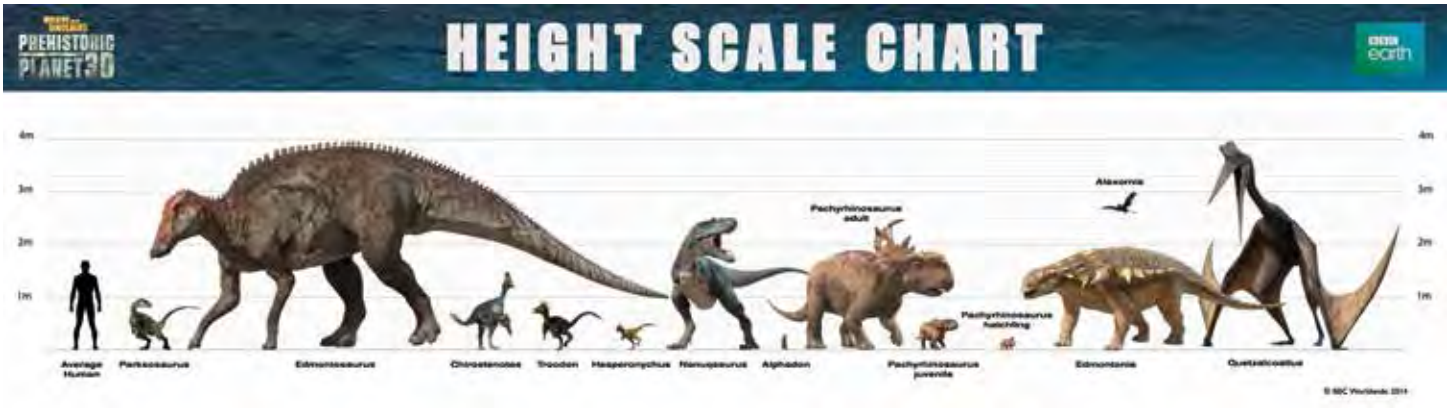
Perot Museum of Nature and Science

GIANT SCREEN FILMS

EDUCATORS GUIDE



Walking with Dinosaurs: Prehistoric Planet is a giant screen adventure that follows a herd of large, frilled, plant eating dinosaurs *(Pachyrhinosaurus)* and their young through the seasons and the challenges of growing up in Cretaceous Alaska. Audiences of all ages will be immersed in the young dinosaurs' epic struggle for survival from the moment they hatch as they face predators, extremes of weather and natural disaster.

Inspired by the major motion picture ***Walking with Dinosaurs: The 3D Movie*** and narrated by Benedict Cumberbatch, the film draws on cutting-edge science to bring our prehistoric world to life, creating creatures as realistic and compelling as the living animals we see in contemporary wildlife documentaries.

In collaboration with BBC Earth, a team of world-class paleontologists and educators from the Perot Museum of Nature and Science, responsible for the recent discovery and public exhibition of *Pachyrhinosaurus* and *Nanuqsaurus*, have developed this guide to help connect the ***Walking with Dinosaurs: Prehistoric Planet*** learning experience to your science curriculum. These hands-on, inquiry-based activities are fun and meaningful for anyone eager to learn more about dinosaurs. Get ready to create models of the Cretaceous Alaskan landscape, solve a dinosaur trackway mystery, and invent a new dinosaur name!

BBC earth

GIANT SCREEN FILMS

Per[o]t
Museum of Nature and Science

Nanuqsaurus

ACTIVITY #1

WHAT'S IN A NAME?

DESCRIPTION: Students will learn how scientists name new species of dinosaurs and will use this knowledge to create new dinosaur names. This activity features animals from ***Walking with Dinosaurs: Prehistoric Planet*** and allows students to build new names using the same roots as found in those dinosaur names.

OBJECTIVES:

- Learn about the process of scientific naming of organisms
- Interpret and use root words to invent new dinosaur names
- Design their own dinosaur, describe its behavior, and give it a name

TIME FRAME: Approx. 45 minutes

MATERIALS:

- ***What's in a Name?*** activity printed for each student
- Drawing materials

ACTIVITY PROCEDURE:

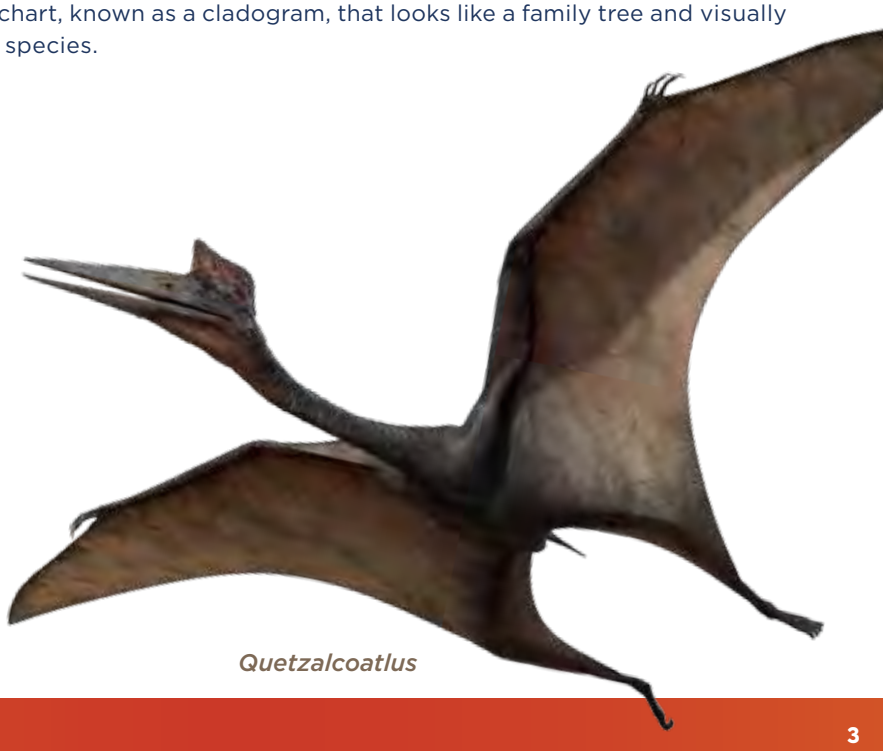
1. Distribute a copy of the ***What's in a Name?*** activity to each student.

2. Discuss the introductory materials at the top of the handout about the meaning of the word "dinosaur" as a class.

3. Distribute drawing and writing materials and have students work individually or in groups to translate and create new dinosaur names.

4. Before students design their own dinosaur, ask them to think about what their dinosaur would have eaten, where it would have lived, whether it would have had feathers or scaly skin, and how it would have behaved. Ask students to reflect on what they learned about dinosaur appearance and behavior while watching ***Walking with Dinosaurs: Prehistoric Planet*** to aid them in thinking about their own dinosaur.

EXTENSION IDEAS: After completing the ***Evolutionary Family Tree*** activity, students could work in groups to create a cladogram of the dinosaurs they draw in this activity. Scientists observe different dinosaurs and compare their skeletons, noting similarities and differences. They use these observations to create a chart, known as a cladogram, that looks like a family tree and visually depicts the evolutionary relationship between different species.



Quetzalcoatlus

ACTIVITY #1

WHAT'S IN A NAME?

BACKGROUND INFORMATION: The word 'dinosaur' comes from the Greek words *deinos*, meaning 'terrible', and *sauros*, meaning 'lizard'. This word was first used in 1842 by paleontologist Richard Owen. Likewise, when scientists discover a new organism, such as a new type of dinosaur, they create a name for it. Dinosaur names are made from combinations of root words. Scientists might pick roots that describe a feature of the dinosaur itself, or the place where the fossil remains were found. A new species could also be named after a person who has inspired or helped the scientists, or the person who discovered the fossils. Many dinosaur names come from Latin and Greek roots, but they can actually be derived from almost any language!

Several of the dinosaurs that you met in ***Walking with Dinosaurs: Prehistoric Planet*** were recently discovered. For example, *Nanuqsaurus* was described and named by Dr. Anthony Fiorillo and Dr. Ronald Tykoski in 2014. They used the word *nanuq,* which means 'polar bear' in Iñupiaq, a language spoken in the part of Alaska where the fossils were found, and *sauros,* the same root word we learned above from 'dinosaur'.

NANUQ ('POLAR BEAR') + SAURUS ('LIZARD') = *NANUQSAURUS*

Here are more examples:

PACHY ('THICK') + RHINOS ('NOSE') + SAURUS ('LIZARD') = *PACHYRHINOSAURUS*

EDMONTO ('FROM EDMONTON, CANADA') + SAURUS ('LIZARD') = *EDMONTOSAURUS*

WHAT'S IN A NAME?

ROOT	MEANING	ROOT	MEANING	ROOT	MEANING
alpha	first	*edmonto*	from Edmonton	*paleo*	old
allo	strange	*eo*	dawn, eastern	*proto*	early
ankylo	fused	*hesper*	western	*ptero*	wing or feather
apato	deceptive	*mega*	huge	*quetzlcoatl*	Aztec feathered serpent god
baro	heavy	*mono*	one	*raptor*	robber
canthus	spiked	*nano*	tiny	*rex, regina*	king, queen
cerat	horned	*nanuq*	polar bear	*rhinos*	nose
chir, cheir	hand	*nychus*	claw	*saurus*	lizard
deino, dino	terrible	*ops*	face	*stenotes*	narrowness
di	two	*ornitho*	bird	*tri*	three
don, dont	tooth	*pachy*	thick	*troo*	wounding

Can you decode the names of other creatures from ***Walking with Dinosaurs: Prehistoric Planet***?

_____ + _____ = **TROODON**

_____ + _____ = **HESPERONYCHUS**

Now you try! Combine the words above to come up with new dinosaur names.

_____ + _____ = _____

_____ + _____ = _____

Dinosaurs can be named after the place where their fossil remains are found, such as *Edmontosaurus,* which means 'Lizard from Edmonton'. If dinosaur fossils were found in your town and you decided to name it after your town, what would it be called?

_____ + _____ = _____

What would a dinosaur named after someone who inspired you be named?

_____ + _____ = _____

WHAT'S IN A NAME?

Now it's your chance to design a new type of dinosaur and create a name for it! Think about what you learned about dinosaur appearance and behavior in ***Walking with Dinosaurs: Prehistoric Planet***. What would your dinosaur eat? What type of teeth would it need? Would it have feathers? Would it live in a herd? Draw your dinosaur in the space below.

NAME: _____ + _____ = _____

MY DINOSAUR:

DESCRIPTION:

CAREER SPOTLIGHT

Dr. Anthony Fiorillo

Curator of Earth Sciences
at the Perot Museum of
Nature and Science

As a paleontologist, I study dinosaurs and their ecosystems from a time about 70 million years ago. Most of my work is focused on exploring the ancient Arctic in an attempt to understand polar dinosaurs. My favorite thing about the work I do is exploring the planet with the hope of contributing to the global understanding of dinosaurs and what dinosaurs mean for our society.

Growing up, I had the good fortune of living near a natural history museum and I am sure that inspired my career choice. I seem to recall as a child spending hours staring at the dinosaur skeletons wondering how those magnificent animals lived.

If you enjoyed creating your own dinosaurs, you'll enjoy finding out what other dinosaurs once roamed the planet in our FREE encyclopaedia app Walking with Dinosaurs: Inside their World.
itunes.apple.com/app/walking-with-dinosaurs-lite/id872514724?mt=8'

MAKE A GEOLOGICAL TIMELINE OF THE HISTORY OF LIFE ON EARTH... FOR YOUR CLASSROOM!

ACTIVITY #2

DESCRIPTION: Students will explore geologic time and prehistoric life by creating a 17.5 meter-long timeline of the history of life on Earth. They will learn how scientists use fossils to understand life in the past and they will explore when some of their favorite prehistoric creatures, including the dinosaurs from ***Walking with Dinosaurs: Prehistoric Planet***, lived.

OBJECTIVES:

- Next Generation Science Standards: 3-LS4-1, MS-LS4-1
- Build a geologic timeline to learn about the history and diversification of life on Earth
- Explore how scientists use fossils to investigate life in the past

TIME FRAME: Approx. 60 minutes

MATERIALS:

- String
- Tape measure
- ***Evolutionary Firsts Timeline Labels*** printed and cut out (1 copy for the class)
- Tape
- Paper
- Drawing materials

INTRODUCTORY DISCUSSION: Discuss with students that scientists use fossils to learn about life in the past, including when various organisms lived. The Earth is about 4.5 billion years old, and the oldest known fossil evidence of life on Earth is 3.5 billion years old! These are fossils of single-celled organisms that lived in colonies, called stromatolites. Today we have a huge number of different living things on Earth. This timeline will tell the story of major evolutionary firsts in the history of life on Earth and will highlight some well-known and scientifically important fossil evidence.

ACTIVITY PREPARATION: For grades Kindergarten–5th, this can be prepared ahead of time by an educator or as a guided group activity with the class. For grades 6th–12th, students can do this step as part of the activity as an exercise in measuring and calculations.

1. Measure out 17.5 meters (that's 57 feet 5 inches) along the wall in the classroom or along a hallway. The timeline may need to go around the corners of your classroom, which can be a lot of fun in this activity.

2. Tape string in a straight line to the wall along this entire length—this will be your timeline.

CAREER SPOTLIGHT

Dr. Steve Brusatte

Paleontologist,
School of GeoSciences,
University of Edinburgh

I am a young paleontologist who studies dinosaurs. I travel around the world doing fieldwork, with the aim of finding new dinosaurs. This work has taken me across the United States, Europe, and to Asia. Every day when I wake up there is the possibility that I will discover something new (a new fossil, a new idea, a new theory) that nobody has ever seen or thought of before. I have named over 10 new species of dinosaur, have written five books, and consult often with journalists and filmmakers. I am the "resident paleontologist" for the BBC's ***Walking with Dinosaurs*** brand.

I was never very interested in dinosaurs when I was a kid growing up in the fossil-barren farmlands of Illinois. It was only in high school that fossils began to capture my imagination. Whenever I go into schools and talk about dinosaurs to young students who want to be paleontologists, I always tell them that they are way ahead of me when I was their age!

MAKE A GEOLOGICAL TIMELINE OF THE HISTORY OF LIFE ON EARTH... FOR YOUR CLASSROOM!

ACTIVITY #2

ACTIVITY PROCEDURE: Explain that this timeline represents the ENTIRE history of life on Earth, and that each 1/2 centimeter represents 1 MILLION years. Ask students to show you how big a centimeter is with their fingers (help them get it right, if needed), then tell them to shrink that in half. That distance represents one million years on the timeline.

3. Call up a volunteer to place the "3,500 million years ago" label at one end of the timeline (this is the same age as 3.5 billion years) and tell them this is the earliest known evidence of life on Earth. Have another student place the "Today" label at the other end of the timeline as a reference and explain to them that this represents the present.

4. Call volunteers to plot and place the following dates on the timeline and read aloud the information about each organism to the class. Here is a list of where each of the suggested fossil finds would be on the timeline:

DATE	EVENT	LOCATION ON 17.5 METER TIMELINE
3,500 million years ago	First Fossil Evidence of Life on Earth	Start of timeline
520 million years ago	First Trilobites	260 cm before 'Today' [17,240 cm after 3,500 mya]
420 million years ago	First Ammonites	210 cm before 'Today'
390 million years ago	First Land Vertebrates	195 cm before 'Today'
230 million years ago	First Dinosaurs	115 cm before 'Today'
150 million years ago	First Birds	75 cm before 'Today'
130 million years ago	First Flowering Plants	65 cm before 'Today'
70 million years ago	***Walking with Dinosaurs: Prehistoric Planet*** Setting	35 cm before 'Today'
66 million years ago	End of Cretaceous Extinction	33 cm before 'Today'

5. If students would like to add more organisms to the timeline, they can research when those organisms lived. The students can then print or draw pictures of the organisms and add them to the timeline.

Edmontosaurus

EVOLUTIONARY FIRSTS TIMELINE LABELS

3,500 MILLION YEARS AGO— THE FIRST LIFE IN THE FOSSIL RECORD

These were cyanobacteria, single-celled organisms that lived in colonies, called **stromatolites**. There are still colonies of cyanobacteria living today.

520 MILLION YEARS AGO— FIRST TRILOBITE

Trilobites lived in the sea and are related to still-living animals like scorpions, horseshoe crabs, spiders, crustaceans, and insects. They were one of the many complex organisms that lived at this time. Prior to this time, no known living organisms had hard parts and almost all life on Earth was simple, unicellular, and microscopic.

EVOLUTIONARY FIRSTS TIMELINE LABELS

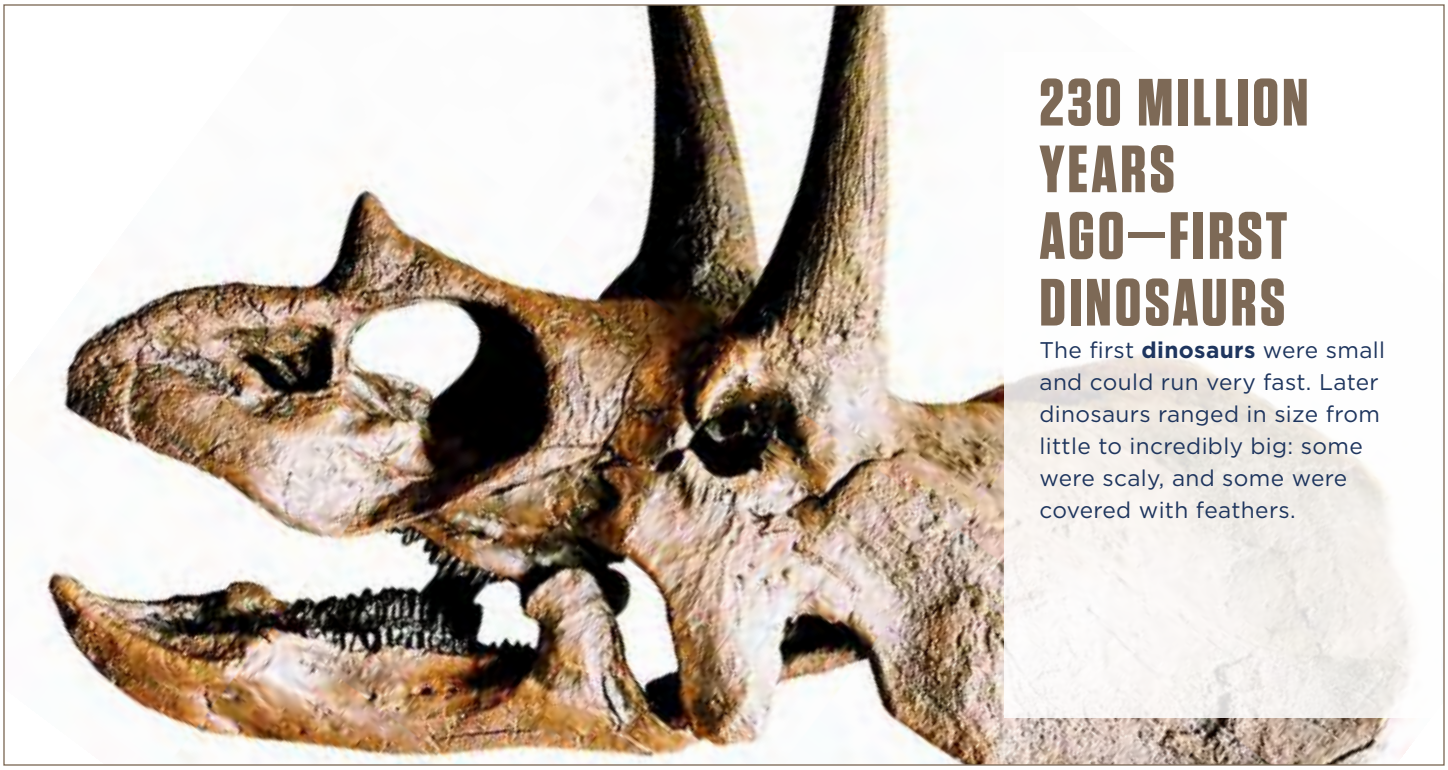
420 MILLION YEARS AGO—FIRST AMMONITES

Ammonites are related to squid and octopi that are alive today—they lived in oceans all over the world, and their fossilized shells can be found worldwide!

390 MILLION YEARS AGO—FIRST LAND VERTEBRATES

Vertebrates are animals with a backbone, including mammals, birds, reptiles and amphibians. These first land vertebrates, unlike their fishy ancestors, could leave the water to spend time on land. They still laid their eggs in the water though, and had to keep their skin moist or risk drying out and dying!

EVOLUTIONARY FIRSTS TIMELINE LABELS



230 MILLION YEARS AGO—FIRST DINOSAURS

The first **dinosaurs** were small and could run very fast. Later dinosaurs ranged in size from little to incredibly big: some were scaly, and some were covered with feathers.

150 MILLION YEARS AGO—FIRST BIRDS

The first **bird** in the fossil record is called *Archaeopteryx*. Its name means "Ancient Feather." Unlike birds alive today, *Archaeopteryx* had teeth in its beak!

EVOLUTIONARY FIRSTS TIMELINE LABELS

125 MILLION YEARS AGO—FIRST FLOWERING PLANTS

Land plants have been around for a long time, but the first flowering plants didn't appear until 125 million years ago. By then, dinosaurs had already been around for about 100 million years!

SETTING OF *WALKING WITH DINOSAURS: PREHISTORIC PLANET*

The dinosaurs and other prehistoric animals you met in ***Walking With Dinosaurs: Prehistoric Planet*** lived near the end the Cretaceous Period of geologic time, about 68—70 million years ago!

CLADISTICS: BUILDING EVOLUTIONARY FAMILY TREES

ACTIVITY #3

DESCRIPTION: Students will learn how scientists study the evolutionary relationship between animals. They will create an evolutionary family tree, known as a **cladogram**, of school supplies to explore this process. This activity will help students delve deeper into the evolutionary connection between birds and dinosaurs discussed in ***Walking with Dinosaurs: Prehistoric Planet.***

OBJECTIVES:

- Next Generation Science Standards: MS-LS4-1, HS-LS4-1
- Explore how scientists used shared features to understand the evolutionary relationships between animals.
- Create a 'family tree' of school supplies by categorizing the supplies by shared characteristics.
- Investigate the evolutionary relationship between birds and dinosaurs.

TIME FRAME: Approx. 60 minutes

MATERIALS:

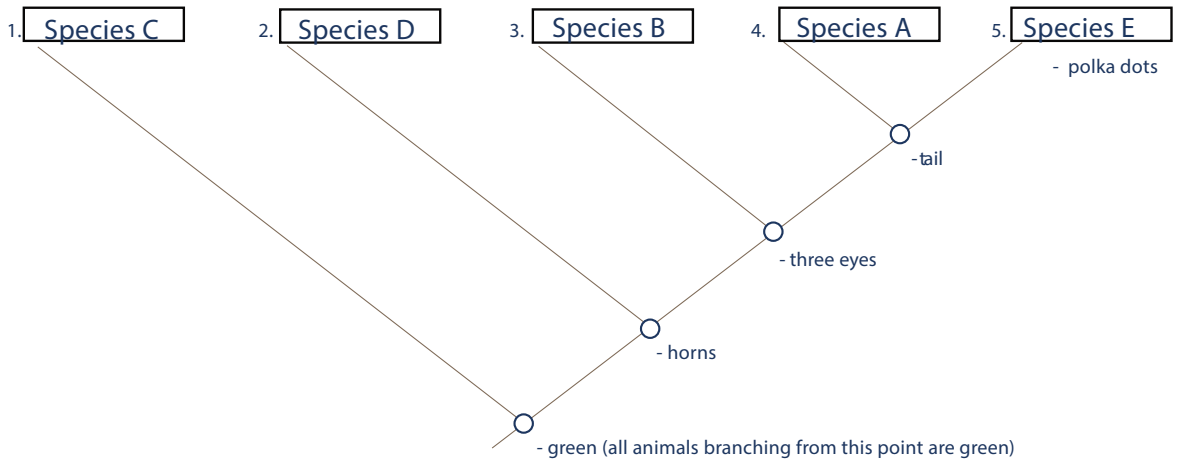
- A copy of the ***Building an Evolutionary Tree*** handout for each student
- Various school supplies for the sorting activity, such as pencils, colored pencils, crayons, pens, markers, rubber bands, paper clips, glue, glue sticks, erasers, etc.

INTRODUCTORY DISCUSSION: Explain to students that scientists observe the shared characteristics of animals to understand how they are related to one another evolutionarily. Ask students how they might tell a bird apart from a mammal or a reptile. Discuss that characteristics such as feathers, fur and scales are used to group animals together. Within each group, scientists look at other characteristics to further organize animals into finer and finer levels of relatedness. For example, what feature shared by all turtles might tell scientists that turtles are more closely related to each other than to all the other kinds of reptiles? (Answer: A shell!). Among turtles, you can further cluster kinds of turtles by other shared features, such as arms and legs turned into flippers in sea turtles, and soft-shelled turtles all sharing the feature of having a soft, leathery shell. Scientists use these observations to create a chart, known as a cladogram, that looks like a family tree and visually depicts the evolutionary relationship between different species.

ACTIVITY PROCEDURE:

1. Distribute the ***Building an Evolutionary Tree*** handout to each student and go through the introduction activity together. Have students observe what traits all the green monsters share. What trait do only 4 of them share? Only 3 of them? Have them fill out the chart with their observations and follow the instructions to fill in the cladogram on page 15.

    a. Answer key:



CLADISTICS: BUILDING EVOLUTIONARY FAMILY TREES

ACTIVITY #3

ACTIVITY PROCEDURE:

2. Now that they have sorted the monsters by shared characteristics, they are ready to sort school supplies into an evolutionary family tree.

3. Divide students into groups or have them work individually. Provide each group or student with an assorted set of school supplies.

4. Tell students they will use the characteristics of various school supplies to sort or group these objects, just like they did with the green monsters. Explain that while cladistics are used for living or once-living organisms and not objects, the activity models the process that scientists use when looking at fossils to determine how they are related.

5. Once the students have decided how to group their school supplies, have them draw out an evolutionary tree like in the green monsters activity, showing which characteristics they used to group the school supplies.

6. In the green monster example there was only one correct tree because the monsters had a small number of traits. When looking at real animals, scientists have to consider many different traits and sometimes they come up with many different trees that all could possibly be the 'correct' tree. Students may come up with many different ways of grouping the school supplies, and that is OK—real scientists do that too!

WRAP-UP DISCUSSION: Remind students that in ***Walking with Dinosaurs: Prehistoric Planet*** we learned that scientists consider birds to be a type of dinosaur. This means that birds must have shared characteristics with the extinct animals we think of when we hear the word 'dinosaur.'

Ask the class if they can think of some characteristics shared between birds and dinosaurs. Possible answers include feathers, laying eggs, building nests, travelling and living in groups, and many others.

This means that next time see a bird outside, you're looking at a living dinosaur! It also means the next time you eat chicken you are eating … a dinosaur!

EXTENSION IDEAS: Students can practice these skills with many different types of data sets. They could make a cladogram using the dinosaurs featured on the flashcards at the end of this packet, the animals they invented in Activity #1, or from printed pictures of dinosaurs and birds.

CAREER SPOTLIGHT

Dr. Ron Tykoski

Paleontologist, Fossil Preparator at the Perot Museum of Nature and Science

I prepare fossils at the Perot Museum of Nature and Science and I have been deeply involved with supporting Chief Curator, Dr. Anthony Fiorillo, in studies on high-latitude, polar dinosaurs and their ecosystems from Alaska. We've co-authored papers about dinosaurs from Alaska, including naming and describing the ceratopsian species *Pachyrhinosaurus perotorum* and the tyrannosaur *Nanuqsaurus hoglundi*, both featured in ***Walking with Dinosaurs: Prehistoric Planet***.

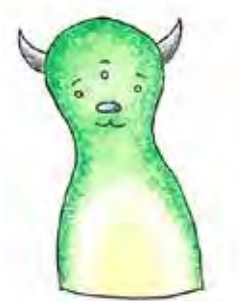
My job gives me the chance to be 'the first,' as in, the first human to see something new be revealed from the rocks in which it was trapped for millions of years. There's really quite a thrill at that 'lightbulb' moment when something that you're looking at has never been seen before by human eyes. That's an awesome rush of pure discovery, and is something that can happen anytime in the lab!

BUILDING AN EVOLUTIONARY FAMILY TREE

Newsflash: Scientists have just found 5 new species of Green Monsters! They want to be able to figure out the evolutionary relationship between the monsters so that they can draw an evolutionary family tree, known as a **cladogram.** Can you help them?

Observe the pictures of the monsters below. Carefully record in the chart which ones share various characteristics, including horns, number of eyes, a tail, and polka dots. If species has that feature, put a '+' mark under the feature label. If it does not have that trait, put a '–' there. Then fill in the tree based on which ones have '+' marks in common.

SPECIES A



SPECIES B

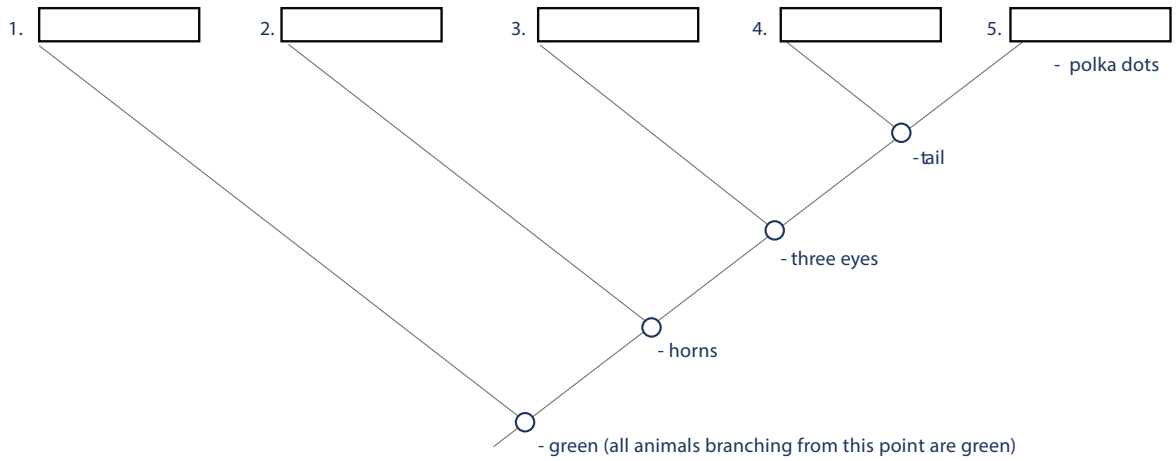
SPECIES C

SPECIES D

SPECIES E

Illustration Credit: *Talia Arvizo*

	GREEN	HORNS	THREE EYES	TAIL	POLKA DOTS
Species A					
Species B					
Species C					
Species D					
Species E					



ACTIVITY #4

PANGAEA FLIP BOOK

DESCRIPTION: Students will create a flip book that shows the movement of the continents in the break-up of Pangaea. They will be able to color the continents different colors so that they can keep track of how they moved over time.

OBJECTIVES:

- Next Generation Science Standards: 4-ESS2-2, MS-ESS2-3
- Observe the breakup of Pangaea and how continents have moved over time.

TIME FRAME: 30 minutes

MATERIALS:

- ***Pangaea Flip Book*** page printed out for each student on cardstock
- Drawing materials
- Scissors
- Stapler

INTRODUCTORY DISCUSSION: Tell students that the Earth has changed over time. The continents have not always been where they are today. Pangaea is the name for a supercontinent that started to break apart about 200 million years ago. To learn more about how the Earth has changed over time, students will create a Pangaea flip book.

ACTIVITY PROCEDURE:

1. Distribute the ***Pangaea Flip Book*** printout, coloring material, and scissors to students.

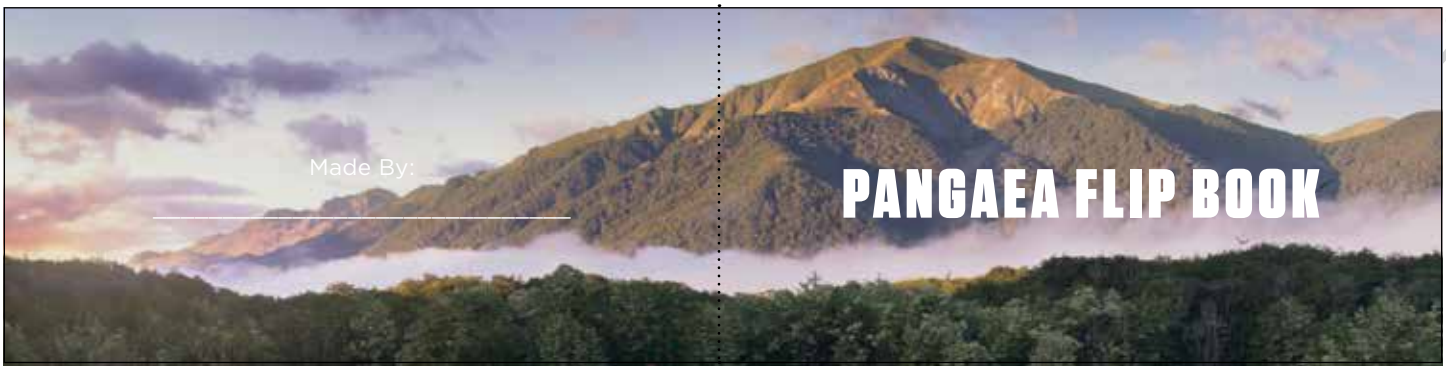
2. Have students create a key for what they will color each continent in the activity. They may want to color the water or leave it blank.

3. After they have colored in each map, have them neatly cut out the images along the dotted lines.

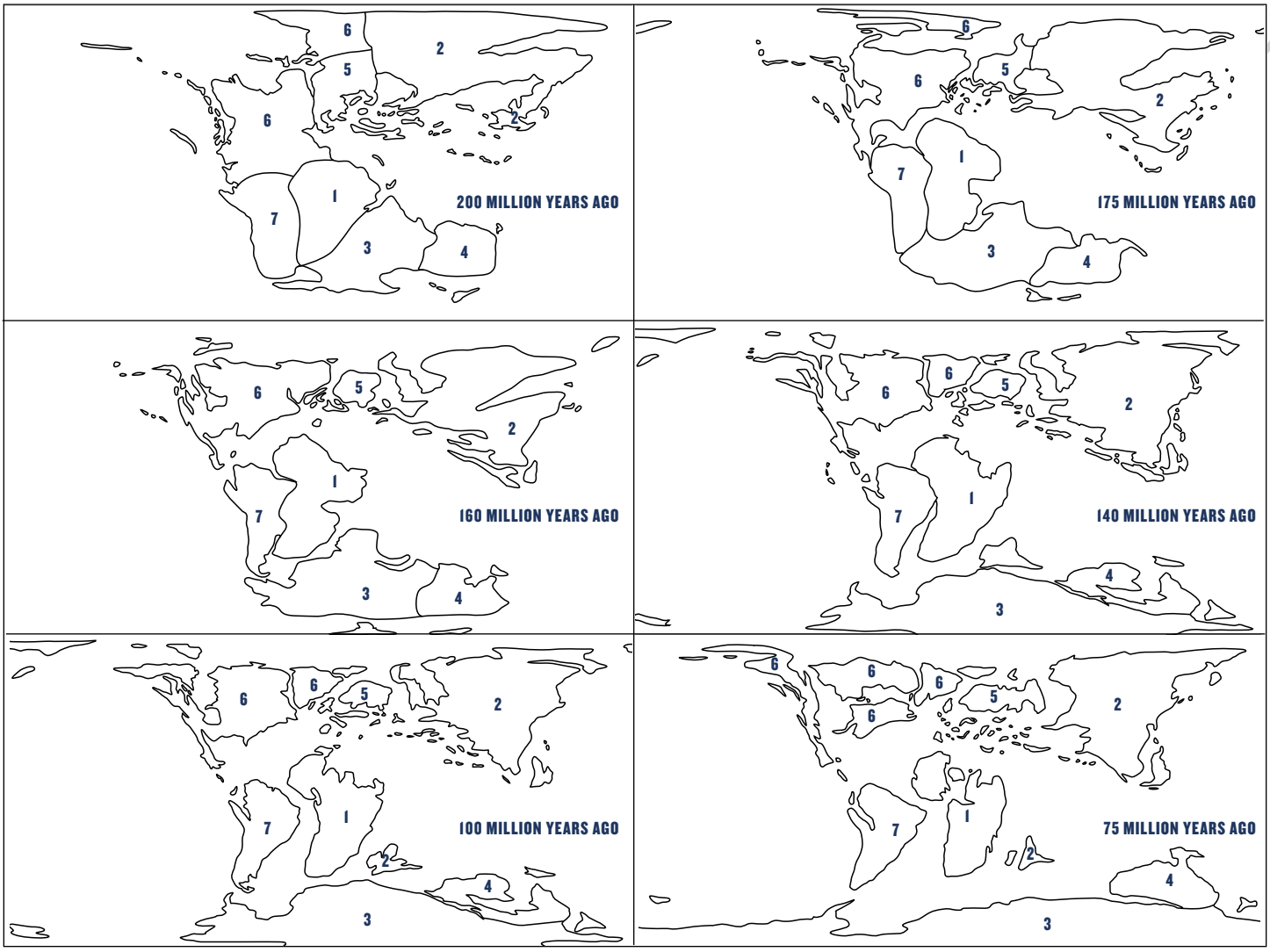
4. After placing images in order from 200 million years ago to today, staple the images together.

5. Students can flip through to watch Pangaea break up into the continents we know today.

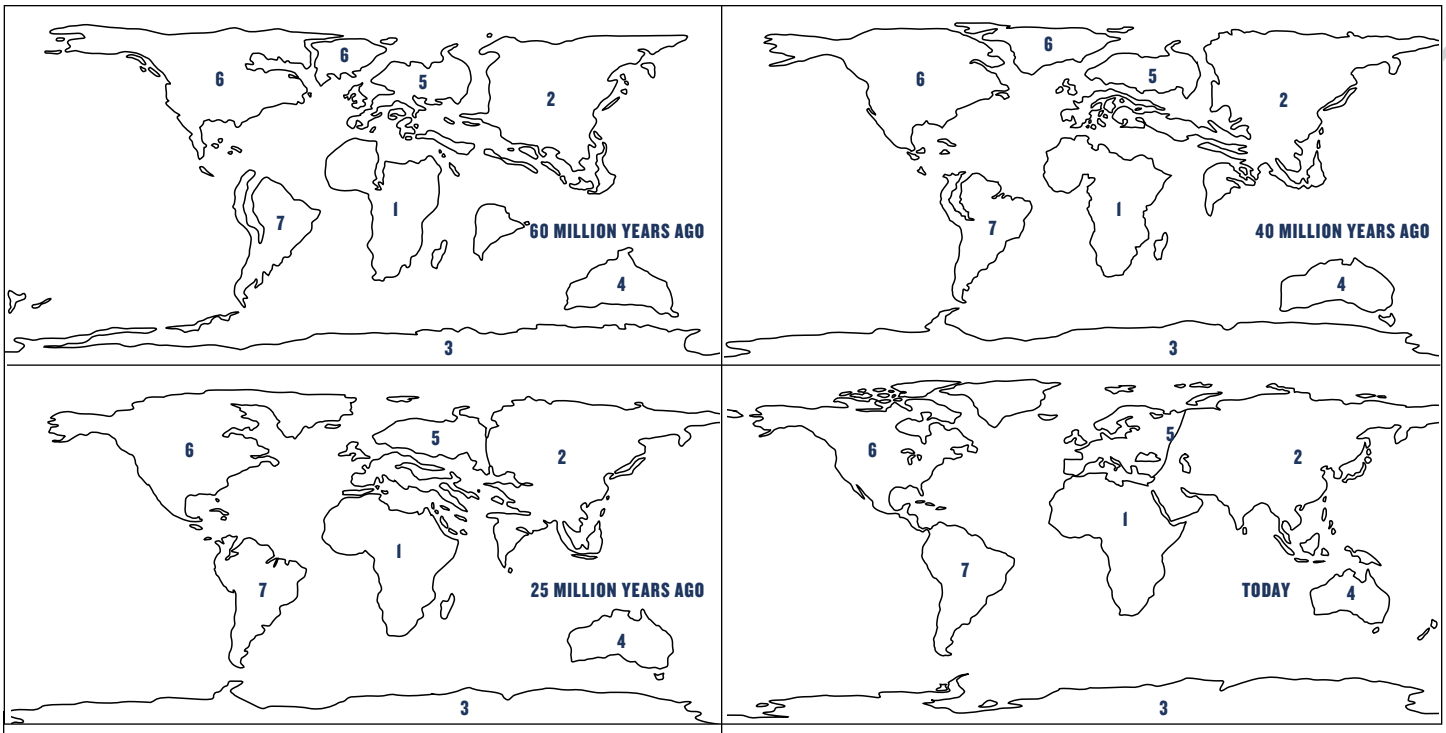
PANGAEA FLIP BOOK



Fold Here



PANGAEA FLIP BOOK



CONTINENT KEY:

1 ☐ Africa
2 ☐ Asia
3 ☐ Antarctica
4 ☐ Australia
5 ☐ Europe
6 ☐ North America
7 ☐ South America

Alexornis

ACTIVITY #5

MAKE YOUR OWN *PACHYRHINOSAURUS* FRILL

DESCRIPTION: This activity explores the diversity and function of head ornamentation (frills, scales, and horns) in ceratopsids, a group that includes *Pachyrhinosaurus* and other horned dinosaurs. Students will explore how scientists infer the appearance and behavior of extinct animals from fossils and from modern analogs. A modern analogue is: a living species that is similar to an extinct species in its size, skeleton, behavior, or other features.

OBJECTIVES:

- Next Generation Science Standards: 1-LS1-1, 4-LS1-1, MS-LS4-
- Explore the variety of head ornamentation among ceratopsid dinosaur species
- Propose hypotheses for how these dinosaurs used their frills and horns by examining how animals use similar head gear today
- Design their own wearable horned dinosaur frill

TIME FRAME: 60 minutes

MATERIALS:

- A copy of the ***Make Your Own Pachyrhinosaurus Frill*** activity sheet for each student
- Craft supplies
- Paper plates
- Writing utensils

INTRODUCTORY DISCUSSION: Fossils, such as bones, skin impressions, and footprints, provide clues about the appearance and behavior of ancient life. One way scientists interpret these clues is by observing the appearance and behavior of organisms alive today. When it comes to figuring out how *Pachyrhinosaurus*, *Triceratops*, and other horned dinosaurs might have used their horns and elaborate frill, paleontologists look at animals that have horns and antlers today. Ask your class what animals they can think of with horns or antlers.

ACTIVITY PROCEDURE:

1. Distribute the ***Make Your Own Ceratopsian Frill*** activity to students.

2. Have them think about which animals today have horns and antlers and how those animals use them.
   a. Examples of animals with horns include: sheep, cows, antelope, kudu, bison, gazelle, and pronghorn.

   b. Examples of animal with antlers include: deer, moose, caribou, and elk.

3. Looking at the pictures of horned dinosaurs provided and have students think about and compare these to the horns and antlers seen today. How are they similar? How are they different? Do they think they could have been used for similar purposes?

WRAP-UP DISCUSSION: Does the fact that some mammals today have horns and some dinosaurs in the past had horns make them closely related? No! This is an example of convergent evolution. Convergent evolution is when the same adaptation occurs multiple times because of similar adaptive needs. Can you think of another example of convergent evolution? (Examples include wings on birds, bats, insects and pterosaurs and long necks on giraffes and sauropod dinosaurs.)

Why not take photos of you as a dinosaur alongside the movie dinosaurs in the FREE Walking with Dinosaurs: Photo Adventure app? Don't forget to share the photos afterwards with family and friends! ***itunes.apple.com/gb/app/walking-dinosaurs-photo-adventure/id692778428?mt=8'***

HORNS AND ANTLERS

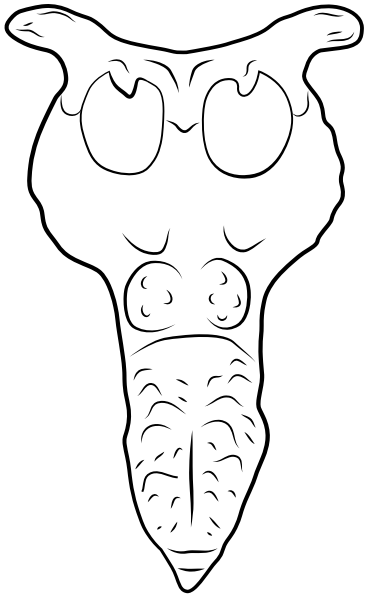
Some mammals alive today have horns or antlers which they use for:
- defense from predators
- competition within their own species for territory and status
- for courtship display and species recognition
- sometimes for rooting in the soil for food

Can you list 3 modern animals with horns and 3 with antlers?

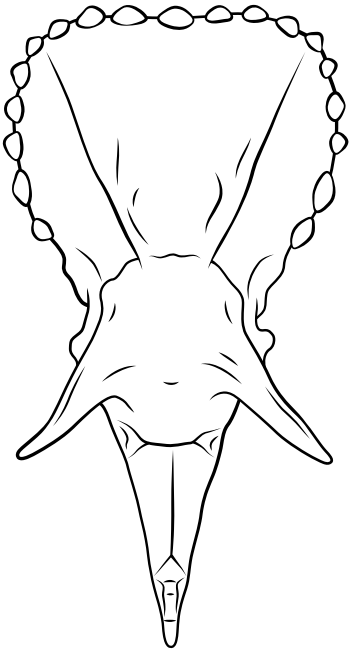
HORNS

ANTLERS

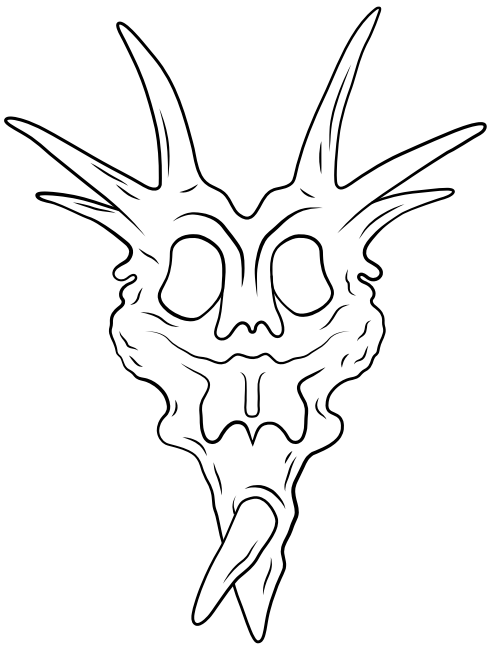
Observe the skulls below from dinosaurs that had horns, frills, and other head gear. Scientists look at living animals today to understand how these dinosaurs would have used their head gear. Examine the images below and compare these to horns and antlers seen on animals today. How are they similar? How are they different? Do you think they could have been used for similar purposes?



PACHYRHINOSAURUS



TRICERATOPS



STYRACOSAURUS

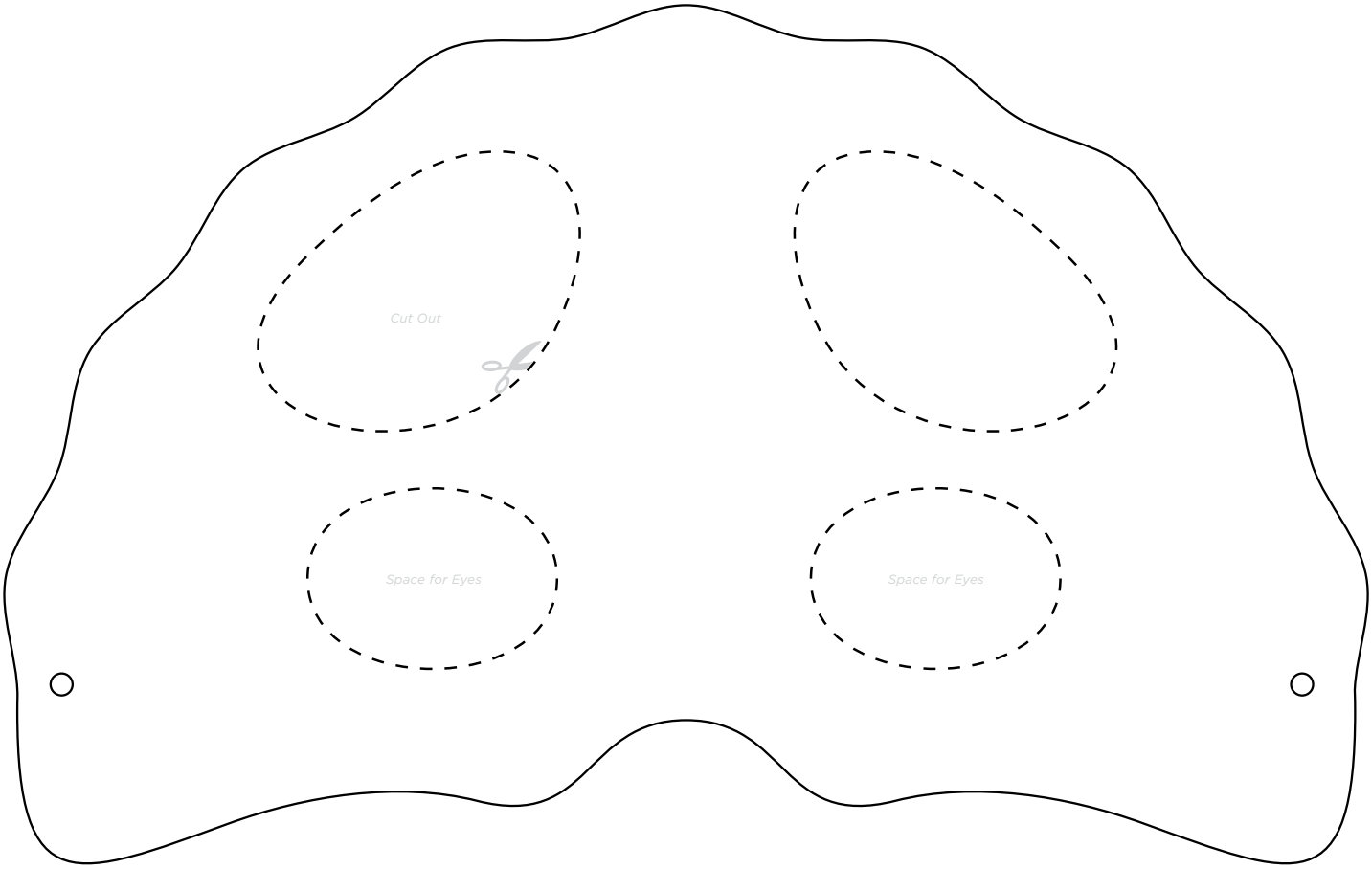
HORNS AND ANTLERS

Even though scientists can't travel back in time to observe behaviors of dinosaurs, they can extrapolate that horned dinosaurs, such *Pachyrhinosaurus* and *Triceratops* would have used their horns for similar reasons to animals with horns and antlers today. Can you recall instances of some of the above behaviors in *Pachyrinosaurus* in ***Walking with Dinosaurs: Prehistoric Planet***?

Pachyrhinosaurus

MAKE YOUR OWN *PACHYRHINOSAURUS* FRILL

Wonder what you would look like with a frill? Try it out! Cut out the mask below and glue it to a paper plate. Use craft supplies to add horns, scales and other features to transform yourself into a *Pachyrhinosaurus*, or maybe into some new type of horned dinosaur! Want to give your new species a name? Check out the root words in the dinosaur naming activity!



ACTIVITY #6

INVESTIGATING FEATHERS

DESCRIPTION: Wondering about the feathered dinosaurs in ***Walking with Dinosaurs: Prehistoric Planet***? This activity explores the evidence that some species of dinosaurs had feathers and introduces students to the possible reasons for these feathers by investigating the structure and function of modern feathers. They will get to decide what type of feathers *Troodon* might have needed and complete a picture of *Troodon* by adding feathers.

OBJECTIVES:

- Explore the various functions of feathers in modern birds
- Understand that some dinosaurs also had feathers

TIME FRAME: 45 minutes

MATERIALS:

- A copy of the ***All About Feathers*** handout for each student
- Assorted feathers from craft store (look for packs where there is an assortment of shapes and sizes)
- Hand lenses
- Glue or glue sticks
- Optional: Cup of water and droppers or spoons to test waterproof proprieties of feathers

INTRODUCTORY DISCUSSION: Ask students to remember which animals in ***Walking with Dinosaurs: Prehistoric Planet*** had feathers. (See the 'Dinosaur Glossary' at the end of the packet for a recap of this information.) Ask them to think about why these animals might have had feathers even though they couldn't fly.

ACTIVITY PROCEDURE:

1. Hand out the ***All About Feathers*** handout and have students read about the various functions of feathers.

2. Hand out an assortment of craft feathers and hand lenses. Optional: Hand out cups of water and droppers or spoons for students to test the waterproofing properties of certain feathers

3. Have students use the hand lenses to observe various properties of the feathers and match them to the descriptions of the various feather functions on the handout.

4. You may want to have students glue one feather of each type on the handout as an example. (Feathers could have more than one function, for example feathers may be bright for display and also aerodynamic for flight).

CAREER SPOTLIGHT

Marco Marenghi

Animation Director

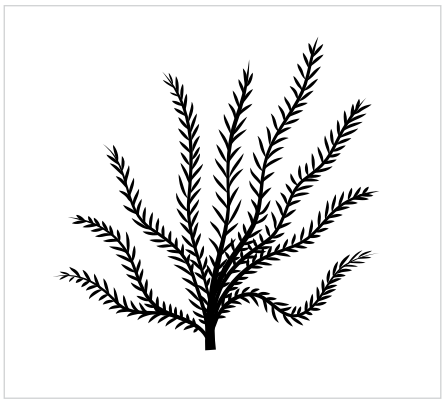
Working as an animator on the original ***Walking with Dinosaurs*** documentary series for the BBC in 1998 was my first job after returning to college to train as an artist. Since then I have had the opportunity to work for Dreamworks and Sony Pictures Imageworks on a variety of films, such as *Minority Report*, *Alice in Wonderland*, *Spiderman* and *Ghost Rider.*

When I heard BBC Earth was making ***Walking with Dinosaurs: The 3D Movie***, I had to be part of it and moved to Australia for 2 years to direct the animation for the show. It was my best experience yet and I had a great time working with wonderful people who all shared my love of dinosaurs and animation!

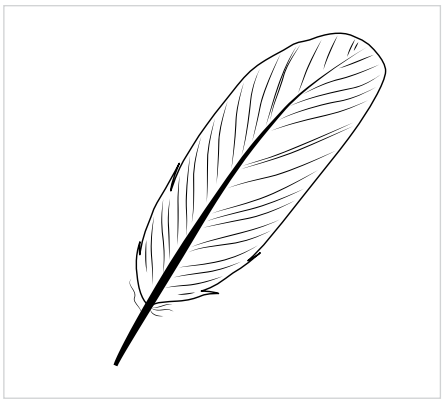
ALL ABOUT FEATHERS

Why do birds today have feathers? There are many reasons! Let's explore some of those reasons to find out how feathers would have been useful to some of the dinosaurs we met in ***Walking with Dinosaurs: Prehistoric Planet***, such as *Troodon* and *Chirostenotes*.

FEATHER STRUCTURE



Down features provide insulation for keeping warm or cool



Contour feathers make an animal more aerodynamic and help support its weight in flight

Feathers can be used to keep an animal dry in the water

EXAMPLE FEATHER: Draw or paste an example of the types of feathers above here.

FEATHER COLOR

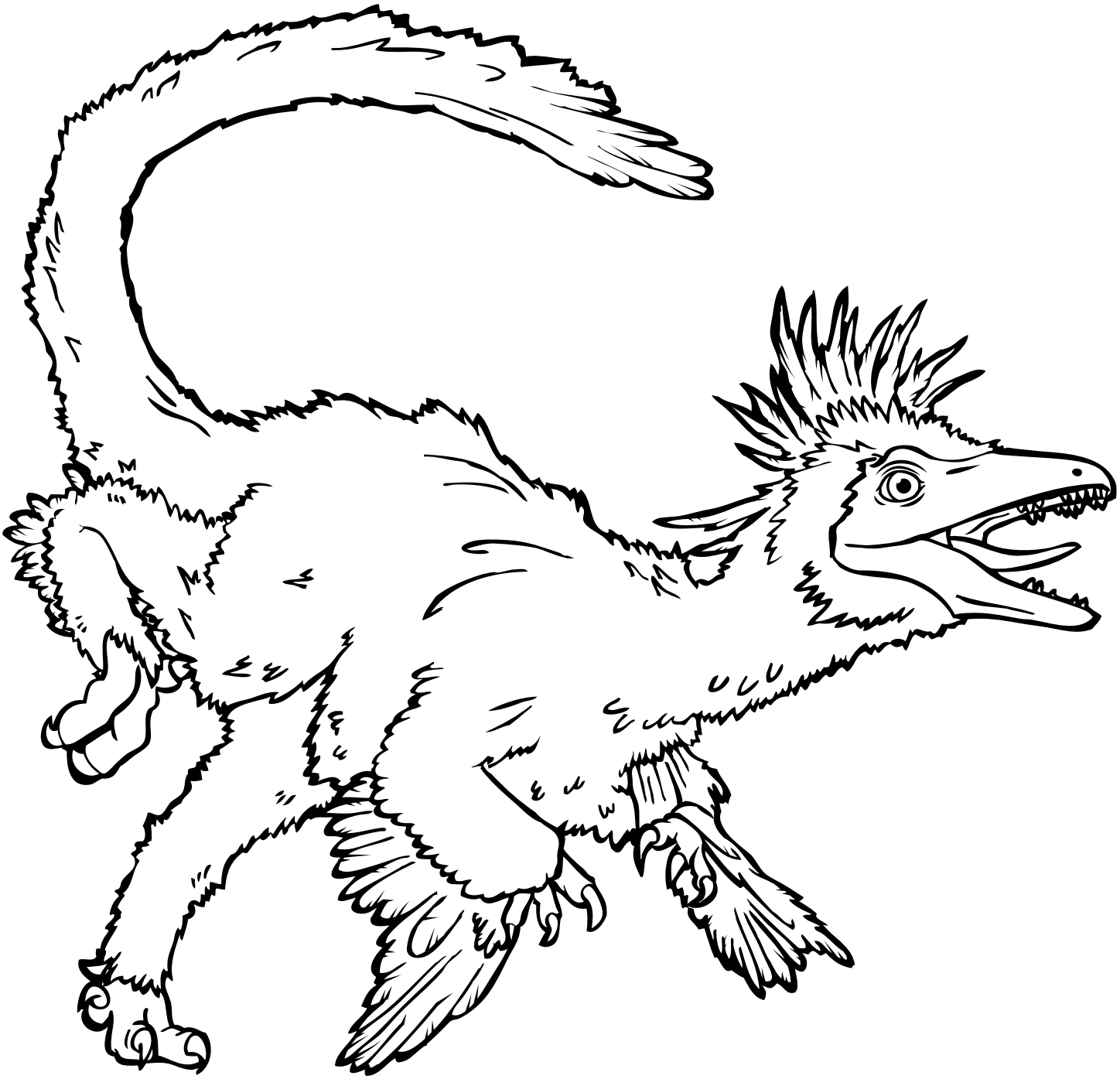
Feathers can be used as display to help attract a mate in courtship.

Feathers can be used to help an animal camouflage, or blend into an environment

EXAMPLE FEATHER:

ALL ABOUT FEATHERS

Uh-oh! Looks like *Troodon* needs some feathers. Can you help out? Decide what types of feathers *Troodon* might need and glue them onto the picture.



DINO-RAMA:
CREATE A CRETACEOUS ALASKAN ECOSYSTEM

ACTIVITY #7

DESCRIPTION: In this activity students will build a model of a Cretaceous Alaskan ecosystem and one of its food webs based on knowledge gained from the film.

OBJECTIVES:

- Next Generation Science Standards: K-ESS3-1, 2-LS4-1, 5-LS2-1, MS-LS2-3
- Explore an ecosystem (Cretaceous Alaska) in depth
- Build a food web for that ecosystem
- Learn about a career as a Paleo-artist/scientific illustrator
- Investigate and learn about climate and animal behavior, such as diet and predator/prey relationships

TIME FRAME: Approx. 120 minutes (can be spread across separate class periods)

MATERIALS:

- Cretaceous Alaskan background and cut-out page for each student
- Art materials such as crayons/markers/colored pencils, scissors, glue sticks
- Shoebox for each student (alternatively, sturdy cardstock folded in half at a right angle can be used instead of a shoe-box)

INTRODUCTORY DISCUSSION: Remind students of the setting of ***Walking with Dinosaurs: Prehistoric Planet***: Alaska during the Late Cretaceous, 68–70 million years ago. Ask them to recall some of the animals that they met in the film. Can they name one that was an herbivore? A carnivore? An omnivore? (See the 'Dinosaur Glossary' at the end of the packet for a recap of this information.) Discuss with students how paleontologists use fossil evidence to know which plants and animals lived together in Alaska in the past and to investigate the food webs of those ecosystems.

ACTIVITY PROCEDURE:

1. Distribute art supplies and printouts of the ***Cretaceous Alaskan Background*** and colorable ***Walking with Dinosaurs: Prehistoric Planet*** cut-outs. Have students color in the background and glue it to the back of their shoebox.

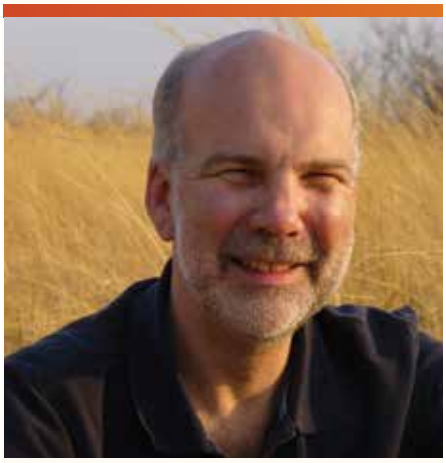
2. Students can then color and cut out the plant and animal figures, and glue them to the bottom and sides of the box using the attached tabs.

3. For grades Kindergarten–2nd: Discuss the importance of plants, herbivores and carnivores in an ecosystem. Have students identify which organisms in their diorama fill each role. Have them talk about what various animals eat and how they behave.

4. For grades 3rd–8th, have a class discussion about food webs and the important roles played by "producers," "primary consumers," "secondary consumers," "herbivores," "omnivores," "carnivores" in ecosystems. Have students identify which organisms in their dioramas fill these roles and have them glue the labeled tabs next to each.

5. For grades 9th–12th, students can glue the cutouts onto the blank trophic energy pyramid provided. They could do this in addition to or instead of creating the diorama.

Why don't you explore the Late Cretaceous some more with the FREE game Walking with Dinosaurs: Dino Run! ***itunes.apple.com/app/walking-dinosaurs-dino-run!/id740275900?mt=8***



CAREER SPOTLIGHT

Neil Nightingale

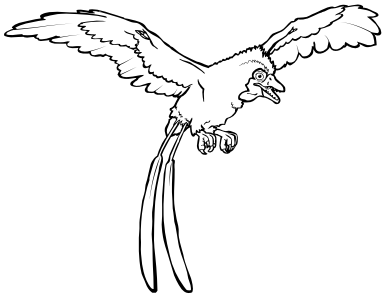
Creative Director, BBC Earth

I've been passionate about animals since the age of 4, studied zoology at university, and could not have dreamed of a more perfect career than making films and TV programs about wildlife. I've travelled to every continent and filmed subjects as diverse as seahorses and sharks, backyard weeds and remote rainforests, the depths of the ocean and Arctic glaciers. Now I lead the development and production of all kinds of new wildlife experiences. As well as co-directing ***Walking with Dinosaurs: The 3D Movie*** and ***Walking with Dinosaurs: Prehistoric Planet***, I also co-directed ***Enchanted Kingdom***, an immersive 3D film about African wildlife.

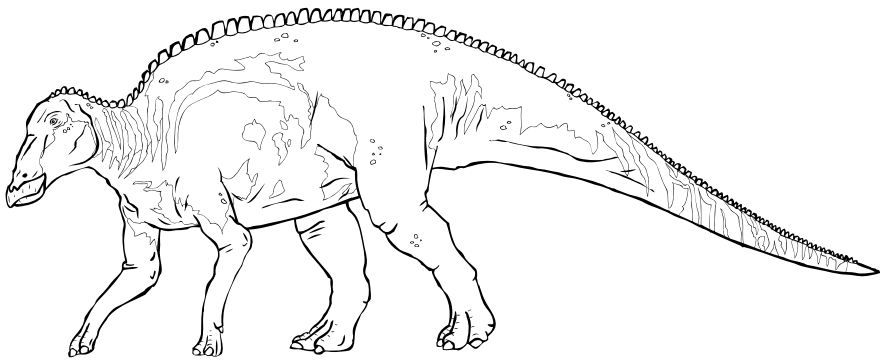
One of my favorite things about my job is being surprised almost every day by new stories, new animals, new places, new behaviors.

I was inspired to turn my passion for wildlife into a career, when I read a book about the BBC Natural History Unit, called ***True To Nature***, written by Chris Parsons.

DINO-RAMA:
CREATE A CRETACEOUS ALASKAN ECOSYSTEM



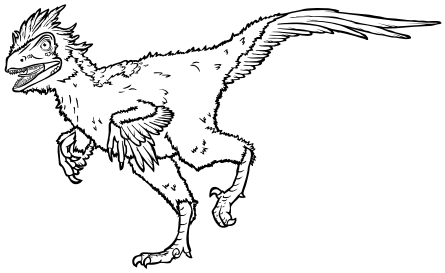
ALEXORNIS



EDMONTOSAURUS

Fold Here

ALPHADON

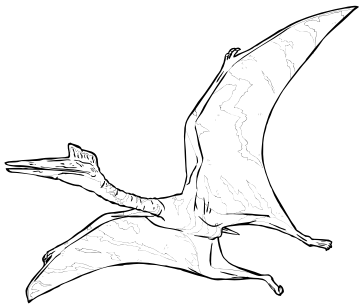


HESPERONYCHUS

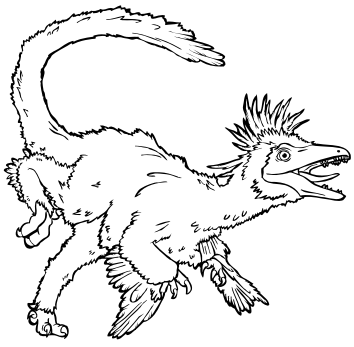
NANUQSAURUS

Fold Here

PACHYRHINOSAURUS



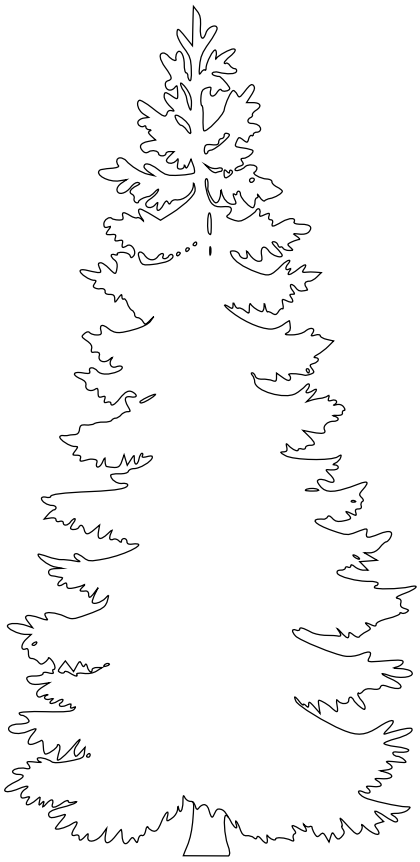
QUETZALCOATLUS



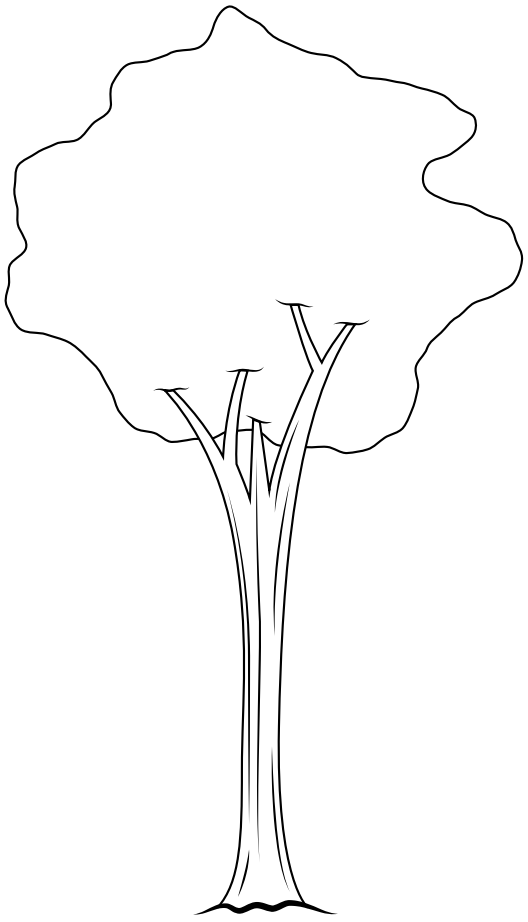
TROODON

Fold Here

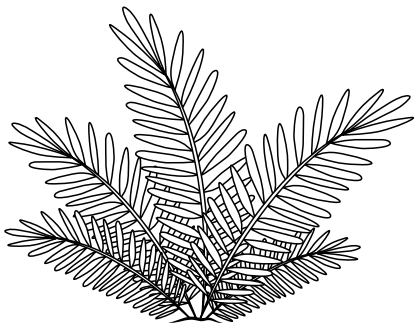
DINO-RAMA:
CREATE A CRETACEOUS ALASKAN ECOSYSTEM



PINE



GINKGO



FERN

Fold Here

PRODUCER	PRIMARY CONSUMER	SECONDARY CONSUMER

Fold Here

HERBIVORE	OMNIVORE	CARNIVORE

Fold Here

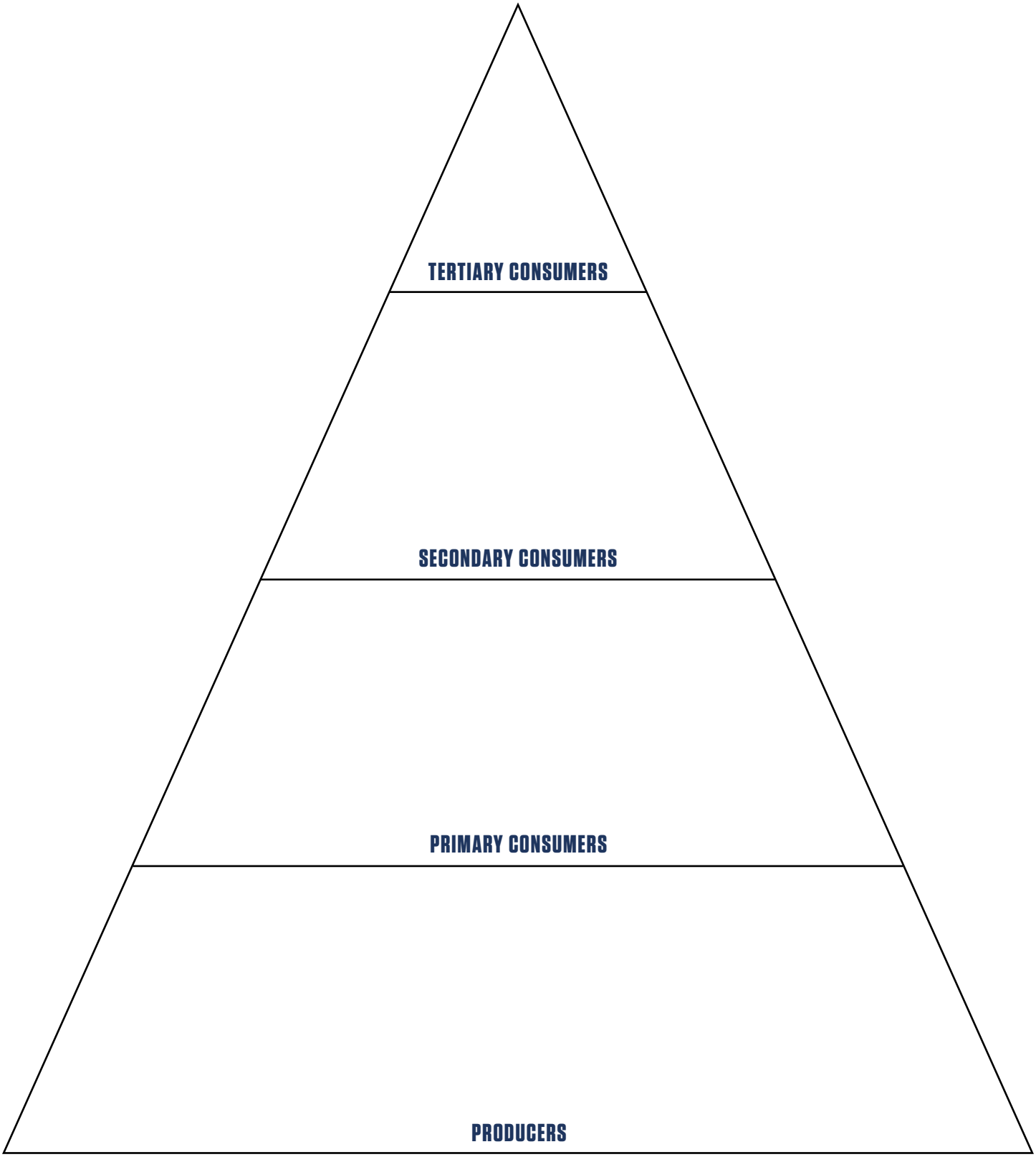
DINO-RAMA:
CREATE A CRETACEOUS ALASKAN ECOSYSTEM

CRETACEOUS ALASKAN BACKGROUND #1

DINO-RAMA:
CREATE A CRETACEOUS ALASKAN ECOSYSTEM

CRETACEOUS ALASKAN BACKGROUND #2

ENERGY PYRAMID



ACTIVITY #8

DINOSAUR TRACKWAY MYSTERY: INVESTIGATING CLUES FROM FOSSIL FOOTPRINTS AT DENALI NATIONAL PARK

DESCRIPTION: Students will investigate clues from a real Denali National Park trackway site to come up with an interpretation about the animals and their behaviors that left those tracks.

OBJECTIVES:

- Next Generation Science Standards: K-ESS3-1, 1-LS1-2, 3-LS2-1, 3-LS4-1
- Investigate and interpret clues from an illustration of real fossilized dinosaur footprints in Denali National Park and Preserve
- Learn about the animals and explore the behaviors, such as living in herds and predator/prey relationships, that are responsible for these tracks

TIME FRAME: Approx. 45 minutes

MATERIALS:

- Copy of ***Dinosaur Trackway Mystery*** for each student

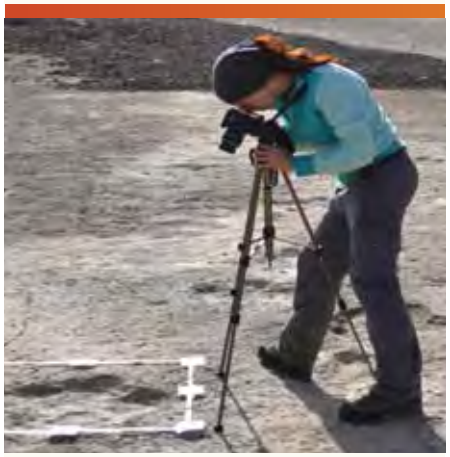
INTRODUCTORY DISCUSSION: Discuss with the class that bones aren't the only fossil evidence of life in the past. In fact **trace fossils**, which are made not of any part of a living organism but are produced as a byproduct of its actions, such as footprints, skin and feather impressions, and coprolites (fossilized faeces), are essential to scientists to understand how dinosaurs behaved.

ACTIVITY PROCEDURE:

1. Distribute a printout of the ***Denali Trackway Mystery*** to each student.

2. If students get stuck on a particular question, ask them to think about their own footprints. For example, would their footprints be closer together if they were running or walking?

Hesperonychus



CAREER SPOTLIGHT

Dr. Michela Contessi

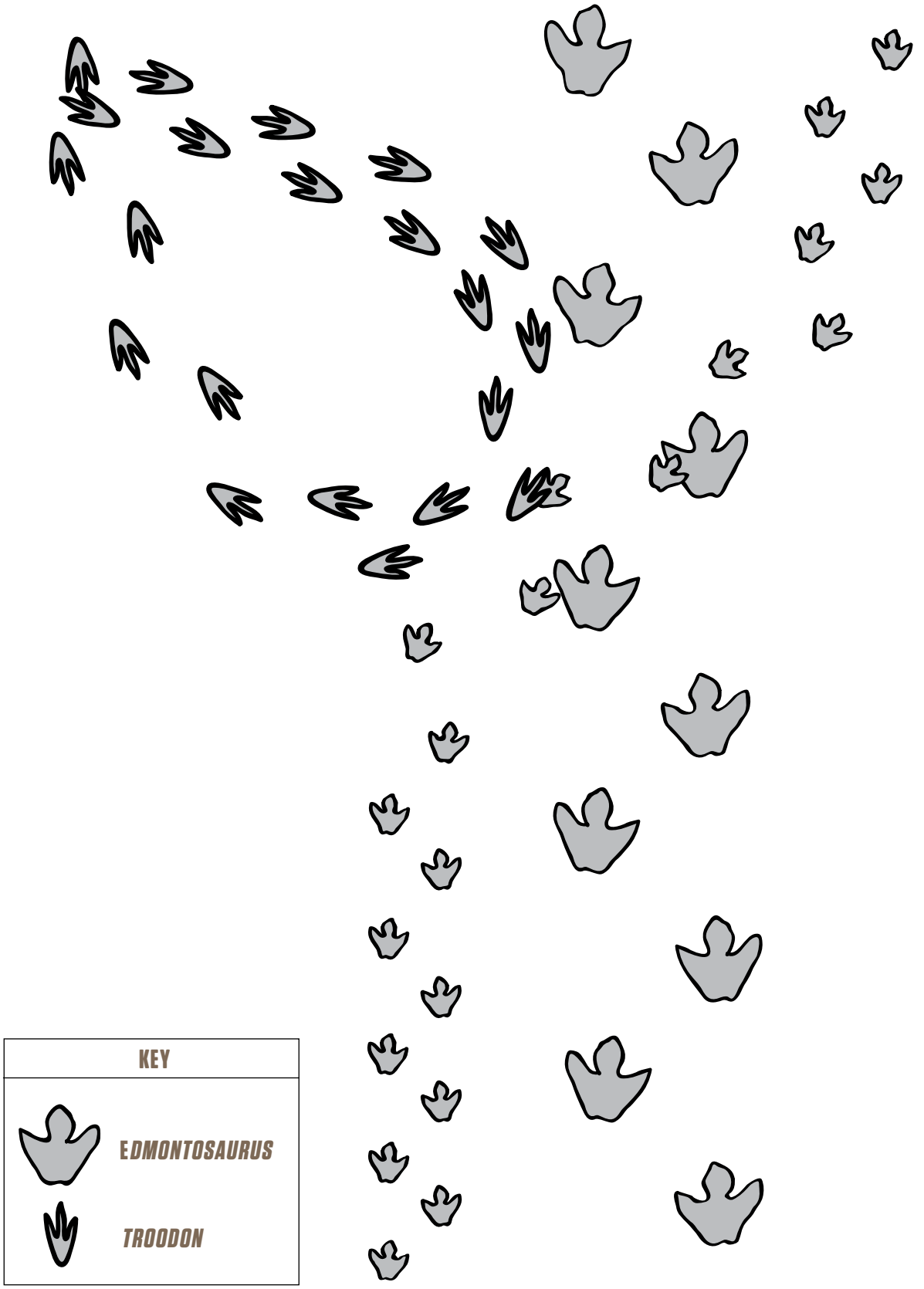
Paleontologist

As a paleontologist, I study and research dinosaur tracks. I have been looking for and recording dinosaur footprints in Tunisia, Alaska and Turkmenistan. I also use technology to create digital versions of footprints and fossils. I currently work for a museum in Italy where, in addition to my research, I also help organize new exhibits and plan learning activities for students.

My favorite part of my job is excavating fossils and cleaning up the mud, sand and dirt after a day out in the field. Paleontologists can often spend a lot of time just looking for fossils before they can actually excavate and study them—but it is a very rewarding job!

Just like the dinosaurs on the Denali Trackway, go on a journey of your own in Walking with Dinosaurs: Patchi's Journey. ***itunes.apple.com/us/app/walking-dinosaurs-patchis/id742170668?mt=8'***

DINOSAUR TRACKWAY MYSTERY



DINOSAUR TRACKWAY MYSTERY

How many individual animals were here? _____

Can you determine which dinosaurs were running? Why or why not? _____

Which animal walked across the area first? How do you know? _____

There are two sets of tracks that are very similar, but different sizes, what might explain this? _____

If these animals all travelled across this area at the same time, they may have interacted with one another. Can you write a paragraph using the information you have gathered here to describe that interaction? _____

ACTIVITY #9

MAKE YOUR OWN FOSSIL REPLICA

DESCRIPTION: Students will make replica casts of fossils using clay and plaster, gaining an understanding of how some fossils form in nature and how scientists are able to make replicas of fossils. Will learn about different field methods and careers in paleontology.

OBJECTIVES:

- Next Generation Science Standards: NGSS–K-ESS3-1, 3LS4-1, MS-LS4-1
- Learn about an important paleontological technique
- Learn about careers in paleontology
- Make a mold and cast of a shell or toy fossil

TIME FRAME: Approx. 45 minutes

MATERIALS: *For about 30 students*

- Seashells or small dinosaur/fossil toys
- One 5 lbs. package of air-dry clay
- 2 cups of Plaster of Paris
- Cupcake foils (2 per student)
- Cup or bowl to mix plaster
- Spoon to stir/pour plaster
- Non-stick cooking spray (optional)

INTRODUCTORY DISCUSSION: Tell the class that it is important for many reasons for scientists to be able to make copies of fossils. Often fossils of large animals, such as dinosaurs, do not have 100% of the bones preserved when they are discovered. Over time various processes, such as scavenging by other animals, weather, or displacement by water, moves or destroys parts of a fossil. If a museum wants to display such a fossil, they can create a replica of the missing bones from another animal of the same species, so they have a complete skeleton to put on display. Making replicas is also important for research and for education so that copies of the fossil can be transported and handled, rather than the original.

Troodon

CAREER SPOTLIGHT

David Krentz

Movie Artist and
Director Paleoartist

As a movie artist, I work in the film industry creating artwork for movies. Sometime I generate ideas about what an animated character will look like. This can be done in a 3D modeling program or many forms of 2D art. Other times I will storyboard a movie sequence directly from a script, sort of like making a comic book of the film, to inform film crews and directors about how the movie will look.

I have worked on many movies about dinosaurs, including ***Walking with Dinosaurs: Prehistoric Planet***, and I still find them fascinating. I enjoy working with scientists to bring new finds to life in films!

ACTIVITY #9

MAKE YOUR OWN FOSSIL REPLICA

ACTIVITY PROCEDURE:

1. Give each student 2 golf ball-sized balls of clay and 2 cupcake liners.

2. Have each student place each ball in a cupcake liner and flatten in until it covers the bottom of the liner. Have students write either their name or initials somewhere on the cupcake liner that is easily visible.

3. Have the students pick which shells or toys they would like to make an imprint of in the clay.

4. Have students push the shell into the clay to make an impression deep enough to pour a small amount of plaster into. This will be the mold from which they will make a copy of the shell or toy. Note: if you have a problem with the clay sticking to the shell/toy you can spray a thin coating of non-stick cooking spray onto the shell/toy. Use sparingly, a little goes a long way!

5. Pour plaster into each mold (while the clay is still wet) and place aside to dry.

6. Once plaster is dry, students can separate the clay and plaster and to reveal fossil replica.

EXTENSION IDEAS:

- Have students paint their fossil replicas
- If your school has a 3D printer students can scan and print replica fossils

DINOSAUR GLOSSARY AND TRADING CARD SET

Use this section as a glossary or print out copies to make trading cards. For trading cards, cut out each box along the solid line and then fold in half along the dotted line. Glue the two sides together and you're done!

ALEXORNIS

Named after paleontologist and ornithologist, Alexander Wetmore, literally **ALEX'S BIRD**

Bird
Omnivore

Alexornis is an extinct, prehistoric bird, about the size of a sparrow that lived at the time of the dinosaurs. One of the most unusual features of many ancient birds like *Alexornis* is that they still had teeth, which modern birds lost at some point during their evolutionary history. Amazingly, scientists have successfully made chickens grow teeth in laboratory experiments. That means the genes that code for teeth are still hidden away in the DNA of living birds!

ALPHADON

FIRST TOOTH

Mammal
Omnivore

Alphadon was a small opossum-like mammal known from rocks across much of western North America. Like many other mammals, *Alphadon* probably had an excellent sense of smell, which would have helped it to track down food during the darkness of night.

Fold Here

DINOSAUR GLOSSARY AND TRADING CARD SET

Use this section as a glossary or print out copies to make trading cards. For trading cards, cut out each box along the solid line and then fold in half along the dotted line. Glue the two sides together and you're done!

LIZARD OF EDMONTON

Dinosaur
Herbivore

Edmontosaurus was a hadrosaur or duck-billed dinosaur —so called because of its wide, flat beak. Its hind limbs were longer than its forelimbs, allowing it to move about on two legs as well as four.

We suspect that hadrosaurs lived in herds because their fossils are often found in huge bone beds. Fossil tracks of them in Alaska also show evidence of them staying in large groups, with tracks from youngsters, half-grown, and fully adult sized animals all together at the same time and place.

WESTERN CLAW

Dinosaur
Carnivore

Hesperonychus was a small predatory dinosaur. They almost certainly had feathers. Feathers of its relative *Microraptor* were iridescent—probably for displaying to potential mates. It is possible *Hesperonychus* had shiny feathers like this too.

Hesperonychus was around twice the size of a domestic cat and probably hunted insects, mammals, amphibians and maybe even baby dinosaurs.

Fold Here

DINOSAUR GLOSSARY AND TRADING CARD SET

Use this section as a glossary or print out copies to make trading cards. For trading cards, cut out each box along the solid line and then fold in half along the dotted line. Glue the two sides together and you're done!

POLAR BEAR LIZARD

Dinosaur
Carnivore

Nanuqsaurus is one of the closest cousins of *T. rex,* but would have looked very different. It was still a fierce, toothy predator that walked on two legs. But it was less than half the size of its famous cousin.

Scientists believe that its dwarf size was due to its environment. Alaska was not as cold during the Late Cretaceous as it was today, but it was still covered in darkness during several months of the year, because of its far northerly position close to the Arctic Circle. This probably would have meant fewer and smaller plants, and therefore fewer and smaller plant-eating dinosaurs to feed on. A big tyrannosaur like *T. rex* may have had a hard time finding enough food to survive.

THICK-NOSED LIZARD

Dinosaur
Herbivore

Pachyrhinosaurus was a rhinoceros-like dinosaur with horns, frill, bony ornaments and a beak. It was closely related to other horned dinosaurs, such as *Triceratops.*

Pachyrhinosaurus fossils are often found in the same region as fossils of the duck-billed dinosaur *Edmontosaurus,* but usually not directly together. Both species lived throughout Alberta and into Alaska. It is possible that they preferred slightly different habitat conditions.

Fold Here

DINOSAUR GLOSSARY AND TRADING CARD SET

Use this section as a glossary or print out copies to make trading cards. For trading cards, cut out each box along the solid line and then fold in half along the dotted line. Glue the two sides together and you're done!

Named after the Aztec flying serpent-god **QUETZALCOATL**

Pterosaur
Carnivore

Quetzalcoatlus was possibly the largest flying creature ever. This pterosaur was lightly built with a long neck, a toothless jaw and a bony crest on its skull. Its wingspan was more than three times larger than today's largest flying birds. When on the ground, it walked on all fours.

Quetzalcoatlus probably would have had excellent binocular vision like all the other pterosaurs adapted for life in the air.

WOUNDING TOOTH

Dinosaur
Omnivore

Troodon was a bird-like dinosaur that was almost human-sized. It had long, slender hindlimbs and large-clawed grasping hands. The second toe of each foot bore a large retractable claw that would have been a dangerous, slashing weapon.

Troodon had huge eyes which would have enabled it to hunt at night or during the long, dark polar winters. It also had one of the largest brains for its size of any dinosaur, meaning it was probably a cunning, dangerous animal.

Fold Here

RECOMMENDED *WALKING WITH DINOSAURS* READING

AGES: 4 TO 8

Walking with Dinosaurs: The Great Migration
Description: Walk with the dinosaurs in this 8x8 storybook with stickers, based on the motion picture. It's time for the *Pachyrhinosaurus* herd to move from their summer home to the Winter Ground.
Available at: *http://www.harpercollins.com/9780062232731/walking-with-dinosaurs-the-great-migration*
***ISBN:* 9780062232731**

Wal*king with Dinosaurs: Patchi's Big Adventure*
Description: Walk with the dinosaurs in this 8 x 8 storybook with a 3D poster and glasses, based on the motion picture *Walking with Dinosaurs: The 3D Movie*. Patchi is ready to leave the *Pachyrhinosaurus* nest. But one small distraction changes his course, sending him off into the forest on a great adventure. Will Patchi be able to find his way back home?
Available at: *http://www.harpercollins.com/9780062232755/walking-with-dinosaurs-patchis-big-adventure*
ISBN: 9780062232755

Walking with Dinosaurs: The Winter Ground
Description: Walk with the dinosaurs in this I Can Read book based on the motion picture. In this story, Patchi and Juniper get separated from their herd during the great migration. Will they make it to the Winter Ground, where their families are waiting? *Walking with Dinosaurs: The Winter Ground* is a Level Two I Can Read book, geared for kids who read on their own but still need a little help.
Available at: *http://www.harpercollins.com/9780062232847/walking-with-dinosaurs-the-winter-ground*
ISBN: 9780062232847

Walking with Dinosaurs: Friends Stick Together
Description: Walk with the dinosaurs in this Level 2 I Can Read book based on the motion picture. In this story, Patchi meets Juniper and knows he's finally found a friend. There's only one problem: She's in a different herd. I Can Read books are designed to encourage a love of reading. Walking with Dinosaurs: Friends Stick Together is a Level Two I Can Read book, geared for kids who read on their own but still need a little help.
Available at: *http://www.harpercollins.com/9780062232861/walking-with-dinosaurs-friends-stick-together*
ISBN: 9780062232861

AGES: 8 TO 12

Walking with Dinosaurs: Encyclopedia
Author: Steve Brusatte
Description: T*he Walking with Dinosaurs* Encyclopedia is filled with facts about the dinosaurs from the movie as well as facts about the world the dinosaurs inhabited and theories about their rise and fall. With full-color images from the film and photos of paleontologists at work, this encyclopedia is a must-have item for Walking with Dinosaurs fans.
Available at: http://www.harpercollins.com/9780062232786/walking-with-dinosaurs-encyclopedia
ISBN: 9780062232786

Walking with Dinosaurs: Handbook
Description: Walk with the dinosaurs in this handbook, with full-color illustrations, based on the feature film—*Walking with Dinosaurs: The 3D Movie*
Available at: http://www.harpercollins.com/9780062232885/walking-with-dinosaurs-handbook
ISBN: 9780062232885

Walking with Dinosaurs: Reusable Sticker Book
Description: Explore the world of dinosaurs in this fun-filled book with games, activities, and more than 50 stickers!
Available at: http://www.harpercollins.com/9780062232809/walking-with-dinosaurs-a-reusable-sticker-book
ISBN: 9780062232809

FOR MORE INFORMATION AND THEATRE LISTINGS, PLEASE VISIT

BBCEarth.com/PrehistoricPlanet

To license this content for educational products or for classroom use, contact BBC Worldwide Learning at ***education.us@bbc.com***.
Discover more at ***bbcworldwidelearning.com.***

Per[o]t
Museum of Nature and Science

BBC EARTH AND RELIANCE ENTERTAINMENT PRESENT IN ASSOCIATION WITH IM GLOBAL A BBC EARTH PRODUCTION IN ASSOCIATION WITH EVERGREEN STUDIOS "WALKING WITH DINOSAURS: PREHISTORIC PLANET 3D" NARRATED BY BENEDICT CUMBERBATCH MUSIC BY PAUL LEONARD-MORGAN EXECUTIVE PRODUCERS STUART FORD MARCUS ARTHUR DAVID NICKSAY TIM HILL MILES KETLEY ZAREH NALBANDIAN PRODUCED BY MIKE DEVLIN AMANDA HILL DEEPAK NAYAR NARRATION WRITTEN BY RICHARD DALE DIRECTED BY RICHARD DALE BARRY COOK NEIL NIGHTINGALE

BBC earth · RELIANCE Entertainment · IM GLOBAL · EVERGREEN STUDIOS


WALKING WITH DINOSAURS
PREHISTORIC PLANET 3D