PALEONTOLOGY

Level 7-8

STUDENT JOURNAL

This journal belongs to:

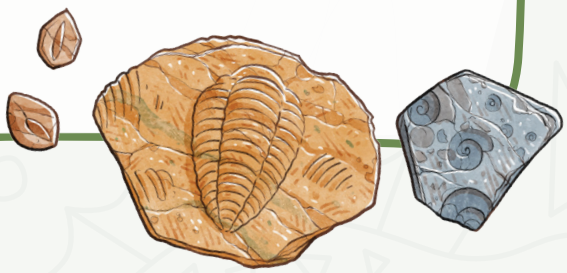
THE GOOD AND THE BEAUTIFUL

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.

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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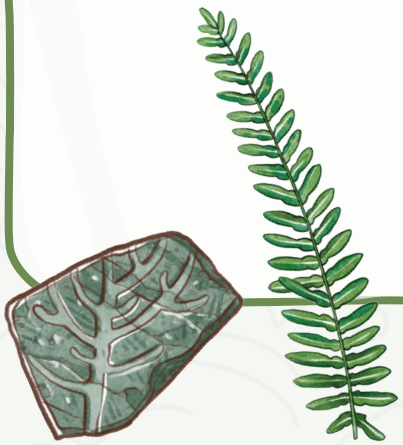


EXTENSION

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.

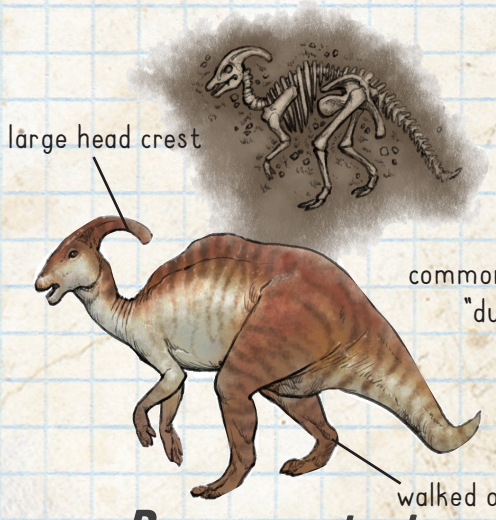
2014

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.

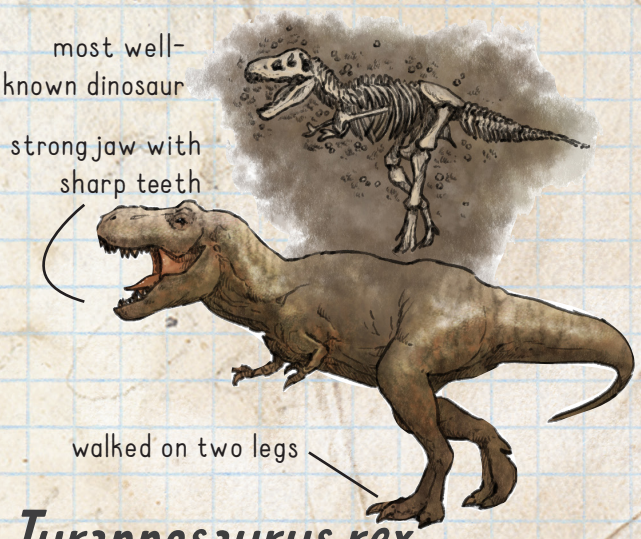
2020

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

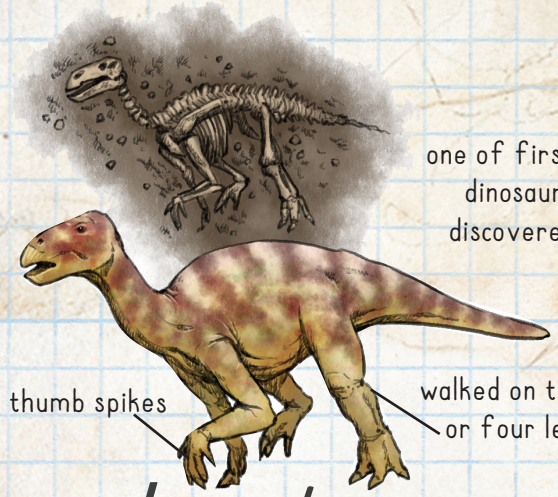
Dinosaur Field Notes



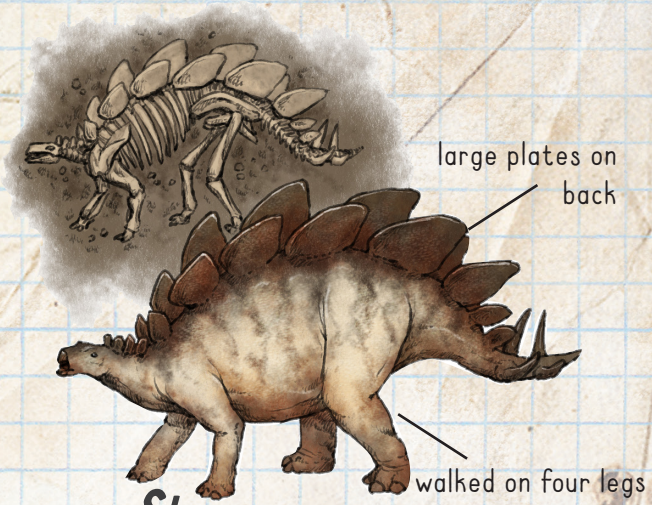
Parasaurolophus



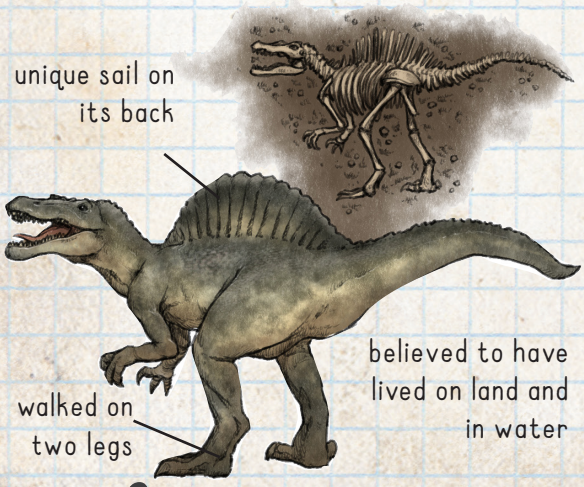
Tyrannosaurus rex



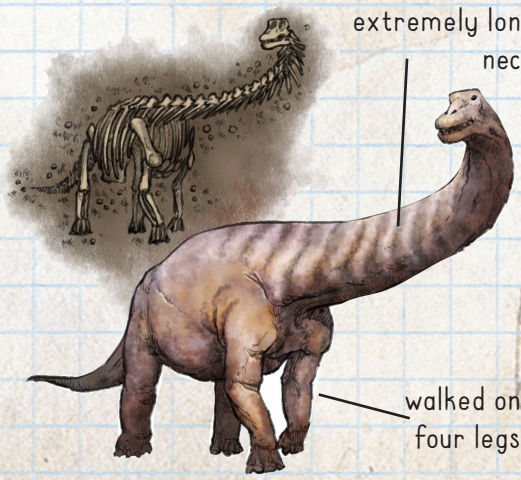
Iguanodon



Stegosaurus



Spinosaurus



Australotitan cooperensis

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.

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.

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.

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

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.

Lesson 10

ARTIFACT ANALYSIS

By:

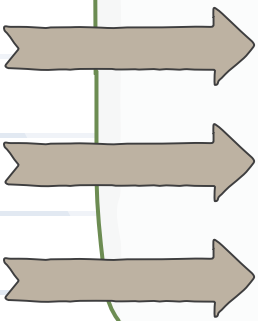
1. What shape is the artifact?

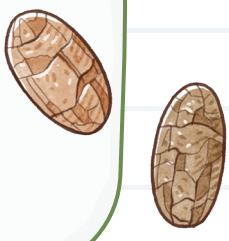
2. Where was the artifact found?

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:





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.

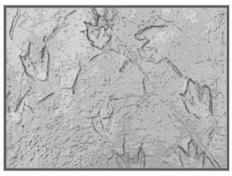
The scientific analyses we have discussed have led archaeologists to believe that these two burials held Viking warrior women. There are thousands of Viking burials, and scientists are now wondering how many more could contain female warriors. This could change the way we view Viking history!

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.