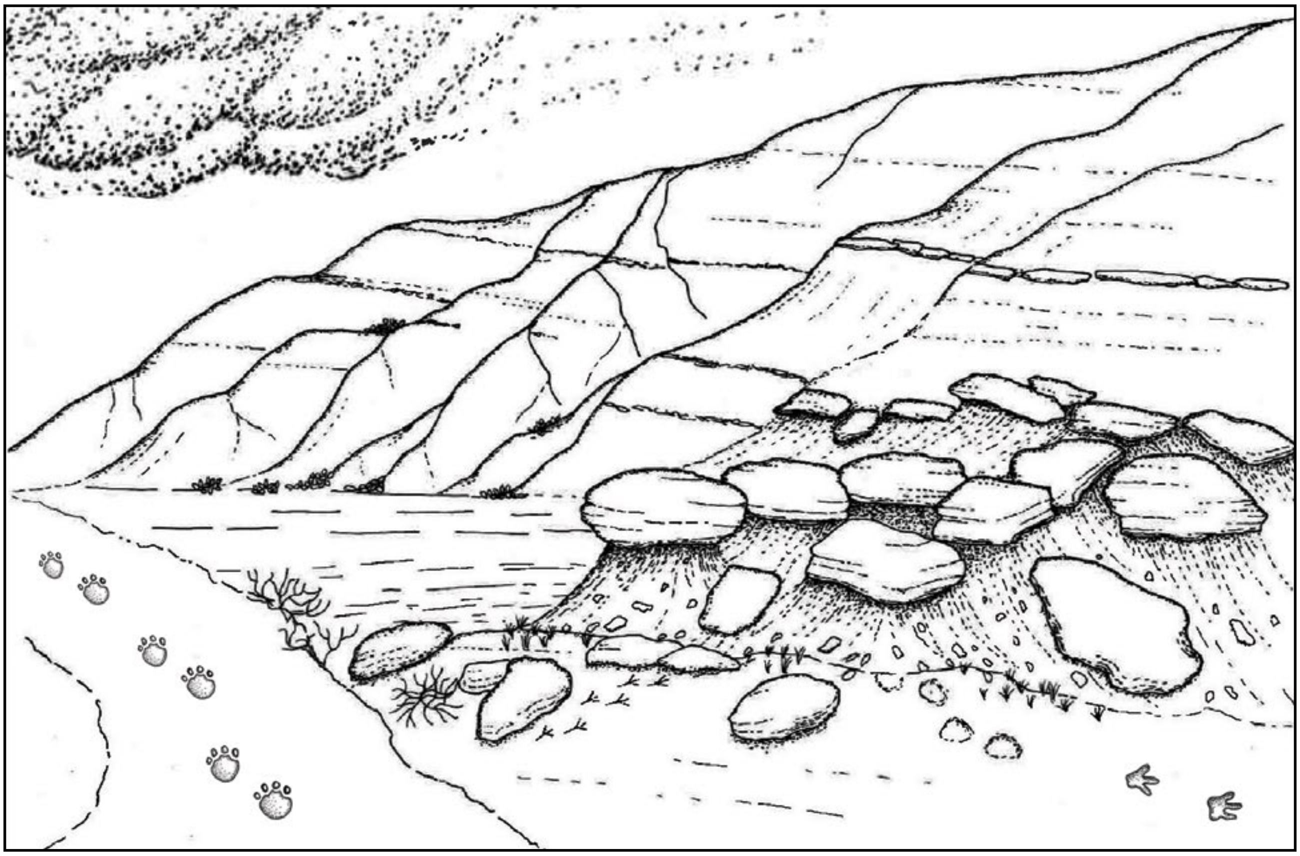
United States Department of Agriculture

TOADSTOOL GEOLOGIC PARK
OGLALA NATIONAL GRASSLAND, NEBRASKA
PREHISTORIC MAMMALS FROZEN IN STONE



SEE

Fossil Tracks Along a Prehistoric River

Nebraska Covered by Ancient Swamps, Oceans, and Glaciers

Great Mammals Who Walked the Earth and are Now Extinct

LEARN

About Fossils and the Creatures Who Made Them

EXPLORE

The Ages of the Earth

The Strange and Wonderful Toadstools of Nebraska

PLUS

Puzzles, Codes, and Activities!

Forest Service FS-1162 January 2021

Toadstool Geologic Park, Oglala National Grassland

The fascinating landforms of Toadstool Geologic Park hold the secrets of an ancient world where strange and wonderful animals walked the Earth. Imagine seeing rhinoceroses, miniature horses, giant tortoises, camels, and a wild pig so huge and ferocious that it's called the "hell pig" in western Nebraska. These creatures inhabited a landscape unlike the one you see today. Fifty million years ago, western Nebraska was a vast, open savannah with streams meandering through forests. Far to the west, volcanoes erupted and ash drifted east to cover the landscape. The secrets of this ancient world are held in the bedrock formations of the Toadstool Geologic Park. As you read this activity book and work the puzzles, let your imagination wander to this ancient time in our Earth's history.

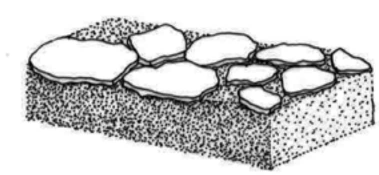
Toadstools

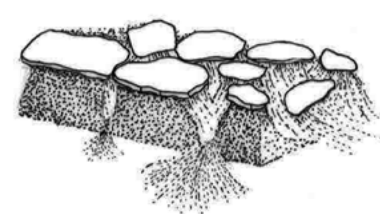
Toadstool is a funny name for a certain type of landform. You can see these rock toadstools capped with flat rocks across the park and recognize their resemblance to real toadstools or mushrooms. How do they form? Rock layers can be more resistant or less resistant to erosion. When softer, less cemented rock underlies harder, erosion-resistant rock, the softer rock will be more easily eroded by water and wind, undermining the harder resistant rock. The harder rock pieces cap the eroded material, forming many unique landforms including toadstools, in what is known as a "badlands" landscape. At Toadstool Geologic Park, sandstone is the harder rock forming the caps of the toadstools and finer grained silts and clays are the more easily eroded rocks forming the pillars.

Activity: Make a Toadstool

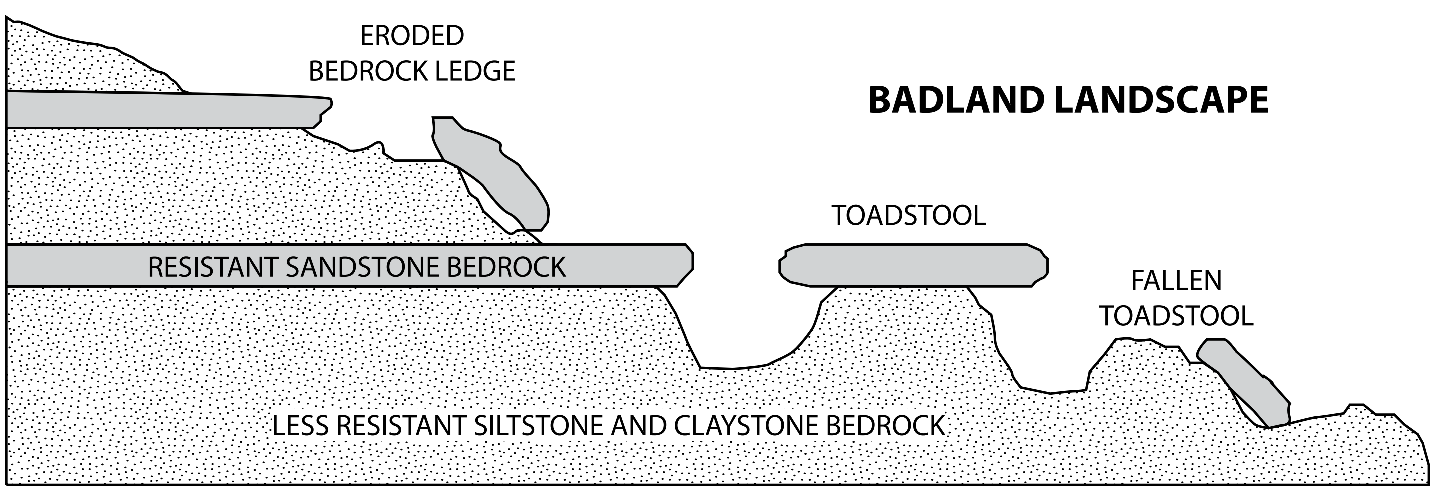
Get some water and sand or dirt. Moisten the sand a little bit and then pack it into a flat box, like a cake pan. Flip it over as though you are making a sand castle. Cover the top of the sand block with flat pebbles and then sprinkle water over the top. The softer sand will erode out from beneath the edges of the flat pebbles, creating a toadstool landscape. For a more natural approach, try leaving your toadstool model outside during a rain storm and observe erosion firsthand.

Sandstone pieces protect softer layers underneath, while unprotected parts erode away.





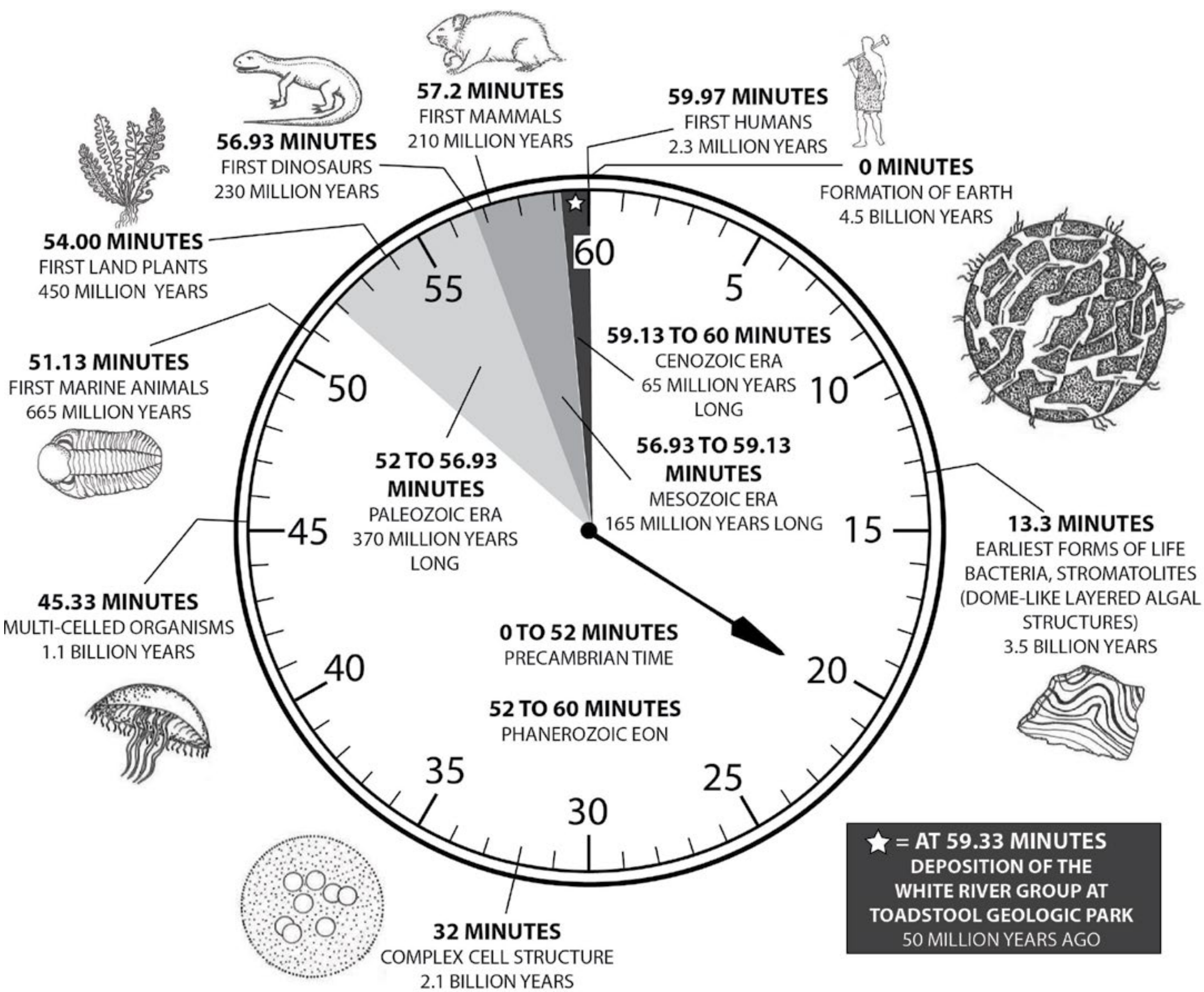
Mimic the process of making toadstool formations using water, sand, and small rocks.



The Age of the Earth as a 60-Minute (One Hour) Interval

Imagine the age of the Earth as the length of a favorite television show or the length of your PE (physical education) class, 60 minutes, as illustrated below by the stopwatch. The Earth was formed at the zero-minute mark and the stopwatch runs to the present at 60 minutes (one hour). Every minute on the stopwatch represents 75 million years (75,000,000 years). Major events in Earth's history are illustrated by the number of minutes it took to arrive there starting from the Earth's formation at time zero.

The ages of the geologic eras are shown as shaded portions. The Toadstool Geologic Park activity book addresses the incredible history of the Cenozoic Era, the Age of Mammals, in western Nebraska. The Cenozoic Era lasted from 65 million years ago to the present. During the Cenozoic Era in Nebraska, strange looking mammals walked the Earth and left their tracks. Many became extinct but some evolved into our modern North American fauna. Man appeared on the scene just seconds away from the present.

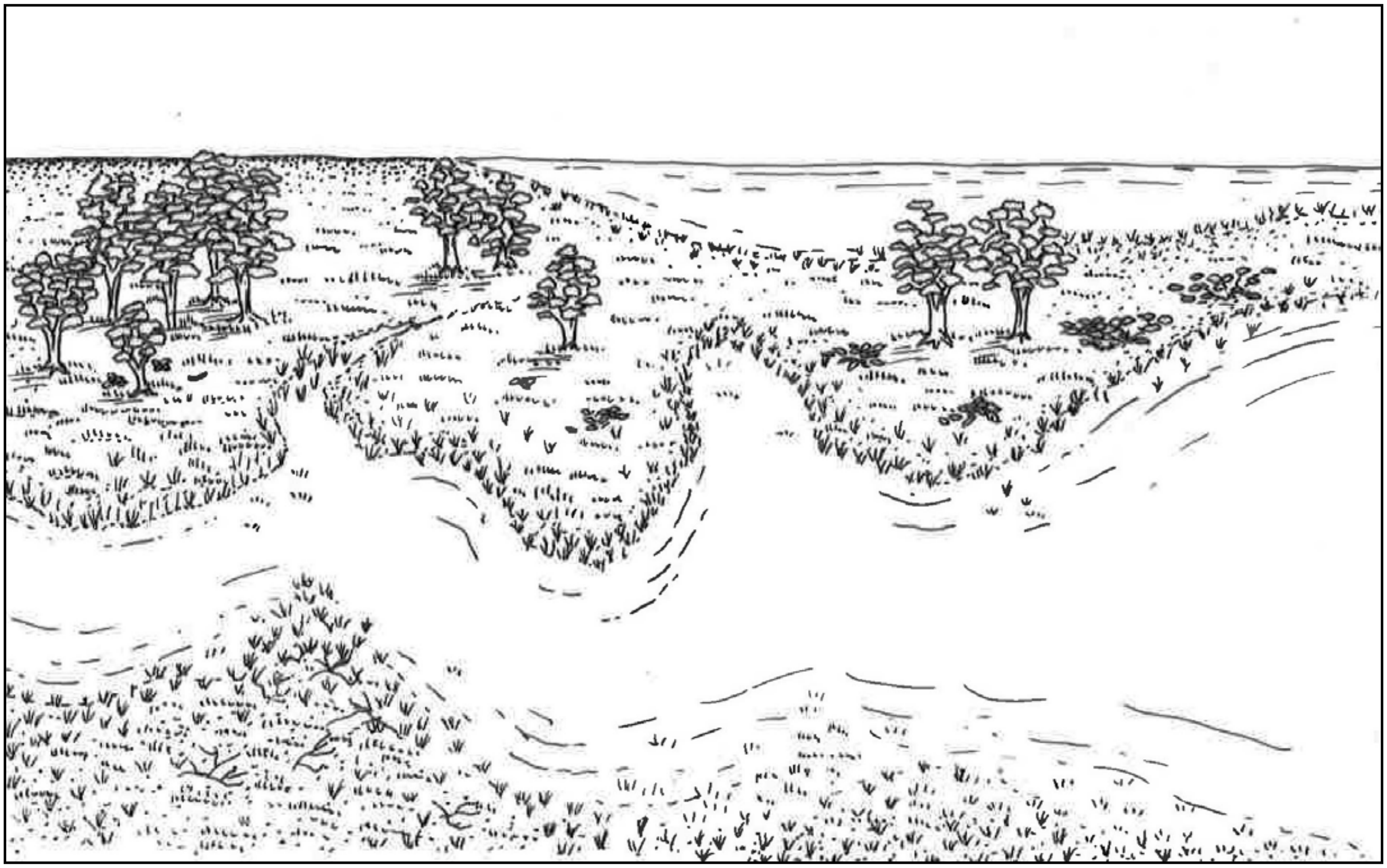


The Phanerozoic Eon—"The Time of Revealed Life"

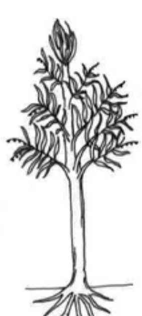
The Phanerozoic Eon is represented by the last 8 minutes on the 60-minute stopwatch. It is divided into 3 eras which are further divided into periods as shown in the table below. We know more about the Phanerozoic Eon than any other time in Earth's history. Why? Geologists have put together the history of the Earth by studying the rock layers and the fossils in them. Geologists know that limestone is deposited on an ocean floor, sand collects on a beach or desert, coal is formed in swamps, and ash and lava are ejected from volcanoes. Younger sediments are deposited on top of older rock layers and, if they are undisturbed, they stay this way. From this and other information, geologists have recreated the history of the Earth. The history of the area that is now western Nebraska is summarized below.

ERA		PERIOD / EPOCH	SYMBOL	APPROXIMATE AGE	GEOLOGIC EVENTS IN WESTERN NEBRASKA
CENOZOIC (MEANS NEW LIFE)	AGE OF MAMMALS	QUATERNARY	Q		
		HOLOCENE		PRESENT TO 10,000	THE "RECENT", COMING OF MAN IN N. AMERICA
		PLEISTOCENE		10,000 TO 2 M.Y.	THE ICE AGE, GLACIATION ACROSS THE NORTH AMERICAN CONTINENT, DEPOSITION ON THE PLAINS
		TERTIARY	T		VOLCANIC ERUPTIONS TO THE WEST
		PLIOCENE		2 M.Y. TO 6 M.Y.	EXTENSIVE DEPOSITION IN WESTERN NEBRASKA FROM EROSION OF MOUNTAINS TO THE WEST
		MIOCENE		6 M.Y. TO 22.5 M.Y.	REGIONAL UPLIFT, MOUNTAIN BUILDING TO THE WEST, DEPOSITION ON THE NEBRASKA PLAINS
		OLIGOCENE		22.5 M.Y. TO 36 M.Y.	VOLCANIC ACTIVITY TO THE WEST, DEPOSITION OF ASH ACROSS THE PLAINS
		EOCENE		36 M.Y. TO 58 M.Y.	EROSION OF OLDER SEDIMENTS
		PALEOCENE		58 M.Y. TO 65 M.Y.	LARAMIDE OROGENY - EPISODE OF MOUNTAIN BUILDING THAT CREATED THE PRESENT DAY STRUCTURE OF THE ROCKY MOUNTAINS
MESOZOIC (MEANS MIDDLE LIFE)	AGE OF DINOSAURS	CRETACEOUS	K	65 M.Y. TO 141 M.Y.	COASTAL AND MARINE DEPOSITION FROM A SHALLOW SEA
		JURASSIC	J	141 M.Y. TO 195 M.Y.	ERODED LAND SURFACE
		TRIASSIC	Ʀ	195 M.Y. TO 230 M.Y.	MOUNTAIN BUILDING TO THE WEST, ERODED LAND SURFACE TO THE EAST
PALEOZOIC (MEANS ANCIENT LIFE)	TERRESTRIAL LIFE	PERMIAN	P	230 M.Y. TO 280 M.Y.	EROSION OF LAND SURFACE TO THE WEST WITH DRY ARID CONDITIONS IN WESTERN NEBRASKA
		PENNSYLVANIAN	ℙ	280 M.Y. TO 310 M.Y.	SHALLOW SEA, SWAMPS, AND SHORELINE
		MISSISSIPPIAN	M	310 M.Y. TO 345 M.Y.	SHALLOW SEA; OUACHITA OROGENY - EPISODE OF MOUNTAIN BUILDING TO THE SOUTH
	FISH	DEVONIAN	D	345 M.Y. TO 395 M.Y.	LOW ELEVATION LAND THEN SHALLOW SEA
		SILURIAN	S	395 M.Y. TO 435 M.Y.	LOW LAND SURFACE AND EROSION
	LIFE EXPLODES IN THE SEAS	ORDOVICIAN	O	435 M.Y. TO 500 M.Y.	MARINE DEPOSITION IN A SHALLOW SEA
		CAMBRIAN	€	500 M.Y. TO 600 M.Y.	ERODED LAND SURFACE THEN MARINE DEPOSITION
PRECAMBRIAN			p €		

The Pennsylvanian Period: 300 Million Year-Old Ocean Shores, Mudflats, Swamps, and Streams



The shoreline of an ancient ocean covered what is now western Nebraska around 300 million years ago. Beaches, tidal basins, and swamps developed along the shore. The water level of the ocean rose and fell over time, creating deposits of sandstone, shale, and limestone. Plant matter in the swampy areas became the source material for coal deposits. Soil layers sometimes formed when the ground surface was exposed for lengthy times, and the soils were preserved as colorful red or green-hued bedrock layers. Trees growing in western Nebraska during the Pennsylvanian Period looked very different from modern trees, with the appearance of ferns and horsetail rushes as shown in the drawings below.



Cordaites

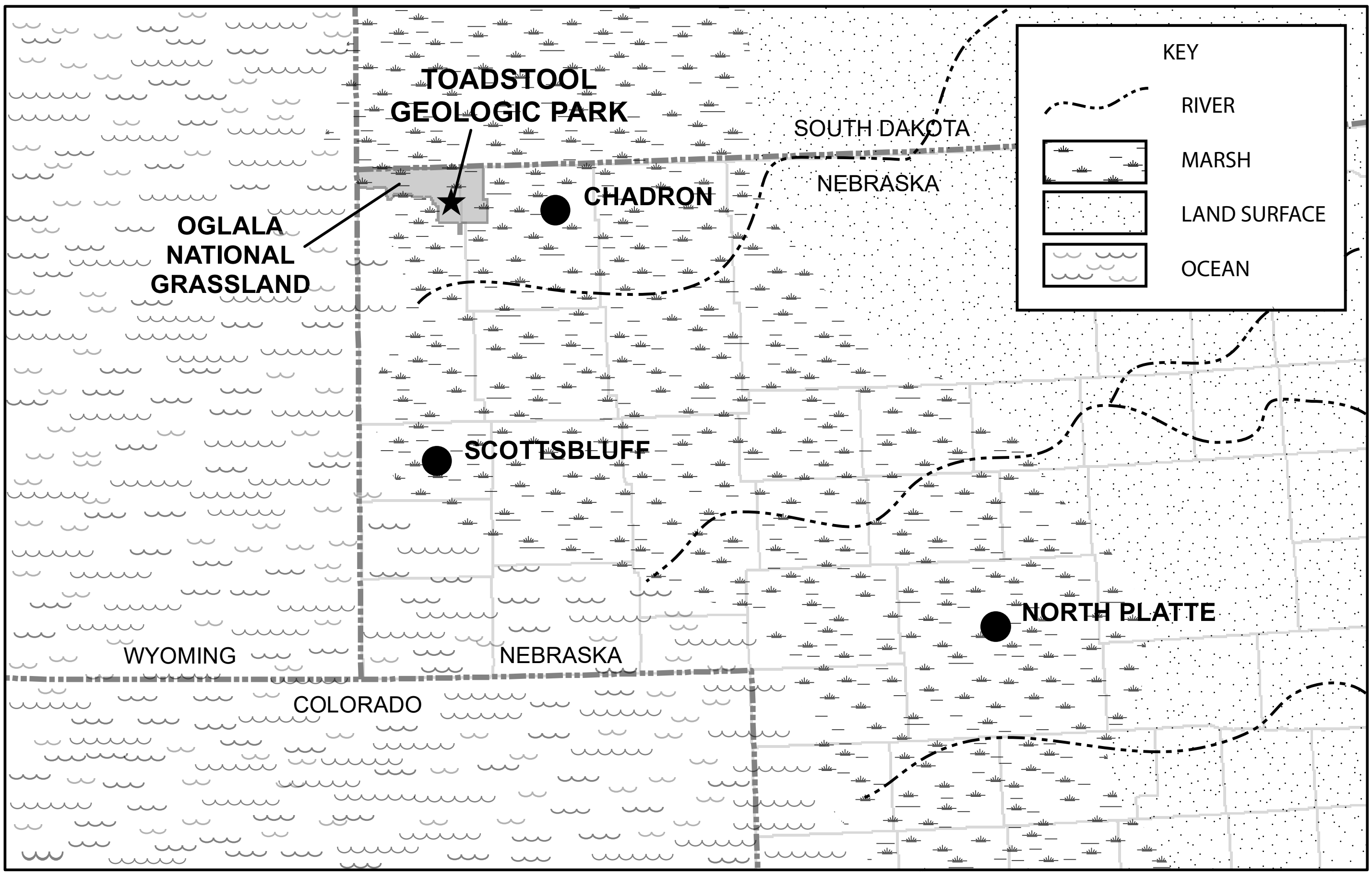
Lepidodendron

Sigillaria

Calamites

The Pennsylvanian Period: 300 Million Year-Old Ocean Shores, Mudflats, Swamps, and Streams

Animal life was also different in the Pennsylvanian Period at the close of the Paleozoic. Ancient reptiles and amphibians slithered and crept through the swamps and shorelines and giant dragonfly-like insects flitted through the air. Corals, clams, and echinoderms (starfish-like creatures) lived on the ocean floor while fish and sharks swam through the open water.

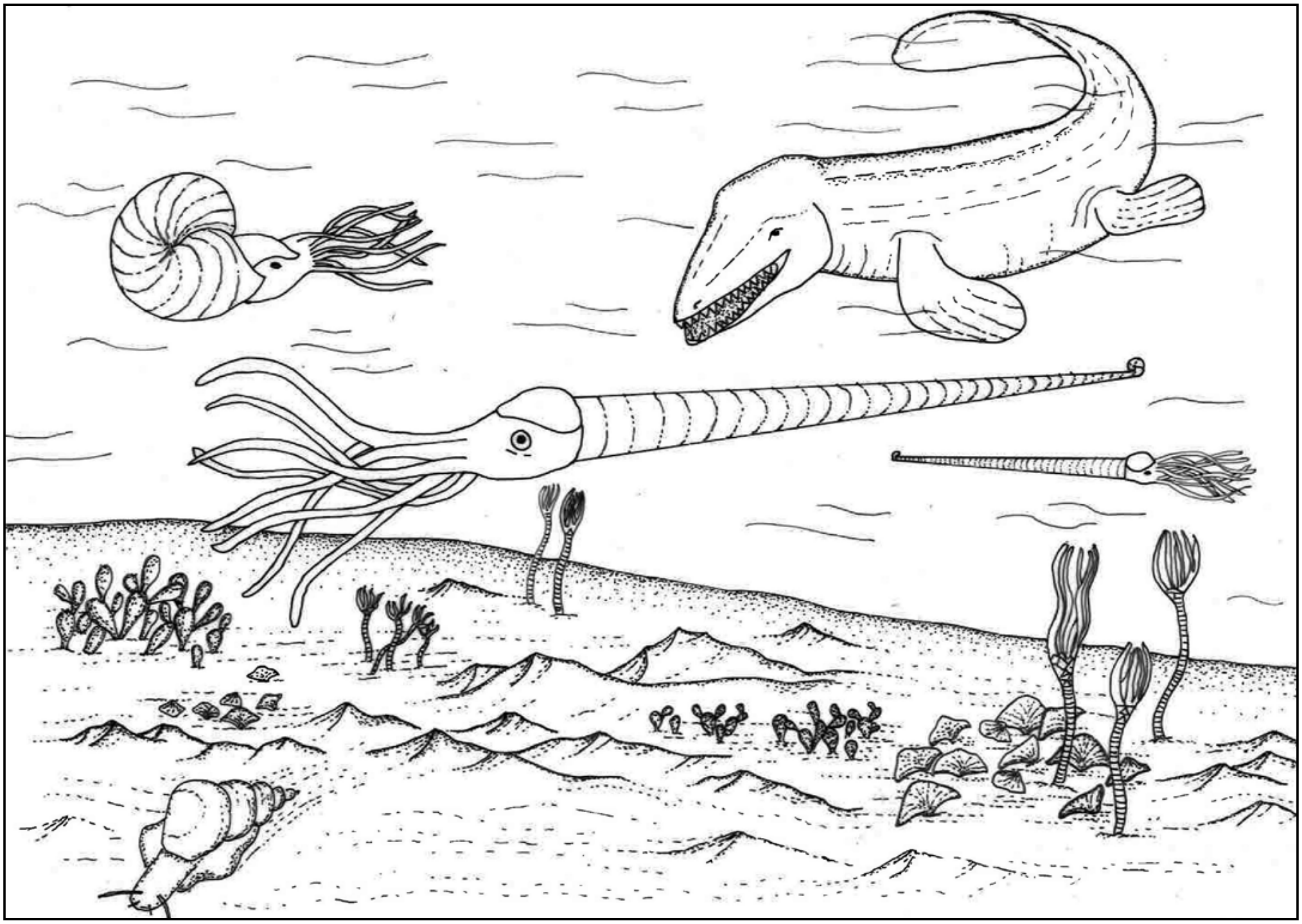


There are three maps like this throughout the booklet. They show the different habitats that existed during a certain period in Nebraska's geologic history. Note how they change with time. This map shows oceans and marshes covering western Nebraska during the Pennsylvanian Period. The specific areas covered by these watery ecosystems were not the same during the entire period. Over hundreds of thousands of years some marsh would become ocean, and then ocean would become marsh again. How would the plant and animal life of this time be different than those of today?

Activity: Read the descriptions of animals in the Pennsylvanian Period above. Draw an example of one of those in the space below. You can also add color to any of the drawings in this book.

The Cretaceous Period: A 75 Million Year-Old Shallow Sea in Nebraska

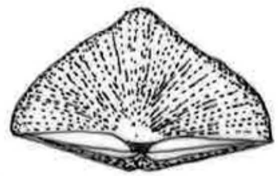
Western Nebraska during the Cretaceous Period was completely covered by a shallow sea that geologists call the Western Interior Seaway. This ocean stretched from the Arctic to the Gulf of Mexico and separated North America into several large land masses. These shallow Cretaceous oceans teemed with prehistoric marine life while dinosaurs roamed over the land.



The drawing above shows a mosasaur, a large air-breathing and ocean-dwelling reptile, closing in on different types of squid-like ammonites; one with a coiled shell and one with a long tusk-like shell. A snail-like gastropod creeps along the ocean floor past clusters of clam-like brachiopods and crinoids, which look like plants growing on stalks and are sometimes called sea-lilies. Pelecypods (clams) and echinoderms (related to starfish) also lived on the ocean floor. Fierce predators swam in the waters of the shallow sea including sharks and long-necked plesiosaurs, another marine reptile of the Cretaceous.

Ammonite

Gastropod



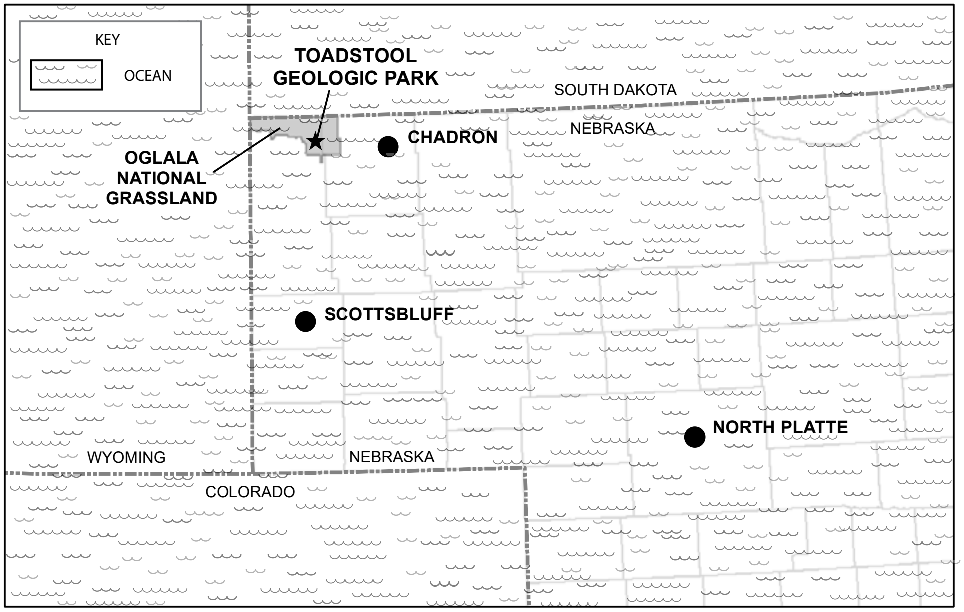
Brachiopod

Pelecypod

Echinoderm

Shark Tooth

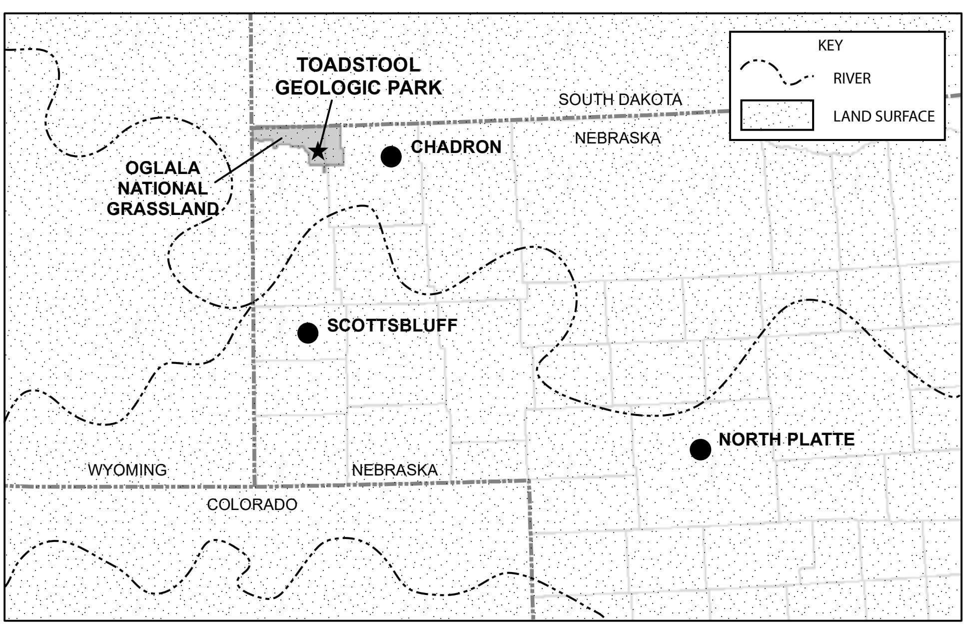
The Cretaceous Period: A 75 Million Year-Old Shallow Sea in Nebraska



Note how this map is different than the map on page 6. This shallow ocean covered most of the present-day central United States. Fossils of the creatures in the drawing on the previous page are common throughout this region.

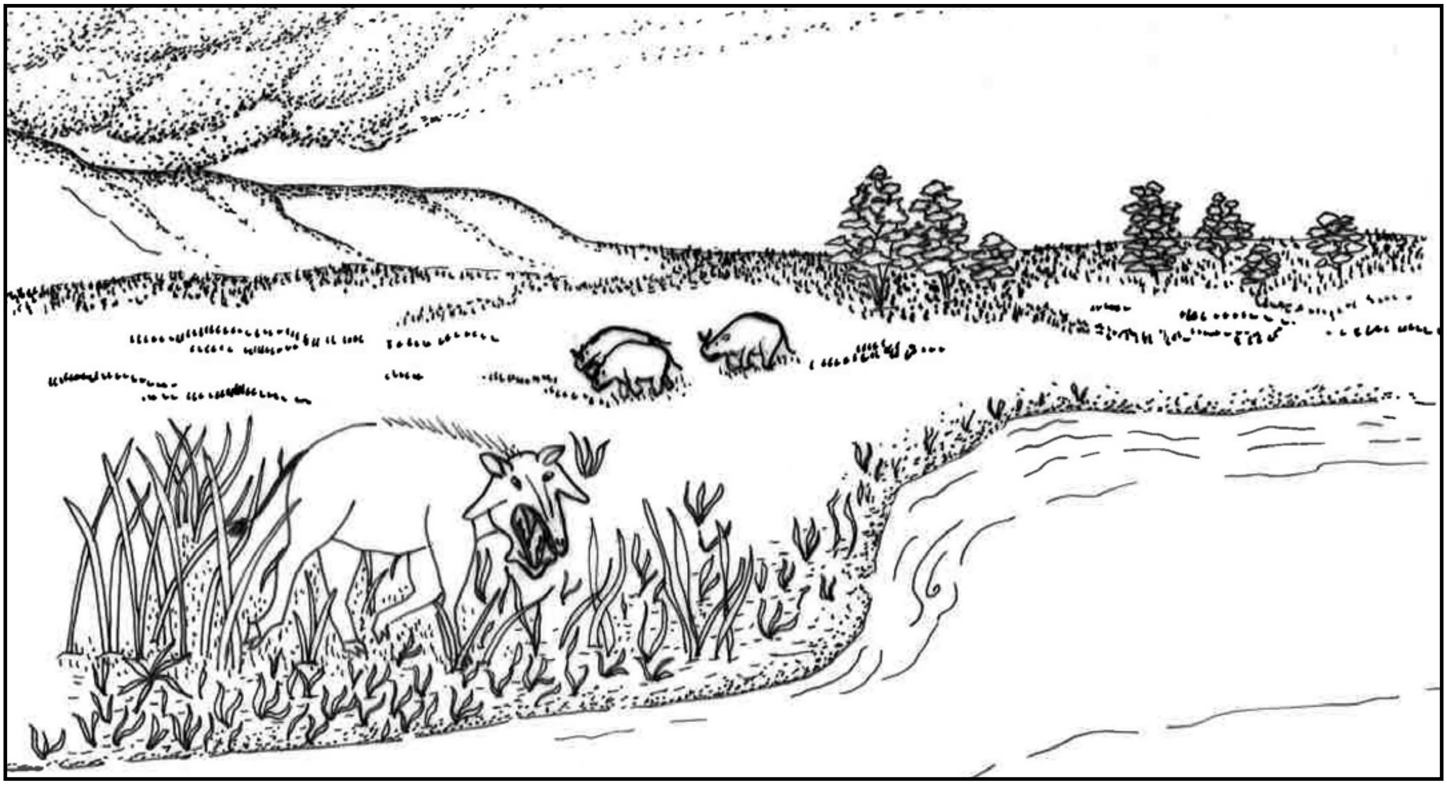
Eocene to Oligocene Periods: 35 Million Year-Old Volcanoes, A River, and a Savannah

Western Nebraska looked something like present-day Africa around 35 million years ago; a broad open savannah where early mammals including camels, rhinos, tiny horses, and fierce pigs once roamed. Streams meandered across the flat, open land, depositing sediments eroded from the Rocky Mountains to the west. Eruptions from volcanoes far to the west also deposited layers of volcanic ash. These various sedimentary layers together form a distinctive rock sequence named the White River Group by geologists, which is divided into two subunits named the Chadron and Brule formations (see page 9). The Chadron Formation was first identified as a distinct rock unit and described by geologists near the town of Chadron, Nebraska and named for that community.

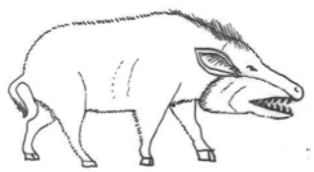


In this map we can see the shallow sea is gone. The ecosystem is starting to resemble present-day Nebraska a bit more, but is still very different. The residents of this ecosystem are also very different than the plants and animals we see in Nebraska today. Over the next few pages, we will meet some of these prehistoric residents and learn more about them.

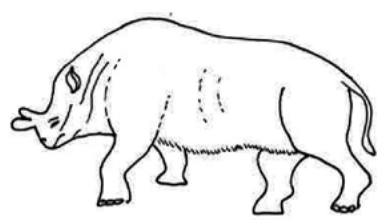
Eocene to Oligocene Periods: 35 Million Year-Old Volcanoes, A River, and a Savannah



In the drawing above, an **entelodont**, or fierce "hell pig" which stood 6 feet tall, darts from the rushes. Several brontotheres graze on the valley floor across the open landscape. A tumbling mass of volcanic ash is billowing eastward from an erupting volcano located further west. The ash will soon cover the landscape, burying living plants to create fossils and preserving footprints of the now extinct animals.



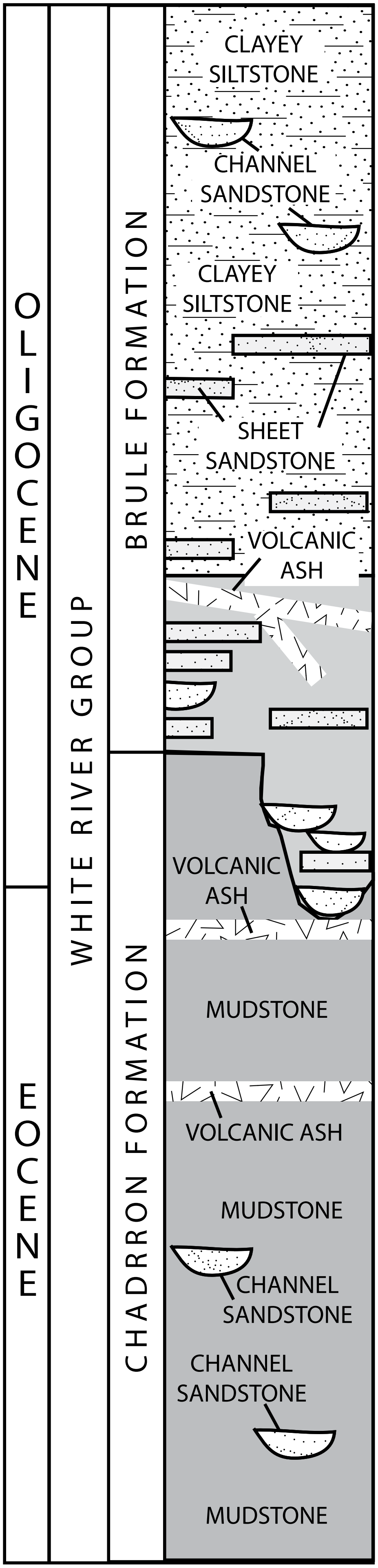
Entelodonts were a family of fierce, pig-like animals.



Brontothere, an early rhinoceros.

The White River Group
Oglala National Grassland, Nebraska

The White River Group is the name geologists have given to the geologic rock sequence that was deposited during the Eocene and Oligocene (from 45 to 24 million years ago) in western Nebraska. The White River Group represents a river valley with water-loving vegetation bordered by higher-elevation areas with vegetation that tolerated drier conditions. Wildlife, including mammals, birds, and reptiles, lived in these environments that were similar to the present-day vast savannahs of Africa. Volcanic activity far to the west in the Pacific northwest sometimes produced ash falls that blanketed the landscape. These ash falls became part of the White River Group, and sometimes preserve the tracks of a variety of prehistoric animals that called western Nebraska home tens of millions of years ago.



The Present is the Key to the Past

The Nebraska landscape looked very different in the Eocene and Oligocene than it does today. It's hard to imagine that the striking badlands landscape of today's Toadstool Geologic Park was once a broad open savannah with flowing rivers. How do we know what the environment was like 30 to 50 million years ago? Geologists make their deductions using the scientific principle that "the present is the key to the past." What this means is that the geologic events we observe today likely also took place in the same manner in the distant past and shaped our world in a manner similar to what we see today. Volcanoes, floods, winds, oceans, and rivers behave in the same manner throughout time and leave recognizable sediment and rock layers, both now and in the past. Geologists can identify bedrock material and types of layers and determine the past environments in which they formed based upon study of how they form in the present. This information can be displayed in a stratigraphic column, like the diagram at left.

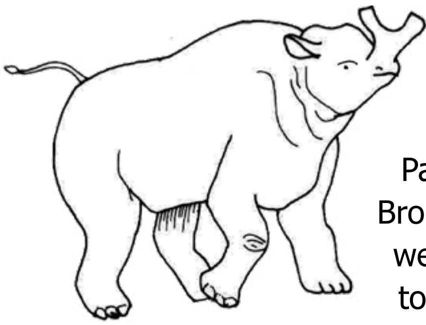
Fossils provide clues about ancient environments and the kinds of life that lived in them. Fossils include more than just bones. Fossils are any evidence of previous life and are as varied as bones, shells, leaves, and the footprints of long extinct creatures in the sands of time. Paleontologists can compare fossils from various bedrock formations and gain information on how the formations were deposited and what the ancient environments were like at the time of deposition.

Why does the Earth continue to change throughout time?

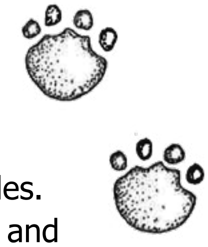
The driving force of much of this change is plate tectonics. This is a scientific term used by geologists which refers to the slow movement of large plates of the Earth's crust over geologic time which has produced the changing shapes and global positions of continents and oceans. As the plates slowly move across our globe, volcanoes and earthquakes bear witness to the immense powers at play. Mountains are thrust upward and then eroded down by wind and water until they are flat and valleys are filled with rock and debris washed down from highlands. Change is truly constant in our world!

Meet the Residents of the White River Group

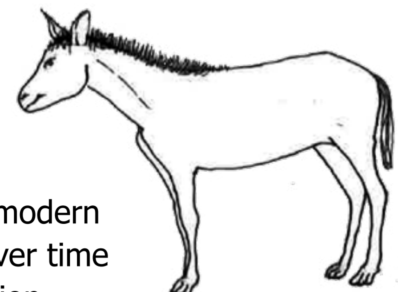
Herbivores: Grazers and Browsers

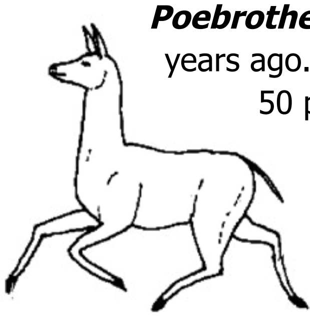


Brontotheres were very large mammals that looked something like a rhino but had the legs of an elephant and a slingshot-like bone on their noses. What was the purpose of the odd shaped horn? Paleontologists believe that it may have been used in battles. Brontotheres probably weighed about a ton (2,000 pounds) and were 8 feet tall at their shoulders. They had an odd number of toes, indicating that they are related to horses and rhinos. Brontotheres were one of the largest mammals in North America during the Eocene.



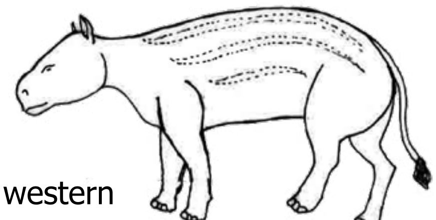
Mesohippus was an early equid (horse family) that lived in western Nebraska during the Eocene and Oligocene. This little horse was about the size of a modern greyhound and had three toes on each foot. Its tooth structure indicated that it probably dined on soft vegetation in forests rather than grazing on grasses like modern horses do. The teeth and body shape of early equids changed over time as environmental conditions changed, supporting the theory of evolution.





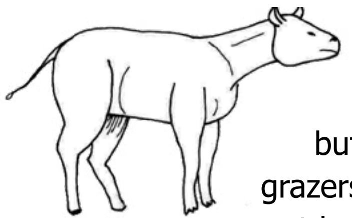
Poebrotherium was an early camel that lived in western Nebraska around 40 million years ago. This little camel stood about two feet tall and weighed around 50 pounds. It looked a lot more like a modern-day llama instead of what we think of as living camels with one or two humps. Its feet had two toes with tiny hooves that looked similar to modern deer hooves. These hooves allowed *Poebrotherium* to run quickly. The fossil record shows that *Poebrotherium* may have been hunted by *Archaeotherium*.

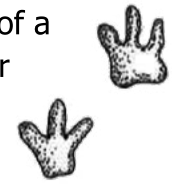
Oreodonts were about 4-½ feet long with a stout body and short legs. They were unusual in having five toes on the front feet and four toes on their back feet. Oreodonts were herbivores, browsing on leaves and young shoots. Oreodonts were very abundant in the environment of the White River Group, although they became extinct in western Nebraska around the end of the Oligocene. Paleontologists think the oreodonts were similar in appearance to modern sheep or pigs.



Meet the Residents of the White River Group

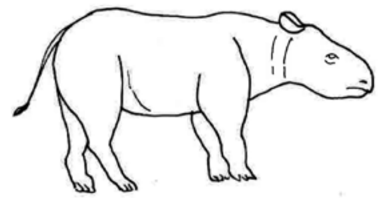
Herbivores: Grazers and Browsers

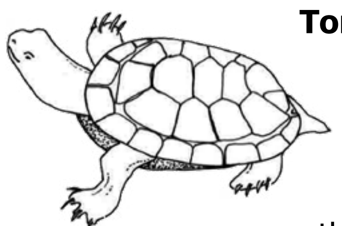




Hyracodon was an early rhinoceros that had the appearance of a modern-day pony. It was about 5 feet long with long slender legs. Its feet had three toes each. Tooth shape shows that *Hyracodon* was a browser, eating leaves and tough foliage, but during the course of evolution modern rhinos became grazers, eating grasses. Unlike modern rhinoceroses, *Hyracodon* did not have a horn. Rhinos, including *Hyracodon*, are now extinct in North America.

Subhyracodon, like *Hyracodon*, was an early rhinoceros without a horn and was about the size of a modern-day cow. This rhino lived along streams and was a browser, meaning that its teeth were shaped to be especially suited to grinding leaves and tough vegetation. *Subhyracodon* had three toes on both its front and back feet.





Tortoises, similar in appearance to modern tortoises, also lived in western Nebraska during Eocene and Oligocene time and left their unique tracks in the soft sediments. Parallel footprints are often separated by a linear impression made by dragging the tortoise's tail. The tortoises lived on land and were herbivores, meaning that they ate plants. Tortoise shell fossils found in the White River Group indicated that these tortoises grew as large at 3 feet across. These very large tortoises later evolved into the smaller, living tortoises that we know today.

Activity: Finding Fossils

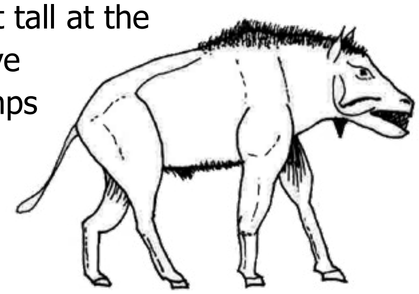
What do you do when you find a really neat fossil? You can make sketches or take photographs of fossils at Toadstool Geologic Park to record them. Collecting fossils is not permitted at Toadstool Geologic Park except by paleontologists with permits, because of the scientific importance of the incredible fossil resources present there. Why are these fossils so important? Each fossil tells a unique story of our planet's past—who lived here and what the environment was like. Scientists are still learning about what the Earth was like 50 million years ago from the fossils in the White River Group at Toadstool Geologic Park.

When you find a fossil, think like a paleontologist! When you take a photograph, use a photo scale such as a ruler or even a coin to indicate the size of the fossil. In your notebook, draw a sketch of the fossil and what the bedrock looked like. Make note of where the fossil was found and what other fossils are present. Were footprints, leaf impressions, shells, petrified wood, or bones also present? Scientists exploring the fossil trails of Toadstool Geologic Park do their best to preserve fossils while learning about them. You can too!

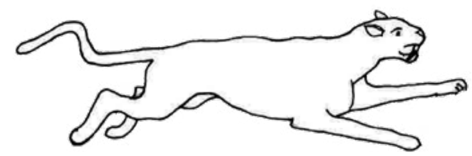
Meet the Residents of the White River Group

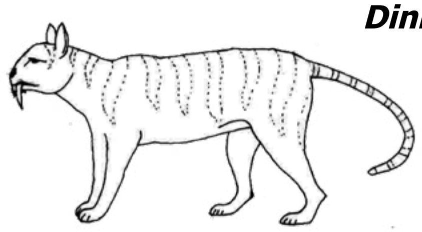
Carnivores: Predators and Scavengers

Archaeotherium was a frightful pig-like creature in the now extinct **entelodont** family. It is called the "hell pig" as it was believed to be very aggressive and stood 6 feet tall at the shoulder. The shoulders and neck of this creature were massive and strong to hold up the large head which had strange bumps on each side. *Archaeotherium* was an omnivore, meaning it ate both meat and plant matter. It was also a scavenger, meaning it didn't pass up an already dead animal for a meal, as well as rooting around in vegetation.



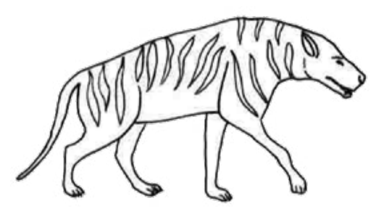
Hoplophoneus was a saber-toothed cat-like creature about the size of a modern leopard. It had a long, sleek body, short legs, and a stout neck. *Hoplophoneus* was a carnivorous (meat eater) predator, and actively hunted prey animals. *Hoplophoneus* was not a true feline even though it looked a lot like modern cats, and its species is now extinct.





Dinictis was a saber-toothed cat about the size of a modern lynx with short legs and a long tail. Both *Hoplophoneus* and *Dinictis* were able to open their jaws incredibly wide to allow them to stab prey with their large saber-like teeth. Paleontologists believe that *Dinictis* lived in open grasslands and stalked its prey.

Hyaenodonts were large dog-like predators that may have fed on carrion similar to modern-day hyaenas. Hyaenodonts ranged in size from a domestic dog to as large as a gray wolf. They lived in the Oligocene Epoch between 23 to 38 million years ago. *Hyaenodon* may have hunted oreodonts because when the oreodonts became extinct, the *Hyaenodon* became extinct as well.

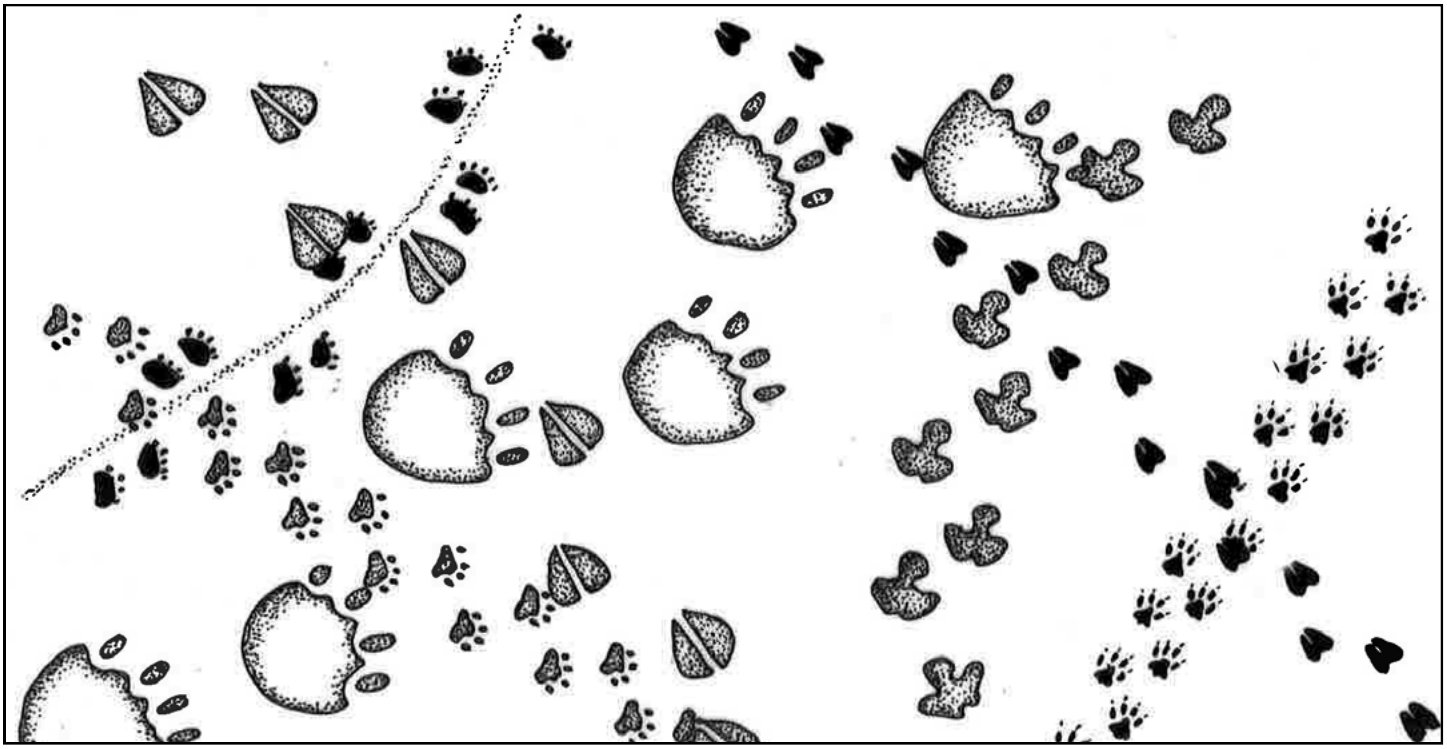


Activity: What other types of animals may have lived here 50 million years ago? Draw one below:

Activity: Tracksite Puzzle

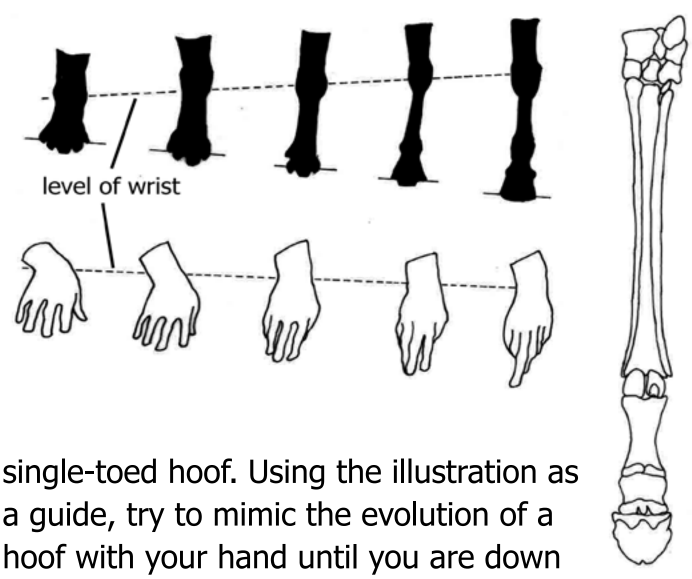
Many Eocene animals left their tracks at Toadstool Geologic Park, only they walked here 50 million years ago! Think like a paleontologist and identify the tracks of each of the animals listed below. Answers are on page 22 of the book.

A. Bronotothere
B. Camel
C. *Hoplophoneus*
D. Turtle
E. Oreodont
F. Entelodont
G. *Hyaenodon*



Tales from Toadstool Geologic Park

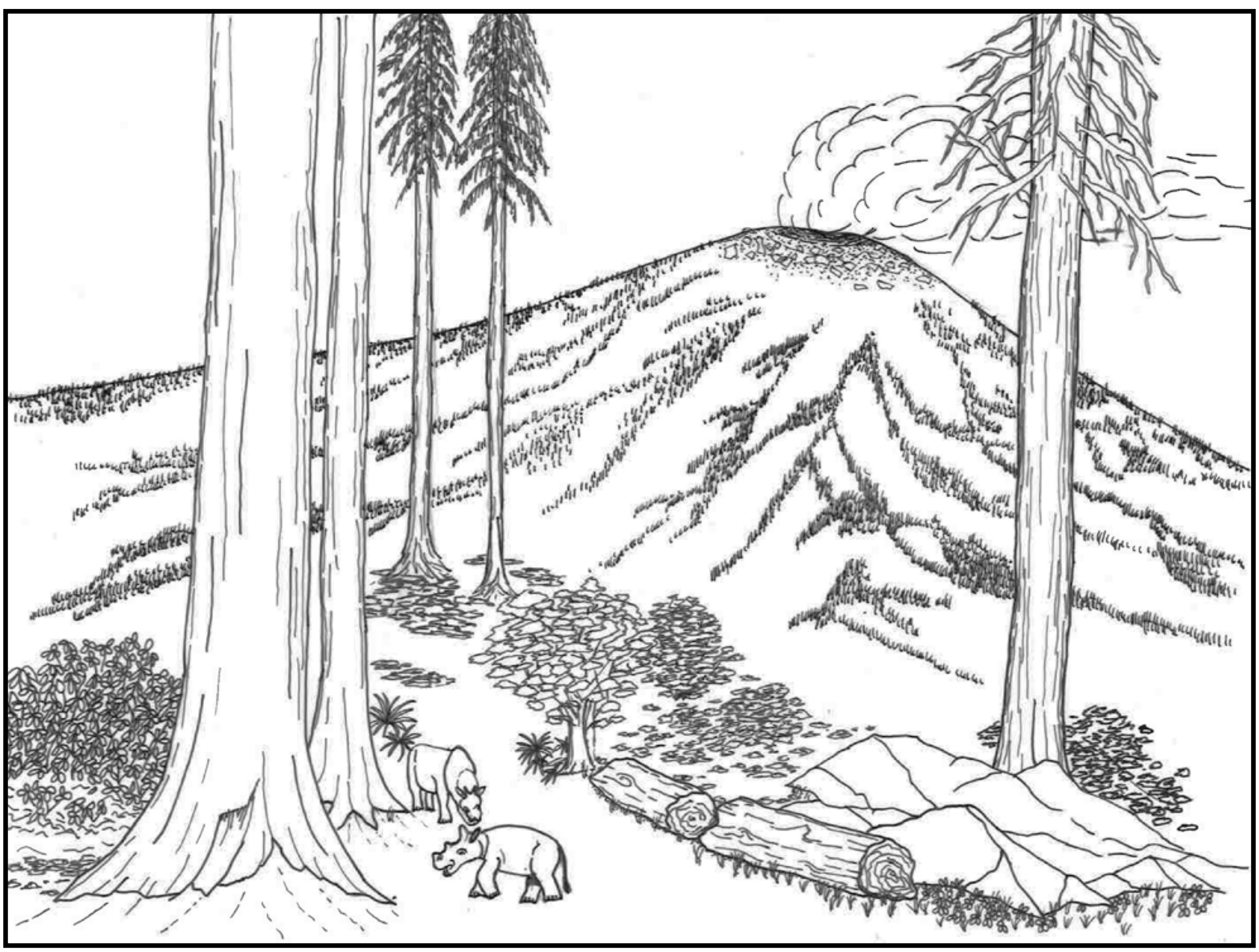
A Tale of Toes: Did you know that a modern horse is actually walking on the tip of a single toe? The horse's hoof is the result of evolutionary change over the last 60 million years. We would see tiny ancestral horses, about 1 foot high, running around on four toes if we were to visit the Toadstool Geologic Park area during the Eocene Epoch (50 million years ago). About 20 million years later during the Oligocene Epoch, a horse's front foot had only three toes. By the time of the Pleistocene Epoch (the "Ice Age," nearly 2 million years ago), horses walked on only one toe, with the toenail strengthened and thickened to form the hoof as we know it today. The pictures show how the horses' foot gradually evolved from a four-toed paw to a single-toed hoof. Using the illustration as a guide, try to mimic the evolution of a hoof with your hand until you are down to only one finger. Imagine walking on only one toe—it's called a hoof!



Tales From Toadstool Geologic Park

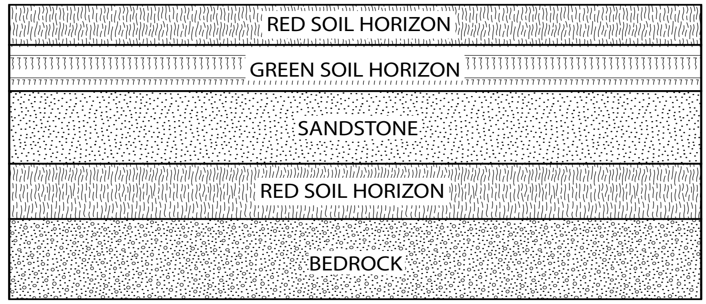
Extinct Horses: We are often taught that the Spanish first brought the horse to the American West, but did they really? As you can see in this activity book, the Eocene-Oligocene landscape of Toadstool Geologic Park was home to prehistoric horses who left their fossil bones and hoof prints as evidence of their ancient presence. Wild horses lived in North America until the end of the last Ice Age, about 11,000 years ago, when they became extinct in North America after having migrated to Europe and Asia. Those horse species continued to live in Europe and Asia where they were tamed and used by early man. The Spanish actually reintroduced horses to the American West when they explored the New World. These horses thrived in the western United States just as they had earlier during the Eocene and Oligocene, and played a critical role in the settling of the west.

Far Away Volcanoes: There was a lot of volcanic activity in the Pacific northwest as well as in Wyoming and Montana during the Eocene (drawing below). Violent eruptions buried living trees under ash where they became petrified in their upright positions. Ash from volcanic eruptions drifted hundreds of miles east to Nebraska and blanketed the vegetation. The ash was rich in silica which percolated into the soil and fossilized even the roots of plants growing there. These fossilized plants in Nebraska, including large trees and smaller plants, provide information on what the landscape and climate were like 50 million years ago. If you want to learn more about unique petrified trees, the Forest Service offers another paleontology activity book on the Gallatin Petrified Forest in Montana.



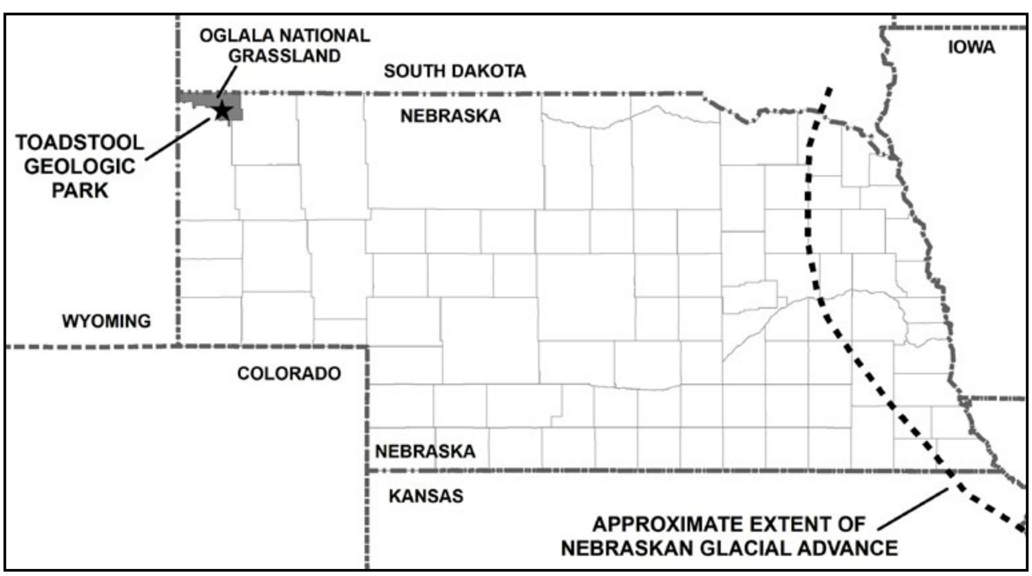
Tales From Toadstool Geologic Park

Colorful Fossil Soils: Have you ever heard of a fossil soil? They do exist and are called ***paleosols*** by geologists. Soil is created when chemical and physical changes at the ground surface modify sediments or weathered bedrock to create a soil layer. Fossil soils, or paleosols, are created when ancient soil layers are buried and preserved, just like plants and animals. If the original soil formed while exposed to the air where oxygen was abundant, the paleosol tends to be red in color. If the soil formed in wet settings like swamps where the oxygen content was much lower (called an ***anaerobic*** environment), the preserved paleosol tends to be greenish or gray in color. The reddish and greenish bedrock layers at Toadstool Geologic Park are paleosols that originally formed at the ground surface of a prehistoric land where now extinct rhinos and camels grazed.



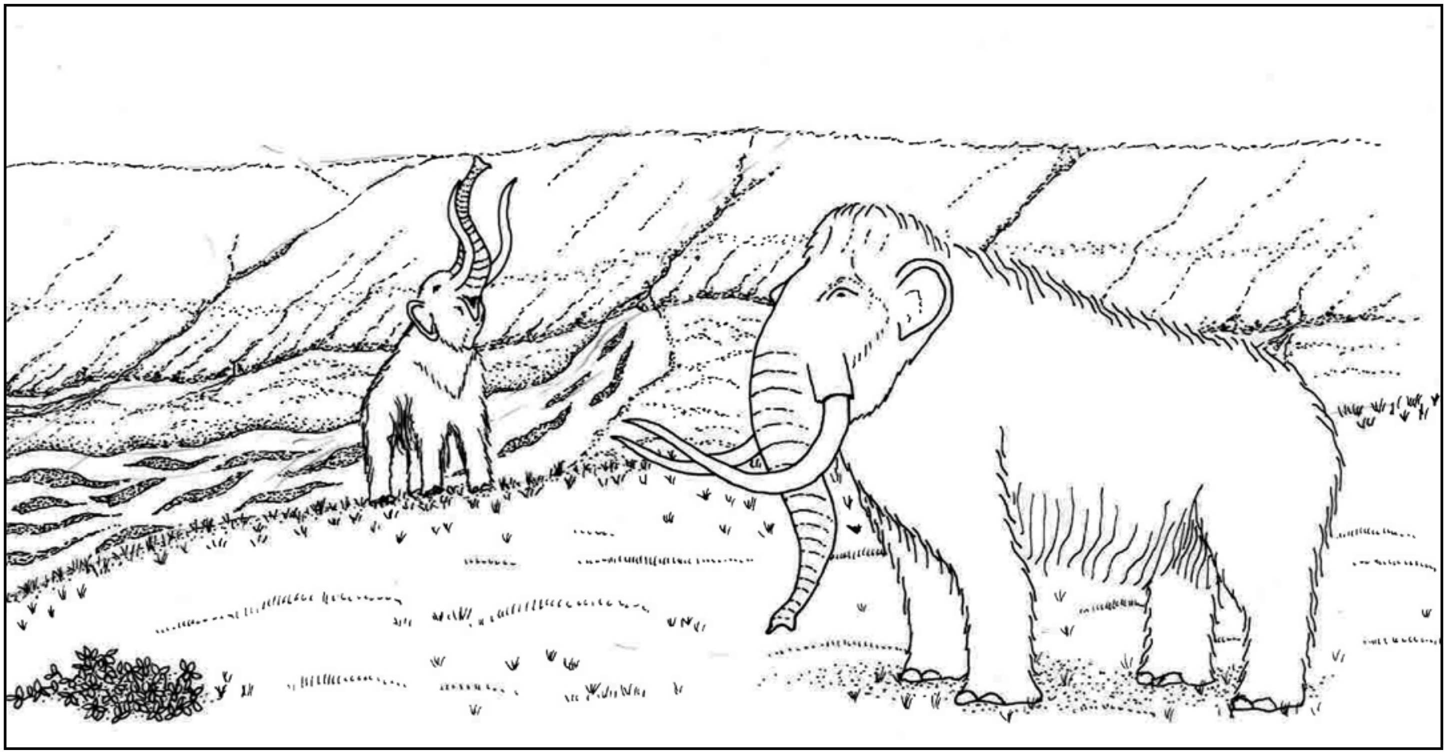
Pleistocene Period: 2 Million Year-Old Glaciers in Nebraska

The Pleistocene Epoch is called the Ice Age because much of North America was covered by ice, not once but many times during the Pleistocene. Glacier ice covered the Rocky Mountains to the west, and a vast continental ice sheet crept down from Canada into the central part of North America. This ice mass is called the Laurentide Ice Sheet, and it blanketed parts of North America not once but four times! Each glacial advance is named for the southernmost State where the ice sheet ended. The earliest ice advance was recognized in Nebraska and is called the Nebraskan Ice Advance. The map below shows the approximate extent of the glacial ice in Nebraska. How do we know how far the ice extended? Continental glaciers left sediment deposits called "drift" as well as erratic boulders, scrape marks, and a "hummocky" (hilly) landscape.



The Ice Age saw huge glaciers marching across North America. These ice sheets, their melt water, and the sediments they carried all left their mark. Nebraska was at the edge of the first of four glacial advances into the present-day United States.

Pleistocene Period: 2 Million Year-Old Glaciers in Nebraska

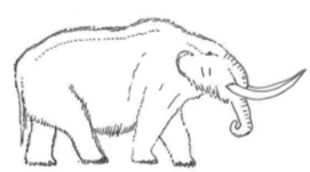


In the drawing above, a mammoth bellows near the edge of the Nebraskan continental ice sheet. Water melting from the face of the glacier flows out across the grassland below where the mammoths graze. The mammoth is the State fossil of Nebraska and mammoth fossils have been found all across the State. Other great mammals, shown below, once lived in Nebraska during the Ice Age and became extinct at the end of the Pleistocene around 12,000 to 10,000 years ago. Prehistoric man may have crossed the Pacific Ocean over the Bering land bridge from Siberia to North America at this time.

Musk ox

Giant sloth

Bison



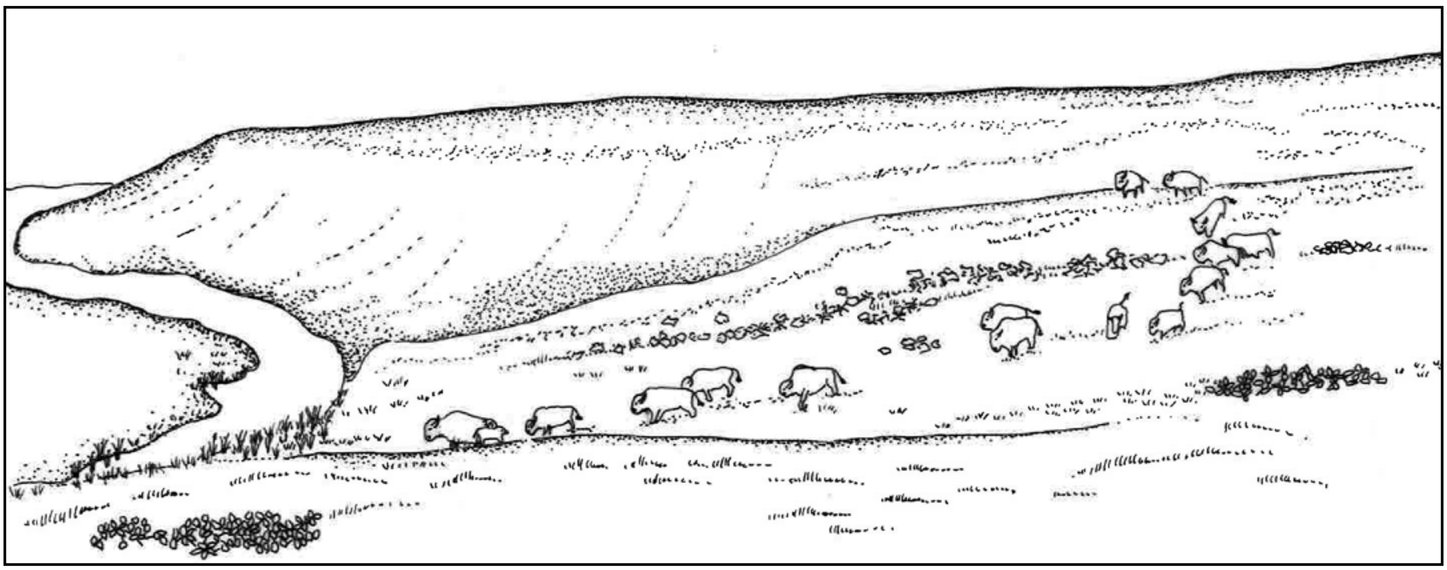
Mastodon

Dire wolf

Activity: Do these prehistoric animals remind you of animals living on Earth today? Research one of these creatures and its modern cousin. Compare and contrast the two in this space:

Hudson-Meng Bison Kill Site, Oglala National Grassland, Nebraska

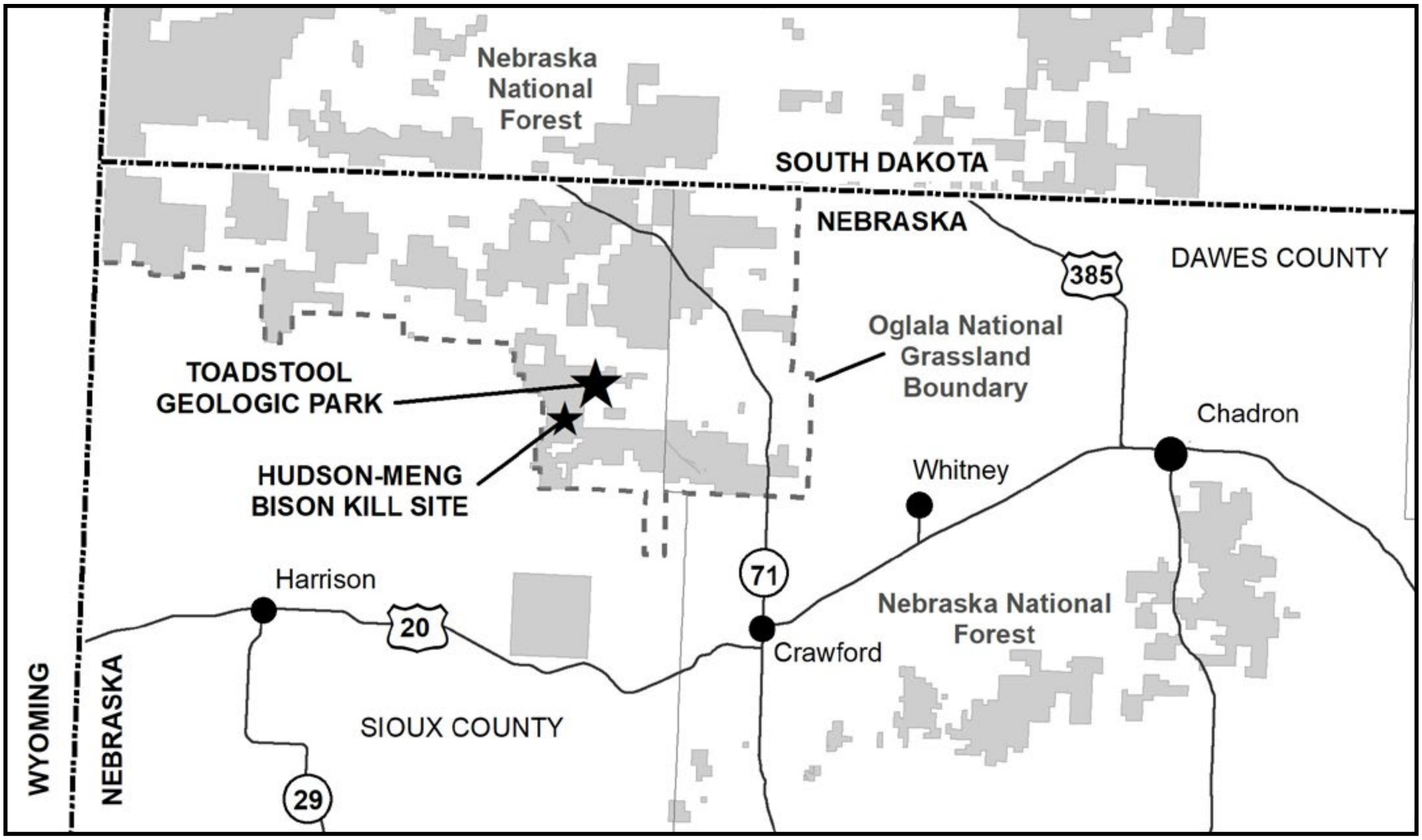
The Hudson-Meng Bison Kill site, located only 5 miles from Toadstool Geologic Park, is a very different kind of fossil setting from Toadstool Geologic Park. Why is it different? The fossils at Toadstool Geologic Park are nearly 40 to 50 million years older than the fossil bison at the Hudson-Meng site. The Hudson-Meng site is only about 10,000 years old and is associated with early North American human residents called Paleoindians. Paleoindians had a stone age culture, meaning they made their tools from stone like the ones shown on the next page. The tightly packed bonebed at the Hudson-Meng site contains the bones of at least 150 bison. It has been studied by many archaeologists, whose excavations provide information about how the bison died and about the Paleoindians who hunted the bison. Archaeologists study the bones, the artifacts associated with the site, and the dates obtained from the site to piece together the history of the last 10,000 years in the Oglala National Grassland.



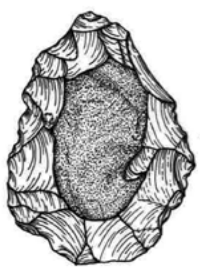
Millions of bison once roamed the prairies of modern Nebraska. These animals provided food, clothing, tools, and other resources for the humans who hunted them.

Paleontologists or archaeologists—what's the difference? Many people don't know the difference between paleontologists and archaeologists, perhaps because the tools and techniques used in excavations are similar. The difference is simple. Archaeologists study evidence of previous human cultures while paleontologists study evidence of all previous life throughout the entire history of the Earth, excluding humans. The span of time studied by paleontologists is hundreds of millions of years ranging back to the origin of life on Earth, while the span of time studied by archaeologists is the most recent tens of thousands of years following the origin of the earliest humans. Most paleontologists are geologists as well as biologists who strive to understand the Earth, its history, past and present life forms, and Earth's resources.

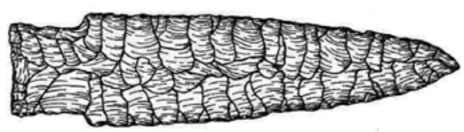
Hudson-Meng Bison Kill Site, Oglala National Grassland, Nebraska



The Oglala National Grassland is named for the Oglala Lakotas who live in this area. The human tools found at the Hudson-Meng bison kill site were used by ancestors of the Oglala and other American Indian people.



Stone scraper



Paleoindian projectile point

Stone scraper

Stone tools have many shapes and sizes. Projectile points were used for hunting. Scrapers were used to prepare meat and skins for food and clothing. **Activity:** In the space below, explain how artifacts like these are different from the fossils at Toadstool Geologic Park.

ACTIVITY: WORD SEARCH

Try to find the following words on the grid below. Answers are on page 22 of the book.

BADLANDS	DEPOSITION	EROSION	TRACKSITE	FOSSIL
CLAYSTONE	PALEONTOLOGY	SANDSTONE	EOCENE	OLIGOCENE
CENOZOIC	TOADSTOOL	CAMEL	OGLALA	NEBRASKA
BRONTOTHERE	OREODONT	BISON	VOLCANO	GLACIER
MESOZOIC	PALEOZOIC	RIVER	TOE	HYRACODON
DINICTIS	OMNIVORE	ENTELODONT	MESOHIPPUS	CHADRON
PIG	ASH	DEPOSITS	GRASSLAND	PALEOSOL

Y	Y	G	O	L	O	T	N	O	E	L	A	P	B	P	D	S	T	W	M	O	P
L	A	R	R	Z	P	K	E	N	O	I	T	I	S	O	P	E	D	M	X	L	A
O	M	N	I	V	O	R	E	S	S	L	Y	G	R	J	L	Q	E	Q	U	M	L
D	V	E	N	T	E	L	O	D	O	N	T	L	O	N	A	C	L	O	V	F	E
G	B	R	O	N	T	O	T	H	E	R	E	V	S	W	O	U	Y	L	T	N	O
K	A	X	Y	F	D	O	U	I	N	O	D	O	C	A	R	Y	H	A	R	A	Z
X	D	R	H	W	I	M	K	H	M	C	R	E	I	C	A	L	G	W	A	L	O
H	L	S	H	S	N	E	O	C	E	N	E	P	P	P	T	V	I	H	C	S	I
W	A	R	S	L	I	S	A	N	D	S	T	O	N	E	W	E	F	S	K	S	C
S	N	Q	U	H	C	O	P	J	T	V	E	K	A	F	R	O	X	P	S	Y	U
K	D	L	T	Y	T	H	L	L	O	O	R	X	K	G	H	T	I	M	I	O	L
R	S	O	E	A	I	I	T	I	B	G	R	A	S	S	L	A	N	D	T	B	F
C	B	S	Y	T	S	P	E	O	G	L	A	Y	A	M	N	Y	M	O	E	P	R
T	R	O	I	O	K	P	U	U	T	O	C	L	R	N	E	T	A	C	G	X	W
P	U	E	T	A	V	U	C	S	D	P	C	U	B	M	G	S	H	I	B	O	A
N	E	L	B	D	U	S	O	A	S	S	H	E	E	P	K	J	O	O	I	N	B
W	L	A	J	S	T	A	Y	R	W	E	A	O	N	M	C	Z	H	Z	S	F	W
S	T	P	E	T	G	X	E	E	E	U	D	F	J	E	M	C	V	O	O	P	T
K	R	X	D	O	G	L	A	L	A	H	R	I	V	E	R	L	A	N	N	I	E
G	U	B	O	O	H	K	S	O	R	E	O	D	O	N	T	S	O	E	T	W	C
M	T	X	Z	L	P	H	L	E	Z	E	N	O	T	S	Y	A	L	C	P	L	G
K	V	S	W	E	C	A	M	E	L	K	O	U	Y	N	O	I	S	O	R	E	C

Activity: Coded Messages

Try to decipher the messages below. Each letter in the alphabet represents another letter. Write your answer below the code. A clue is given at the bottom of the page. Answers are on page 22 of the book.

Message #1:

PLCVMCA KE TMAH RAH TRXPL JLPRXPH

____

XOP XCRHVXCCZ ZRAHDCLY

____

Message #2:

GNQSBI PWAG ZL XNWDCIGFNCS QJCVQPI QZFKJM

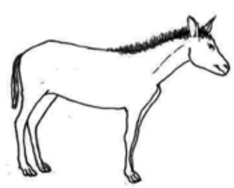
____

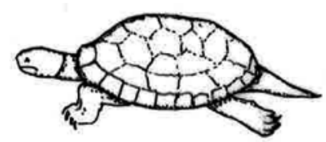
QG GFQMIGFFP EWFPFECS XQNB

____

Activity: Scrambled Words

These words from the Toadstool Geologic Park activity book are scrambled. Try to spell the word. As a hint, there is a drawing of what each word is. Answers are on the back of the book.

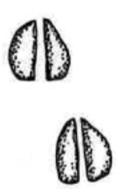




A. TTROOHREBNE ____________________

B. KCRAT ____________________

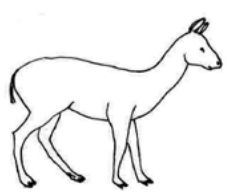
C. OODLSOTTA ____________________

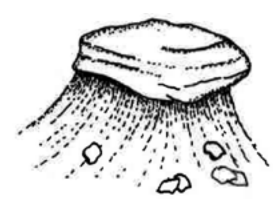


D. ETSNO OOTL ____________________

E. HSOMSPIPEU ____________________

F. TOOEELNNDT ____________________



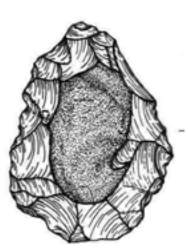


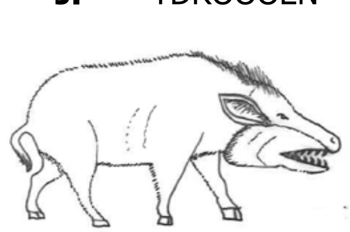
G. ISTTOORE ____________________

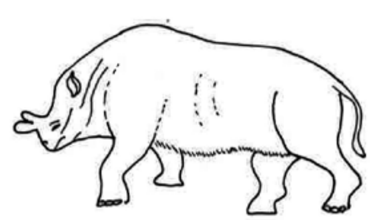
H. TOMMMHA ____________________

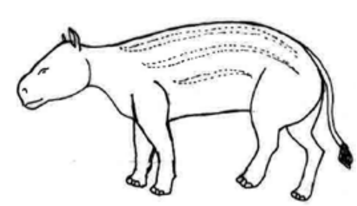
I. AECLM ____________________

J. TDROOOEN ____________________









MESSAGE #1 CLUE: T REPRESENTS THE LETTER W; MESSAGE #2 CLUE: F REPRESENTS THE LETTER O

Answer Page

Tracksite Puzzle:

A. Brontothere, large early rhino
B. Camel
C. *Hoplophoneus*, early cat-like animal
D. Turtle, dragging its tail
E. Oreodont, an early herbivore
F. Entelodont, the six-foot tall "hell pig"
G. *Hyaenodon*, a dog-like predator

Word Search:

Y	Y	G	O	L	O	T	N	O	E	L	A	P	B	P	D	S	T	W	M	O	P
L	A	R	R	Z	P	K	E	N	O	I	T	I	S	O	P	E	D	M	X	L	A
O	M	N	I	V	O	R	E	S	S	L	Y	G	R	J	L	Q	E	Q	U	M	L
D	V	E	N	T	E	L	O	D	O	N	T	L	O	N	A	C	L	O	V	F	E
G	B	R	O	N	T	O	T	H	E	R	E	V	S	W	O	U	Y	L	T	N	O
K	A	X	Y	F	D	O	U	I	N	O	D	O	C	A	R	Y	H	A	R	A	Z
X	D	R	H	W	I	M	K	H	M	C	R	E	I	C	A	L	G	W	A	L	O
H	L	S	H	S	N	E	O	C	E	N	E	P	P	P	T	V	I	H	C	S	I
W	A	R	S	L	I	S	A	N	D	S	T	O	N	E	W	E	F	S	K	S	C
S	N	Q	U	H	C	O	P	J	T	V	E	K	A	F	R	O	X	P	S	Y	U
K	D	L	T	Y	T	H	L	L	O	O	R	X	K	G	H	T	I	M	I	O	L
R	S	O	E	A	I	I	T	I	B	G	R	A	S	S	L	A	N	D	T	B	F
C	B	S	Y	T	S	P	E	O	G	L	A	Y	A	M	N	Y	M	O	E	P	R
T	R	O	I	O	K	P	U	U	T	O	C	L	R	N	E	T	A	C	G	X	W
P	U	E	T	A	V	U	C	S	D	P	C	U	B	M	G	S	H	I	B	O	A
N	E	L	B	D	U	S	O	A	S	S	H	E	E	P	K	J	O	O	I	N	B
W	L	A	J	S	T	A	Y	R	W	E	A	O	N	M	C	Z	H	Z	S	F	W
S	T	P	E	T	G	X	E	E	E	U	D	F	J	E	M	C	V	O	O	P	T
K	R	X	D	O	G	L	A	L	A	H	R	I	V	E	R	L	A	N	N	I	E
G	U	B	O	O	H	K	S	O	R	E	O	D	O	N	T	S	O	E	T	W	C
M	T	X	Z	L	P	H	L	E	Z	E	N	O	T	S	Y	A	L	C	P	L	G
K	V	S	W	E	C	A	M	E	L	K	O	U	Y	N	O	I	S	O	R	E	C

Coded Messages:

EROSION BY WIND AND WATER CREATED THE TOADSTOOL LANDFORMS

TRACKS LEFT BY PREHISTORIC ANIMALS ABOUND AT TOADSTOOL GEOLOGIC PARK

Scrambled Words:

A. BRONTOTHERE
B. TRACK
C. TOADSTOOL
D. STONE TOOL
E. MESOHIPPUS
F. ENTELODONT
G. TORTOISE
H. MAMMOTH
I. CAMEL
J. OREODONT

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