

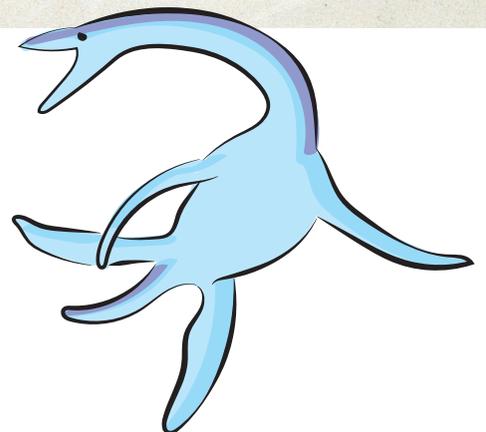
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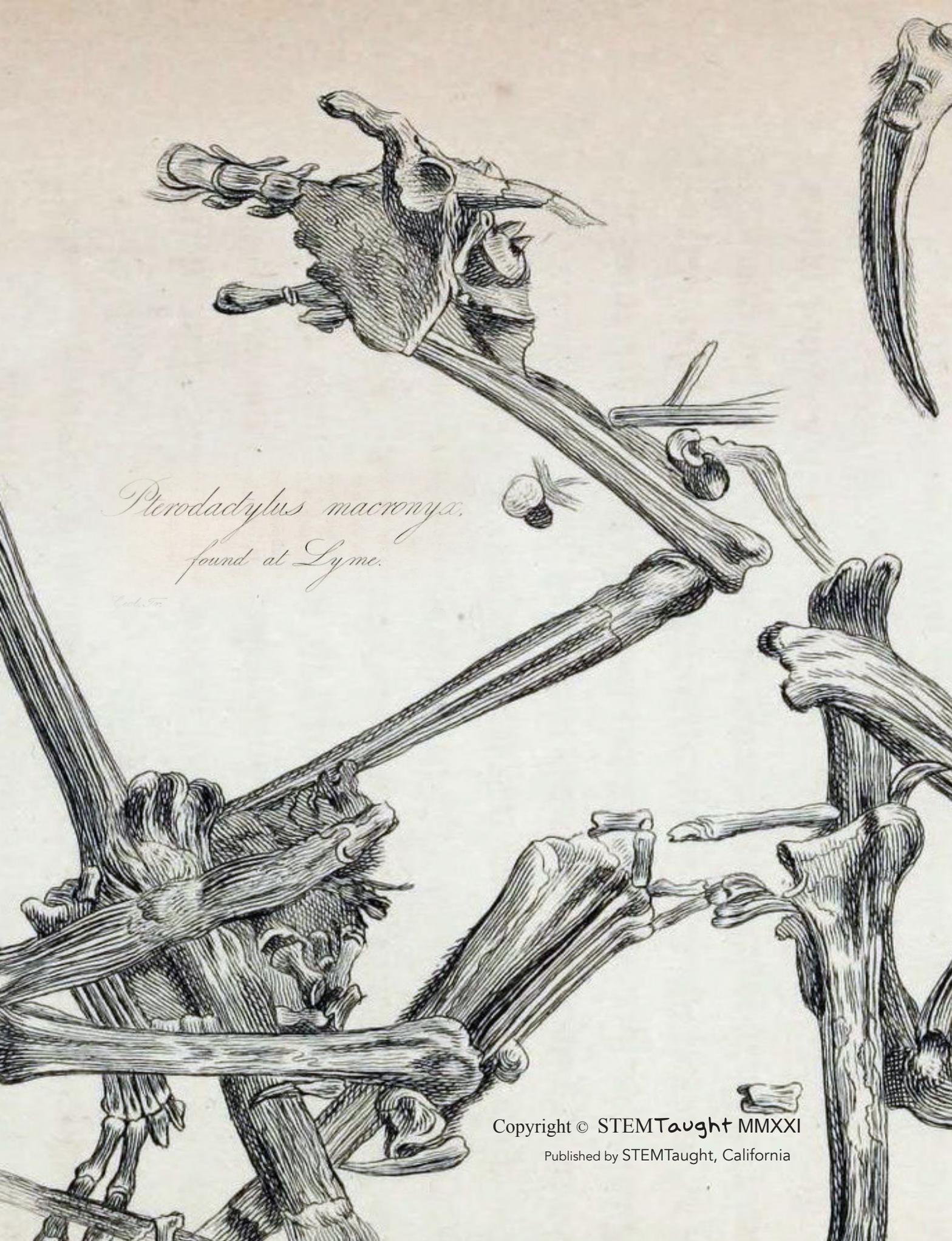
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Scale One inch to each Foot



THE PRINCESS OF PALEONTOLOGY





Pterodactylus macronyx,
found at Lyme.

L. S. F.

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Fossils and Sedimentary Rocks - The Story of Earth's Past

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Written by Jake Hunter, Beth Hunter, Aysha Imtiaz, and Kat Robles. Edited by Grant Cowell. NGSS Correlation and Assessments by Nathan Price PhD.

Illustrations by Bella Hunter, Jake Hunter and Mary Anning



STEMtaught® Grade 4
Next Generation Science

Earth's Place in the Universe 4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.



This is sketch by Mary Anning (1830) of a pterodactyl fossil that she discovered.



Mary Anning

Fossil collector/Paleontologist
London, England (1799–1847)

Mary Anning's stories, drawings and discoveries are featured in this unit. Enjoy learning about the world's first true paleontologist. May her curiosity for discovering fossils and her fascination for the natural world inspire you to make amazing discoveries of your own.



Aysha Imtiaz

Language Arts Teacher, Acedemia Civitas, Pakistan

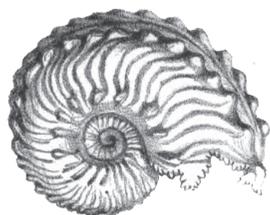
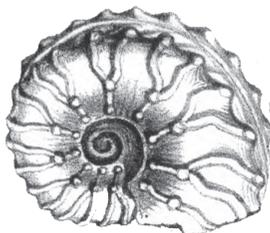
Aysha is an amazing author who researched the life of Mary Anning so that she could write a story about her for you.



Beth and Jake Hunter

Earth Scientist and Mechanical Engineer, STEM Taught

There are a lot of neat things to discover on the Earth, and there are a lot of reasons to enjoy exploring. Look at the rocks everywhere you go. If you learn to recognize sedimentary rocks by their layered patterns you can find fossils, so keep an eye out for sedimentary rocks when you go places!



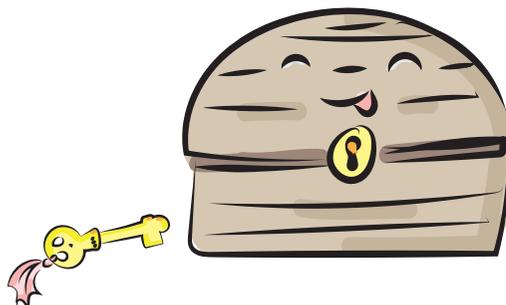


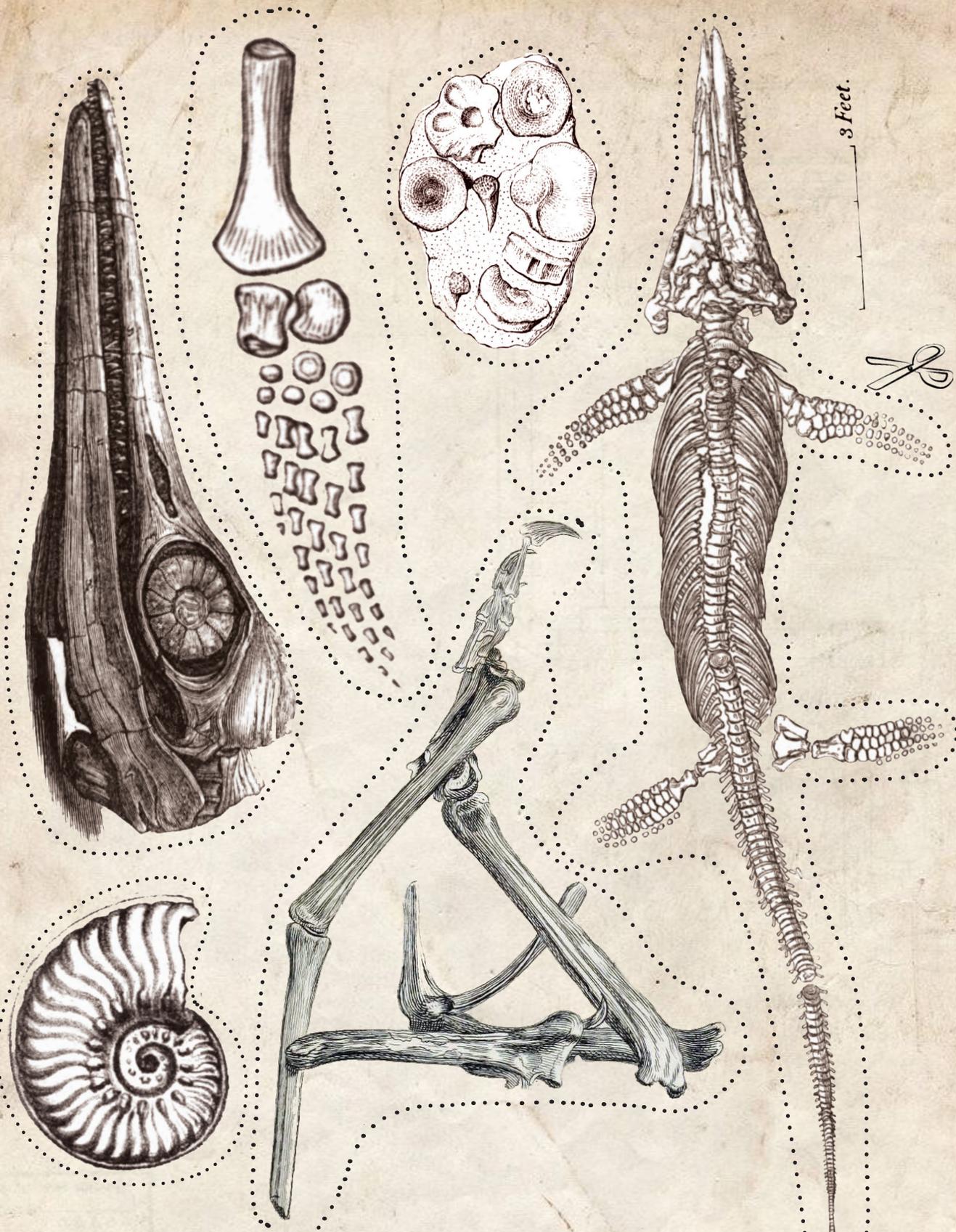
Riddle

Some think I'm fast, and some think I'm slow,
but my speed never changes.

I always move forward and I never stop.
If you wait for enough of me to pass by,
I can turn plants and animals into fossils.

What am I?

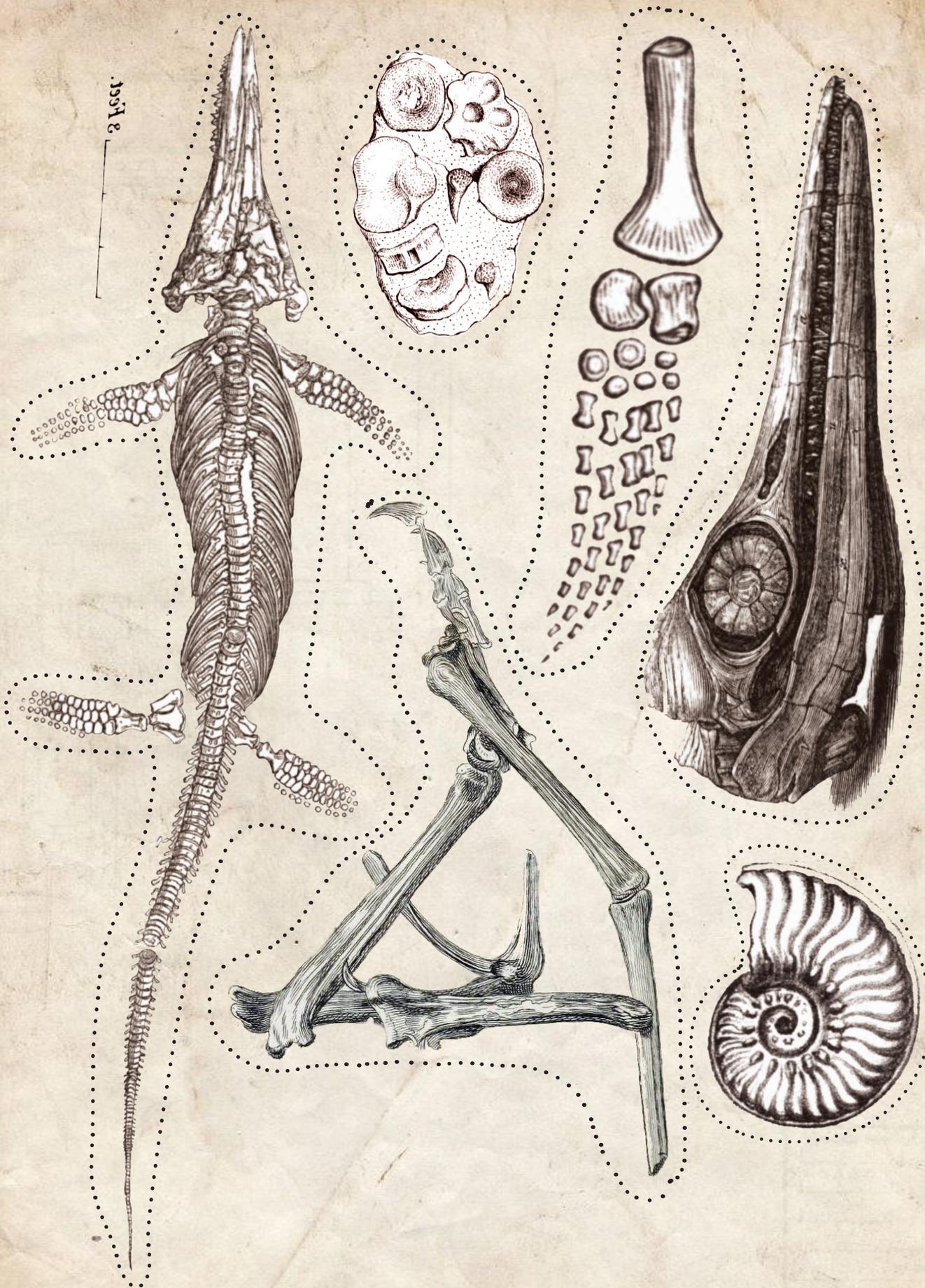




3 Feet.



Mary found and extracted these fossils very carefully. As you read, you can decide where each of these fossils goes. Cut them out and paste them into the story where they belong!



THE PRINCESS OF PALEONTOLOGY



Mary Anning

1799-1847

Fossil collector/Paleontologist

This story features Mary Anning, who was the first to discover a complete skeleton of a *Plesiosaurus* and the first *Ichthyosaurus* known in London. She also found the first remains of what is now known as a pterodactyl. Her discoveries started when she was only 12 years old! With a shovel, a pick and her dog named Tray, little Mary Anning changed the world's understanding of fossils and Earth science!

Plesiosaurus

Plesiosaurus means 'near to reptile.' Mary's discovery of a plesiosaur was literally huge! The dinosaur was over 17 feet long!



Ichthyosaurus

Ichthyosaurus means 'fish lizard.' Mary's fossil ichthyosaur was so well preserved that you can still see some fish bones and scales inside its rib cage—its last dinner!



Pterodactyl

Pterodactyl means "winged finger," which is a description of the wing structure that this ancient creature had. This pterosaur was an ancient relative of birds.



(Pictured here are actual fossil specimens that Mary found.)

Part 1

Mary's fossiliferous playground

Some kids play with dolls or toys. Not Mary. She loved to explore the fossil-bearing cliffs near her town, Lyme Regis, in England. The steep cliffs were her friends, and their jagged corners and crevices were her playground. The cliffs were constantly eroding and changing as they were battered by the rains and tides, creating mudslides and rock falls. Mary, her father, her brother Joseph and her dog Tray would set out to look for fossil discoveries together. Three humans and one animal—10 legs—balancing precariously on the crumbly rocks searching for fossils.

It didn't matter what time it was, or how long it took. The curious team could be found peering closely at rocks that were dimly lit with possibility at dawn and bathed in the orange glow of discovery by sunset.

Name two ways in which the landscape is changing.

Think,
Pair,
Share!



While exploring today, I found a round fossil shell with circular ridge-like patterns swirling out from the center. It is an ammonite!

Paste the fossil you think Mary is describing here.

Ammonites are extinct squid-like creatures with a protective shell. They are related to the modern day nautilus.



These are the same cliffs that Mary explored to find her fossils. The Blue Lias cliffs near Lyme Regis contained sedimentary rocks with fossils from the Jurassic period.

Part 2

Fossils tell stories

The cliffs near Mary's house were the perfect place to look for fossils because they were made of layers of sedimentary rock—chalk, sandstone and limestone. These rocks had originally formed on the ocean floor over 200 million years earlier. The thin sediment layers perfectly preserved remnants of the past—like giant dictionaries with ancient creatures (fossils) tucked deep within their pages.

Sometimes, Mary wondered how many pages of the story had already been lost to pounding waves and the relentless journey of time. How many treasures had surfaced, only to quietly weather away before Mary, Joseph, Pa or Tray ever looked for them?



The processes of erosion and weathering of the rocks are the forces that made Mary's fossil discoveries possible.

How do layers of sedimentary
rock tell a story?

Think,
Pair,
Share!



Mary was fortunate to have lived in an area where she could find fossils, observe them and solve their mysteries. Piecing together the story of Earth's past was a puzzle that nobody from her time had solved. Mary was hardworking and intelligent. She was able to put in the time to turn her hard work and fabulous discoveries into new knowledge.

She worked during the winter months. In winter, there was a lot of rain. The moisture caused landslides, which exposed new fossils that had to be collected quickly before they were lost to the sea.

Today, Joseph discovered a strange-looking fossilized skull. Its dome-like head looked almost like a crocodile. I helped him slowly and carefully chip around its edges to remove it from the rock.

Paste Mary's newest fossil
discovery here.

This is a sketch that Mary drew of the skull she discovered. She would soon discover that she had found the first complete plesiosaurus fossil.

Part 3

The many layers of Mary's work

In November of 1810, when Mary was just 14 years old, her father died of tuberculosis. Joseph had to work to make enough money for the family to eat. Mary sought comfort in exploring for fossils as her father had taught her. The familiar crunch, crunch of the rocks under her shoes was the same, and the fossilized treasures were, too. But now, there were only 6 legs, not 10. Without Pa, and without Joseph it was just Mary and Tray. Tray and Mary. Mary and Tray and thousands of animals that had lived and perished before Mary had ever been born. They were waiting in the rocks for Mary to find them.

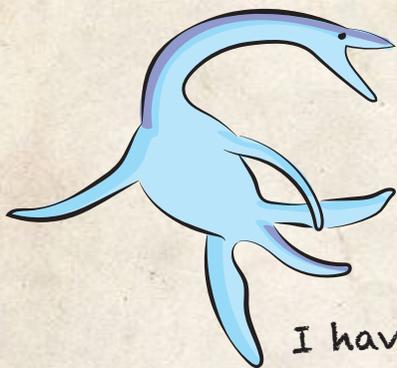
These days, however, Mary was unearthing an animal that was very, very large. Mary was almost 15 now. Three years ago, Joseph had discovered the strange-looking fossilized skull. Each day, Mary and Tray went to the same site with a shovel and a pick to slowly chip away and reveal more of the magnificent creature. It had taken months, but when she was done uncovering the fossilized skeleton, its length spanned over 23 feet!

What processes can cause rock
to weather away and expose
fossils?

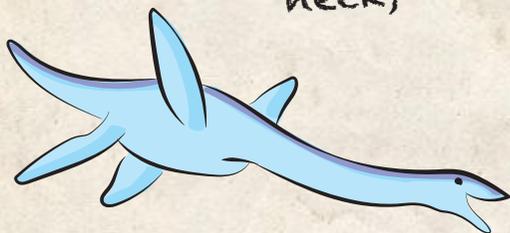
Think,
Pair,
Share!



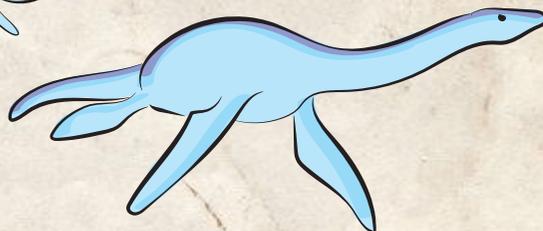
Today, I uncovered more of this magnificent fossilized skeleton. It looks like the bones of a fin or flipper. It is truly a remarkable aquatic animal.



I have a very long neck,



a snakelike head...



...and a lizard-like body.

Paste the fossil you think Mary is describing here.

Each time Mary unearthed one more fossil from the gigantic creature, she imagined the cold rocky sea cliffs were teeming with tropical marine wildlife. How many thousands or millions of years had it taken to create these layers of sedimentary rock? Like life itself, nature was full of unpredictable events. Mary was determined to try to learn as much as she could from her observations of these magnificent fossils.

It was hard work. At night Mary nursed her calloused hands and drew in her sketchbook. She recorded all her findings as she tried to piece together both the creature and its story. Although she was in the middle of a tremendous scientific discovery, her family still had to eat, so Mary also searched for other fossils to sell. The first time Mary sold a large ammonite for half a crown, Mary, Joseph, Ma and Tray had a full meal to celebrate. Mary felt happy that she could help her family because the fossils in the rocks always seemed to be looking out for her.

What did Mary do that made her like a scientist and not just a fossil hunter?

Think,
Pair,
Share!



Mary sketched her giant plesiosaurus fossil in this autographed letter. In the letter she explains that she believes that it is not ichthyosaurus, but is in fact the supposed plesiosaurus.



Scale One Inch to each Foot

I have endeavoured for a rough sketch to give you some idea of what it is like. If you understood me right in thinking that I said it was the supposed plesiosaurus, but its remarkable long neck and small head, shows that it does not in the least ^{resemble} their conjectures; in its analogy to the Ichthyosaurus, it is large and heavy, but one thing I may venture to assure you it is the first

Part 4

Tray was loyal to the end

Just like it's difficult to find a lost trinket on a vast expanse of shoreline, remembering where the fossils are is hard. Sometimes, Mary wasn't able to dig out her findings right away. Tray faithfully followed Mary as she searched for the fossils she had found to continue digging. By this time, many tourists had started purchasing these 'curiosities' from Mary. Tray kept watch, like a good little dog, to help Mary. One day, Tray tumbled off a cliff and Mary couldn't rescue him in time. Mary cried and cried. Her loyal companion had been lost to the raging sea, and she hadn't been able to help him. Although she was lonely, fossil finding helped her feel closer to both Tray and her father.

News spread of Mary's discoveries. As people flocked to Lyme Regis to learn more about Mary's never before seen creatures. Mary dedicated herself to her craft. By reading, drawing, observing and imagining, she was able to understand the ancient environment that these large reptiles lived in. Mary became known as one of the smartest scientists in the land.

What clues do fossils give us about ancient environments?

Think,
Pair,
Share!





People came from all around to visit Lyme Regis and admire the fossils that Mary had uncovered.

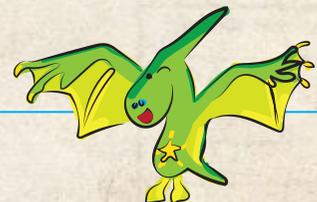
Just keep digging, just keep digging

When she was in her 20s, Mary unearthed what people called a flying dragon. She had discovered the first pterosaur in England! It was a pterodactyl, the flying ancestor of modern birds. Mary's discoveries were showing people what the creatures were like that lived on Earth long ago.

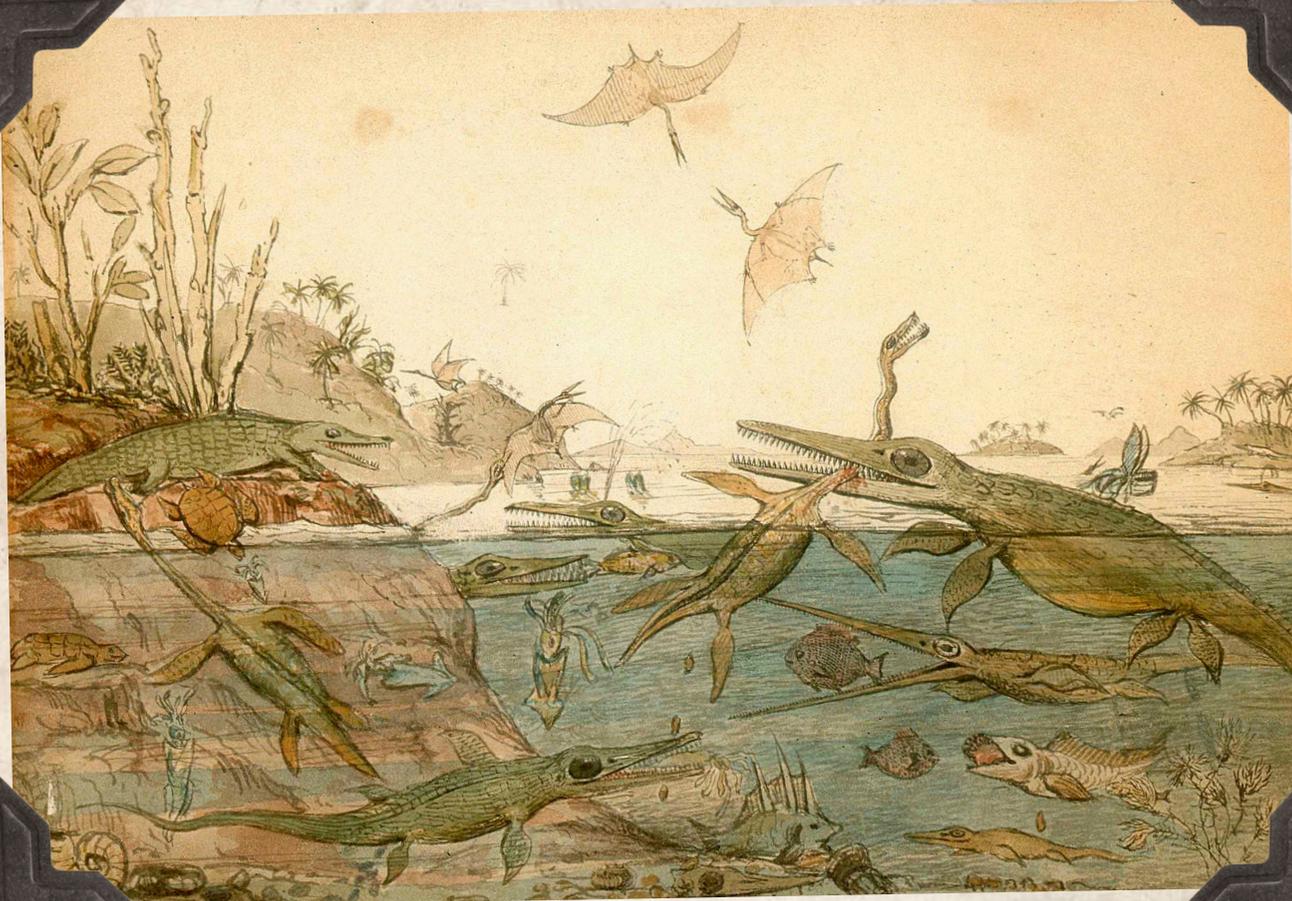
Mary understood that certain species may have been alive before, but weren't alive anymore. Perhaps Mary's biggest contribution to science was her understanding that these ancient species had either changed or become extinct.

Today, I uncovered the fossils of a magnificent winged creature—a flying pterosaur!

Paste the fossil you think Mary is describing here.



This is a sketch that Mary drew of her pterosaur fossil.



With Mary's knowledge of her fossil discoveries, she could describe in great detail the ancient tropical marine environment that her fossilized creatures had lived in. It was said of her:

"The extraordinary thing about this young woman is that she has made herself so thoroughly acquainted with the science that the moment she finds any bones she knows to what animal they belong. Through reading and observing she has arrived to that degree of knowledge as to be in the habit of writing and talking with professors on the subject, and they all acknowledge that she understands more of the science than anyone else in this kingdom."

Like the ancient environments of her fossil hunting grounds, Mary understood that the world was always changing and that it is still changing today.

Like her fossils, Mary's work lives on

Mary was more than a fossil hunter. She was a storyteller, a detective and a scientist. Mary was the first person to correctly identify some strange rocks containing shell fragments and fish vertebrae. She recognized that they were fossilized animal droppings, now known as coprolites. She noticed that the coprolites were always near the larger skeletons she uncovered. By collecting and studying coprolites, she could understand what these extinct species ate. With her keen eye for detail, she was the first person to recognize that even fossilized droppings could give us important clues about the past.

She also discovered the first complete ichthyosaur, a gigantic marine reptile with a short neck and deadly powerful jaws rowed with sharp teeth. Her life was a constellation of firsts, and even today she is honored and remembered as the pioneer of paleontology. She is truly the princess of paleontology. Many of the things we understand today could not have been understood without her work. Her gift to the world was an improved understanding of how our Earth functions—and how it changes.

Mary's life teaches us that no discovery is too big or too small, and no task too hard. Her legacy is an inspiration to all, especially to little girls and boys across the world. From her example, we realize that anyone can live a life of discovery. All you have to do is get out and adventure, observe, and be curious!

Today, I uncovered another magnificent creature. It is the very most complete fossil specimen of a ichthyosaur ever found. It looks very much like an aquatic lizard.

And guess what else I found? Another treasure. Others thought it was just a rock, but I know from looking at it that it is fossilized poo! I just learned what an animal ate for dinner in this ancient ecosystem.

Put the fossil Mary discovered here.

Put the fossil Mary discovered here.

