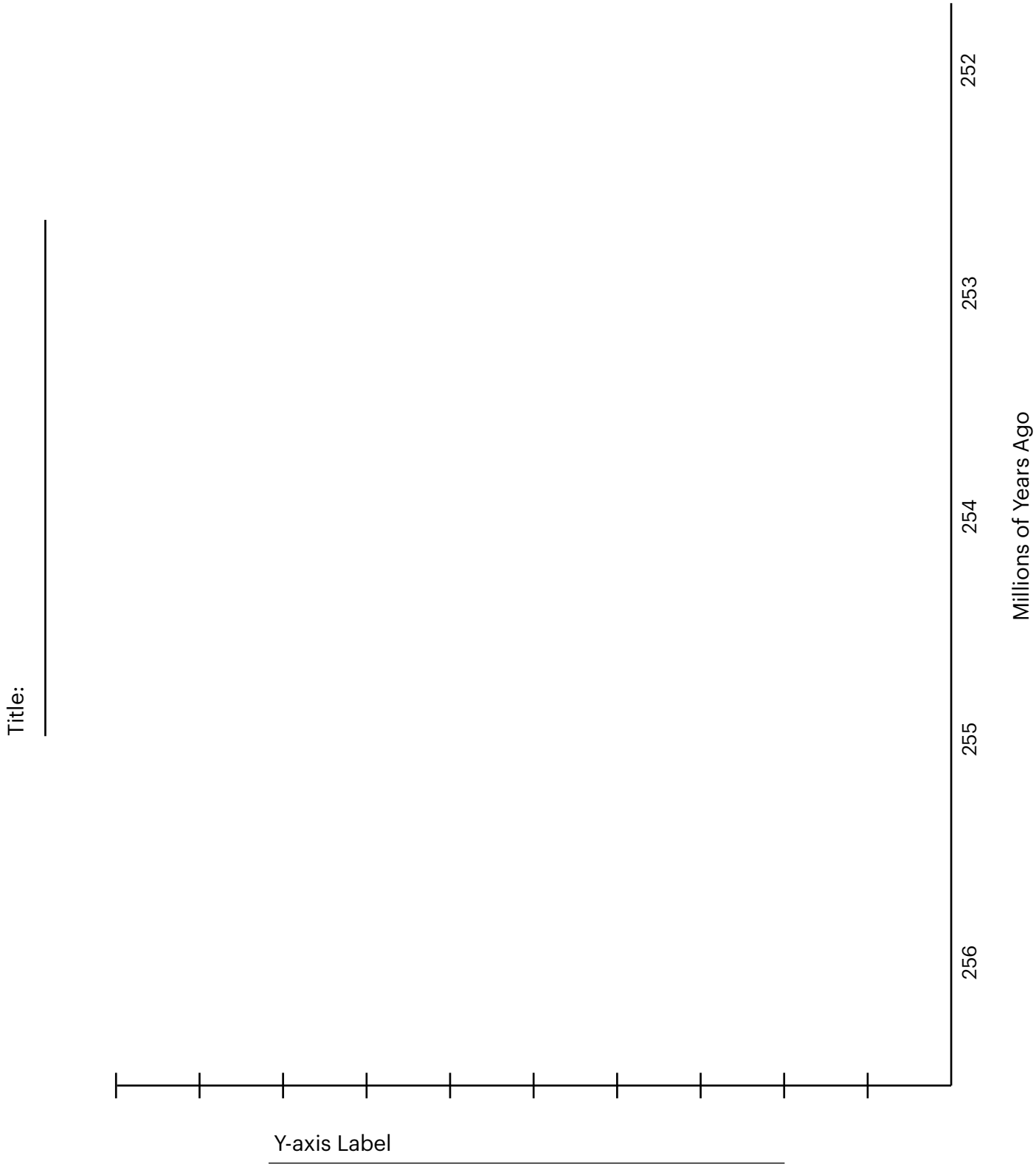


Teacher Resource

Names

Line Plot Site 4

Teacher Resource 5.0

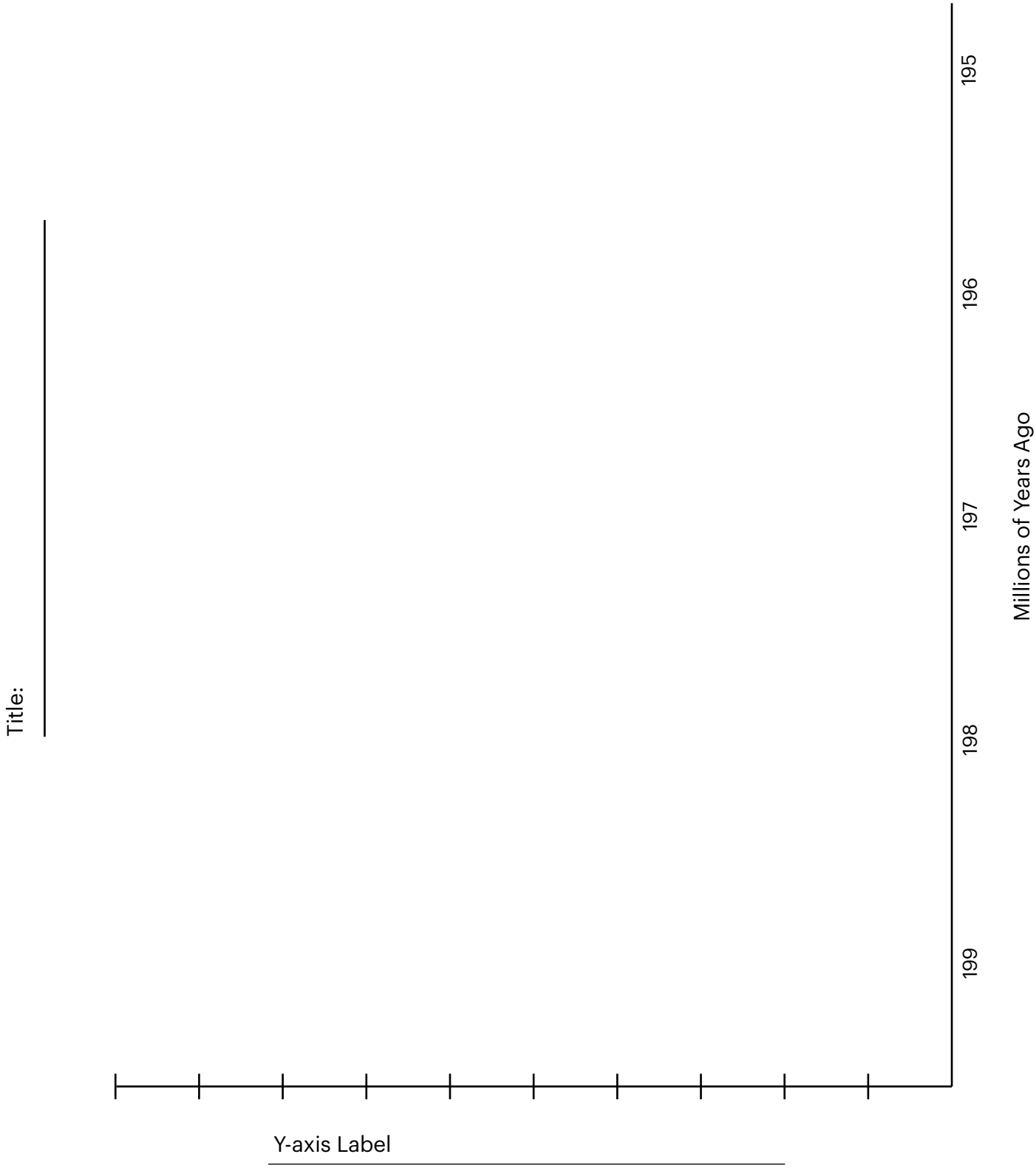


Teacher Resource

Names

Line Plot Site 5

Teacher Resource 5.0



Teacher Resource

Research Group Roles

Student Resource 1.0

Field Scientist

The field scientist must be up for adventure and ready for anything. Field scientists travel out to remote locations that need to be explored.

Field scientists in paleontology are fossil hunters and that requires someone with a keen eye who can learn to distinguish regular sedimentary rock from fossilized bone.

A field scientist goes out to explore and brings back data and specimens that the entire team (including the field scientist) works to make sense of in the lab.

Tasks for this project:

- Search your group's site for all fossil specimens
- Bring fossils to the collections manager
- Assist team in making sense of the findings

Collection Manager-Recorder

The collections manager is responsible for making sure that any specimens acquired by the field scientist are recorded properly and cared for in the collection.

This person needs to be meticulous and organized, but they also need to be flexible so that they can find a logical place when something new and unexpected comes into the collection.

Collections managers also know the specimens well, and they help the team discover new details and look at other specimens in the collection differently.

Tasks for this project:

- Obtain fossil specimens from Field Scientist
- Record and tally the data in the species record tables
- Assist team in making sense of the findings

Science Communicator-Presenter

The science communicator helps to create the message that needs to be shared with other research teams and the public about new discoveries and new questions that have come up in the research.

The communicator should understand the scientific concepts as well as their audience in order to present the data in a way that is meaningful and useful.

Science communicators should be creative and detail oriented so that the right message gets communicated without creating any misconceptions.

Tasks for this project:

- Get the data from the Collections Manager and create graphs communicate the data visually
- Assist team in making sense of the findings
- Write the presentation of the findings for your peers

Species Record

Student Resource 2.0

Instructions

1. Decide within your team who should have each role. If there are more than three in your group, two people can have the same role.

2. The field scientist will dig in the site to find the fossils. Be very thorough to make sure you get all of the fossils out of the site.

3. As the field scientist finds fossils they will pass them along to the collection manager/recorder. The collection manager will look at the data on the fossil and record it on the graphic organizers below.

4. Work as a team to help the science communicator prepare the graphs for the class symposium. The science communicator will present your findings to the class.

Organism	Number of Occurences
Example: Tyrannosaurus	

Student Resource

Student Resource 2.0 Species Record

Organism Found	Date
Example: Tyrannosaurus	67 million years ago (mya)

Graphing Group Data

Student Resource 3.0

Bar charts are helpful in comparing the differences between multiple groups. We will use a bar chart to compare the difference in how many times each type of fossil organism was found at each site (occurrences).
Find the Bar Chart Template (Student Resource 3B)
This graph will present the data that was recorded tallying up occurrences of each organism at your fossil site.

Line plots are a type of graph that uses symbols (for example an X or an O) to show how data is distributed across a number line. Ask your teacher for the Line Plot Template for your site.
Compare the number line at the bottom of your Line Plot Template to the species data that you collected. What does that number line represent?

Remember to complete all of the T.A.I.L.S. data on the graphs.

All charts and graphs need T.A.I.L.S..

Title

A statement that describes what was being studied when collecting this data.

Axes

Two straight lines at right angles (perpendicular) to one another; X is horizontal (side to side), Y is vertical (up and down).

Intervals

As you move up or left on an axis each number should increase at an equal amount.

Labels

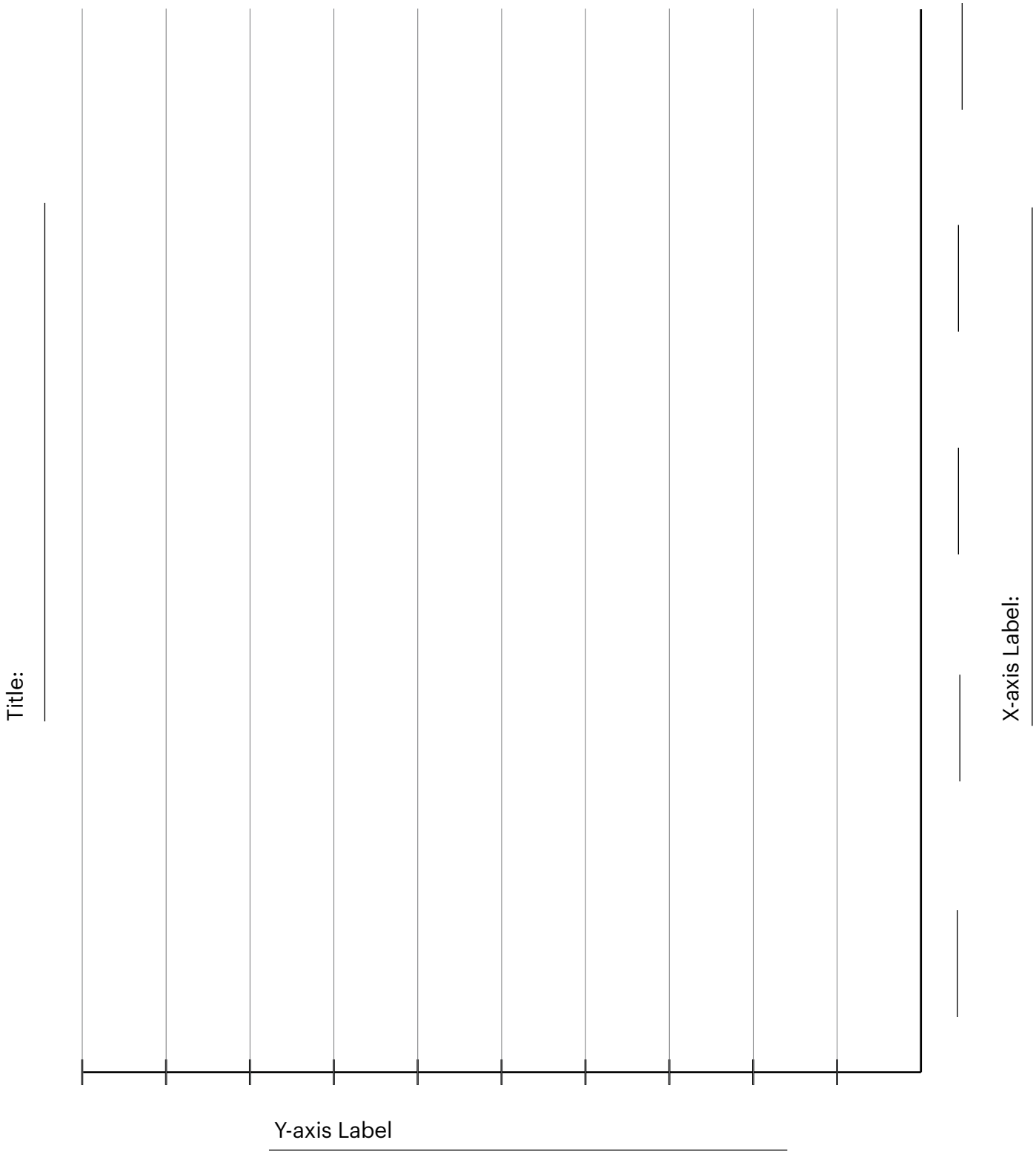
Titles for each axis describing the variable measured that includes the unit of measurement (for example: hours) in parentheses

Scale

The overall number range for each axis should be selected so that the data fills the chart field.

Graphing Group Data

Student Resource 3.0



Student Resource

Environmental Claim, Evidence, Reasoning

Student Resource 4.0

After you complete your graphs for the presentation look at them as a group and discuss the following questions. Then, as a group, make a claim about what the environment of your dig site was like when the fossil organisms were alive. Use the Claim, Evidence, Reasoning graphic organizer on the back of this page to organize what your group will share at the Class Paleontology Symposium.

Were different organisms found in equal amounts or did a single organism dominate the environment?

Were the organisms consumers or producers?

Were the consumers mainly herbivores (plant eaters) or carnivores (meat eaters)?

Were they all close in size, or were there big differences across organisms?

Looking at the data on the line plot, were the number of organisms increasing or decreasing over time?

Student Resource 4.0 Environmental Claim, Evidence, Reasoning

Claim: Make a claim about the environment of at the dig site at the time when the fossil organisms were living.

Evidence: Provide evidence from the fossil data to support your claim.

Reasoning: What connections can you draw between the claim you made and the evidence that you found.

THE GRIFFIN DINOSAUR EXPERIENCE

FIELD MUSEUM

The Educator Toolkit is part of the Griffin Dinosaur Experience, made possible by the generous support of the Kenneth C. Griffin Charitable Fund.