PALEONTOLOGY

3–8 Science Unit Study



THE GOOD AND THE BEAUTIFUL



Paleontology

CREATED BY THE GOOD AND THE BEAUTIFUL TEAM

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Unit Information

Student Journal

All The Good and the Beautiful science units include activities in a student journal. Each student should have his or her own student journal, and the parent or teacher will direct the student regarding when to complete the activities as directed in the lessons. This book can be purchased by going to **goodandbeautiful.com/science** and clicking on the *Paleontology* unit link.

Science Wall

All The Good and the Beautiful science units include vocabulary words to be placed on your science wall, which is a wall or tri-fold presentation board in your learning area on which you can attach the vocabulary words and other images. ***Cut out the vocabulary word cards at the beginning of the unit.*** The course will indicate when to place them on the wall.

Lesson Preparation

All The Good and the Beautiful science units include easy-to-follow lesson preparation directions at the beginning of each lesson.

Activities

Many of The Good and the Beautiful science lessons involve hands-on activities. **Adult supervision is recommended for all activities as some require sharp objects, heat sources, or small objects that could be a choking hazard for young children.** There are no experiments in this unit.

Unit Videos

Some lessons include videos that were created by The Good and the Beautiful. Have a device available that is capable of playing the video from **goodandbeautiful.com/sciencevideos** or from the Good and Beautiful Homeschool app.

Content for Older Children

Some lessons include extra content that is more applicable for older children (grades 7–8). Parents or teachers may choose to skip this content if instructing only younger children.

Content for Younger Children

Some lessons include extra content that is more applicable for younger children (grades 3–6). Parents or teachers may choose to skip this content if instructing only older children.

Belief Statement

The *Paleontology* unit has been written with a focus on basic Bible principles, allowing all families to use this unit and add in their specific beliefs. This unit works well for those who hold either Young Earth or Old Earth beliefs.

Versions

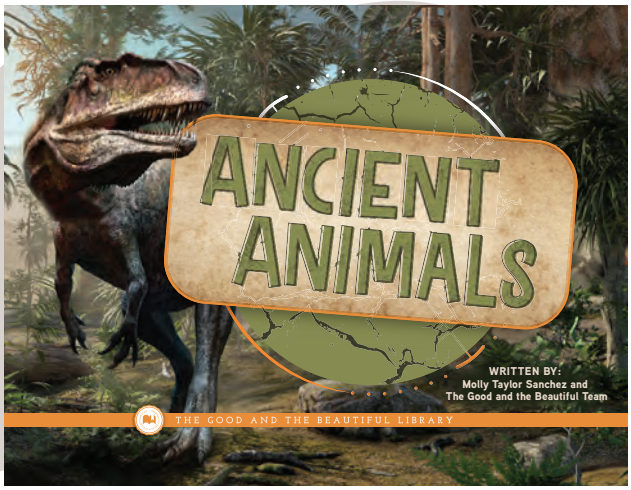
New discoveries are being made on an ongoing basis. This course is reviewed and revised periodically to keep information as up to date as possible. This version is the first edition of this unit.



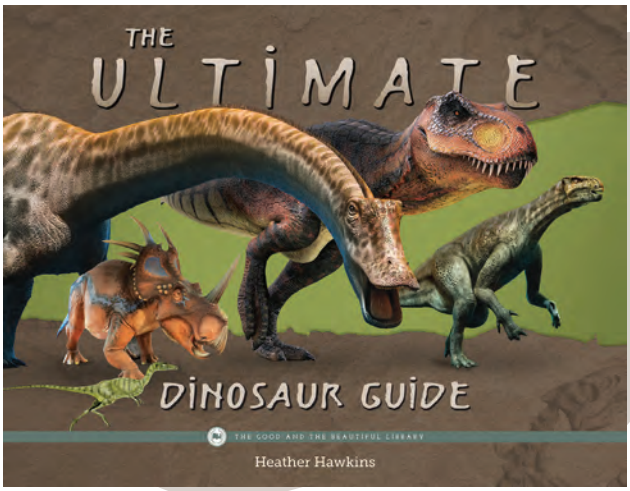
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Read-Aloud Book Pack

The books below are optional read-aloud books that complement this unit. These books can be purchased as a book pack by going to **goodandbeautiful.com/science** and clicking on the *Paleontology* link.



Ancient Animals
By Molly Taylor Sanchez and
The Good and the Beautiful Team



The Ultimate Dinosaur Guide
By Heather Hawkins





CORRELATED BOOKS

The Good and the Beautiful has several books that correlate well with the *Paleontology* unit. It can be a wonderful experience for children to read books at their levels that are related to the subjects they are learning in science. The bookshop includes both fiction and nonfiction books organized according to reading level. Find the correlated books by going to **goodandbeautiful.com/science** and clicking on the *Paleontology* science unit product page.

GRADES 7–8

Lesson Extensions

How the Extensions Work

Each lesson has an optional lesson extension for children in grades 7–8. Complete the lesson with all the children, and then have the older children complete the self-directed lesson extension. These extensions are located in the Grades 7–8 Student Journal.

Answer Key

The answer key for the lesson extensions can be found on the free Good and Beautiful Homeschool app in the science section. Visit **goodandbeautiful.com/apps** for information on accessing the app. The app can be accessed from a computer, phone, or tablet.

Flexibility

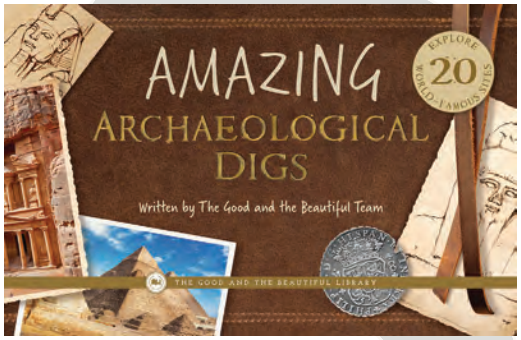
The amount of time it will take to complete each lesson extension will vary for each child. The average time is about 10–15 minutes per extension. Parents/teachers and children may choose to omit parts of the lesson extension if desired. Encourage the children to stretch their capabilities, but also reduce work if needed.

Taking Notes

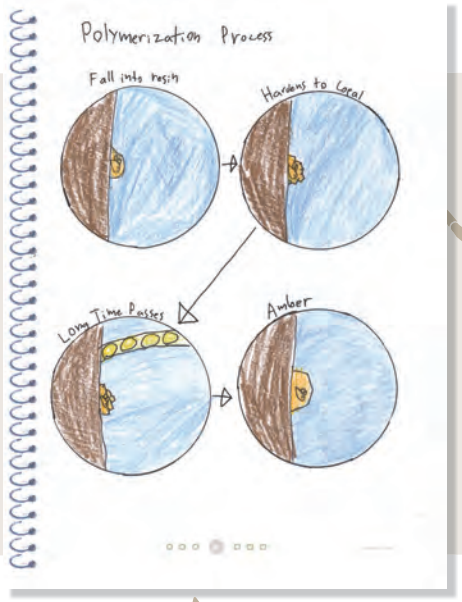
Some of the grades 7–8 lesson extensions have the children summarize the material read. Teach the children to look for key information, summarizing the most important points. Students can also add notes with their thoughts and the facts that are most interesting to them.

Optional Grades 7–8 Reading Book

We recommend *Amazing Archaeological Digs* as extra reading for students in grades 7–8. This book can be purchased by going to **goodandbeautiful.com/science** and clicking on the *Paleontology* unit link.



Amazing Archaeological Digs
By The Good and the Beautiful



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Supplies Needed

You will need the following supplies for activities. There are no experiments in this unit.

Lesson 1

None

Lesson 2

- 2 cups of cornstarch per child
- 1 cup of water per child
- 1 medium-sized bowl and spoon per child
- 2 straws cut in half per child
- 1–2 small toys with smooth, hard surfaces (plastic dinosaurs if available) per child

Lesson 3

- Permineralization activity prepared previously
- Simple tools for digging (toothpick, butter knife, fork, etc.)
- Glue

Lesson 4

- Sidewalk chalk or tape
- Glue
- 5 leaves (any leaves, such as from a tree or houseplant)
- 3 cups filled halfway with water

Lesson 5

None

Lesson 6

None

Lesson 7

- 2 bananas (optional)
- Thermometer (optional)
- One large and one small plastic bottle (such as a 2-liter pop bottle and a standard 16.9-oz water bottle)

Lesson 8

- 4 slices of sandwich bread per child
- 3–4 small objects per child, such as paper clips, candies, toothpicks, etc., that can be placed between the bread
- 1 heavy book per child

Lesson 9

- 1 small-to-medium soft chocolate chip cookie per child
- 2 toothpicks per child

Lesson 10

- A pair of scissors for each child

Lesson 11

- 9 pennies
- 9 dimes
- Tape
- Optional: 4 additional coins (if all the children are working together in a timed game)



Vocabulary

Instructions: Cut out the vocabulary cards in this section. Place them on your science wall when prompted to do so in the lessons. Review the vocabulary words several times during this unit and, if desired, at various times throughout the school year.



Paleontology

the scientific study of the remains of ancient animals and plants

Fossil

the preserved remains, or traces of remains, of ancient organisms



Impression

an indented mark formed by life preserved in rock



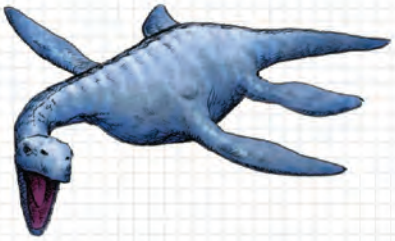


Pterosaur

an extinct group of flying reptiles

Plesiosaur

an extinct group of marine reptiles



Permafrost

a layer of earth that stays frozen year-round, found primarily in polar regions



Archaeology

the study of human culture and history

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Introduction to Paleontology

Objective

Help the children feel the wonder of discovering ancient life and understand the process of finding and studying remnants of the past.



Preparation:

- None

Activity Supplies:

- None

Read to the Children

Have you ever wondered what it would be like to discover something from long ago? In this unit we will learn about the branch of science where people specialize in studying the things left behind by the animals, plants, and people of times past.

Science Wall: Vocabulary Word

Place the vocabulary card PALEONTOLOGY on your science wall. Read and discuss the word and its definition.



Read to the Children

Children have made important discoveries in paleontology. Young Wylie Brys discovered a nodosaur [NO–doh–sore] bone at a construction site in Texas, USA, and 12-year-old Nathan Hrushkin found a hadrosaur [HAD–roh–sore] bone while hiking in Canada. In this science unit, you will learn so much about where and how to look for ancient artifacts that maybe someday you will find a dinosaur bone, too!

Picture Observation

Have the children observe the images of paleontologists included on page 6 of this lesson.

Read to the children: Paleontologists, scientists who work in paleontology, use a variety of tools to remove and study the remains of ancient life, ranging from jackhammers to dental picks. What similarities do you see in these pictures? [clothing, environment, tools] Do you see the string set up in a grid? Why do you think that grid is used? We will discover the answer in the next activity.



Dinosaur Discovery Video



Watch the video titled "Paleontology: Discovering Dinosaurs" at goodandbeautiful.com/sciencevideos.

Read to the children: Why do you think scientists take careful notes? When a dinosaur is found, the position of each bone and the rock surrounding it provide clues that help scientists learn about the dinosaur and the world it lived in.

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World of Discovery Map Activity

Refer to the "World of Discovery Map" at the end of this lesson.

Read to the children: Do you see the red circles on the map? These are discovery hot spots where dinosaur bones are often found. Do we live near any of these hot spots? We are going to read about each one in order. As I read about each hot spot, find its circle on the map. Write the blue underlined letters in each hot spot's name in order on the spaces on the journal page to find out the name of the first discovered dinosaur.

1 Drumheller, Alberta, Canada

Drumheller is home to Tyra, the world's largest dinosaur statue, which is over four times as large as a real *Tyrannosaurus rex* [ty–RAN–no–SOR–us rex]. Visitors can climb stairs inside to her head to look out over the rocky badlands where Nathan Hrushkin found the bones of a hadrosaur.



2 Golden Gate Highlands National Park, South Africa

Known for its red and golden-orange sandstone cliffs, this national park is home to an exciting recent discovery of 10 *Massospondylus* [MASS–oh–SPON–duh–lus] nests. Eggs, embryos, and even tiny dinosaur footprints were found in and around the nests.



3 Gobi Desert, Mongolia

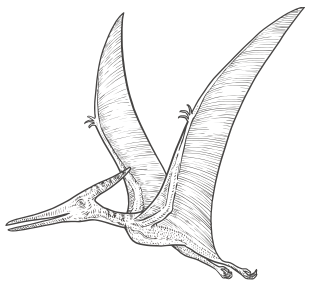
The first dinosaur discovered here, an oviraptor [OH–vir–AP–tor], was thought to be stealing the eggs found near it. It was later discovered that the dinosaur was simply sitting on the eggs. The largest sauropod [SAR–oh–pod] footprint was also found here in 2016.



4 Hell Creek Formation, USA

The famous paleontologist Barnum Brown made three important discoveries here, including a skeleton of a *Tyrannosaurus rex*, something never found before. In 2003, a unique discovery was made—a dinosaur tail with patches of mummified skin attached.





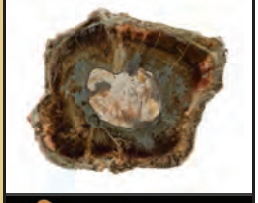
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World of Discovery Map



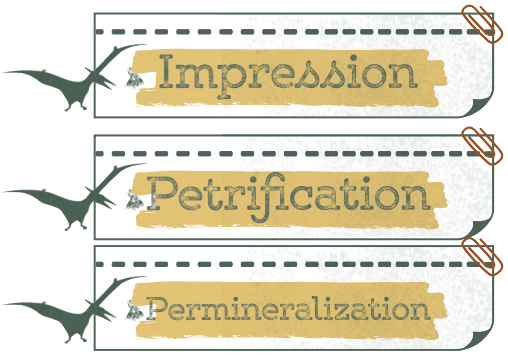

Arctic Ocean
RUSSIA
KAZAKHSTAN
MONGOLIA
3
CHINA
TURKEY
IRAQ
IRAN
AFGHANISTAN
PAKISTAN
SAUDI ARABIA
INDIA
6
BURMA
THAILAND
YEMEN
SOMALIA
ETHIOPIA
KENYA
TANZANIA
MADAGASCAR
INDONESIA
PHILIPPINES
AUSTRALIA
NEW ZEALAND
Bering Sea
Sea of Japan
East China Sea
South China Sea
North Pacific Ocean
Arabian Sea
Bay of Bengal
Indian Ocean
Coral Sea
Tasman Sea

Types of Fossils

Category	Example	Formation
Trace Fossil	 	Trace fossils are indirect evidence from animal activity such as footprints, feces, eggs without embryos, and burrows. They are covered by sediment before water or wind erodes them. Then they harden into rock.
Impression	 	Similar to trace fossils, impressions are created by the body of an organism that has decomposed. Sometimes casts are created when the impression fills with sediment.
Petrified Remains	 	Molds are impressions left from the body of an organism. Casts are these molds filled with sediment.
Preserved Remains	 	Material is preserved in its original form by amber, ice, or tar, which keeps the organism from decomposing as quickly, if at all.

Science Wall: Vocabulary Words

Place the vocabulary cards IMPRESSION, PETRIFICATION, and PERMINERALIZATION on your science wall. Read and discuss the words and their definitions.



Permineralization Activity

Give each child a bowl, a spoon, two cups of cornstarch, one cup of water, straws, and a couple small toys.

Read to the children: We are going to create fossils!

1. Mix the cornstarch and water until smooth.
2. Place your straws and any small toys you would like to dig out into the mixture.
3. Leave the mixture for 48 hours until fully hardened.

Permineralization is a ***petrification*** process in which minerals replace the original material. This is replicated in this activity. We will see the results and dig out our fossils in the next lesson. **Note: Discard your project if mold growth occurs. For best results, set the project in a cool, dry place to harden.**

Fossil Detective Activity

1. Lay all of the cut-out "Fossil Detective Cards" face up on the table.

2. Have the children take turns picking a picture card and trying to match it to the correct information card, using clues from the fossil (answer key provided on page 14).

Lesson 2 Extension

7–8

Have children grades 7–8 complete the self-directed Lesson 2 extension titled "Coprolites" in their student journals.

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Fossil Detective Cards

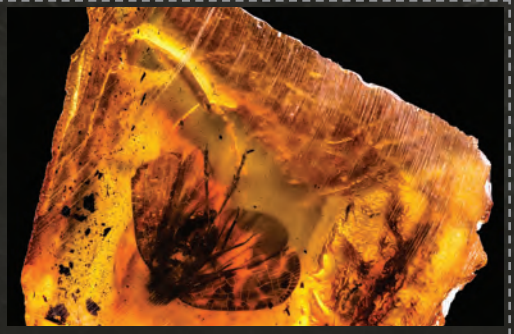
















strange creatures were discovered, scientists began to wonder if this was a unique species that was now ***extinct***, meaning no members of the species were still alive. Richard Owens identified dinosaurs as a new species in 1842 and gave them the name ***dinosaur,*** which means "terrible lizard." Early scientists trying to piece together fossils often made their closest guesses using the information they had at the time. As later scientists gathered more information, they corrected some of what early scientists thought. When the *Iguanodon* was discovered by Dr. Gideon Mantell and his wife, Mary Ann, Dr. Mantell believed the spike went on its nose.



Iguanodon **with nose spike**

Mantell used the information he had at the time. Newer evidence has led paleontologists to believe that the *Iguanodon* had spikes on its thumb instead of its nose.



Iguanodon **with thumb spike**

Dinosaur Classification Activity

Have the children cut out the "Dinosaur Field Notes" cards in Lesson 3 of their student journals. Note that these cards will be used in this activity, as well as the activity following the upcoming video.

Read to the children: *Classification* is the process of organizing something based on shared characteristics, like how many legs it has, the size, the bone structure, if it has horns or not, and so on. **Using one student journal's set of cards, select four dinosaur cards.** Together we are going to classify these cards based on shared characteristics. For example, one group could have two legs and the other could have four. **Pause for activity and discussion.**

I am now going to give you two more dinosaurs, and you have to decide if they fit into either of the categories you created for your classification system. If not, create a new group or start over and classify all the dinosaurs using a new system. **Continue giving the children two dinosaurs and allowing them to classify them until all the cards have been used.** What did you learn from this activity? [Dinosaur classification has changed over the years as new dinosaurs have been discovered.]

Dinosaur Fossils Video

Watch the video titled "Dinosaur Fossils: Pieces of a Puzzle" at goodandbeautiful.com/sciencevideos.

Discuss with the children: What is your favorite type of dinosaur? What is something new you learned about a dinosaur today? How are scientists learning new things about dinosaurs?

Dinosaur Field Journal

Have the children turn to the "Dinosaur Field Journal" booklet in Lesson 3 of their student journals.

Read to the children: Let us use your "Dinosaur Field Notes" cards to learn more about how and where these species were found as we glue the cards onto the correct spots in the "Dinosaur Field Journal."

Optional activity: As the students glue the cut-out cards in the correct places, look at a map or globe to locate where the dinosaur fossils were found.

Lesson 3 Extension

Have children grades 7–8 complete the self-directed Lesson 3 extension titled "Mr. Bones: Dr. Barnum Brown" in their student journals.

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Land of Giants

Objective

Help the children learn about a variety of creatures and discover hypotheses about how some of them grew to be giants.



Preparation:

- ☐ Cut out the "Record Holders" cards on pages 19 and 21.

Activity Supplies:

- Sidewalk chalk or tape
- Glue
- 5 leaves (any leaves, such as from a tree or houseplant)
- 3 cups filled halfway with water

Read to the Children

There have been dragonfly fossils discovered that are as long as your arm! Do you know what a millipede is? Hold out your leg. Mammoth millipede fossils longer than your leg have also been discovered! **Look at and discuss the "Dinosaur Comparisons" on page 23 of this lesson.** One reason dinosaurs are so fascinating is their size. But how did they get so big? The best explanation from scientists is simple: oxygen.

Leaves and Oxygen Activity

Give the children five leaves and three cups half full of water, then have them turn to the "Leaves and Oxygen Activity" in Lesson 4 of their student journals. Have them place three leaves in one cup and one leaf in each of the remaining cups. Place the cup with three leaves and a cup with one leaf in direct sunlight. Place the other cup with one leaf in a dark closet.

Read to the children: Fossils show us that when dinosaurs were alive, the climate varied from place to place. Plants take in carbon dioxide and release oxygen. To do this, they need sunlight. **Have the children fill out the description portion of the "Leaves and Oxygen Activity" page.**

Scientists have done experiments placing insects in highly oxygenated environments to discover the effects of oxygen on their growth. They found that in environments with more oxygen, insects will grow larger. You will complete your journal activity later in the lesson.

Record Holders

Take out the "Record Holders" cards. A child could read the cards during this activity if he or she is able. Optional: This activity can be done outside by marking a sidewalk or long driveway with sidewalk chalk. Start with the "*Arthropleura*" [AR–throw–plur–uh] card.

Read to the children: We are going to see the lengths of some record-holding ancient animals. **Have a child draw or tape a line on the ground. Have one child take eight steps from the line and draw or tape another line on the ground. Read the facts on the "***Arthropleura***" card while the child walks.** This represents the approximate length of an *Arthropleura*. **Continue with each of the cards, having the children take turns walking one step for every foot of the creature's length, beginning from the starting line each time. If the children cannot walk in a straight line for the full length due to the size of the area, have them double back and see how many times they have to walk the length of the space that is available.**

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Record Holders

Cut along the dotted lines. Read the facts as a child marks the length with chalk or tape.

Quetzalcoatlus
10.7 m (35 ft) wingspan

- **Largest flying reptile**
- **First fossil found was a partial wing discovered in Texas, USA**
- **Specimens found have not been near ancient water sources, which leads paleontologists to believe it didn't eat fish**



- **Very few fossils have been found, so much is unknown about this flying reptile**
- **Like other pterosaurs, its wing consisted of an elongated fourth finger and webbed membrane**

Argentinosaurus
35 m (115 ft) long

- **Largest land creature**
- **Was a *titanosaur***
- **Top speed is estimated to have been 8 km/h (5 mph)**
- **Lived in South America, particularly Argentina**



- **Estimated to have taken 40 years to reach its maximum size**
- **Complete skeleton has not been found**

"Scotty" the *Tyrannosaurus rex*
12.2 m (40 ft) long

- **Largest *Tyrannosaurus rex***
- ***Tyrannosaurus rex* means "king of the tyrant lizards"**
- **Females were larger than males**
- **Lived for about 30 years**



- **Weighed up to 8.2 metric tons (9 US tons)**
- **Was able to bite 28 times more powerfully than humans**

Arthropleura
2.4 m (8 ft) long

- **Largest land invertebrate**
- **Has been found in North America and Scotland**
- **Scientists believe it was an herbivore based on pollen found in its stomach**



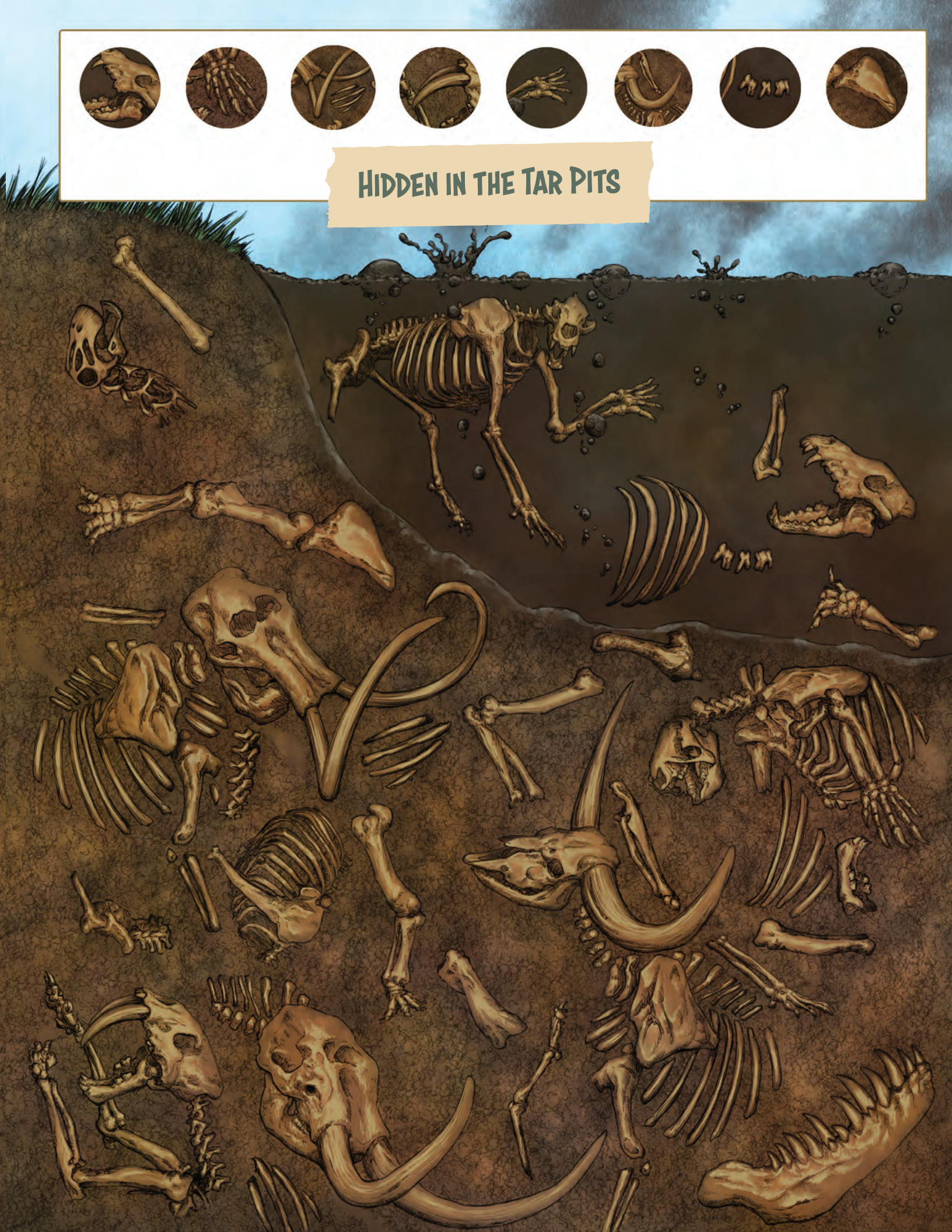
- **Tracks found in Nova Scotia revealed details of the creature's habitat and size**
- **No complete fossil has been found**


Pterodactyl
Titanosaur
Iguanodon
Triceratops


Stegosaurus


Tyrannosaurus rex


Velociraptor


Hidden in the Tar Pits

Creatures of the Tar Pits

Read the corresponding facts when a child finds the hidden item on the page.



Saber-toothed Cat

- Its teeth were very fragile.
- It is often mistakenly called saber-toothed tiger, but its correct name is saber-toothed cat.
- *Smilodon* is the name of the most famous species.



- The teeth could have been as long as 20 cm (8 in).
- Thousands of these teeth have been found in the La Brea Tar Pits.
- Scientists believe it hunted in packs.



Ground Sloth

- Former US president Thomas Jefferson identified one species of giant ground sloth.
- They could grow as tall as 3.65 m (12 ft) and were roughly the size of an elephant.
- They were herbivores that had large claws on their hands for pulling down trees.

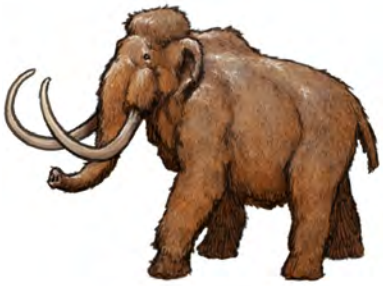


- A mummified ground sloth was found preserved by the volcano it fell into.
- Paleontologists believe its claws might have also been used to dig for food.



Mammoth

- Tusks could grow as long as 4.6 m (15 ft), and paleontologists identify the creature's age by the growth rings in its tusk, similar to a tree's trunk.
- They likely lived in matriarchal herds similar to elephants.



- Based on preserved specimens, paleontologists know that their fur came in a range of colors, just like human hair.
- A species of mini mammoths lived on an island off the coast of California.



Steppe Bison

- Some had horns 2.4 m (8 ft) across from point to point, much larger than bison today.
- They lived in Alaska in the grassy flatland environment known as a steppe.



- These are often found in the tar pits. One mummified specimen was found in Alaskan permafrost by gold miners in 1979. It had blue skin caused by a mineral coating. It was nicknamed "Blue Babe."
- They were hunted by American lions.

Introduction to Archaeology

Objective

Help the children feel the wonder of discovering ancient life and understand the process of finding and studying remnants of the past.



Preparation:

- ☐ None

Activity Supplies:

- 4 slices of sandwich bread per child
- 3–4 small objects per child, such as paper clips, candies, toothpicks, etc., that can be placed between the bread
- 1 heavy book per child

Hussein the Water Boy

Read to the children: The year is 1922, and 12-year-old Hussein is carrying water to an excavation site in Egypt's Valley of the Kings. Hussein has the important job of keeping the workers hydrated in the extreme heat of the desert. Their team has already uncovered a few small tombs where nobility were buried. Hussein digs a small hole in the sand to help his water jars sit upright and uncovers a smooth stone different from the ones around it. He tells a worker, and the team discovers it is a stone step . . . and there is another below it! The team continues to dig and makes an important discovery. We will find out where the stone steps took them at the end of this lesson.



Bread Layers Activity

Read to the children: The story of Hussein is a true account of a boy who worked for the famous archaeologist Howard Carter. The day described in the story was the day of one of the greatest discoveries in history. Would you like to know what led up to this discovery? Why do you think Carter's team was digging in the dirt to find the remnants of history?

Give each child four slices of bread and three or four very small objects that can be flattened between the bread (paper clip, small candies, toothpick, etc.). Have the children place a slice of bread on the table and 1–2 objects on top of it, then another piece of bread. Have them continue layering bread and objects until they have no more. Then place a heavy book on top and press it down until the bread is fairly flat.

Read to the children: Look at your layers of bread from the side. Each piece of bread is like a layer of earth guarding its hidden treasures. Just like with fossils, over the course of many years, layers of sediment, such as dirt, rocks, grass, or other debris, are blown or washed over objects and bury them. Imagine you left a toy outside for many years. One year there is a mighty wind storm that blows dirt over the toy. Another year a flood carries dirt on top of the wind layer. Now imagine someone left another toy in the same spot 100 years later. There are now two layers of toys. Which toy is older? Archaeologists often find objects in many different layers of dirt, unearthing parts of history

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PALEONTOLOGY

Level 3-6

STUDENT JOURNAL

This journal belongs to:

THE GOOD AND THE BEAUTIFUL



INSTRUCTIONS

This student journal accompanies The Good and the Beautiful Paleontology science unit. It contains all of the activity and journal pages that are needed to complete the unit. Each student will need a copy of the science journal.

Have each student spend enough time to create high-quality work as the activities and worksheets are completed. Students may enjoy looking back on their past discoveries after they've finished.



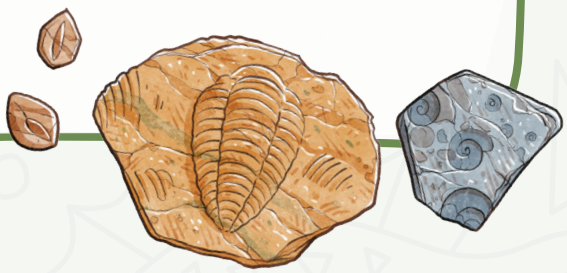


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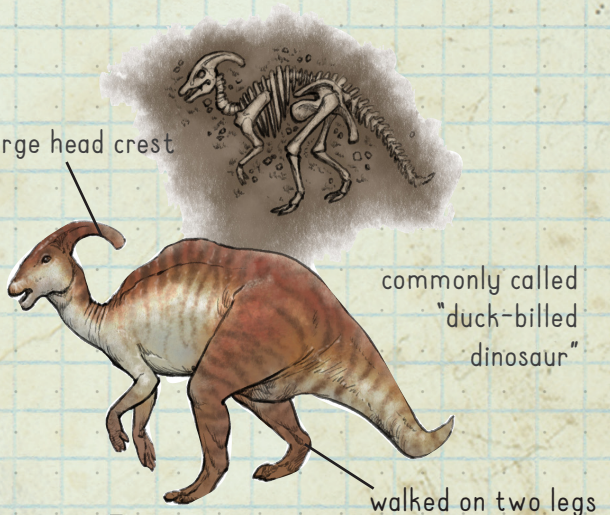




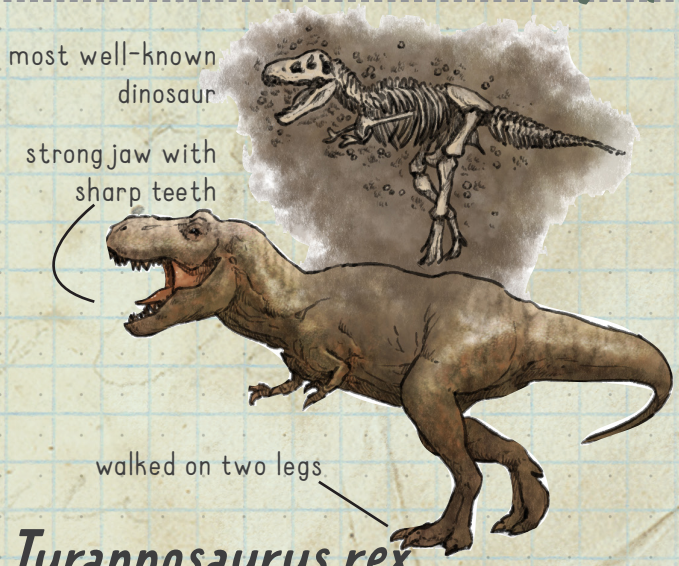




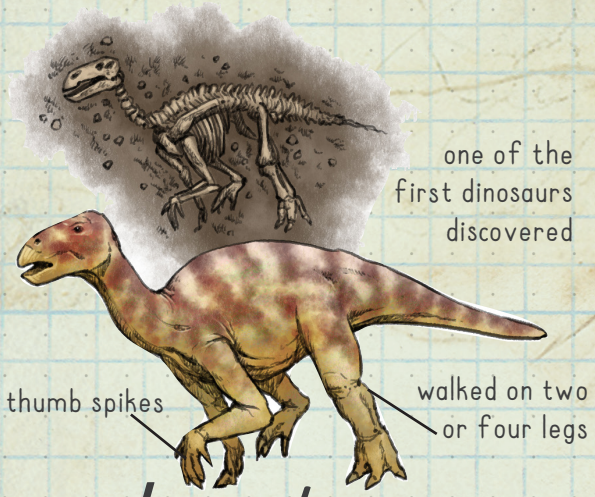
Dinosaur Field Notes



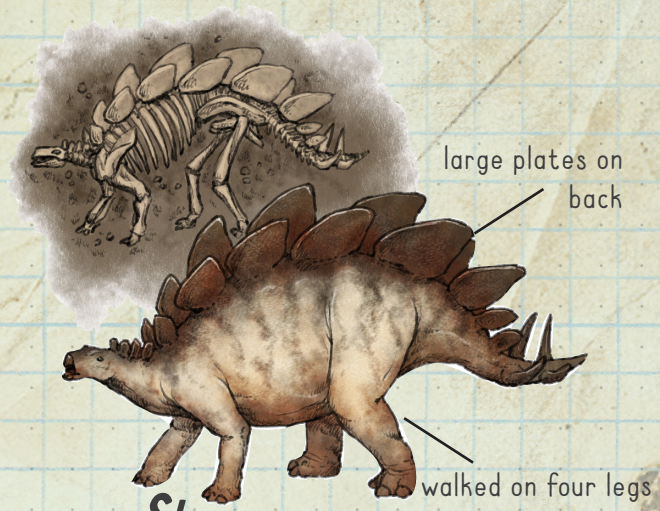
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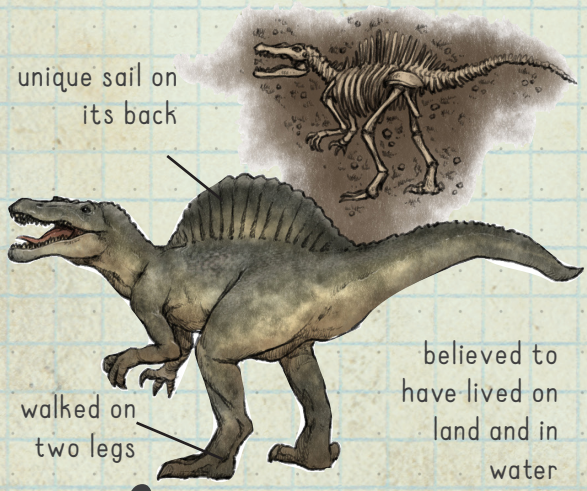
Tyrannosaurus rex



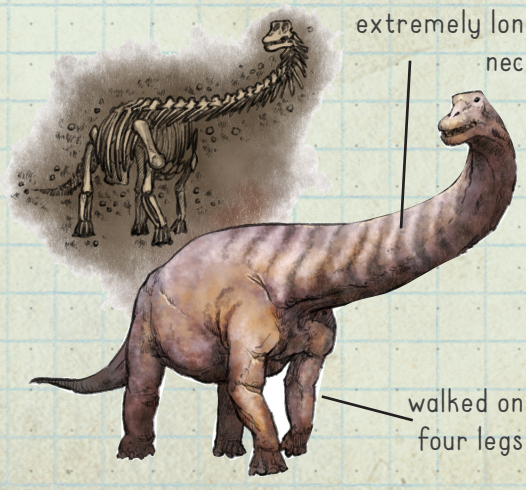
Iguanodon



Stegosaurus



Spinosaurus



Australotitan cooperensis

© Jenny Phillips

Lesson 3

Dinosaur Field Journal



At the age of 14, Sandy Mackenzie found a dinosaur fossil near his home in Queensland, Australia. It was the first fossil found in this area, and it jump-started a search that led to the discovery of the largest dinosaur found in Australia, *Australotitan cooperensis* [AH–struh–lo–TIGH–tan COO–per–EN–sis].

Nicknamed Scotty, the largest *Tyrannosaurus rex* [Ty–RAN–no–SOR–us rex] fossil ever found took over two decades to excavate and analyze. It was found in Saskatchewan, Canada, by a schoolteacher who had volunteered to help with a local excavation. Exploring after lunch, he stumbled upon Scotty's vertebrae. The team became even more excited when they discovered more bones, including the jaw with teeth intact.

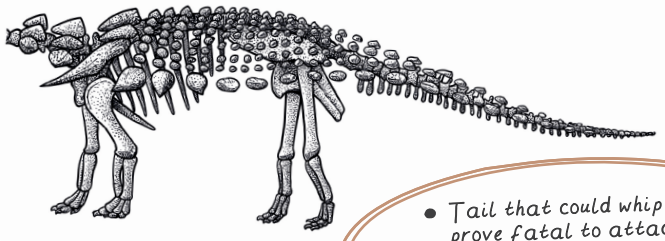
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Lesson 5

FINISH THE DINOSAUR

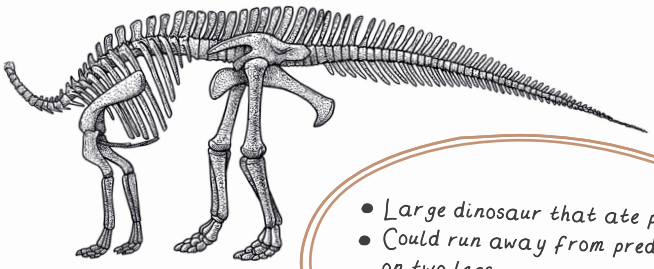




CARNIVORE
HERBIVORE

- Tail that could whip and prove fatal to attackers
- Armored plating covering back
- Shoulder spikes

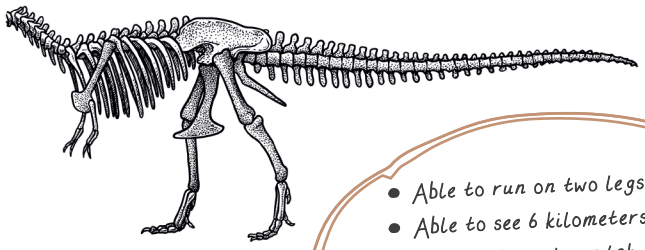




CARNIVORE
HERBIVORE

- Large dinosaur that ate plants
- Could run away from predators on two legs
- Had a mouth like a duck and a horn pointing back on its head

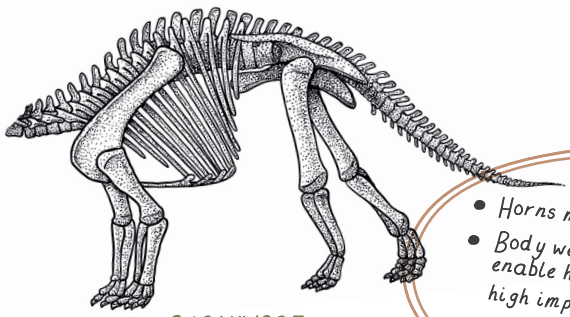




CARNIVORE
HERBIVORE

- Able to run on two legs
- Able to see 6 kilometers away
- Used its jaws to catch and eat other animals
- Giant head





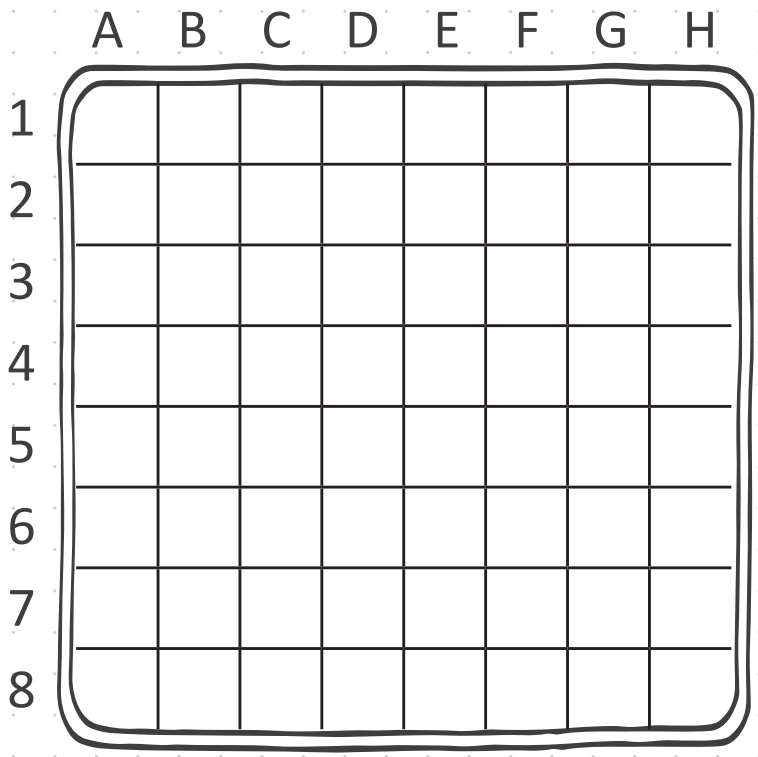
CARNIVORE
HERBIVORE

- Horns made of bone
- Body weight centered forward to enable head to receive and inflict high impact strikes
- Teeth made for chewing plants

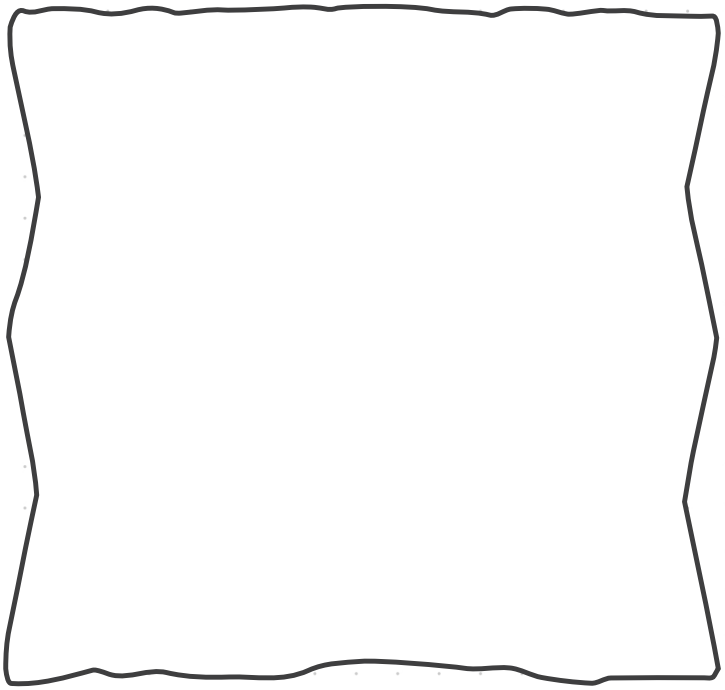
© Jenny Phillips

Cookie Excavation

Cookie Grid



Artifact Laboratory



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Lesson 9

ARCHAEOLOGICAL SITE REPORT

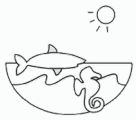
By:

Site's Name:

Date of Discovery:

Circle the type of environment the site is in.


Desert


Ocean


Grassland

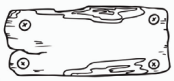

Forest


Mountain


Residential

Circle the types of objects that were found.


Bone


Wood


Jewelry


Food


Architecture


Art


Ceramic

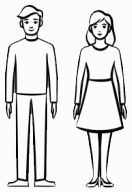

Armor


Dishes


Shells

Circle the age of the person who first discovered it.









Color where in the world this site was discovered.



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PALEONTOLOGY

Level 7-8

STUDENT JOURNAL

This journal belongs to:

THE GOOD AND THE BEAUTIFUL



INSTRUCTIONS

This student journal accompanies The Good and the Beautiful Paleontology science unit. It contains all of the activity and journal pages that are needed to complete the unit. Each student will need a copy of the science journal.

The lesson extensions are also found here. These extensions are optional for older students (grades *7–8*) to complete on their own. Each extension is accompanied by lined paper so the student can keep his or her work in one place.

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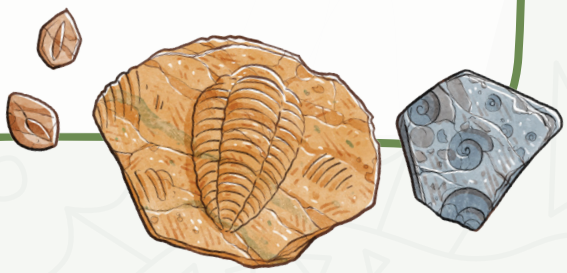
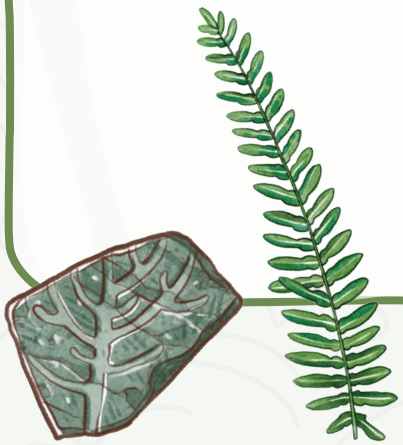


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EXTENSION

Instructions:

1. Read the information below.
2. Summarize the information in a paragraph that is at least five sentences long. Then share your summary with a parent or teacher.

The Utahraptor Megablock

In November 2014 a team of construction workers and scientists worked tirelessly to remove an 18,000-pound rock from a high mesa near Arches National Park in Utah. A National Geographic camera crew stood nearby, capturing this historic event that was the culmination of nine years of effort. A wood-framed sled was built for the megablock to slide down the steep incline. Why was so much effort put into removing this block from the side of a cliff? Dinosaurs.

The process all began in 2005 when geology graduate student Matthew Stikes discovered an arm bone in the rock formation he was studying. Paleontologists quickly discovered more bones, including the lower jaw of a *Utahraptor* [YOU–tah–RAP–tor] with the delicate teeth still intact. Because they are so fragile, paleontologists often don't remove bones that are trapped in rock at the dig site; instead, they cut out the smallest possible block they can. They work to find weaknesses or cracks in the rock that can be broken off without also breaking any bones. The megablock was full of bones, and the rock would shatter instead of break in clean lines. To protect the bones, the block was transported elsewhere with a semi-truck!

When the team finally found a location large enough to house the block, they began studying it more closely. Using microscopes and a pneumatic air scribe (similar to a vibrating dental chisel), geologist Scott Madsen has slowly picked away at the block for years and has found bones of *Utahraptors*, *Iguanodons* [ig–WAHN–uh–DONS], and others. He believes that there were so many bones because the solid rock was once quicksand. This hypothesis was developed by studying the surrounding rock, which was white in color like the rock in the area. The megablock rock was greener and had fossilized algae growing on top, signs of a location with different compositions. The sheer number of bones found inside also indicates this was a dinosaur trap of some kind.

Read through the timeline on the right. In 2020 the block was moved to the Utah Geological Survey Center. Scott Madsen continues to study and excavate. Others working on the megablock are using ***photogrammetry***, a technology that uses photographs to create 3D models, to document the details of each bone's location and eventually create a 3D map of the block. These details can help us get a picture of what happened many years ago to the dinosaurs now trapped in rock.

Megablock Timeline

2005

Matthew Stikes finds an arm bone and contacts the Utah Geological Survey. Paleontologists arrive and discover even more bones!



2006

Excavation begins, and the first small block is hauled down the cliff on an old car hood. Several dozen *Utahraptor* and *Iguanodon* bones are found.



2007

Returning to the site, the team sees that rocks from the cliff have fallen and broken apart some of the previously prepared blocks.



2007-2014

The team begins excavating more in earnest. They appear on TV shows and work with construction teams and engineers to figure out how to get the block out and down.



2014

The big day arrives, and they pull the block on its wooden sled with a backhoe. They lift it onto the semi and haul it away.



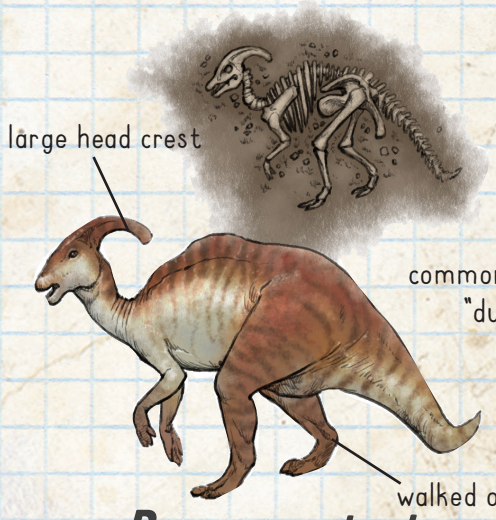
2020

After working on the block at their temporary facility for five years, it is relocated to a permanent home.

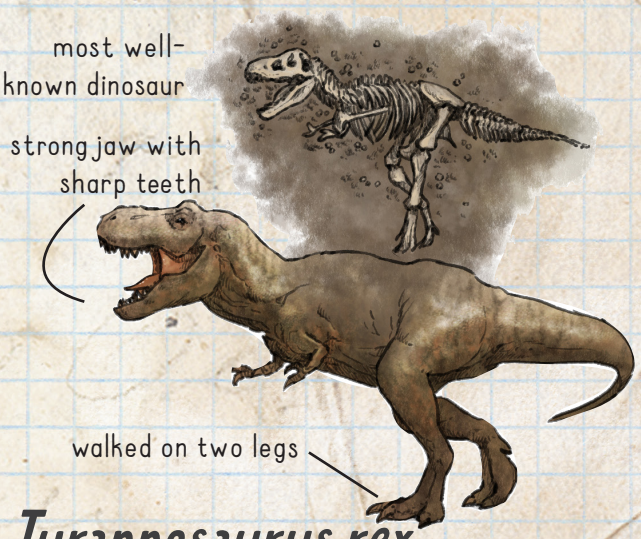


© Jenny Phillips

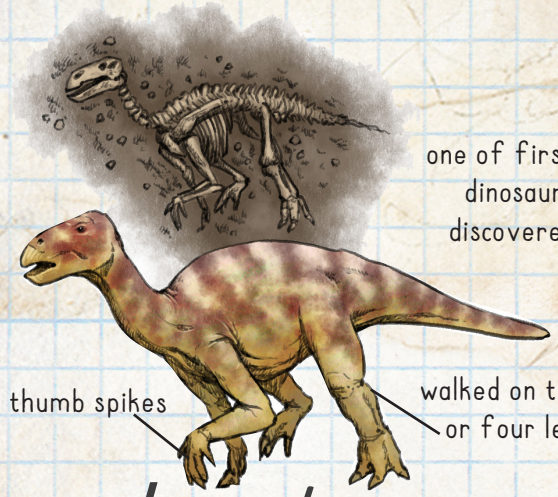
Dinosaur Field Notes



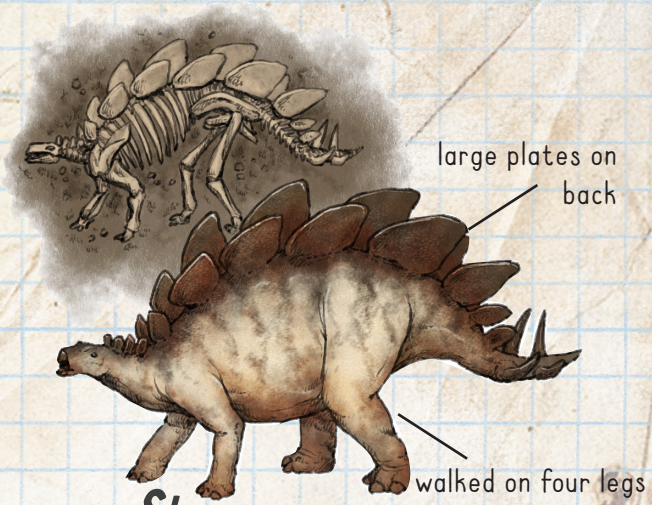
Parasaurolophus



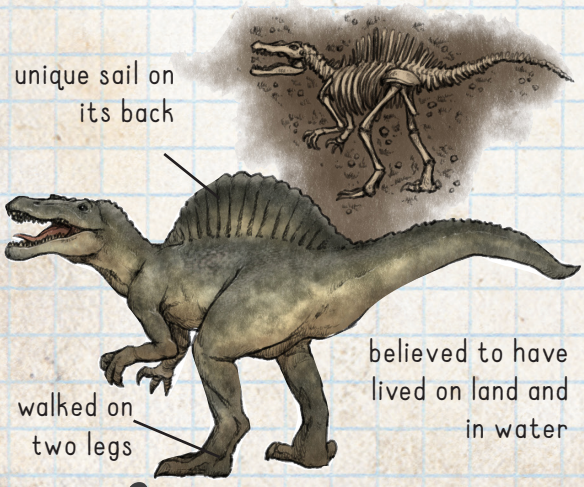
Tyrannosaurus rex



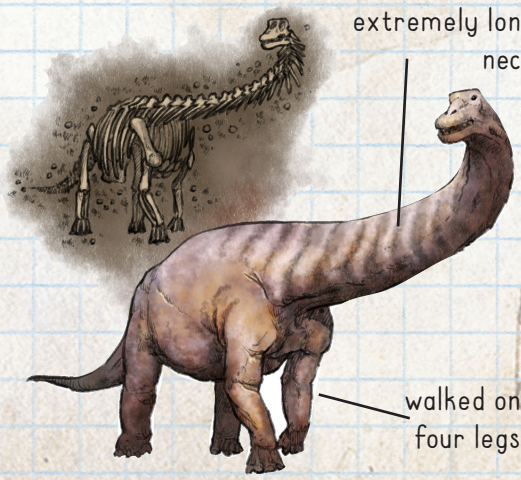
Iguanodon



Stegosaurus



Spinosaurus



Australotitan cooperensis

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Lesson 3

Dinosaur Field Journal



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GLUE CARD HERE

GLUE CARD HERE

Lesson 4

LEAVES AND OXYGEN ACTIVITY

Description

Describe the location where each cup has been placed.

Results

Count the bubbles in each cup and write the correct number by each picture below.







© Jenny Phillips

EXTENSION

Instructions:

1. Read the information below, highlighting the parts that are most interesting to you.
2. Summarize the information on this page in a two-minute oral report to your parent or teacher. Write down the points you would like to cover, including what you found most interesting, and practice one or two times before giving your report.

Shark Fossils

Sharks grow and shed their teeth throughout their lives. Given that they have hundreds of teeth in their jaw at one time, over their lifetime, they will lose around 30,000 teeth! This makes finding shark teeth a fairly easy feat. You have probably seen or maybe even owned one in your life. Finding fossilized teeth is not difficult either. Sharks of the past lost thousands of teeth as well. However, it is much more difficult to find a fossilized shark skeleton. Why do you think this might be?

Sharks grow and replace many teeth, but they only have one skeleton. Unfortunately for paleontologists, these skeletons are made out of ***cartilage***, a firm but flexible, whitish connective tissue that is not bone. Your nose has cartilage in the tip, which helps maintain its shape but also allows for more flexibility. Why do you think it would be advantageous to a shark to have a skeleton made out of cartilage? And why would this be a disadvantage for paleontologists?

Cartilage is coated in hundreds of thousands of fragments of calcite. These fragments are held together by tiny bits of ***collagen***, which is a protein. As the shark grows, these structural materials grow with it. Cartilage is more lightweight than bone, which makes a shark more buoyant. Not having to use extra energy to keep a heavy skeleton afloat, sharks have more energy available for propulsion, or moving forward, at greater speeds. With flexible bodies that are able to move quickly in the water, sharks are more successful at catching their prey.

This soft flexibility also makes it hard for the skeletons to fossilize. When a shark dies, its skeleton will often collapse. The organic collagen fibers holding the skeleton together disintegrate, and the collapsed skeleton falls apart. Often all that is left are the teeth.

In order for a shark skeleton to be preserved, some conditions have to be met; there must be very little oxygen in the water where it dies so bacterial decomposition is prevented, the skeleton must sink to the ocean floor where it can be covered in silt layers which harden into rock, and it must remain undisturbed while fossilization takes place. Such were the circumstances of the Godzilla Shark of New Mexico, the *Manzano ctenacanth* [mahn–ZAHN–oh TEN–uh–canth], an ancient shark found where a shallow, warm lagoon is now the Manzano Mountains.

Shown below is a fossilized shark tooth.



© Jenny Phillips

EXTENSION

Instructions:

1. Read the information below and complete the closing exercise in your journal.
2. Using the list of Greek and Latin descriptive words, create a name to describe a new dinosaur. Write the name of the dinosaur you discovered and its translation in your science journal. For example, Pentadactylgallussaurus would be a "five-fingered chicken lizard." If you like, you can also draw the dinosaur you discovered.

Naming New Species

Naming a dinosaur is one of the greatest honors given to those who find new species. Although dinosaurs have interesting names like "Ichabodcraniosaurus" (a headless velociraptor skeleton), there are some general rules to follow when naming a new specimen. First, every dinosaur is named in Greek or Latin using the classification orders of ***genus*** and ***species***. For example, a *Tyrannosaurus rex* belongs to the genus *Tyrannosaurus* and species *rex*.

With this in mind, dinosaurs are usually given names based on one or more of these three things: body features, where they were found, and/or who discovered them. This is true for modern creatures as well. Many dinosaurs have the suffix "saurus," which means lizard. Dinosaurs found in China are often given the suffix "long," which means dragon. There are a few fun exceptions to these rules, such as the three dinosaurs below.

Irritator challengeri, a dinosaur similar to *Spinosaurus*, is an exception to these rules. In an attempt to get more money for their discovery, dinosaur hunters added bones to the skeleton from a different dinosaur so that the dinosaur would appear more complete. When purchased by a museum, the paleontologists became irritated as they unraveled the problem created by the dishonest hunters.

Spinosaurus



There is also *Camelotia borealis*, named after the legendary Camelot, home to the knights of the round table and King Arthur. The partial remains of this dinosaur were found in England, but little is known about the species. Just like its legendary namesake, this dinosaur remains shrouded in mystery.

Finally, we have *Bambiraptor*. It was named after the fictional deer "Bambi," because of its similar size. Take a look at the "Latin/Greek Guide" to the right. Using the guide, find the meanings of the names of the following dinosaurs and write them in your science journal: *Ichthyosaurus*, *Ornithoraptor*, *Brachiosaurus*, *Pachycephalosaurus*, and *Triceratops*.

Latin/Greek Guide

NUMBERS
- Mono = One
- Di = Two
- Tri = Three
- Tetra = Four
- Penta = Five

BODY
- Brachio = Arm
- Cephalo = Head
- Cerato = Horn
- Cheirus = Hand
- Dactyl = Finger
- Ptero = Wing
- Rhino = Nose

ANIMAL
- Draco = Dragon
- Gallus = Chicken
- Ichthyo = Fish
- Ornitho/Ornis = Bird
- Saurus = Lizard
- Suchus = Crocodile
- Taurus = Bull

SIZE/SHAPE
- Baro = Heavy
- Brachy = Short
- Macro = Big
- Megalo = Huge
- Micro = Small
- Nano = Tiny
- Titano = Giant
- Pachy = Thick

BEHAVIOR
- Archo = Ruling
- Carno = Meat-eating
- Dino = Terrible
- Dromeus = Runner
- Gracili = Graceful
- Raptor = Hunter/Thief
- Rex = King
- Tyranno = Tyrant
- Veloci = Fast

OTHER
- Archaeo = Ancient
- Austro = Southern
- Crypto = Hidden
- Hydro = Water
- Lago = Lake
- Nycto = Night
- Ovi = Egg
- Pelta = Shield
- Pro = Before
- Stego = Roof
- Thalasso = Ocean

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ARCHAEOLOGICAL SITE REPORT

By:

Site's Name:

Date of Discovery:

Questions you would ask if you discovered the site:

How the site was discovered:

Things you found interesting:





Color where in the world this site was discovered.

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Lesson 10

ARTIFACT ANALYSIS

By:

1. What shape is the artifact?

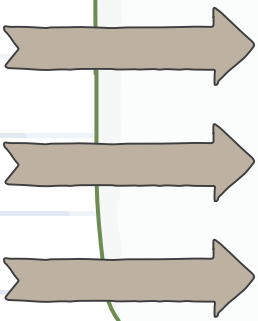


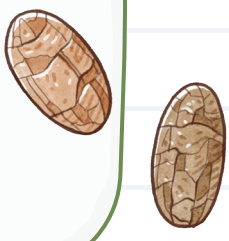
2. Where was the artifact found?

3. Circle the material the artifact is made of and describe the color.

Bone	Stone	Gold/Metal	Fur	Glass
Wood	Fabric	Paper	Plastic	Ceramic

4. Three questions you have about the artifact:





© Jenny Phillips

EXTENSION

Instructions:

1. Read the information below.
2. Create a Venn diagram in your science journal to compare and contrast the two Viking women burials discussed, including details such as artifacts, methods used to investigate, and conclusions made.

Viking Warrior Women

Until recently Viking warriors were believed to be only men. Using science to analyze and study the buried remains of various Viking warriors, archaeologists are trying to prove that this assumption is incorrect. Through intense study and analysis, these important questions are just two that they hope to answer: Could there have been Viking warriors that were women? And could women have even been military leaders?

There are two Viking burial chambers in particular that scientists believe hold answers to these questions. The "Birka Warrior" burial, discovered in Birka, Sweden, contained two horses, arrows, a bow, a silver coin, and even pieces of a strategy game. The "Norwegian Warrior" burial in Solør, Norway, contained an assortment of weapons and a shield under the warrior's head. Both of these burials were originally identified as containing a male. Scientists are now making the case that both individuals were, in fact, female warriors. Using DNA testing they were able to identify each buried specimen as female, but were these women truly warriors?



Forensic scientists discovered that the shoulder bone and spinal column of the Birka Warrior had signs of wearing. This indicated that one arm was used more than the other in a repeated motion. When you combine this evidence with the arrows buried with her, you see she was most likely an archer.

When examining the bones of the Norwegian woman, they discovered a dent in her forehead bone. Using facial reconstruction technology, they were able to not only reconstruct this woman's face but also the head wound. It was a significant blow, a blow most likely inflicted in combat.

Archaeologists also apply the scientific method when testing theories through reenactment. By producing replica bows, arrows, and axes, and having female fighting experts put them to the test, archaeologists saw that the weapons in the burial chambers with the women would have allowed them to fight effectively. In the case of the Norwegian Warrior, the axe by her side was originally believed to be for domestic purposes, but re-creating the axe and reenacting its use revealed that it was a deadly weapon much more likely used to fight than to chop wood.

Using data from the original excavations and computer programming, archaeologists looked at the artifacts and their placement. In these warrior women's burial chambers, the weapons were laid close to them, and proximity indicates importance. The proximity of pieces of a strategy game to the Birka Warrior lead archaeologists to believe that she may very well have been a military leader.

The scientific analyses we have discussed have led archaeologists to believe that these two burials held Viking warrior women. There are thousands of Viking burials, and scientists are now wondering how many more could contain female warriors. This could change the way we view Viking history!

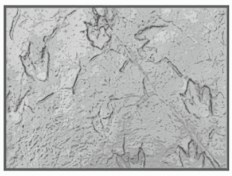
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REVIEW QUESTIONS

List three things archaeologists analyze on an artifact.

A footprint of a T. rex was found next to a smaller dinosaur footprint. Tell your teacher two questions you could ask to find out more about this discovery.

Circle the type of fossil that is created when minerals replace bone.



Trace Fossil



Cast Fossil



Petrified Fossil



Preserved Fossil

Write one difference between an archaeologist and a paleontologist.

Write one reason why it is important to study the past.

Write two of the ways ancient creatures are commonly preserved. The pictures are hints.





1.

2.

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