Lost Worlds of Colorado

Teacher's Guide

Grades 2–5

Objective

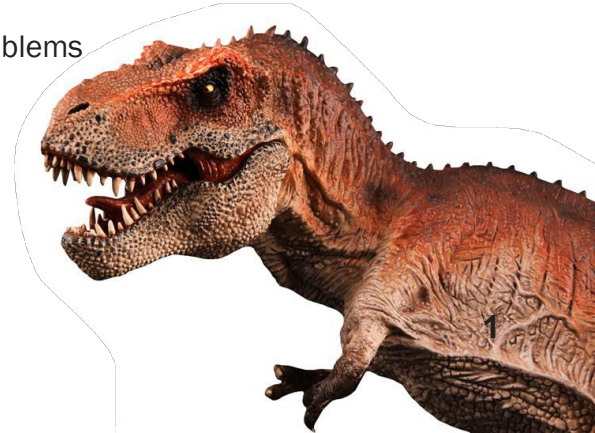
To re-create Colorado's ancient time periods using fossil evidence like paleontologists do.

Key Concepts

- Colorado's environment and animals have changed dramatically over time.
- Stratigraphic layers represent periods of time and reveal different animals and plants that once lived together.
- Paleontologists use evidence they have collected and analyzed to reconstruct what the lost worlds of the past looked like.

Colorado Academic Standards

- SC09-GR.2-S-GLE2: Each plant or animal has different structures or behaviors that serve different functions.
- SC09-GR.3-S.3-GLE1: Earth's materials can be broken down and/or combined into different materials such as rocks, minerals, rock cycle, formation of soil and sand - some of which are usable resources for human activity.
- SC09-GR.4-S.2-GLE.2: Comparing fossils to each other or to living organisms reveals features of prehistoric environments and provides information about organisms today.
- SC09-GR.5-S.3-GLE.2: Earth's surface changes constantly through a variety of processes and forces.
- NGSS Practice 1: Asking Questions and Defining Problems
- NGSS Practice 4: Analyzing and Interpreting Data
- 21st Century Skills: Critical Thinking and Reasoning, Collaboration, Self Direction, Invention



Provided in Museum Box

1 TEACHER BOX containing:

1 Teacher's Guide *

1 iPad loaded with video *

1 iPad video cord *

1 iPad charging cord *

1 iPad charger *

1 USB drive with video loaded *

3 Teacher Data Collection Answer Sheets *
(1 for each time period)

9 *Ancient Denvers* books *
(1 per group)

9 Data Collection Sheets
(1 per group; yours to keep)

1 Fossil Clue Card set *

3 FOSSIL BOXES

- 1 Jurassic box *
- 1 Cretaceous box *
- 1 Pleistocene box *

2 RESOURCE BOXES containing:

9 Fossil Clue Cards *
(1 per group)

9 diorama backdrops *

9 diorama bases *

36 plant pieces *

28 3-D dinosaur models *

* *Items to be returned to the Museum*

NOTE: This guide contains some material in Spanish.

Classroom Materials

Projector
(optional to view videos from iPad or USB)

Pencils or pens Paper

Clipboards (optional)

Index cards
(for diorama descriptions)

KEY VOCABULARY	DEFINITION
Paleontologist	A scientist who studies fossils to figure out their origin, their environment, and what the fossil can tell us about the history of Earth.
Fossil	Any evidence of ancient life, such as a bone, shell, or track that is 10,000 years old or older.
Period	A division of geologic time that is smaller than an era, but larger than an epoch. Scientists can identify a geologic period by the fossils contained in the rocks.
Epoch (ep-*uh*k)	A division of geologic time that is smaller than a period, but larger than an age. Epochs are marked by a distinct change in rocks and the fossils that are in them.
Jurassic Period	A period in the Mesozoic Era from 201 to 145 million years ago. Characterized by the presence of dinosaurs and the first appearance of birds.
Cretaceous Period (kri-tey-sh*uh*s)	A period in the Mesozoic Era from 145 to 66 million years ago. Characterized by the greatest development and extinction of dinosaurs and the arrival of flowering plants and modern insects.
Pleistocene Epoch (plahy-st*uh*-seen)	An epoch in the Quaternary Period from 2.5 million to 11,700 year ago, also called the Ice Age. Characterized by the formation of widespread glaciers in the Northern Hemisphere and by the appearance of modern humans.
Diorama	A model representing a scene, which includes three-dimensional figures.
Coprolite (kop-*ruh*-lahyt)	Fossilized feces. While dinosaurs make the biggest coprolites, they also come from fish, crocodiles, turtles, and insects.

VOCABULARIO IMPORTANTE	DEFINICIÓN
Paleontólogo	Un científico que estudia fósiles para averiguar sus orígenes, medio ambiente y lo que puede decirnos un fósil sobre la historia de la tierra.
Fósil	Cualquier evidencia de vida antigua como un hueso, concha o huella, que tiene por lo menos 10,000 años o más.
Período	Una división de tiempo geológico que es menor que una era, pero mayor que una época. Los científicos pueden identificar un período geológico por los fósiles contenidos en las rocas.
Época	Una división de la escala temporal geológica que es menor que un período, pero mayor que una era. Las épocas están marcadas por cambios notables en las rocas y en los fósiles que están en ellas.
Período Jurásico	Un período en la Era Mesozoica de 201 a 145 millones de años atrás. Se caracterizó por la presencia de dinosaurios y la primera aparición de aves.
Período Cretáceo	Un período en la Era Mesozoica de 145 a 66 millones de años atrás. Se caracterizó por el mayor desarrollo y extinción de dinosaurios, la llegada de plantas que florecen y de los insectos modernos.
Época de Pleistoceno	Una época del Período Cuaternario de 2.5 millones de años a 11,700 años atrás, también llamada la Era Glacial. Se caracterizó por la formación de extensos glaciares en el hemisferio norte y por la aparición del ser humano actual.
Diorama	Un modelo que representa una escena e incluye figuras tridimensionales.
Coprolito	Excrementos fosilizados. A pesar de que los coprolitos más grandes son de dinosaurios, también se encuentran de peces, cocodrilos, tortugas e insectos.

I. Classroom Set-Up: 15 minutes	Materials	Tips and Adaptations
A Place fossil boxes in three separate areas of the classroom.	- iPad or USB drive with classroom projector - Fossil boxes - Dinosaur and plant models - Diorama backdrops - Diorama bases - Video adaptor - Clue Cards	Ensure there is enough space around each fossil box to accommodate 9–10 children. Students will use all three colors of clue cards to determine which box and time period they are exploring.
B Sort the backdrops, bases, model kits, and plant pieces into three color-coded categories so they can be handed out after the fossil exploration. = Jurassic = Cretaceous = Pleistocene		
C Preview video.		

II. Activate Prior Knowledge: 5 minutes	Materials	Tips and Adaptations
A Ask the students if they know what paleontologists do. Encourage them to share their ideas.		Students will learn about paleontologists in the video.
B Review vocabulary.		
C Encourage students to pay attention to the video to learn more about paleontologists.		
D Watch the introduction video.	-iPad or USB drive with classroom projector	
E Ask the students to share what they learned from the video. **Potential Responses** · Paleontologists study fossils. · Over time (billions of years) sediment accumulates to create layers of rock. · Plants and animals get trapped between layers to form fossils. · Each layer is a different time period (oldest on bottom, youngest on top). · Coprolite is fossilized poop. · Artists use fossil evidence to imagine and re-create ancient worlds.		Write on paper, pair share, or discuss as a class. Note: Video instructs students to find “clues in their dig.” Dig refers to the fossil box.

III. Examine, Analyze, Research: 15 minutes	Materials	Tips and Adaptations
A **Class Structure** Break students into nine groups and give each group a number (1–9). Note: *Do not tell* the students the epoch or period they have been assigned—this is for them to discover.		Groups 1-3share Jurassicbox Groups 4-6share Cretaceous box Groups 7-9 share Pleistocene box
B **Behavioral Expectations and Safety** Explain to the students that they will be working with fossil casts and real fossil specimens from the Denver Museum of Nature & Science. The specimens should remain in each designated area. Encourage students to touch and pick up the specimens to examine them.		Instruct the students to work collaboratively and take turns manipulating the fossils and using materials.
C **Instructions and Material Distribution** 1. Direct each group to one of three fossil boxes. Instruct them to examine, discuss, and discover what each fossil might be, the animal or plant it came from, and the time period using the Clue Cards, *Ancient Denvers* book, and Data Collection Sheet. 2. Review the Clue Cards. Point out that these cards include clues about each specimen and time period. Note: There are three sets of color-coded Clue Cards, one for each time period. Students are still unaware of which time period they are exploring. **Groups 1–3** **Jurassic** **Groups 4–6** **Cretaceous** **Groups 7–9** **Pleistocene** 3. Review the sample on the Data Collection Sheet with the class. 4. Instruct teams to begin their exploration and complete the Data Collection Sheet for their fossils.	**For Each Group** - Set of Clue Cards, color-coded - *Ancient Denvers* book - Data Collection Sheet - Clipboards (optional) - Pens/pencils	**Suggested Team Roles** - Scribe (records observations on Data Collection Sheet) - Clue Card Researcher (locates and shares information from the cards) - Artist (draws pictures of the fossils on the Data Collection Sheet) - Researcher (locates and shares information from the *Ancient Denvers* book) Encourage students to take turns in each role.

III. Examine, Analyze, Research: (continued from previous page)	Materials	Tips and Adaptations
D **Fossil Discovery Reveal** 1. As teams finish their Data Collection Sheets, review them using the Answer Sheets that follow. 2. If correct, give students their diorama materials (color coded). Instructions for creating dioramas are posted on the BACK of each backdrop. 3. If incorrect, give students a hint and ask them to continue exploring.	- Diorama backdrops and bases - Dinosaur models - Plant models - Pencils - Completed Data Collection Sheets - Teacher Data Collection Answer Sheets	Students come to teacher to review their Data Collection Sheet. **Remember...** Groups 1–3 Jurassic Groups 4–6 Cretaceous Groups 7–9 Pleistocene
IV. Create: 15 minutes	**Materials**	**Tips and Adaptations**
A **Instructions** 1. Instruct students to use the backdrops, bases, and models to create a diorama about their animals and time period. Encourage them to use the *Ancient Denvers* book for inspiration. 2. Explain that they will be sharing their dioramas with the class. 3. Explain that photographs will be taken of the dioramas to share with other classes, parents, or the Museum.		**Extension Options** - Write a description of the diorama. - Make up a story about the animals, plants, and time period. - Create a song or rap about the diorama. - Add to the diorama by drawing additional animals and plants on separate paper and placing them in the diorama.
V. Closure: 15 Minutes	**Materials**	**Tips and Adaptations**
A Ask each team to present their diorama (and any extensions) to the class.		
B Ask the students why they think it is important to study animals from the past.		
C Instruct students to repack fossils into boxes and return all models to their bags. Diorama backdrops and bases can be returned to the front of the room.		
VI. Extension		
Share photographs of your dioramas with the Museum using #LostWorldsDMNS		

Groups 1–3 Jurassic

Teacher Data Collection Answer Sheet

DENVER MUSEUM OF NATURE & SCIENCE

What type of fossil is it?	What is it from?	Habitat	What can it tell us?	Sketch the fossil
Plate on back of animal	Animal, dinosaur, *Stegosaurus*	Land	May have been used for display or protection to make itself look bigger to predators	
Tooth	Animal, dinosaur, *Allosaurus*	Land	It ate meat, carnivore, tooth is pointy	
Tooth	Animal, dinosaur, *Camarasaurus*	Land	It ate plants, herbivore, tooth is flat	
Jaw with teeth	Animal, dinosaur, *Ceratosaurus*	Land	It ate meat, carnivore, teeth are pointy	
Leaf	Plant, *ginkgo*	Land	Climate was warm and wet	
Leaves	Plant, fern	Land	Climate was warm and wet	
Pine needles	Tree, cycad	Land	Climate was warm and wet	
Leaves	Tree, monkey puzzle tree, *Araucaria*	Land	Climate was warm and wet	

Groups 4–6
Cretaceous

Teacher Data Collection Answer Sheet

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What type of fossil is it?	What is it from?	Habitat	What can it tell us?	Sketch the fossil
Horn	Animal, dinosaur, *Triceratops*	Land	Used it for protection, to fight other animals, to look bigger	
Tooth	Animal, dinosaur, *Tyrannosaurus rex*	Land	It ate meat, carnivore, tooth is pointy	
Shell	Animal, clam, *Inoceramus*	Water	Similar to clams of today	
Imprint	Animal, insect, dragonfly	Land, sky	It has wings, flies, a living fossil, dragonflies exist today	
Head, skull	Animal, marsupial, *Didelphodon*	Land	It ate plants and animals, omnivore, sharp and flat teeth	
Jaw with teeth	Animal, dinosaur, mosasaur	Water	It ate fish shells, carnivore, teeth are pointy	
Shell	Animal, shell, ammonite	Water	Shell protects animal inside	
Leaf	Plant, relative of modern ginger plant	Land	Subtropical floodplains	
Leaf	Plant, climbing fern, relative of modern fern	Land	Subtropical and wet	

Groups 7–9
Pleistocene

Teacher Data Collection Answer Sheet

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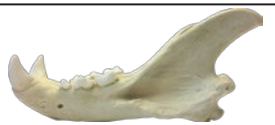
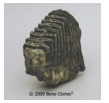
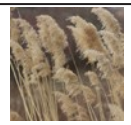
What type of fossil is it?	What is it from?	Habitat	What can it tell us?	Sketch the fossil
Tooth, molar	Animal, bison, *Bison antiquus*	Land	It ate plants, herbivore	
Jaw with teeth	Animal, mammal, American lion	Land	It ate meat, carnivore, teeth are pointy	
Tooth, molar	Animal, *Camelops*	Land	It ate plants, herbivore	
Tooth, molar	Animal, Columbian Mammoth	Land	It ate plants, herbivore	
Branch, pine needles	Plant, conifer, pine tree	Land	Cool temperate climate, similar to Colorado today	
Leaves	Plant, sage	Land	Cool temperate climate, similar to Colorado today	
Sedge, grass-like plant	Plant, sedge	Land	Cool temperate climate, similar to Colorado today	

Grupos 1 a 3
Jurásico

Hoja de respuestas de recolección de datos de los maestros

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¿Qué tipo de fósil es?	¿De qué es?	Hábitat	¿Qué nos puede decir?	Dibuja el fósil
Placa en el lomo de un animal	Animal, dinosaurio, *Estegosaurio*	Terrestre	Puede haberla usado para exhibirse o protegerse o para verse más grande ante los predadores	
Diente	Animal, dinosaurio, *Alosaurio*	Terrestre	Comía carne, carnívoro, el diente es puntiagudo	
Diente	Animal, dinosaurio, *Camarasaurio*	Terrestre	Comía plantas, herbívoro, el diente es liso	
Mandíbula con dientes	Animal, dinosaurio, *Ceratosaurus*	Terrestre	Comía carne, carnívoro, los dientes son puntiagudos	
Hoja	Planta, *gingko*	Terrestre	El clima era tibio y húmedo	
Hojas	Planta, helecho	Terrestre	El clima era tibio y húmedo	
Agujas de pino	Árbol, palma sago	Terrestre	El clima era tibio y húmedo	
Hojas	Árbol, rompecabezas de mono, *Araucaria*	Terrestre	El clima era tibio y húmedo	

Grupos 4 a 6
Cretáceo

Hoja de respuestas de recolección de datos de los maestros

DENVER MUSEUM OF NATURE & SCIENCE

¿Qué tipo de fósil es?	¿De qué es?	Hábitat	¿Qué nos puede decir?	Dibuja el fósil
Cuerno	Animal, dinosaurio, *Triceratops*	Terrestre	Lo usaba como protección para luchar con otros animales, para verse más grande	
Diente	Animal, dinosaurio, *Tiranosaurio rex*	Terrestre	Comía carne, carnívoro, el diente es puntiagudo	
Concha	Animal, almeja, *Inoceramus*	Acuático	Similar a las almejas de hoy	
Huella	Animal, insecto, libélula	Terrestre, aéreo	Tiene alas, vuela, un fósil viviente, las libélulas todavía existen	
Cabeza, cráneo	Animal, marsupial, *Didelphodon*	Terrestre	Comía plantas y animales, omnívoro, dientes afilados y dientes lisos	
Mandíbula con dientes	Animal, dinosaurio, Mosasaurio	Acuático	Comía peces, conchas, carnívoro, los dientes son puntiagudos	
Concha	Animal, concha, Amonita	Acuático	La concha protege al animal adentro	
Hoja	Planta, pariente de la planta moderna del jengibre.	Terrestre	Llanuras inundables en regiones subtropicales	
Hoja	Planta, helecho trepador, pariente del helecho moderno.	Terrestre	Climas subtropicales y húmedos	

Grupos 7 a 9 Pleistoceno

Hoja de respuestas de recolección de datos de los maestros

DENVER MUSEUM OF NATURE & SCIENCE

¿Qué tipo de fósil es?	¿De qué es?	Hábitat	¿Qué nos puede decir?	Dibuja el fósil
Diente, molar	Animal, bisonte, *Bison antiquus*	Terrestre	Comía plantas, herbívoro	
Mandíbula con dientes	Animal, mamífero, león americano	Terrestre	Comía carne, carnívoro, los dientes son puntiagudos	
Diente, molar	Animal, *Camelops*	Terrestre	Comía plantas, herbívoro	
Diente, molar	Animal, Mamut de Columbia	Terrestre	Comía plantas, herbívoro	
Rama, agujas de pino	Planta, conífera, pino	Terrestre	Común en Colorado durante el Pleistoceno un fósil viviente, todavía crece	
Hojas	Planta, salvia	Terrestre	Arbusto de olor agradable común en Colorado, un fósil viviente, todavía crece	
Junco, planta similar a la hierba	Planta, junco	Terrestre	Arbusto de olor agradable común en Colorado, un fósil viviente, todavía crece	

DATA COLLECTION SHEET

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Group #___ Group Color_____ Names of Students _____

What type of fossil is it?	What is it from?	Habitat	What can it tell us?	Sketch the fossil
Sample: Tooth	*Stegosaurus*	Fern meadows	Ate plants	(draw an example in the space provided)

What type of fossil is it?	What is it from?	Habitat	What can it tell us?	Sketch the fossil

What is your time period? **Jurassic Period** **Cretaceous Period** **Pleistocene Epoch**

Write a description of your diorama. *(Include information on the plants, animals, and climate.)*

HOLA DE RECOLECCIÓN DE DATOS

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Grupo #___ Color del grupo _____ Nombres de los estudiantes _____

¿Qué tipo de fósil es?	¿De qué es?	Hábitat	¿Qué nos puede decir?	Dibuja el fósil
Ejemplo: Diente	*Estegosaurio*	Praderas de helechos	Comía plantas	(Dibuja un ejemplo en el espacio indicado)

¿Qué tipo de fósil es?	¿De qué es?	Hábitat	¿Qué nos puede decir?	Dibuja el fósil

¿Cuál es tu período en el tiempo? **Período Jurásico** **Período Cretáceo** **Época de Pleistoceno**

Escribe una descripción de tu diorama. *(Incluye información sobre las plantas, animales y el clima).*

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Teacher Model Reference

Jurassic

Stegosaurus

Allosaurus

Camarasaurus

Ceratosaurus

Cretaceous

Triceratops

Tyrannosaurus Rex

Dragonfly

Mosasaur

Ammonite

Pleistocene

Columbian mammoth (baby)

Columbian mammoth (adult)

Bison

American Lion

Camelops

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Modelo de referencia para Maestros

Jurásico

Estegosaurio

Alosaurio

Camarasaurio

Ceratosaurus

Cretáceo

Triceratops

Tiranosaurio rex

Libélula

Mosasaurio

Amonita

Pleistoceno

Mamut de Columbia (bebé)

Mamut de Columbia (adulto)

Bisonte

León americano

Camelops