Become a Junior Paleontologist

The National Park Service protects natural places and historic sites all across the United States. Today, more than 259 national parks are known to preserve fossils!

There are many places to see and discover these fossils in person.

In this book you can learn about ancient life, complete fun activities, and explore just some of the national parks that offer a look into the past.

EXPLORE the ways that paleontologists work, and the methods and tools they use to understand ancient life.

LEARN about Earth’s history, ancient plants and animals, and changes to past climate and environments.

PROTECT our national parks, including fossils and the rocks in which they are found.

Activities in this book are marked with an age indicator. Look for the symbols below:

TRILOBITE Ages 5 and up.

SAUROPOD Ages 8 and up.

SABER-TOOTH CAT Ages 10 and up.

How old are you? ______ That is the number of activities you must complete to become a Junior Paleontologist. Feel free to complete more activities if you have the time.

After completing the activities, there are two ways to receive your Junior Paleontologist badge.

1) Return the completed book to a ranger at a participating park.

2) Visit http://go.nps.gov/jrpaleo for information on how to have a badge mailed to you.

My name is ______________________ I received this book from ______________________

My address is ____________________________________________
To Play: Use something small like a dime or small candy as your game piece and place it on start.

With a partner, take turns flipping a coin to move your game piece: heads you move two spaces, tails you move three spaces.

Follow the instructions on the purple spaces along the way. The first player to discover the fossil wins!

Road to Fossilization (#1)

It takes a lot of luck and good timing to become a fossil. Big creatures with hard parts (bones and shells) that die where sediment is collecting have the best chance at preservation. Fragile or small things are rarer fossils.

Follow the Road to Fossilization and discover more about how fossils form.

Fossils are rare and cannot be replaced. It is exciting to find one, but important to protect it and keep it in place.

If you find a fossil in a national park, leave the fossil where it is and share your discovery with a park ranger.

Paleontologists are very important in national parks. They help the National Park Service protect fossils by finding them and teaching visitors to protect them.

Discovered!
Vertebrate Fossils
Animals with backbones (vertebrae) are known as vertebrates. Mammal, fish, and dinosaur bones or teeth are all examples of vertebrate fossils.

Invertebrate Fossils
Animals without backbones are known as invertebrates. Shells and exoskeletons help organisms like clams and corals to be preserved.

Plant Fossils
Fossil plant remains include petrified wood, leaves, cones, seeds, pollen, and sometimes even flowers. Amber is tree sap and can preserve other organisms.

Trace Fossils
Trace fossils—tracks, burrows, and coprolites (ancient poop)—are evidence of organisms interacting with their environment.

Fossil Types (#3)
Did you know that footprints made by an ancient animal or the imprint of a leaf can be considered a fossil? Fossils are evidence of life preserved within a geologic context. Paleontologists study both the fossil and the rocks that they are preserved in to understand past life forms and the environment in which they lived.

Write the letter of each picture in the box of the fossil type it represents.

Vertebrate Fossils
Animals with backbones (vertebrae) are known as vertebrates. Mammal, fish, and dinosaur bones or teeth are all examples of vertebrate fossils.

Invertebrate Fossils
Animals without backbones are known as invertebrates. Shells and exoskeletons help organisms like clams and corals to be preserved.

Plant Fossils
Fossil plant remains include petrified wood, leaves, cones, seeds, pollen, and sometimes even flowers. Amber is tree sap and can preserve other organisms.

Trace Fossils
Trace fossils—tracks, burrows, and coprolites (ancient poop)—are evidence of organisms interacting with their environment.

Fossil Hunters (#2)
A paleontologist uses fossils to understand the story of Earth’s history. This story includes the plants and animals that once lived on Earth. Evidence of this past life is found by paleontologists within sedimentary rocks. These rocks are made of the broken pieces of other rocks called sediment that have become compacted or cemented together over time.

Sediment can be clay, sand, or gravel. Rocks can form on land or in water. An ancient beach might leave behind sand which forms into sandstone. Ocean sediments could develop into marine shale made of clay, or limestone from broken down shells. If the remains of an animal or plant, like bones or leaves, are covered by sediments, a fossil may become preserved in the rock formed from these sediments.

PALEONTOLOGISTS and ARCHEOLOGISTS are scientists who dig and study old things from the ground. They both use the same tools and techniques to look for things in sedimentary rocks, but there are some big differences too.

PALEONTOLOGISTS study the remains of past animals and plants. ARCHEOLOGISTS study the remains of human history, culture and civilizations.
Paleontologists are scientists who study what life was like on Earth a very long time ago. They do this by "reading" fossils and rocks for clues about past environments and life. Look at the pictures below and fill in the missing word to find out some of what paleontologists do.

**WORD BANK**
Applying  Digging  Sealing  Looking  Brushing

- _a jaw bone out of the rock with a rock hammer._
- _glue to a petrified wood stump in the field._
- _away sediment from bones inside an opened plaster cast._
- _at fossil bones with the help of a microscope._
- _fossil bones in plaster jacket for transport._

For every hour they spend in the field, paleontologists spend at least three hours in the lab. Imagine that for every hour you spent playing outside you then had three hours of homework!

- _fossil bones in plaster jacket for transport._

**Find the Fossil (#6)**
It is not always easy to see fossils in rocks. **Search** the pictures below carefully and **circle** your 9 fossil finds.

The fossils in these pictures are very different from each other. Each lived at a different time and formed in different ways. More information about fossil types can be found on page 6 of this book.
Geologic Time (#7)

Earth formed 4.6 billion years ago. We can divide that time into smaller sections called eons, eras, and periods. Paleontologists are interested in these different times because each had unique plants and animals.

The colors below represent 4 major divisions of geologic time—the Precambrian, Paleozoic Era, Mesozoic Era, and Cenozoic Era. First, draw a line from each picture of a major event to where it would fall on the time line. Then, using the pictures and events as clues, label each colored section as one of the following Ages: Mammals, Fishes, Early Life, or Reptiles.

25 thousand years ago: Smilodon and other mammals dominate.

220 million years ago: Dinosaurs like Coelophysis appear.

500 million years ago: Trilobites and fish dominate the seas.

From 4.6 billion years ago until 541 million years ago was a time period called the Precambrian.

If we made this timeline to scale the red bar would take up 4 pages!

It’s All Relative (#8)

At Grand Canyon National Park, Arizona, the rocks form neat layers. You can see their different colors in this picture. These layers can help paleontologists find out the age of a fossil by using relative age dating.

Relative age dating is a way to compare the age of different fossils in a section of rock based upon their position. This gives a general idea of what is older or younger.

To get exact ages, paleontologists use absolute age dating techniques like testing the minerals of volcanic rocks.

2 billion years ago: Stromatolite colonies formed in shallow warm waters.

440 million years ago: Cycads and ferns grow on land.

541 million years ago: Explosion of Diverse Life

66 Million Years Ago: Mass Extinction

125 million years ago: Flowering plants appear.

252 Million Years Ago: Mass Extinction

500 million years ago: Trilobites and fish dominate the seas.

220 million years ago: Dinosaurs like Coelophysis appear.

25 thousand years ago: Smilodon and other mammals dominate.

500 million years ago: Trilobites and fish dominate the seas.

From 4.6 billion years ago until 541 million years ago was a time period called the Precambrian.

If we made this timeline to scale the red bar would take up 4 pages!

25 thousand years ago: Smilodon and other mammals dominate.

220 million years ago: Dinosaurs like Coelophysis appear.

500 million years ago: Trilobites and fish dominate the seas.

From 4.6 billion years ago until 541 million years ago was a time period called the Precambrian.

If we made this timeline to scale the red bar would take up 4 pages!

RULERS OF RELATIVE AGE DATING:
#1: Sediments were originally laid down flat.
#2: The oldest rocks are found on the bottom.
#3: Fossils in the same layer are the same age.

Using the rock column to the left and the rules found above, compare the ages of the fossils and answer some questions. (HINT: Use the timeline on page 9 to help you!)

Which is older: the mammal jaw or the sea worm?

Which is older: the trilobite or the jellyfish?

What time period is not shown?

Which organism was around for the most time periods?
Climate Change (#9)

The story of life on Earth began in a time known as the Precambrian. During this time soft-bodied creatures like worms and jellyfish lived in the world’s oceans while the land remained barren. Looking at the world today, we can see that things have changed a lot.

In Glacier National Park, Montana, we can learn about climate change from some of the first life forms: ancient plant-like organisms called algae (al-gee). Precambrian algae formed large colonies called stromatolites in warm, tropical waters. Over time these colonies were buried under sea sediment and turned to stone.

The landscape also tells us about climate change. When the Rocky Mountains formed, rocks that had been at the bottom of the ocean were folded and pushed up high into the sky while the North American continent moved north. Glaciers carved the landscape creating rugged mountains that we see today and paleontologists find ancient tropical algae under ice and snow!

Buried Treasures (#10)

You can trace the transition from Precambrian life to more complex creatures in Yukon-Charley Rivers National Preserve in Alaska. This park protects one of the best continuous records of ancient life in the world – from 800 million to 40 million years ago.

Fossils found there include everything from Precambrian sea creatures like jellyfish and worms to Pleistocene pollen from land plants that lived in the area tens of thousands of years ago.

You can practice stewardship—protecting natural areas—by helping to preserve Yukon-Charley Rivers in this game. Follow the directions to save squares of land one at a time.

Ranger Talk

Climate has changed many times in the Earth’s history. Many scientists are studying how climate is changing today. Ask a Ranger:

Does this park have any evidence of climate change?

How have plants and animals changed here over time?

Climate change is not a thing of the past. Today scientists are studying how quickly temperatures and weather patterns are changing on Earth. With over 6 billion people on the planet, humans are affecting the climate.

Citizens concerned with protecting a natural or historic area may work to get that place designated as a national park. What else can you do to protect important areas around you?

To Play: Take turns connecting 2 dots with a solid line. When a player’s line makes a square, that player puts initials the square and takes another turn. The player with the most squares wins!
Connect the dots to see a Paleozoic Era fish called a placoderm.

Plants began to take root on land, with ferns and conifers providing food to land animals.

North America looked very different during this time. It was near the equator with water covering much of today’s dry land.

How are these plants different than those near your home?

MammOTH Cave National Park, Kentucky, formed out of Paleozoic limestone. This limestone eroded as water flowed through and created magnificent caves.

Some fish, called placoderms, had hard armor and sharp jaws making them fierce predators of the Paleozoic seas.

Placoderms were marine arthropods, meaning they are distantly related to shrimp, lobsters, and crabs!

United States during the late Paleozoic Era, 400 million years ago.

Read the bubbles of information to find out more about the Paleozoic era and answer the questions.

United States during the late Paleozoic Era, 400 million years ago.

What animals today live part of their lives in the water and part on land?

What do you think a trilobite felt like?

Wet and Wild (#11)

The Paleozoic began with a huge change in life called the Cambrian Explosion. Many never-before-seen creatures with shells and new body designs are found in rocks from this time period. The late Paleozoic Era is known as the Age of the Fishes because the first fish appeared and rapidly evolved during this time period.

Would your hometown have been dry during this time?

At the end of the Paleozoic, a huge extinction event claimed life on the planet once again. 70% of all land organisms and 95% of all marine species became extinct at that time.

Wet and Wild (#11)

The Paleozoic began with a huge change in life called the Cambrian Explosion. Many never-before-seen creatures with shells and new body designs are found in rocks from this time period. The late Paleozoic Era is known as the Age of the Fishes because the first fish appeared and rapidly evolved during this time period.

Read the bubbles of information to find out more about the Paleozoic era and answer the questions.

Would your hometown have been dry during this time?

At the end of the Paleozoic, a huge extinction event claimed life on the planet once again. 70% of all land organisms and 95% of all marine species became extinct at that time.
Dinosaur National Monument, Utah and Colorado preserves an amazing record of Jurassic fossils including dinosaur bones and fossilized clams. Dinosaurs, just like living things today, were specially suited for their environments. Plant-eating Diplodocus and meat-eating Allosaurus both had to find food and shelter in the environments of the time.

Imagine what the Jurassic forest of conifers, ferns, and cycads would offer to a dinosaur that lived there. Draw your Jurassic creature below.

To become petrified, the trees above were covered in wet sediment. Over time the chemicals in the trees were replaced with other chemicals and the wood turned to stone.

Grass and flowering plants did not appear until the end of the Mesozoic Era, about 120 million years ago. Until then, ferns, cycads, and conifers dominated.

Cycads have tough, scaley bark on their trunks and bright cones. Can you find one on the next page?

The Triassic marks the first appearance of dinosaurs. One of the earliest dinosaurs, the 4 foot tall Coelophysis (see-low-fi-sus), lived among the giant trees in Petrified Forest.

Early dinosaurs were often smaller than the giants of later times like Tyrannosaurus rex or Stegosaurus.
Everything is Bigger in Texas (#14)

Giants ruled the late Mesozoic Era. Paleontologists have found the remains of dinosaurs, flying reptiles called pterosaurs, and others in the Cretaceous rocks of Big Bend National Park, Texas. These enormous creatures (some bigger than blue whales!) dominated the land for millions of years before they became extinct at the end of the Cretaceous Period, about 120 million years ago.

Compare yourself to these giant creatures and find out how big they really were! Fill in your height and answer the questions.

Could you have fit inside the mouth of a hungry Deinosuchus? Could your parents?

____________________________________________________________________________

How many people your height could lay down for a ride on the wings of Quetzacoatlus?

____________________________________________________________________________

How many feet longer is the Alamosaurus than you are tall?

____________________________________________________________________________

Make up your own question to ask a parent or friend: ______________________________

____________________________________________________________________________

What’s in a name?

Deinosuchus (di-no-soo-kuss) means terrible crocodile.

Quetzacoatlus (ket-za-co-ot-lus) was named for the Aztec feathered serpent god Quetzalcoatl.

Alamosaurus (al-uh-mo-sore-us) was not named for the famous Texas landmark, but for the rock formation in which the bones were first found (Ojo Alamo formation, New Mexico).
Cenozoic Round-Up (#15)

With the extinction of dinosaurs and giant reptiles 66 million years ago, mammals were able to diversify and grow in numbers. Evidence of these recent wild creatures is well represented in the fossil record. Some look like animals alive today.

Guess the modern relatives of each animal and write them on the cards. Then answer the questions below.

Paleontologists find and study fossils, but they often rely on artists to bring ancient creatures to life. By studying fossils and comparing them to living plants or animals artists can create a picture of what the organism might have looked like when it was alive.

Examples of an artist’s reconstructions of 52 million year old fish from Fossil Butte National Monument, Wyoming are shown below. Match the 2 illustrations to the fossils (blue box) they were based on.

If you could choose one of the animals above to be a pet, which would you choose? Why?

Paleontologists name plants and animals based on characteristics such as: what they look like, what they eat, and where they were found. What would you name your new pet?

What could you buy at the grocery store to feed your new pet?

Eye of the Beholder (#16)

Paleontologists find and study fossils, but they often rely on artists to bring ancient creatures to life. By studying fossils and comparing them to living plants or animals artists can create a picture of what the organism might have looked like when it was alive.

Examples of an artist’s reconstructions of 52 million year old fish from Fossil Butte National Monument, Wyoming are shown below. Match the 2 illustrations to the fossils (blue box) they were based on.

Now it is your turn! Draw what you think the Cenozoic fish below would have looked like during its life. Imagine what colors or patterns its scales might have had.

It is unusual for soft-bodied animals to be well preserved. Fish with tough bones and scales have a better chance. Quick burial in calm lake waters preserved amazing complete fish skeletons.

If you could choose one of the animals above to be a pet, which would you choose? Why?"
What kind of fossils might you find where you live? Here is a map of parks that preserve fossils across the United States. How many are in your home state? You can find out more about fossil parks near you at http://go.nps.gov/nfd_fossilparks.

Fossils are such a popular resource that many states have chosen a "State Fossil" or "State Dinosaur." Typically, the State Fossil represents a fossil which is well known or common in that state. Check at your library or on the internet to find your state's special fossil. If your state hasn't chosen one, choose a fossil to represent your state. You can even write a letter to your state legislature and encourage them to adopt your fossil choice as the state fossil!

State: Draw your state fossil below!

Fossil:

Where was it found?:

How does it represent your state?

The map above shows more than 259 parks that preserve fossils, but one is missing! In 1922 Fossil Cycad National Monument was established in South Dakota. This monument preserved one of the largest deposits of Cretaceous cycad fossils (palm-like tree), many nearly perfectly preserved. The fossils were so spectacular, in fact, that researchers collected nearly all of the fossils from the monument. Removal of fossil material was so great that the site was withdrawn as a national park unit in 1957.

The National Park Service is much more careful with fossil resources today. With the help of Junior Paleontologists like you, we can protect the remaining fossils from disappearing.

Learn more about Fossil Cycad National Monument at http://go.nps.gov/nfd_focy

Fossils Where You Are

In addition to the National Park Service, many other Federal, state, county, and local areas and museums provide opportunities to see fossils and learn about paleontology.

Draw or describe fossils from the site you are visiting today, or would like to visit in the future!
Celebrate National Fossil Day! Find out more at http://go.nps.gov/nationalfossilday

Content
Krista L. Jankowski

Layout and Design
Krista L. Jankowski
Caroline Marshall Hill

Photographs and Images
Krista L. Jankowski - Grinnell Glacier background photo, pg 11
Catherine Riihimaki - Stromatolites, Glacier National Park, pg 11
Ron Blakey - US map, pg 13
TheColoringSpot.com - Precambrian life, pg 10
Additional images courtesy of the National Park Service.

Illustrations © individual artists. Used with permission.
Hermes Arriola - Road to Fossilization graphics, pgs 3-4; Coelophysis, pg 15
Errolyn Weston Daley - Sketches, pg 5
Elizabeth Fodde-Reguer - Jurassic ecosystem, pg 16
Jose Garcia - Reconstructions, pg 20
Andrew Hartsock - Age indicators (trilobite, saber-tooth cat); Quetzacoatlus, pg 18; Glyptodon, pg 19
Jessie Katz - Age indicator (sauropod)
Jennifer McDonald - Miacis and Mesohippus, pg 19
Thea Price-Eckles - Petrified stump, pg 15
Simone?! Satchell - “Follow up” graphic
Jonathan Steadman - Deinosuchus, pg 18; Mammuthus, pg 19
Ethan Wood - Sketches, cover and pg 2

Additional Support
Vincent Santucci
Jim F. Wood
Jason Kenworthy
Melanie Ransmeier

Elena Evans
Marcia Fagnant
Arvid Aase
Victoria Stauffenberg

Bruce Nash
Jeff Selleck
Jeff Wolin

Matt Greuel
Christie Young
Allyson Mathis

Laine Weber
Annette Rousseau
Erica Clites