

Science & Literacy Activity

GRADES 6-8

OVERVIEW

This activity, which is aligned to the Common Core State Standards (CCSS) for English Language Arts, introduces students to scientific knowledge and language related to pterosaurs and their diversity. Students will read content-rich texts, visit *Pterosaurs: Flight in the Age of Dinosaurs*, and use what they have learned to complete a CCSS-aligned writing task, which includes creating an illustrated text about pterosaurs and their fossils.

Materials in this activity include:

- Teacher instructions for:
 - Pre-visit student reading
 - Visit to *Pterosaurs* and Student Worksheet
 - Post-visit writing task
- Text for student reading: “Ancient Flyers”
- Student Worksheet for the *Pterosaurs* visit
- Student Writing Guidelines
- Teacher rubric for writing assessment

SUPPORTS FOR DIVERSE LEARNERS: An Overview

This resource has been designed to engage all learners with the principles of Universal Design for Learning in mind. It presents multiple ways for your students to engage with scientific concepts through reading, observing, discussing, and writing. While certain tasks may challenge individual students, we suggest that all learners participate in each part of the experience. In the paragraphs labeled “Supports for Diverse Learners” that supplement this activity, we have provided suggestions for how to adapt each section for students with different skill-levels. If any students have an Individualized Education Program (IEP), consult it for additional accommodations or modifications.

Common Core State Standards:

WHST.6-8.2, WHST.6-8.8, WHST.6-8.9, RST.6-8.1, RST.6-8.2, RST.6-8.4, RST.6-8.10

New York State Science Core Curriculum:

LS3.2c

Next Generation Science Standards:

PE MS-LS4-1

DCI LS4: **Evidence of Common Ancestry and Diversity.** The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.

1. BEFORE YOUR VISIT

This part of the activity engages students in reading and discussion of a non-fiction text about pterosaurs and pterosaur fossils. The reading and discussion will prepare students for their visit by introducing them to the topic and framing their investigation.

Student Reading

Have students work in pairs, small groups, or as a class. First ask them to create a chart of words or phrases they associate with the words “pterosaurs” and “fossils.” List them in columns, leaving space for notes in each column.

Have students read “Ancient Flyers” and make notes in the right-hand margin. For example, they could underline key passages, paraphrase important information, or write down questions.

Have students add new information to the charts. They should paraphrase and insert information from the reading in the appropriate columns, and correct any misinformation. Students should then discuss their lists, and show where in the reading information is located.

Finally, draw students’ attention to the last paragraph of the student reading and the phrase “fossil record.”

- Ask each pair or group to explain how “fossil record” is different from “fossil.”
(A: The fossil record comprises all fossils that have been found and the information they contain; fossils represent individual organisms.)
- Then ask what we can learn about pterosaurs from fossils versus the fossil record.*
(Answers will vary but may include: individual fossils reveal information about the anatomy of individual pterosaurs, and sometimes about their behavior, whereas the fossil record can show the diversity of pterosaurs.)

Have students discuss and take notes.

* NOTE: The reading does not explicitly answer the last discussion question. Students must reflect on the kinds of evidence and make inferences. For some students, it may be helpful to pose this question as two separate questions and then ask them to compare their answers.

SUPPORTS FOR DIVERSE LEARNERS: Student Reading

- “Chunking” the reading can help keep them from becoming overwhelmed by the length of the text. Present them with only a few sentences or a single paragraph to read and discuss before moving on to the next “chunk.”
- Provide “wait-time” for students after you ask a question. This will allow time for students to search for textual evidence or to more clearly formulate their thinking before they speak.
- Either in place of or in addition to students’ own lists of associations with the words “pterosaur” and “fossil,” create a class list on chart paper to keep posted for the duration of the activity, available for students to refer back to when preparing for the post-visit writing assignment.

2. DURING YOUR VISIT

This part of the activity engages students in exploring *Pterosaurs: Flight in the Age of Dinosaurs* exhibition.

Museum Visit & Student Worksheet

Explain to students that they will be focusing on finding examples throughout the exhibition of pterosaur fossils and models or illustrations, and using worksheets to gather all the necessary information about what the fossil record reveals about pterosaurs and their diversity. Encourage them to choose fossils that show different features and to use their worksheets to highlight the similarities and differences they observe. Note that answers on the Student Worksheet will vary based on their selections. Tell students that back in the classroom they will refer to these notes when completing the writing assignment.

SUPPORTS FOR DIVERSE LEARNERS: Museum Visit

- Review the Student Worksheet with students, clarifying what information they should collect during the visit.
- Have students explore the exhibition in pairs, with each student completing their own Student Worksheet.
- Encourage student pairs to ask you or their peers for help locating sources of information. Tell students they may not share answers with other pairs, but they may point each other to places in the exhibition where answers may be found.

3. BACK IN THE CLASSROOM

This part of the activity engages students in an informational writing task that draws on the pre-visit reading and on observations made at the Museum.

Writing Task

Distribute the Student Writing Guidelines handout, which includes the following prompt for the writing task:

Based on your reading, your visit to *Pterosaurs: Flight in the Age of Dinosaurs*, and your discussions, write an essay in which you explain what the fossil record reveals about pterosaurs and their diversity during the time that they existed on Earth. Support your discussion with:

- definitions of “fossil record” and “pterosaur”
- descriptions of the features of at least three pterosaur fossils
- a comparison of the same three fossils
- labeled illustrations of the fossils or sections of fossils you write about

Go over the handout with students. Tell them that they will use it while writing, and afterwards, to evaluate and revise their essays.

Have students work in pairs, small groups, or as a class. First have them use the prompt and guidelines to discuss the information that they gathered in the *Pterosaurs* exhibition, and to compare and exchange their findings.

Referring to the writing prompt, have students underline or highlight all relevant passages and information from the reading, their class notes, and their notes from the exhibition. Drawing on these sources, students should write individual essays.

SUPPORTS FOR DIVERSE LEARNERS: Writing Task

- Re-read the “Before Your Visit” assignment with students. Ask what they saw in the exhibition that helps them understand what the fossil record reveals about pterosaur anatomy and behavior.
- Allow time for students to read their essay drafts to a peer and receive feedback based on the Student Writing Guidelines.

Student Reading

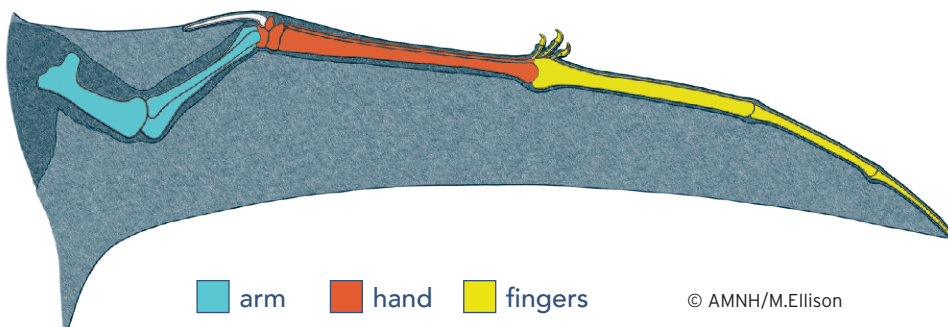
Ancient Flyers

Millions of years ago, pterosaurs ruled the skies. Some of these amazing creatures were the size of a small airplane. Others were as small as a paper airplane. Pterosaurs were not birds. They weren't even dinosaurs. Pterosaurs were flying reptiles that lived alongside dinosaurs from 220 to 66 million years ago. They are all extinct.



© AMNH 2014

Pterosaurs were the first animals with backbones to develop powered flight. They didn't just leap or glide through the air. Rather, they flapped their wings to generate lift, and could travel by air over long distances. Pterosaurs had hollow bones and long forelimbs. All of these features were adaptations for life in the air. Their wings had a strong but flexible membrane that stretched out over a long fourth finger. If you were a pterosaur it would be like using your ring finger to fly!



© AMNH/M.Ellison

How do we know what we know about pterosaurs?

Scientists who study ancient creatures like pterosaurs are called paleontologists. They study fossil remains to learn what pterosaurs looked like and how they behaved.

Fossils show that there were many types of pterosaurs. Paleontologists have discovered more than 150 species. Pterosaur fossils have been found on every continent. But 90% of them come from just five locations. One is in the United States. The others are in Germany, China, England, and Brazil.



© AMNH/C.Chesek

This skeleton of *Rhamphorhynchus muensteri* (ram-fo-RIN-kus MOON-ster-eye) is very well preserved. Wrinkles from its partly folded wings can still be seen.

What are fossils?

Fossils are the remains of ancient organisms. Most formed from the hard parts of organisms such as teeth, shells, and bones.

It is very rare to find a fossil that formed from soft tissues like organs, skin, or muscle.

Because fossils only form under certain conditions, they are very rare. Usually when a creature dies its body is quickly destroyed. A predator or scavenger might eat its flesh. A storm or natural disaster could scatter its bones. Decomposers break down the remains. In most cases, there is nothing left of the body to become a fossil.

Not only that, but to become a fossil, a creature must be buried in just the right environment. Bodies of water like lagoons and lakes are perfect places. Sediments such as mud and sand cover the remains of an organism over time. This protects it from scavengers and natural decay.



© AMNH/C.Chesek

Around 150 million years ago, a young *Pterodactylus antiquus* (tair-o-DAK-til-us an-TEEK-wus) died. Its body sank to the bottom of a lagoon. Before the corpse could decay, layers of sediment settled on top. The sediments pressed the pterosaur flat, like a flower pressed between pages of a book. Minerals replaced the bones, so the skeleton turned to stone.

Fossils don't only form where there is water. Some volcanoes eject ash when they explode. The ash can quickly kill and bury plants or animals in the area. This protects the remains from decay or scavenging.

What kinds of fossils are there?

One kind of fossilization is called replacement. Replacement happens when water flows through small channels in a bone. The water carries dissolved minerals. The minerals grow as tiny crystals in the bone. Eventually they replace the original bone with minerals and it becomes a rock. Once it is a rock this fossil will not wear away easily. Most of the fossils we find today formed like this millions of years ago.

Sometimes things that pterosaurs left behind fossilized too. These are called trace fossils. Fossilized dung is called a coprolite. Paleontologists study coprolites to find out what pterosaurs ate. A set of footprints, called trackways, tells paleontologists how pterosaurs walked. They even provide clues about how these flying reptiles took off and landed. Fossilized eggs help paleontologists understand how pterosaurs developed.

Paleontologists can also make inferences about pterosaur behavior by studying fossils. Take a look at these pterosaurs, and what paleontologists have learned about their diet by studying their teeth.

SHELL CRACKER

The rugged skull of *Dsungaripterus weii* (sun-ga-RIP-tor-us way-eye) shows several adaptations for crushing shellfish. The heavy, pointed snout might have been used to dig clams out of the mud. Then the pterosaur may have used its large, rounded back teeth like a nutcracker. It crushed open the clams to get the meat inside.



© AMNH/C.Chesek



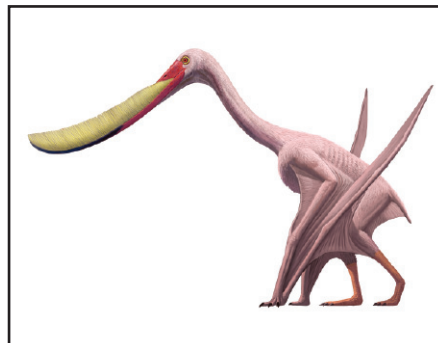
© AMNH 2014

FILTER FACE

The teeth of *Pterodaustro guinazui* (tair-o-DOW-stro gee-NA-zoo-eye) were so thin they resembled the bristles of a brush. The animal had about a thousand of these teeth. They lined the entire lower jaw. But these teeth were not for biting. Scientists think the animal likely scooped up water and strained it for food instead. As the water flowed through its teeth, tiny animals would be filtered out and then swallowed. Living animals like flamingos feed in this way today.



© AMNH/C.Chesek



© AMNH 2014

SOMETHING SWEET

Tapejara wellnhoferi (ta-pe-JAR-a well-n-HOF-er-eye) had a shortened face and downturned beak. It was also toothless. Toucans have these same features today. Like toucans, these pterosaurs may have



© AMNH/C.Chesek



© AMNH 2014

moved through branches and leaves to find hidden fruit and seeds. This pterosaur might have helped Cretaceous plants reproduce by spreading fruit seeds in its droppings.

More to Discover

In 2013, paleontologists working with the American Museum of Natural History made an exciting discovery in Transylvania, a region in Romania.

REMAINS OF A GIANT

This fossil was from a species even heavier than *Quetzalcoatlus northropi* (ket-zel-KWAT-a-lus NORTH-rup-eye). *Quetzalcoatlus* was the largest known pterosaur up to this point. This new pterosaur had a thicker build and larger neck.

These are just a few of the many species that have been discovered so far. Paleontologists continue to find new fossils of pterosaurs. These and other fossils form the fossil record of past life on Earth. With each new discovery we increase our understanding of ancient life.



© AMNH/M.Ellison

Pterosaur neck vertebra
Late Cretaceous, Maastrichtian
Around 67 million years ago
Sebes Formation, Hateg Basin, Romania

Student Worksheet

Choose four pterosaur fossils in the exhibition. Try to choose examples that show a wide range of features, e.g. tooth types, crest size/shape, size, etc. Record the following information for each.

Fossil 1

Fossil age:

Fossil discovery location:

Pterosaur name:

Describe what this fossil reveals about the pterosaur when it was alive:

Sketch and label the pterosaur fossil.

Fossil 2

Fossil age:

Fossil discovery location:

Pterosaur name:

Describe what this fossil reveals about the pterosaur when it was alive:

Sketch and label the pterosaur fossil.

Fossil 3

Fossil age:

Fossil discovery location:

Pterosaur name:

Describe what this fossil reveals about the pterosaur when it was alive:

Sketch and label the pterosaur fossil.

Fossil 4

Fossil age:

Fossil discovery location:

Pterosaur name:

Describe what this fossil reveals about the pterosaur when it was alive:

Sketch and label the pterosaur fossil.

Student Writing Guidelines

Based on your reading, your visit to *Pterosaurs: Flight in the Age of Dinosaurs*, and your discussions, write an essay in which you explain what the fossil record reveals about pterosaurs and their diversity during the time that they existed on Earth. Support your discussion with:

- definitions of “fossil record” and “pterosaur”
- descriptions of the features of at least three pterosaur fossils
- a comparison of the same three fossils
- labeled illustrations of the fossils or sections of fossils you write about

Support your discussion with evidence from the reading and your visit to the *Pterosaurs* exhibition.

Use this checklist to ensure that you have included all of the required elements in your essay.

- I clearly introduced the topic of pterosaurs and the fossil record.
- I clearly and correctly defined “fossil record” and “pterosaur.”
- I explained what the fossil record reveals about pterosaurs and their diversity.
- I included three descriptions of pterosaur fossils that further support my explanation.
- I included three labeled illustrations of pterosaur fossils that further support my explanation.
- I only included relevant information about what the fossil record reveals about pterosaurs and their diversity.
- I used information from “Ancient Flyers” to explain what the fossil record reveals about pterosaurs and their diversity.
- I used information from the *Pterosaurs* exhibition to explain what the fossil record reveals about pterosaurs and their diversity.
- I used academic, non-conversational tone and language.
- I used transitional phrases or text structures to make the connections between ideas clear.
- I included a conclusion at the end.
- I proofread my essay for grammar and spelling errors.

Assessment Rubric

Scoring Elements		1 Below Expectations	2 Approaches Expectations	3 Meets Expectations	4 Exceeds Expectations
RESEARCH	Reading	Attempts to present information in response to the prompt, but lacks connections to the texts or relevance to the purpose of the prompt.	Presents information from the text relevant to the purpose of the prompt with minor lapses in accuracy or completeness.	Presents information from the text relevant to the prompt with accuracy and sufficient detail.	Accurately presents information relevant to all parts of the prompt with effective paraphrased details from the text.
	AMNH Exhibit	Attempts to present information in response to the prompt, but lacks connections to the Museum exhibit content or relevance to the purpose of the prompt.	Presents information from the Museum exhibit relevant to the purpose of the prompt with minor lapses in accuracy or completeness.	Presents information from the Museum exhibit relevant to the prompt with accuracy and sufficient detail.	Accurately presents information relevant to all parts of the prompt with effective paraphrased details from the Museum exhibit.
WRITING	Focus	Attempts to address the prompt, but lacks focus or is off-task.	Addresses the prompt appropriately, but with a weak or uneven focus.	Addresses the prompt appropriately and maintains a clear, steady focus.	Addresses all aspects of the prompt appropriately and maintains a strongly developed focus.
	Development	Attempts to provide details in response to the prompt, including retelling, but lacks sufficient development or relevancy.	Presents appropriate details to support the focus and controlling idea.	Presents appropriate and sufficient details to support the focus and controlling idea.	Presents thorough and detailed information to strongly support the focus and controlling idea.
	Conventions	Attempts to demonstrate standard English conventions, but lacks cohesion and control of grammar, usage, and mechanics.	Demonstrates an uneven command of standard English conventions and cohesion. Uses language and tone with some inaccurate, inappropriate, or uneven features.	Demonstrates a command of standard English conventions and cohesion, with few errors. Response includes language and tone appropriate to the purpose and specific requirements of the prompt.	Demonstrates and maintains a well-developed command of standard English conventions and cohesion, with few errors. Response includes language and tone consistently appropriate to the purpose and specific requirements of the prompt.
SCIENCE	Content Understanding	Attempts to include science content in explanations, but understanding of the topic is weak; content is irrelevant, inappropriate, or inaccurate.	Briefly notes science content relevant to the prompt; shows basic or uneven understanding of the topic; minor errors in explanation.	Accurately presents science content relevant to the prompt with sufficient explanations that demonstrate understanding of the topic.	Integrates relevant and accurate science content with thorough explanations that demonstrate in-depth understanding of the topic.