Science & Literacy Activity

GRADES 3-5

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 pterosaur fossils. 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.

Materials in this packet 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

Common Core State Standards:
W.3-5.2, W.3-5.8, W.3-5.9, RI.3-5.1, RI.3-5.2, RI.3-5.4, RI.3-5.10

New York State Science Core Curriculum:
LS3.2c

Next Generation Science Standards:
PE 3-LS4-1
DCI LS4: **Evidence of Common Ancestry and Diversity.** Some kinds of plants and animals that once lived on Earth are no longer found anywhere. Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.

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.

1. BEFORE YOUR VISIT

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

Student Reading
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. They may also use this space to draw the pterosaurs and pterosaur body parts described in this reading.

Discussion Questions:

- What is a fossil? How do fossils form?
  (Fossils are the remains of organisms that have been dead for thousands of years. Fossils form when an organism dies and is quickly buried by sediments. Animal bodies, even hard parts like skeletons, are normally destroyed over time, but buried remains are protected. Slowly, minerals can fill the empty spaces within bones or teeth, and even replace the remains entirely. This turns the fossil into rock, allowing it to last for millions of years.)
- How do paleontologists use fossils to learn more about extinct organisms? Give specific examples from the reading.
  (Fossils are the remains of dead organisms. They can help paleontologists understand how organisms lived because they preserve features like wings, beaks, and teeth. These contain information about behavior and diet. For example, Pterodaustro had hundreds of thin teeth, which would have been useful for scooping up water and filtering out food.)
- What have scientists learned about pterosaurs from studying fossils?
  (Scientists learned that pterosaurs had light, hollow bones, had wing membranes, and varied greatly in size. Some pterosaurs had teeth and others did not.)

Students can work in pairs, small groups, or as a class. During discussion, remind them to use specific examples from the text to explain their thinking.

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.

2. DURING YOUR VISIT

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

Museum Visit & Student Worksheet
Explain to students that they will be focusing on pterosaur fossils and using worksheets to gather all the necessary information about what these fossils tell us about past life. The Student Worksheet prompts students to find, sketch, and collect information on fossils in five different sections of the exhibition; use the map in the Educator's Guide (amnh.org/pterosaurs/educators) to help students find these sections. Remind students that back in the classroom they will refer to these notes when completing the writing assignment. Note that answers on the Student Worksheet will vary based on their selections.

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 the article "Ancient Flyers," your visit to *Pterosaurs: Flight in the Age of Dinosaurs*, and your discussions, write an essay in which you:
>
> - define the word "fossil"
> - explain how fossils help scientists understand extinct organisms like pterosaurs
> - describe at least one pterosaur species in detail
> - include an illustration of a fossil showing the pterosaur species
> - label this illustration to identify three or more important things about pterosaurs' bodies.
>
> Support your discussion with evidence from your reading and the *Pterosaurs* exhibition.

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 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 pterosaurs.
- 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


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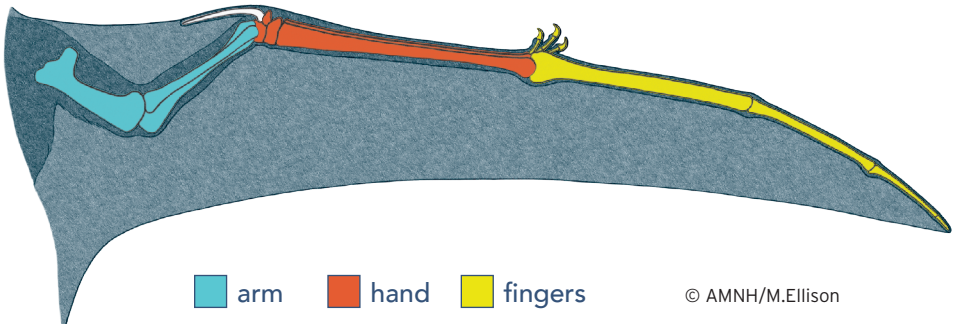
Millions of years ago, pterosaurs ruled the skies. Some of these amazing creatures were the size of a small airplane. Others were as small as a paper airplane. Pterosaurs were not birds. They weren't even dinosaurs. Pterosaurs were flying reptiles that lived alongside dinosaurs from 220 to 66 million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

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!



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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.


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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.

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.

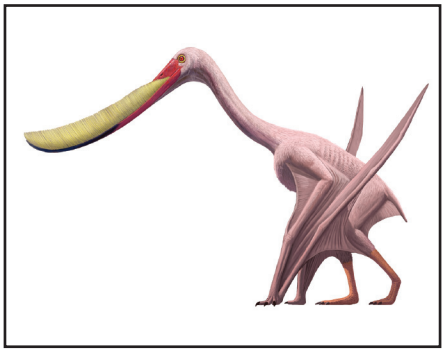
Paleontologists can also make inferences about pterosaur behavior by studying fossils. Take a look at these pterosaurs, and what paleontologists have learned about their diet by studying their teeth.

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.

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.



SOMETHING SWEET

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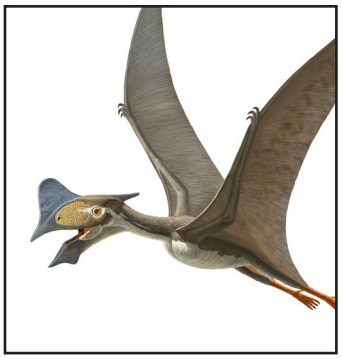

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Tapejara wellnhoferi (ta-pe-JAR-a well-n-HOF-er-eye) had a shortened face and downturned beak. It was also toothless. Toucans have these same features today. Like toucans, these pterosaurs may have moved through branches and leaves to find hidden fruit and seeds. This pterosaur might have helped Cretaceous plants reproduce by spreading fruit seeds in its droppings.

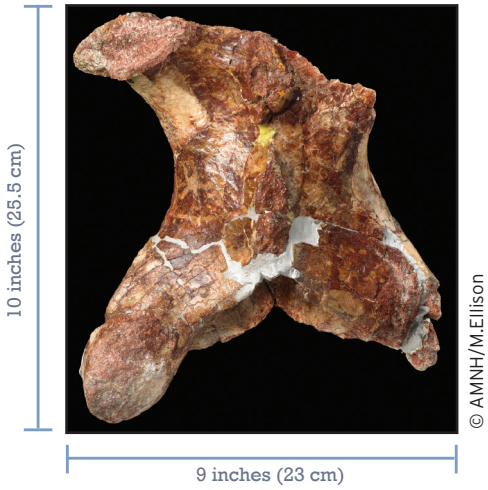
More to Discover

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.



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

Student Worksheet

Each section of the exhibit displays fossils, the evidence used to understand pterosaurs.

As you walk through the sections listed below, select one fossil from each. Sketch and label this fossil, and record useful information about it.

Section 1: What Is a Pterosaur? Go to the "Famous Finds" display.

Draw a pterosaur fossil. Label three or more body parts.

Species:

Describe this fossil.

What can we learn from this fossil?

Section 2: From the Ground Up Go to the "Life on Land" display.

Draw a pterosaur fossil. Label three or more body parts.

Species:

Describe this fossil.

What can we learn from this fossil?

Section 3: Into the Air Go to the "Flight" display.

Draw a pterosaur fossil. Label three or more body parts.

Species:

Describe this fossil.

What can we learn from this fossil?

Section 3: Into the Air Go to the "Colorful Crests" display.

Draw a pterosaur fossil. Label its parts.

Species:

Describe this fossil.

What can we learn from this fossil?

Section 4: A Watery World Go to the "Finding Food" display.

Draw a pterosaur fossil. Label its parts.

Species:

Describe this fossil.

What can we learn from this fossil?

Student Writing Guidelines

Writing Prompt:

Based on the article "Ancient Flyers," your visit to *Pterosaurs: Flight in the Age of Dinosaurs*, and your discussions, write an essay in which you:

- define the word "fossil"
- explain how fossils help scientists understand extinct organisms like pterosaurs
- describe at least one pterosaur species in detail
- include an illustration of a fossil showing the pterosaur species
- label this illustration to identify three or more important things about pterosaurs' bodies.

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 introduced pterosaurs.
- ☐ I defined the word "fossil."
- ☐ I clearly named one pterosaur species and described how fossils provide information about this species.
- ☐ I included a labeled illustration of a specific pterosaur fossil with three or more labeled body parts.
- ☐ All of the information I presented is relevant to pterosaurs.
- ☐ I used information from "Ancient Flyers" to explain pterosaurs and fossils in detail.
- ☐ I used information from the *Pterosaurs* exhibition to explain pterosaurs and fossils in detail.
- ☐ 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 include text using examples, quotes, or other references.	Presents some information from reading materials but may lack accuracy or relevance.	Accurately presents information from reading materials relevant to the purpose of the prompt to inform or explain.	Accurately and effectively presents important information from reading materials to inform or explain.
	AMNH Exhibit	Attempts to include Museum exhibit content using examples, quotes, or other references.	Presents some information from Museum exhibit but may lack accuracy or relevance.	Accurately presents information from Museum exhibit relevant to the purpose of the prompt to inform or explain.	Accurately and effectively presents important information from Museum exhibit to inform or explain.
WRITING	**Focus**	Attempts to address the prompt, but is off-task.	Addresses the prompt, but focus is uneven.	Addresses the prompt with an adequately detailed response; stays on task.	Addresses key aspects of prompt in a detailed response; stays on task.
	Development	Attempts to inform or explain but lacks details.	Informs or explains by presenting some details.	Informs or explains using appropriate details.	Informs or explains by providing detailed and relevant information.
	Conventions	Lacks cohesion and control of grammar, usage, and mechanics appropriate to grade level	Demonstrates an uneven command of standard English conventions appropriate to grade level.	Demonstrates a command of standard English conventions, with few errors as appropriate to grade level.	Maintains a well-developed command of standard English conventions, with few errors. Response includes language and tone appropriate to the purpose and specific requirements of the prompt.
SCIENCE	**Content Understanding**	Content is irrelevant, inappropriate, or inaccurate.	Shows uneven understanding of disciplinary content related to the topic.	Presents generally accurate disciplinary content related to the topic.	Presents accurate and relevant disciplinary content to enhance understanding of the topic.