FIELD TRIP GUIDE FOR MADERA UNIFIED SCHOOL DISTRICT

FOR DISTRICT SECOND GRADERS

IN PARTNERSHIP

WITH THE FOSSIL DISCOVERY CENTER OF MADERA COUNTY

3.d. Students know that fossils provide evidence about the plants and animals that lived long ago and that scientists learn about the past history of Earth by studying fossils. 32
Suggested Titles for California Science State Standard 3.d.

PLEASE NOTE: All teachers are electronically provided Pre and Post Packets of information for their students on the Fossil Discovery Center to share with their students.

Madera Unified second grade students have access to an excellent facility that fulfills their the above California State Science Standard. The Fossil Discovery Center of Madera County is located at 19450 Avenue 21 ½ Chowchilla,CA 93610. The operating hours for field trips would be Monday through Friday from 8:30a.m. to 4:00p.m. and the priority months for Madera Unified's approximately 1,800 students would be November, December, and January. The cost is $7.00 per student which includes a guided tour and fossil dig. Each field trip lasts about two hours and there is an eating area for lunches. Reservations should occur at least four months in advance. Groups can be from 60-80 students per field trip. All other comments or questions can be taken by Michele Pecina, Ed.D. at 559-664-8277.

FOSSIL DISCOVERY CENTER CHOWCHILLA, CALIFORNIA

TEACHER PRE-VISIT PACKET

The following material is not organized by grade. Please use whichever pages you determine are best for your class.

Written and illustrated by Blake Bufford

INFORMATION REGARDING YOUR FIELD TRIP TO THE FOSSIL DISCOVERY CENTER

Thank you for booking a field trip with the Fossil Discovery Center!

We have a few requests to make so that your visit will be as enjoyable as possible for everyone.

1. Please have the buses pull up in front of the FDC in the drop off zone and unload passengers there.

2. We would like to request that teachers and chaperones help us to maintain order with the students by keeping them with the group and maintaining discipline, for example, raise your hand to make a comment or ask a question, be polite and listen to the tour leader, etc.

3. Please provide name tags for your students.

4. Please turn off pagers and cell phones during tours. If you must take a call, please step away from the group.

5. If you will be visiting the Gift Shop, please limit the number of students to 10 at a time.

We look forward to seeing you at the Fossil Discovery Center!

FACTS ABOUT THE FAIRMEAD FOSSIL SITE

The fossils were discovered in 1993 by heavy equipment operators at the Fairmead Landfill. A worker was excavating a huge hole (or "cell") to fill with garbage. He noticed something which turned out to be a Columbian mammoth tusk – this tusk had been uncovered 35 feet below the surface. Paleontologists from the University of Berkeley were called in and fossils have been found ever since.

The fossils appear approximately 12 feet below the surface and continue down to approximately 67 feet in depth. The excavations do not go below 67 feet, so we don't know exactly how far down the bones may continue.

The Fairmead Fossil Site is one of the largest fossil sites on the West Coast. The San Joaquin Valley was home to Columbian mammoths, horses, camels, and giant ground sloths. There were also predators such as Dire wolves and Saber-tooth cats. There is a wide array of other animals including birds, reptiles, amphibians, and fish. This diversity provides good evidence of what the environment may have been like.

The fossils date back to the Pleistocene epoch. The Pleistocene began approximately 1.8 million years ago and ended approximately 10,000 years ago. The Fairmead fossils are from the middle of the Pleistocene and are between 500,000 and 700,000 years old.

The Pleistocene is known as the Ice Age when much of the earth was colder and huge sheets of ice covered much of North America.

There are NO "Woolly" mammoths here. We had the larger "Columbian mammoths". Although cooler than today, it was not cold enough for our mammoths to wear fur coats.

There are NO dinosaur bones here. Dinosaurs died out over 65 million years ago. California has few dinosaurs because most of it was under the ocean during the dinosaur era.

There were NO people here during the Middle Pleistocene. (Note: the earliest people arrived in North America towards the END of the Pleistocene, about 12,000 years ago.)

The San Joaquin Valley was covered by grasslands cut by rivers and creeks flowing from the Sierra Nevada range to the east. When the rivers flooded in the wet season they buried the bones of these animals beneath layers of sediment. Their rapid burial and subsequent preservation is why the bones are still here. Burial was the key to preservation.

At the end of the Pleistocene, there was massive die off/extinction of many of these animals. Reasons for this could have been a warming climate, changing vegetation patterns, an unknown disease, over hunting by early people who arrived in North America around 12,000 years ago, or a combination of factors. The exact reasons are still being debated.

WHAT YOU WILL SEE AND DO DURING YOUR VISIT TO THE FOSSIL DISCOVERY CENTER

First, you will be greeted by staff members of the Fossil Discovery Center. It works well to have the children separated into groups of 10 to 15 at most. School staff members will help maintain discipline and attention during the tours. Each group will begin their visit at different points within the center and after each segment of the tour, they will move to the next point of the tour.

One group begins the tour at the Mock Dig. Here they are given a brief introduction about excavating fossils. Skulls and jaws of some of the animals found at the fossil site are buried in the large sand area. They are shown how to use the tools given to them which include two plastic trowels and a paintbrush. They are also instructed in the differences between an herbivore and carnivore by looking at the teeth and eye placement and whether the fossil is the skull or jaw of that animal. They then enter the actual dig area and can excavate as many" fossils" as time permits. This activity usually lasts about 30 minutes.

The other groups begin their tour inside the center where they will watch an introductory 8 minute video then take a guided tour of the fossil displays led by FDC staff members or volunteers. Depending on the time determined by the school leaders as well as weather conditions, there is also a tour outside around the pond. This pond is landscaped with plants native to the San Joaquin Valley and is a re-creation of the area before development. It is built to resemble the Valley during the Pleistocene era. The pond has aquatic insects, frogs and birds and is a good introduction to the natural history of the San Joaquin Valley and how it has changed over time. The groups will then rotate to a different activity until everyone has experienced all the aspects of the Fossil Discovery Center.

Tables inside or outside the Center are provided for the students to eat their lunches or snacks and to do other activities. There is also a gift shop for any of the students who may want to buy gifts or souvenirs (if this is allowed by the school or group leaders.)

Most groups arrive by 9 or 10 a.m. and are finished by 11 a.m. or 12 noon. A 2 to 2 ½ hour visit is typical.

TYPES OF ANIMALS THAT ARE COMMONLY FOUND AT THE FAIRMEAD FOSSIL SITE

Herd animals/Herbivores:

Horse. Horses are the most common animal found here. A large percentage of the bones are from this extinct species of horse. Horses are native to North America. They went extinct here about 8,000 to 10,000 years ago. Most were smaller than typical horses today.

Camel. The camel is the second most common animal found at Fairmead. They were also native to North America and migrated to other parts of the world around 3 million years ago. They were larger than modern camels.

Columbian mammoth. The Columbian mammoth was one of the largest mammoths in North America. They could stand up to 14 feet in height and weigh 20,000 lbs. They ate about 600 pounds of grass per day.

Giant ground sloth. Although not a herd animal, these animals are very numerous in the fossil record at Fairmead. There were three different species. Harlan's Ground Sloth was the largest at 3,500 lbs. Next was Wheatley's Ground Sloth, and finally the Shasta Ground Sloth, which was the size of a black bear.

Predators/Carnivores

Predator bones are extremely rare at Fairmead. This is natural since there is always more prey than predators in nature. Some of the predators found at Fairmead are the following:

Dire wolf. These wolves were slightly larger than modern wolves. They had larger heads and jaws than wolves today. They weighed about 130 to 190 lbs. Wolves are social animals and they hunted in packs.

Saber-tooth cat. These cats were heavier than modern day African lions and were extremely strong. They weighed up to 700 lbs. Their serrated canines were 7 inches long. They were ambush predators, springing from cover with short bursts of speed.

Scimitar cat. This cat was similar to a Saber-tooth but had shorter canines up to 4 inches long. It weighed about 300 to 550 pounds. It was probably faster than the Saber-tooth cat. It would spring from cover and could possibly chase down its prey.

American cheetah. The American cheetah was approximately 6 feet long and weighed about 100 to 150 pounds. They were fast runners and probably chased down their prey. Similar cheetahs still exist in Africa today.

Short-faced bear. This was the largest predator in North America at this time. They weighed over 1,000 pounds and could have possibly run at 40 miles per hour. On all fours, they were 5 feet tall. On two legs, they were between 10 and 12 feet tall.

There are many other species found at Fairmead. Some are extinct, but most are still living today. Some animals that still exist are coyotes, badgers, Canada geese, ground squirrels, wood rats, deer, mourning doves, and Sacramento perch. Below is a list of the types of animals discovered at Fairmead so far.

Vertebrate fauna from the Fairmead site:

Archoplites interruptus	Sacramento perch
Clemmys marmorata	Western pond turtle
Xerobates agassizi	desert tortoise
Athene cunicularia	burrowing owl
Branta Canadensis	Canada goose
Tadorna tadorna	common shelduck
Zenaida macroura	mourning dove
Sorex sp.	shrew
Paramylodon harlani	Harlan's ground sloth
Nothrotherios shastensis	Shasta ground sloth
Megalonyx wheatleyi	Wheatley's ground sloth
Canis latrans	coyote
Canis dirus	Dire wolf
Vulpes velox	swift fox
Homotherium sp.	Scimitar cat
Smilodon sp.	Saber-tooth cat
Miracinonyx sp.	American cheetah
Taxidea taxus	badger
Arctodus sp.	giant short-faced bear
Spermophilus sp.	ground squirrel
Neotama sp.	wood rat
Peromyscus sp.	deer mouse
Microtus sp.	pocket gopher
cf. Dipodomys sp.	kangaroo rat
Lepus sp.	rabbit
Mammuthus columbi	Columbian mammoth
Equus sp.	horse
Camelops sp.	camel
Hemiauchenia sp.	llama
Tetrameryx irvingtonensis	Irvington pronghorn
Capromeryx sp.	small-sized pronghorn
Odocoileus sp.	deer
Platygonus vetus	Leidy's peccary

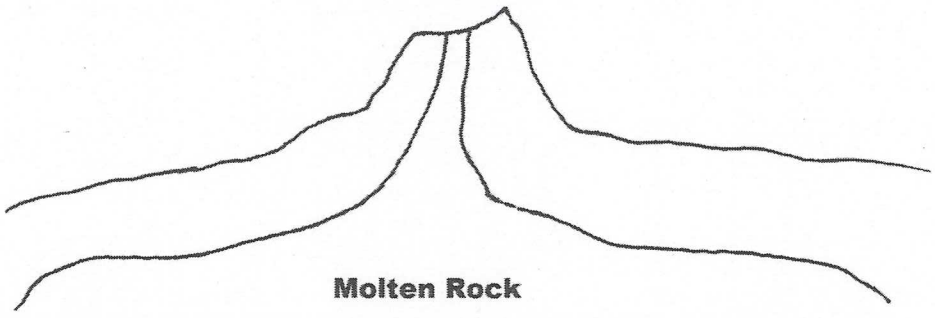
LOOKING FOR FOSSILS

A paleontologist is a scientist who looks for and studies fossils

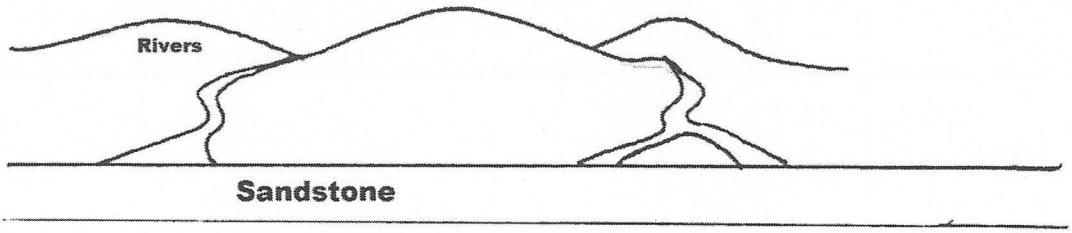
Fossils are any evidence of past life. This may include bones, teeth, shells, or plants.

To look for fossils, we must learn about three basic types of rock. They are:

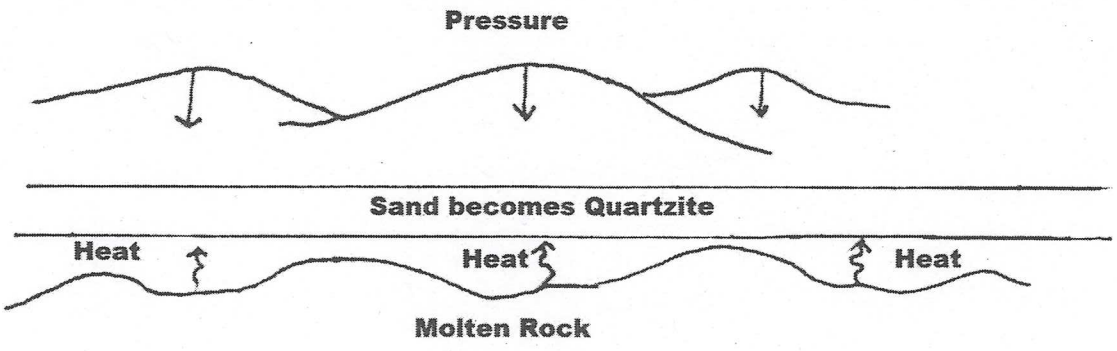
Igneous rocks. These rocks are formed by volcanos or other intense heat deep within the earth. They are made of melted rock and minerals.



Sedimentary rocks. These rocks are formed from loose material such as sand or silt or clay which is deposited in layers and then compressed by other layers until they turn into rock. Sedimentary rock often contains fossils



Metamorphic rocks. These rocks are formed underground when sedimentary or igneous rocks are changed by intense heat or pressure or both. Metamorphic rocks do not have any fossils.



Where would igneous rocks come from?

A. a volcano
B. a lake
C. a river

Where would sedimentary rocks come from?

A. an ocean floor
B. a lava flow
C. from melted stone below the surface of the earth

Where would you find metamorphic rocks?

A. on a beach
B. in a river bed
C. in a desert
D. all of the above

Examples of Igneous Rocks: Granite, Obsidian, Basalt, Gabbro.

Examples of Sedimentary Rocks: Sandstone, Limestone, Claystone, Shale.

Examples of Metamorphic Rocks: Quartzite, Marble, Slate, Schist.

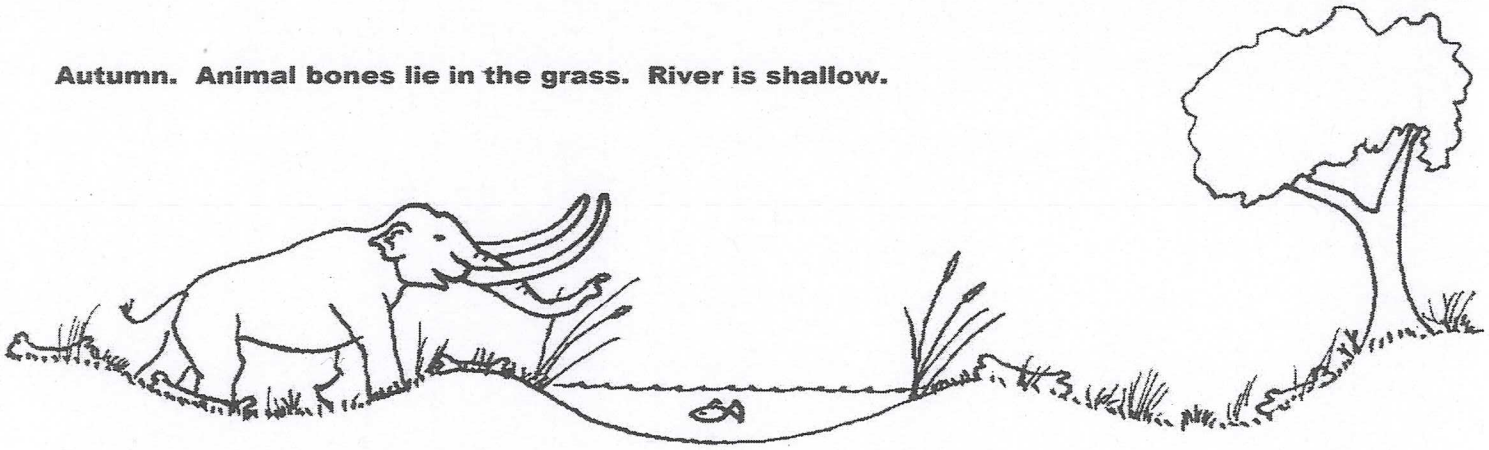
NOTE: Rocks of all three basic types can also be found jumbled together because nature often mixes them up in river channels or through the erosion of mountains and hillsides.

We know not to look in igneous or metamorphic rock because there will be no fossils in them. There are no fossils in igneous or metamorphic rock because of the heat and pressure that makes them. Any organic material is destroyed or never existed in them to begin with.

Fossils are found in **SEDIMENTARY** deposits. Sedimentary rocks usually form when sand, silt, or clay is deposited by water. Animals or plants are buried in the sand or clay and their remains are preserved. The Fairmead fossils are not found in sedimentary *rock* but in sediments that have not yet turned into rock.

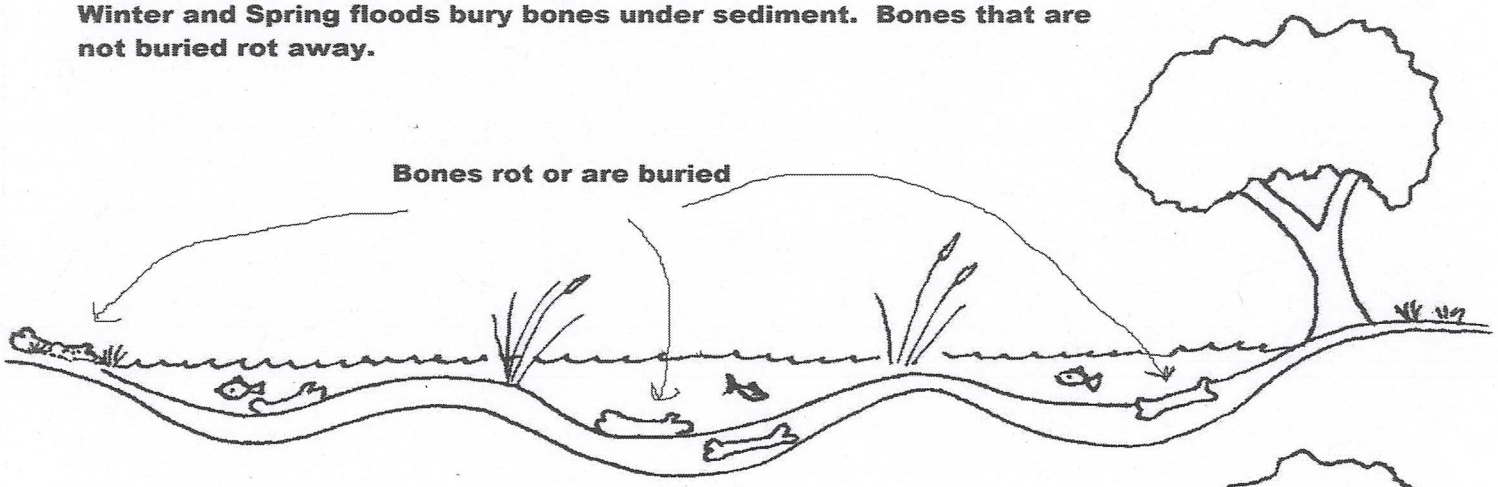
The Fairmead Landfill gives a rare glimpse of the ancient landscape of the area. On the next page is an illustration of the possible process of flooding that buried the bones under sediment.

Autumn. Animal bones lie in the grass. River is shallow.

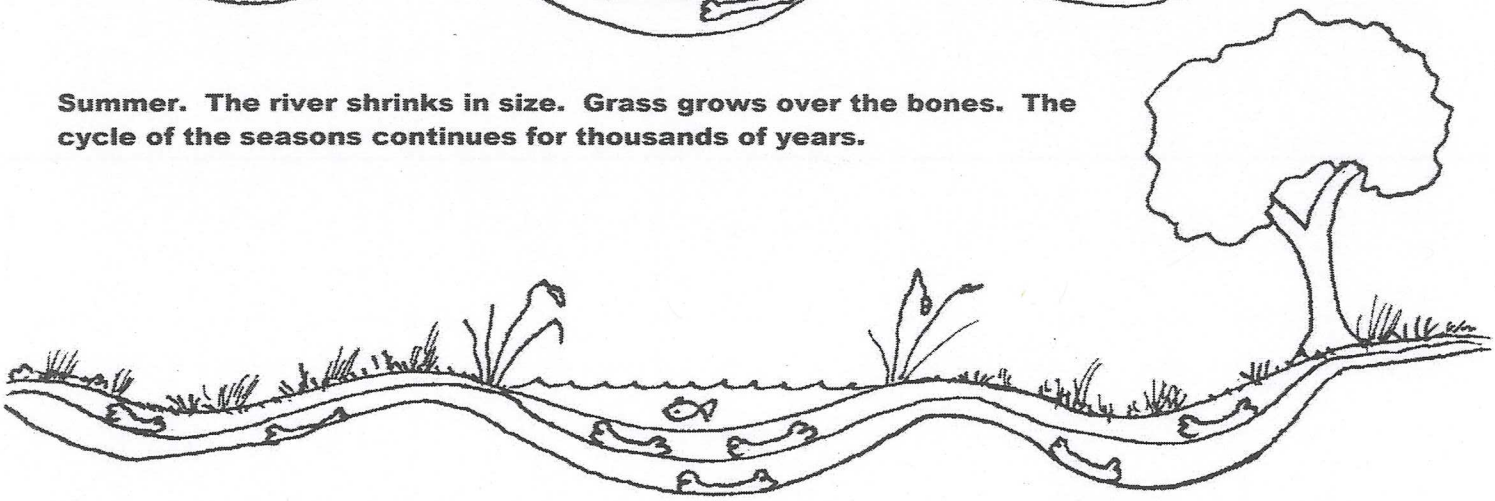


Winter and Spring floods bury bones under sediment. Bones that are not buried rot away.

Bones rot or are buried



Summer. The river shrinks in size. Grass grows over the bones. The cycle of the seasons continues for thousands of years.



HOW TO PRESERVE FOSSILS

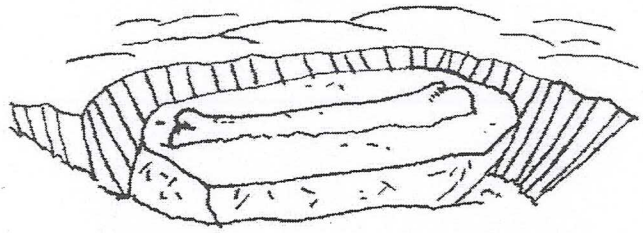
When a paleontologist finds a fossil, it often is very fragile. To preserve it and make removing it easier without damaging it, a "jacket" is made around the fossil. A jacket is a combination of four materials. These are burlap, plaster of Paris, water, and toilet paper or aluminum foil. Burlap is a thin, coarse, fabric. Plaster of Paris is just that; plaster. Water and toilet paper and foil everyone knows.

Steps in making a jacket:
First, the fossil is prepared by digging around it with hand tools until there is just enough dirt left around it to lend support. If all of the dirt is removed, the fossil is weakened and may collapse.

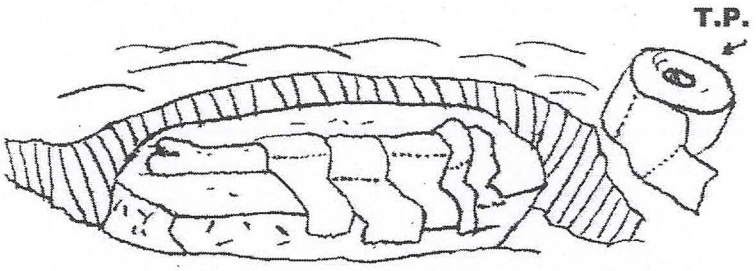
Second, layers of damp toilet paper are laid across any exposed bone. Aluminum foil can be used in place of toilet paper and is easier to handle. This creates a barrier between the fragile and often porous bone and the wet plaster.

Third, Plaster of Paris and water is mixed in a bucket or pan until it is thicker than plain water but thinner than paste.

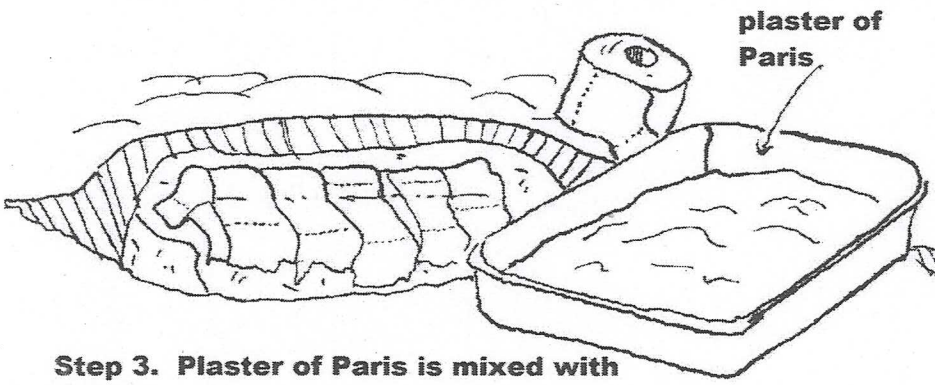
Fourth, Strips of burlap are then quickly soaked in the plaster until coated, then wrapped around the prepared fossil. More plaster coated burlap strips are applied in different directions (criss-crossed) until the entire fossil is covered by them. It is then left to harden. When firm enough to lift without breaking, the fossil is turned over and the bottom is then jacketed as well. When it is entirely dry the jacketed fossil is removed from the field.



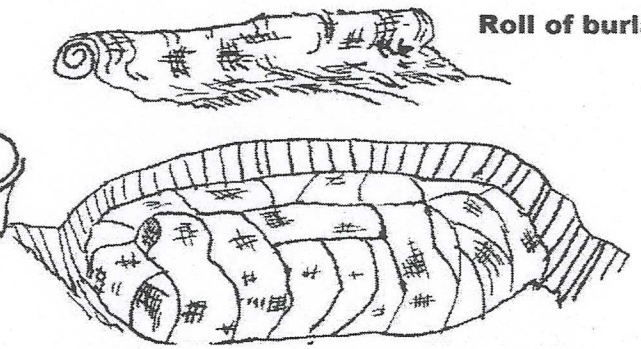
Step 1. The fossil is partially excavated.



Step 2. Damp toilet paper is applied.



Step 3. Plaster of Paris is mixed with water.



Step 4. The fossil is wrapped in burlap and plaster of Paris - ready for removal!

IT'S ALL RELATIVE

One way geologists date fossils is called "relative dating". Basically, this means that fossils found in deeper layers of rock are older than fossils found in shallower layers. Also, fossils found in the same layers are of the same age.

BASIC RULES OF RELATIVE AGE DATING

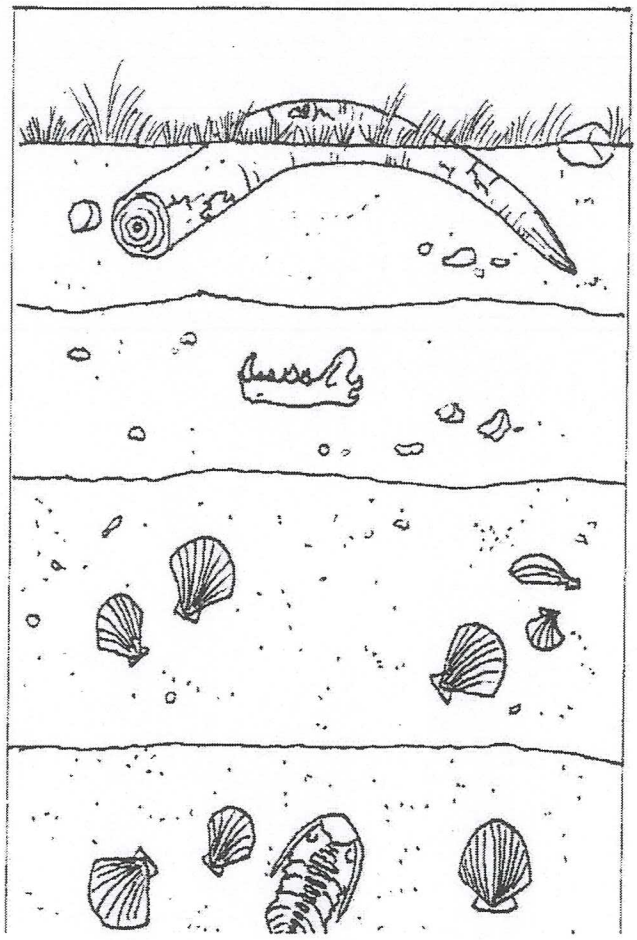
1. Sediments were originally laid down flat.
2. The oldest rocks are found on the bottom.
3. Fossils in the same layer are the same age.

Using the rock column below, compare the ages of the fossils and answer some questions.

Which is older: the mammal jaw or the sea shell?

Which is older: the trilobite or the mammoth tusk?

Which organism was around for the longest time?



TAPHONOMY

The life cycle of a fossil is called "Taphonomy". This refers to everything that happens to that bone (fossil) from the moment the animal dies until the time it is discovered again. By studying the taphonomy of a fossil we can tell if it was gnawed, trampled, rolled down a river, weathered in the sun, or hit by a bulldozer. All of these things tell a story.

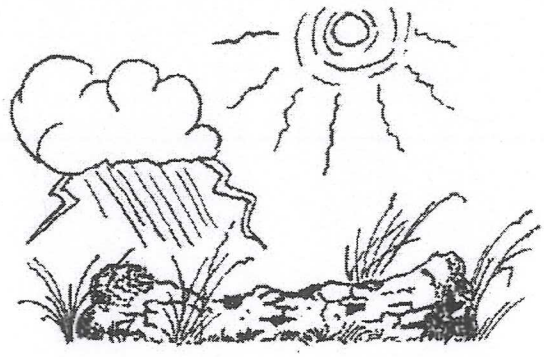
Most of the bones at the Fairmead Landfill are broken. Below are illustrations about what happened to many of the fossils that we find.

If a bone lays out in the fields the sun will cause it to crack and flake. We can tell that some of the bones were not buried until after they lay on the ground for several years.

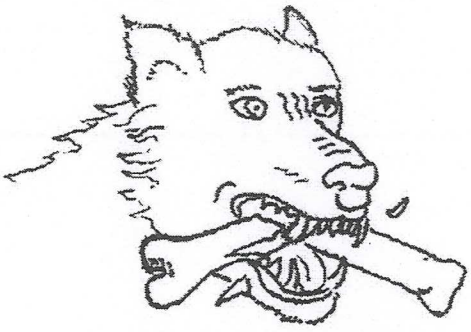
If it is gnawed by an animal it will have teeth marks. Some of the Fairmead fossils have very distinctive teeth marks. Carnivores are not the only animals to gnaw bones, but rodents also like to chew on bones for calcium.

Large, heavy animals like Columbian mammoths stepped on many of the bones and crushed them.

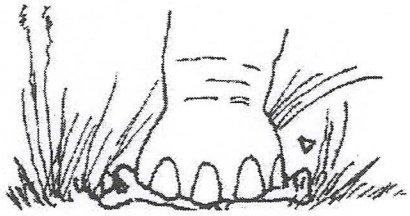
Last, but definitely not least, the heavy machinery that uncovers the bones will damage or completely destroy them.



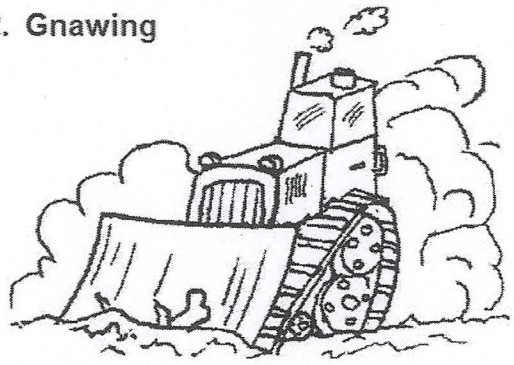
1. Weathering



2. Gnawing



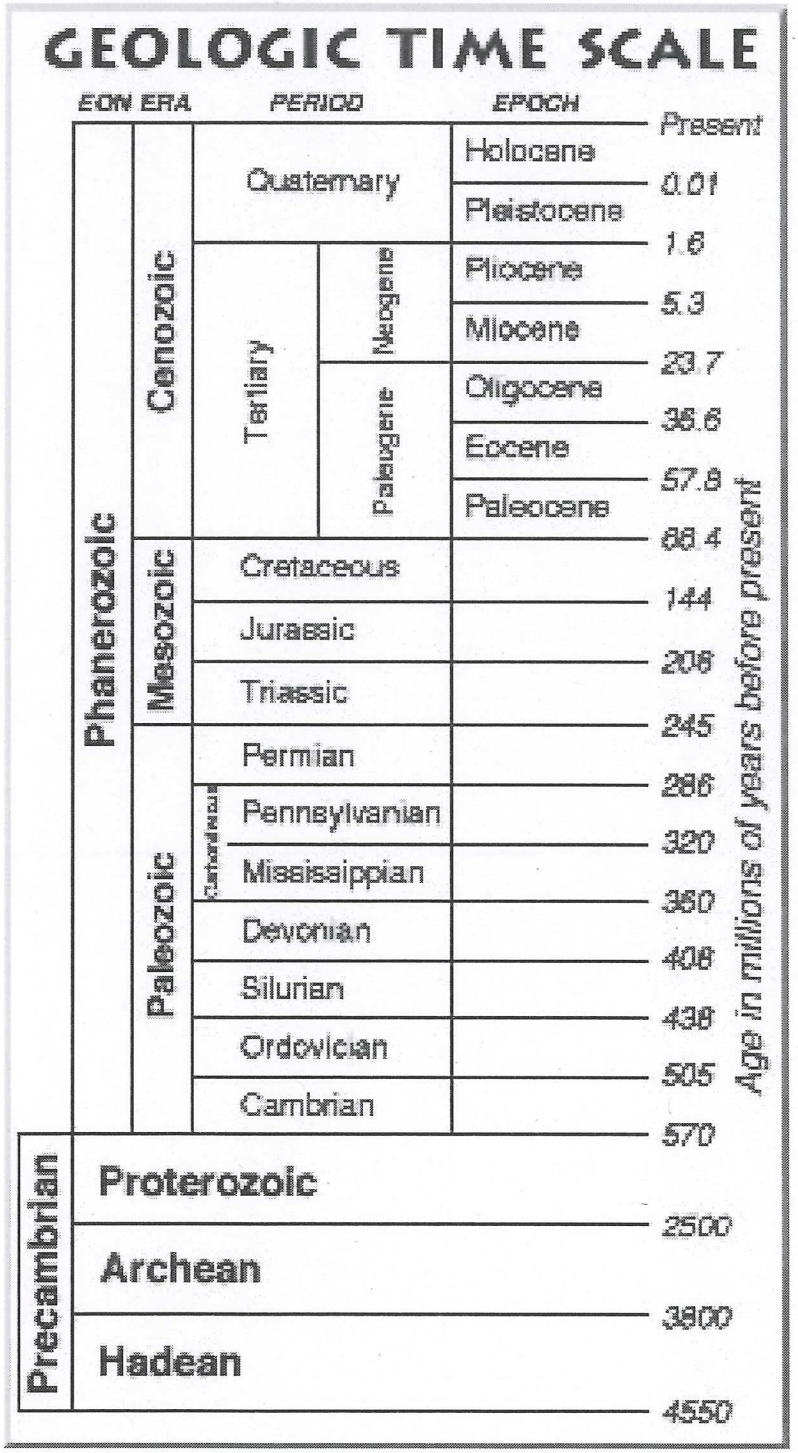
3. Trampling



4. Excavating

GEOLOGIC TIME SCALE

Below is a Geologic Time Scale. It shows the history of the earth including the Pleistocene as well as the time period we are currently living in called the Holocene. The word Pleistocene is derived from Greek and means “most new”. The word Holocene in Greek means “entirely new”.



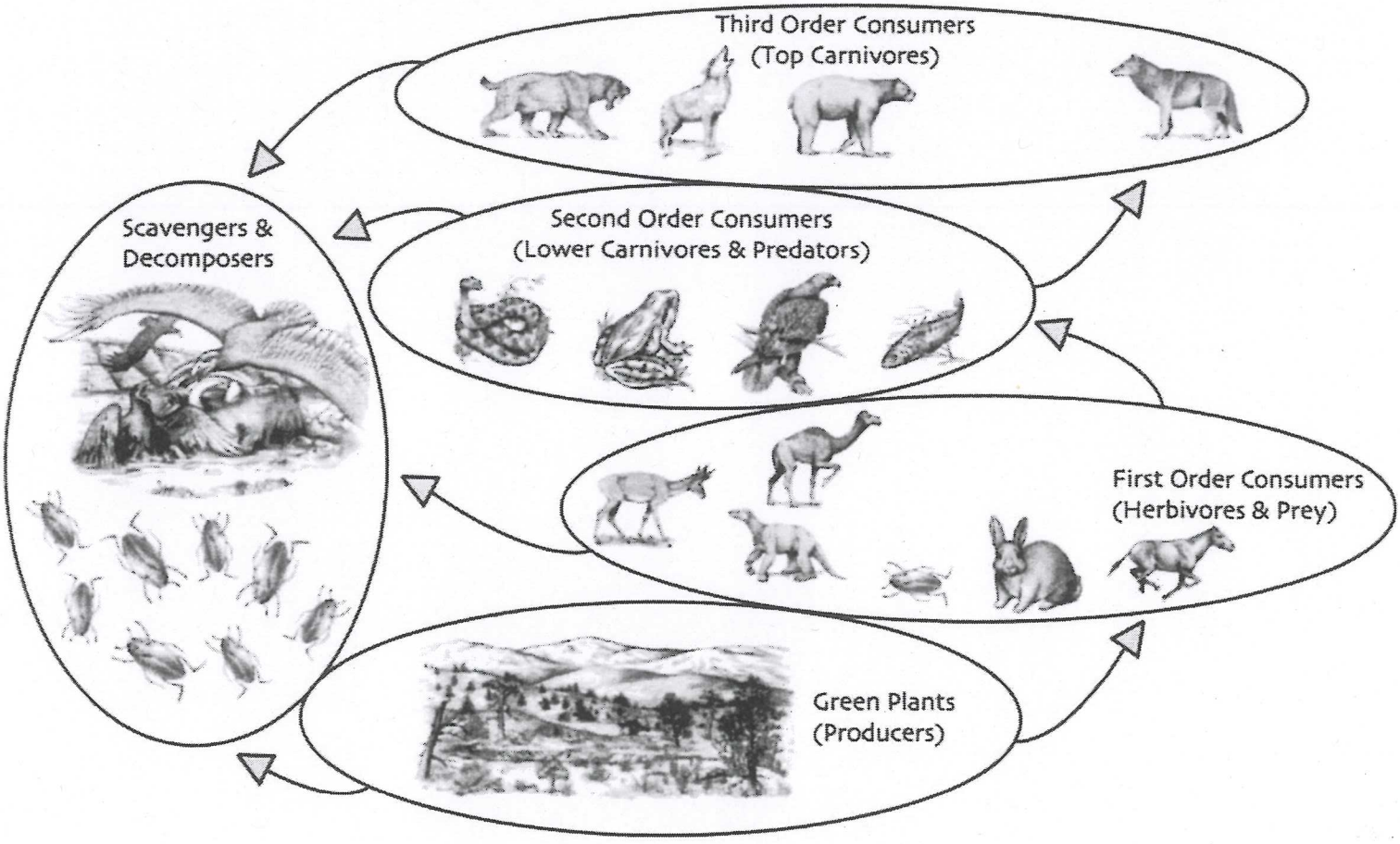
CLUES FROM THE PAST

Based upon the types of animals present, we know something about the environment of the Fairmead area. The most common animal bones found are those of horses which depend on grass for food. There were also numerous mammoths, and camels present which also ate grass. An adult Columbian mammoth would eat about 300 to 600 pounds of grass a day. Therefore the environment was probably mostly grasslands.

Ground sloths were herbivores as well. There were 3 different species of sloth, two of which ate grass and other soft plants (Harlan's and Wheatley's), as well as another (Shasta), which was more of a browser and fed on more woody material such as leafy stems. The browsers need shrubs and trees to eat so there were these types of plants present as well.

There were many different species of predators. There were 3 kinds of big cats (Saber-tooth cat, Scimitar cat, cheetah). There were also packs of Dire wolves as well as coyotes and short-faced bears. The wide variety of predators means there was plenty of game for them to eat. We can infer from this that there were large herds of herbivores to support the variety of carnivores.

Below is a food web based upon the fossils found at the Fairmead site. (courtesy of the George C. Page Museum.)



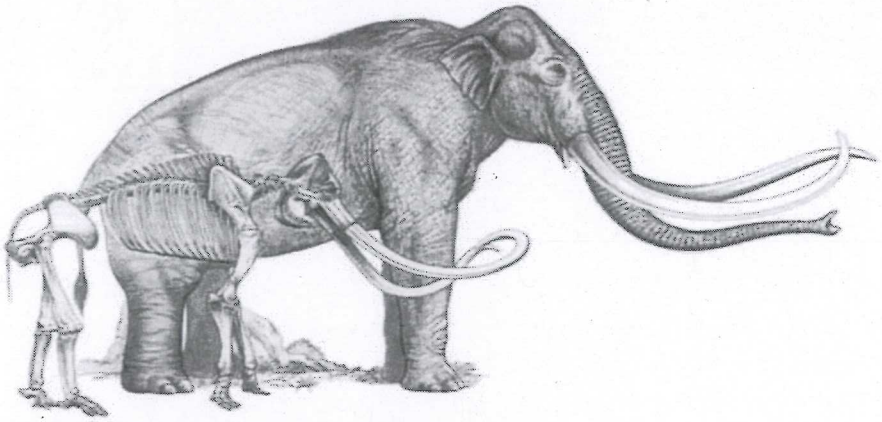
ANSWER PAGE

LOOKING FOR FOSSILS

Where would igneous rocks come from?	A. a volcano
Where would sedimentary rocks come from?	A. an ocean floor
Where would you find metamorphic rocks?	D. all of the above

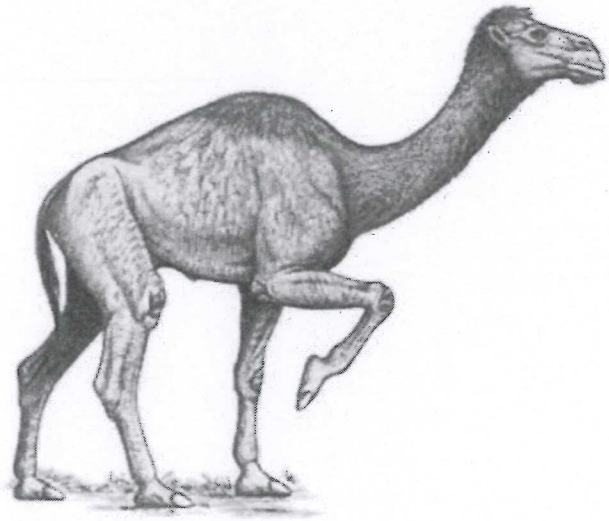
IT'S ALL RELATIVE

1. Shell
2. Trilobite
3. Shell

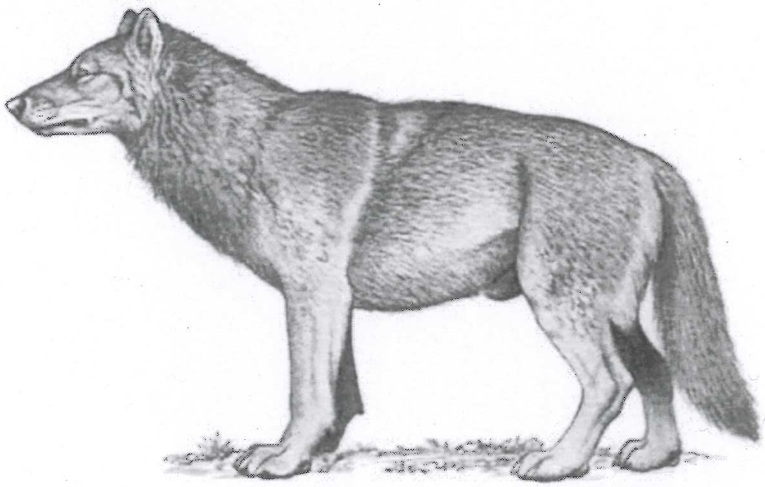


Columbian mammoth

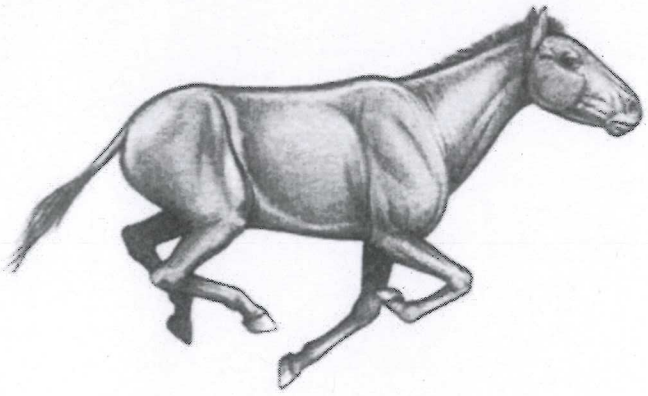
(with skeleton of a Woolly mammoth)



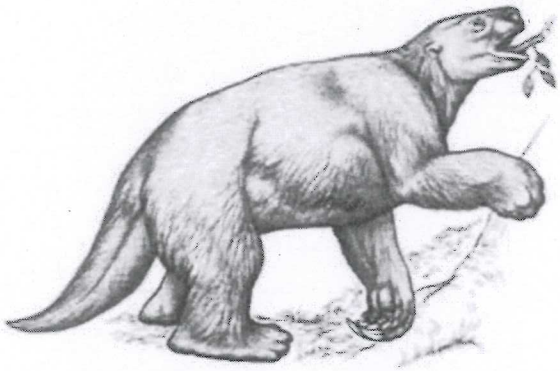
Western camel



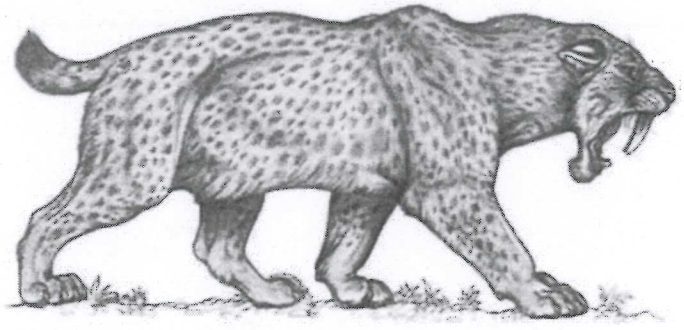
Dire wolf



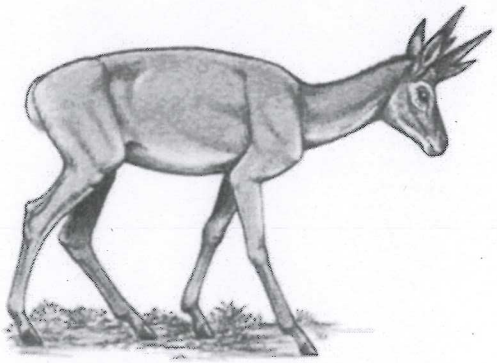
Western horse



Harlan's ground sloth

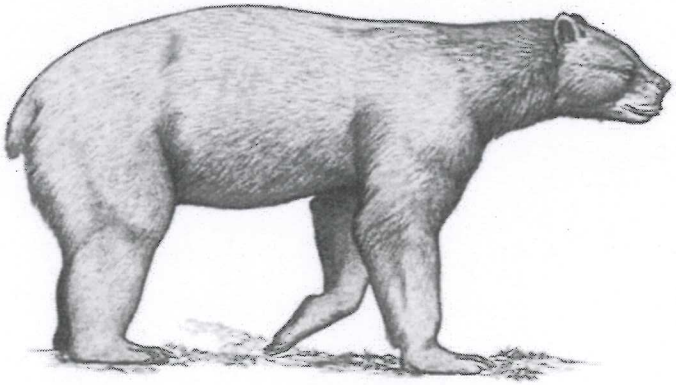


Saber-tooth cat



Dwarf pronghorn

Peccary



Short-faced bear

Last three pages of Pleistocene animal illustrations courtesy of the George C. Page Museum

DEFINITION OF TERMS

FOSSIL. Any evidence of past life such as bones, teeth, shell, wood, plants, or trace fossils.

TRACE FOSSIL. Indirect evidence of past life in the form of tracks, impressions, burrows, or other activities of living things. An impression of a leaf is a trace fossil.

PALEONTOLOGIST. A scientist who studies past life on earth by looking for and studying fossils of plants and animals.

ARCHAEOLOGIST. A scientist who studies evidence of past human activity.

PLEISTOCENE. The epoch of time that lasted from 1.8 million years ago until 10,000 years ago. Also known as the Ice Age. The Fairmead Fossils are from this epoch.

ICE AGE. Also known as the Pleistocene when much of the northern hemisphere was covered by snow and ice - 1.8 million years ago until 10,000 years ago.

HOLOCENE. The epoch that we live in now. It began when the Pleistocene or Ice Age ended about 10,000 years ago and is still continuing.

CARNIVORE. An animal such as a wolf that eats other animals.

HERBIVORE. An animal such as a horse that eats only plants.

OMNIVORE. An animal such as a bear that eats both plants as well as other animals.

SEDIMENTARY. A type of sediment or rock composed of small grains of other rocks in the form of sand, clay or silt that are deposited in layers. It is usually formed by water such as that found in rivers or lakes. Sandstone is a sedimentary rock.

IGNEOUS. A rock that is made from molten or melted rocks and minerals (usually beneath the earth's surface.) They may also spill out onto the surface from volcanos. Basalt is an igneous rock.

METAMORPHIC. A rock that has been altered or changed by heat, pressure, or both. Quartzite is a metamorphic rock.

ALLUVIAL FAN. A wide fan shaped deposit of water-transported material. They occur where a mountain stream or river quickly slows down when it reaches a valley and drops its sediment in a spreading fan shaped formation.

ROCK HAMMER. A hammer with a squared end and a pick or flat blade on the other. It is used to break open rocks or to dig with.

SHOVEL. A large digging tool used to uncover fossils or to move large amounts of dirt.

PICK. A larger two handed version of the rock hammer that is used to dig through hard soil or sediment.

TROWEL. A diamond shaped mason's trowel (not a garden trowel.) Used for digging or scraping away dirt from fossils. Archaeologists use these also.

JACKET. A protective layer placed around a fossil. A jacket is composed of a coarse, thin cloth called "burlap", plaster of Paris, and water.

DENTAL PICK. A small sharp metal tool used by dentists to clean teeth and also by paleontologists to slowly remove sediment from fossils. Used mostly in the laboratory.

PAINT BRUSH. A brush used by paleontologists to remove fine dirt and dust from a fossil.