Badlands

Lesson Plans

- Use with the **Badlands** module.
- Use with the **Badlands** worksheets.
- Appropriate for grades **Kindergarten** through **8**.

Created by the staff members of Badlands National Park

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* - These lessons are designed to be presented by Badlands staff members. If you are within 100 miles of the park, please contact us to find out staff member availability.

A Special Place

The National Park Service cares for special places saved by the American people so that all may experience our heritage.

Grade: Kindergarten
Length: 30 minutes

Lesson One

South Dakota Content Standards

♦ Kindergarten Writing: Students will create illustrations which represent information.

♦ Kindergarten Writing: Students will use pictures when telling a story.

Objectives

Recall, draw, and decribe a special place.

In this lesson, students identify their own special place. Please discuss with your students what makes places "special". Badlands National park is also a special place. The fossils, plants, and animals make this a special place that people like to visit.

Primary Theme

Studying and restoring the mixed grass prairie ecosystem and humans' relationship to it will help us understand the changing grassland ecology of the Midwest, and ensure the protection of this fragile and remarkably diverse ecosystem.

Materials

♦ Paper

♦ Pencil

♦ Crayons

Procedure

1. Talk about special places. Special places make us feel good! Everyone has a special place. This place may be where you go to play or have fun. It may be a house of a relative or friend. Usually it is a place where you feel nice and happy.

2. Have the students close their eyes and remember a time when they visited a special place.

3. Pass out paper and crayons. Ask the students to draw their special place.

4. Have each student share his or her picture with the class and describe his or her special place.

5. Badlands National Park is a special place - one that everyone can visit. Talk about some of the things we find at the Badlands. Also discuss some of the things we do not find at the Badlands - it is not a park like a zoo or playground. It is a park that is a natural area.

6. Post the special places around the room so everyone can see them first-hand.

Plants, Animals, And Fossils - Oh My!

Grade: Kindergarten
Length: 50 minutes

South Dakota Content Standards

♦ Kindergarten Life Science: Students will recognize similarities and differences in diverse species.

♦ Kindergarten Life Science: Students will compare size, shape, and structure of living things.

Primary Theme

Studying and restoring the mixed grass prairie ecosystem and humans' relationship to it will help us understand the changing grassland ecology of the Midwest, and ensure the protection of this fragile and remarkably diverse ecosystem.

Materials

♦ *Vanishing Vistas* poster

♦ Badlands National Park pictures

♦ Puzzles

♦ Fossil travel box

♦ Assortment of stuffed animals, pelts, and antlers

Procedure

1. Introduce Badlands National Park.

2. Hand out picture of Badlands National Park to each student. Ask what they see in the picture. You should get a variety of responses.

3. Show the *Vanishing Vistas* poster. Talk about prairie animals with the help of some of the props (stuffed animals, pelts, and antlers).

4. Arrange the students in small groups. Pass out puzzles for them to assemble.

5. After students complete the first puzzle, compliment them, and give them a few fossils to look at.

6. Distribute the Titanothere puzzles for the students to assemble.

7. Reiterate the important resources of Badlands National Park.

Color Of The Prairie

Grade: Kindergarten
Length: 20 minutes

South Dakota Content Standards

♦ Kindergarten Life Science: Students will recognize similarities and differences in diverse species.

♦ Kindergarten Life Science: Students will compare size, shape, and structure of living things.

Objectives

Name prairie animals.

Describe some characteristics of prairie animals.

Primary Theme

Studying and restoring the mixed grass prairie ecosystem and humans' relationship to it will help us understand the changing grassland ecology of the Midwest, and ensure the protection of this fragile and remarkably diverse ecosystem.

Materials

♦ Coloring Page (page 9 in this packet)

♦ Crayons

Procedure

1. Hand out the coloring sheets to the students.

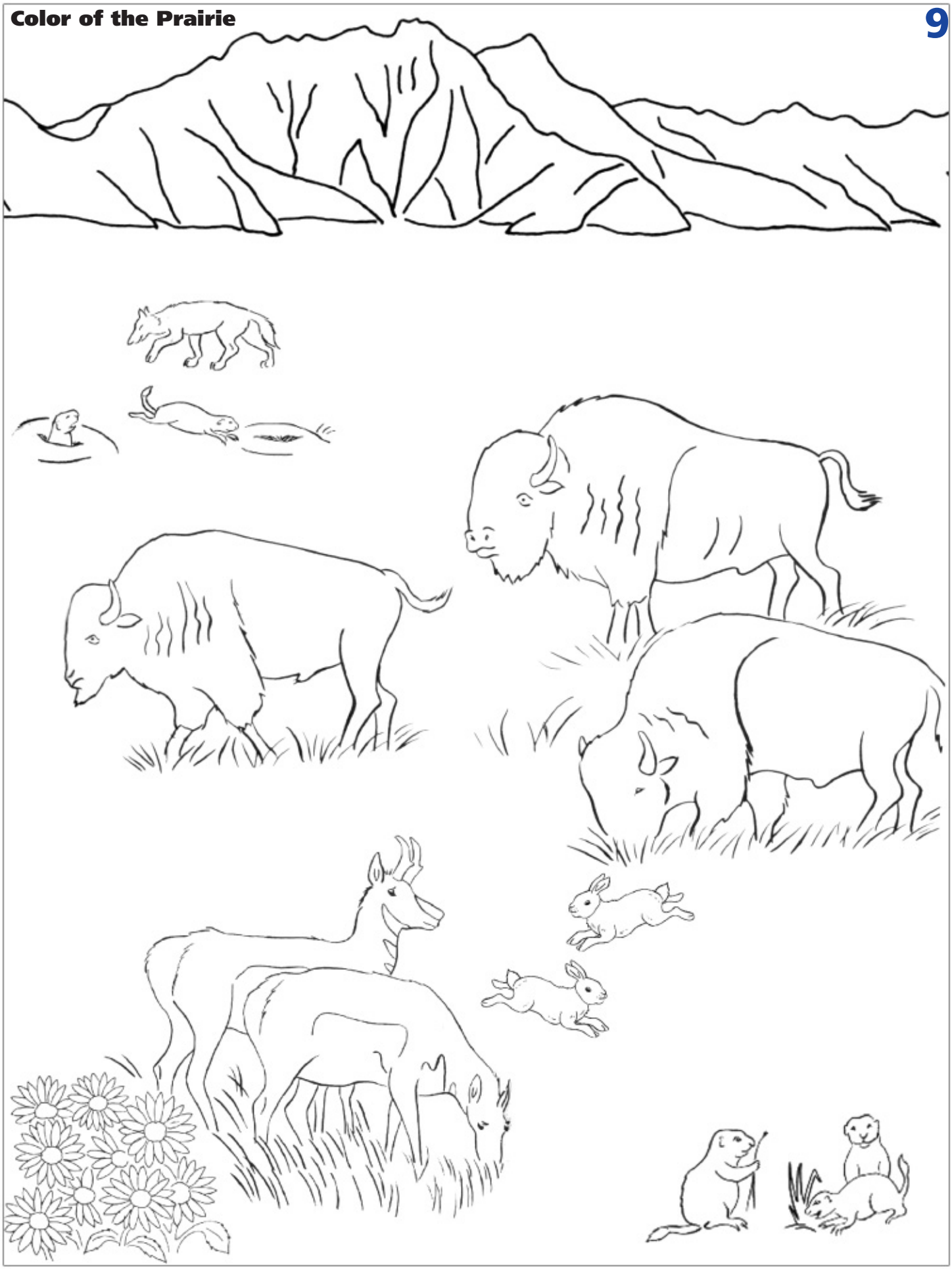
2. Have the students color the picture.

3. Ask the students questions about the prairie. Include specific questions about the animals shown in the picture.

Sample Questions
a. What animals live in the prairie?
b. What does the bison eat?
c. Where does the prairie dog live?
d. How does the bison stay warm in the winter?
e. Who else shown in the picture might live in where the prairie dogs do?
f. What types of plants might you find on the prairie?

Extension

Take a field trip to Badlands National Park or conduct a virtual visit with the *Views of the National Parks* program.



Everybody Needs A Home

Grades: 1 and 2
Length: 50 minutes

South Dakota Content Standards

- 1st Grade Life Science: Students will describe life needs of animals, including people (food, water, shelter, air).
- 1st Grade Life Science: Students will describe a variety of habitats.

- 2nd Grade Life Science: Students will compare plants and animals in their immediate surroundings with those in other habitats.
- 2nd Grade Life Science: Students will describe similarities and differences of animals.

Objectives

List several needs of animals, including people.

Describe the kinds of "homes" some common animals live in.

Primary Theme

Studying and restoring the mixed grass prairie ecosystem and humans' relationship to it will help us understand the changing grassland ecology of the Midwest, and ensure the protection of this fragile and remarkably diverse ecosystem.

Materials

- Paper
- Pencils
- Crayons

Background

Humans and other animals - including pets, farm animals, and wildlife - have some of the same basic needs. Every animal needs a home. But that home is not just a house like those in which people live. Home, for many animals, is a much bigger place and is outdoors. The scientific term for an animal's home is habitat. An animal's habitat includes food, water, shelter, and space. Because animals need the food, water, shelter and space to be available in a way that meets the animals' needs, we say that these things must be available in a suitable arrangement.

People build houses, apartments, trailers, houseboats, and other kinds of shelter in which to live. Animals need some kind of shelter also. The shelter might be underground, in a bush, in the bark of a tree, or in some rocks.

Procedure *(Adapted from Project WILD activity guide)*

1. Ask the students to draw a picture of their house. Alternatively, they can draw a picture of a friend's house. Ask the students to include pictures in their drawing of the things they need to live. For example, a place to cook and keep food, a place to sleep, a neighborhood.

2. Once the drawings are finished, have a discussion about the drawings. Ask the students to point out the things they need to live that they included in their drawings.

3. Make a "gallery of homes" out of the drawings. Point out to the students that everyone has a home.

4. Ask the students to close their eyes and imagine: a bird's home, an ant's home, a beaver's home, the President's home, and their own home. OPTIONAL: Show the students pictures of different places that animals live. Allow them to compare and contrast the animal homes.

5. Talk about the things every animal needs in its home: food, water, shelter, and space in which to live, arranged in a way that the animal can survive. Summerize the discussion by emphasizing that although the homes are different, every animal - personal pets, farm animals, and wildlife needs a home. Talk about the idea that a home in actually bigger than a house. In some ways, it is more like a neighborhood. For animals, we can call that neighborhood where all their survival needs are met a habitat.

OPTIONAL: Now have the students draw an animal house. Make sure they have seen some pictures of wild animal homes previously. Display these near the people home pictures.

Extensions

Take the students outside to look for animal homes. Be sure not to bother the animals, or the homes, in the process!

Additional Information

National Park Service - www.nps.gov
Information on all of America's National Parks. Includes a special section for students and teachers.

Views of the National Parks - www2.nature.nps.gov/views
Virtual experiences of national parks and knowledge centers on various natural resource themes.

Project WILD - www.projectwild.org
Project WILD activity guide book.

What Color Was I?

Grades: 1 and 2
Length: 20 minutes

South Dakota Content Standards

♦ 1st Grade Life Science: Describe various forms of information left by prehistoric animals and their habitats.

♦ 2nd Grade Life Science: Compare characteristics of extinct animals with those that are living today.

Primary Theme

The Badlands fossil and geological record reflects changing climates and the diversity of life; its study provides insight into the survival of species.

Background

Badlands National Park is well known for its excellent fossil record from "the golden age of mammals". This time in Earth's history occurred from 37 to 25 million years ago, and is called the Eocene and Oligocene Epochs. Dinosuars were extinct, but humans had not yet appeared. Some of these ancient mammals have familiar forms and some look quite strange to us. But, all mammals share the basic characteristics that make them mammals. In this lesson, students color pictures of these prehistoric mammals. These coloring will be referred to during the next lessons.

Materials

♦ Coloring page (page 15 in this packet)

♦ Crayons

Procedure

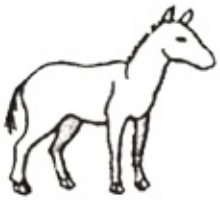
1. Make copies of the coloring sheets and hand out one to each student.

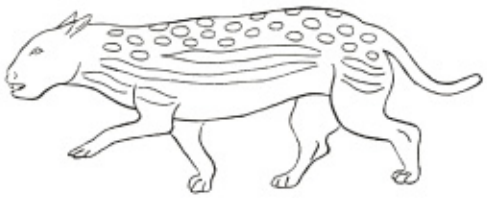
2. Have the students color the animals. Students should use the colors that they think the animals really were.

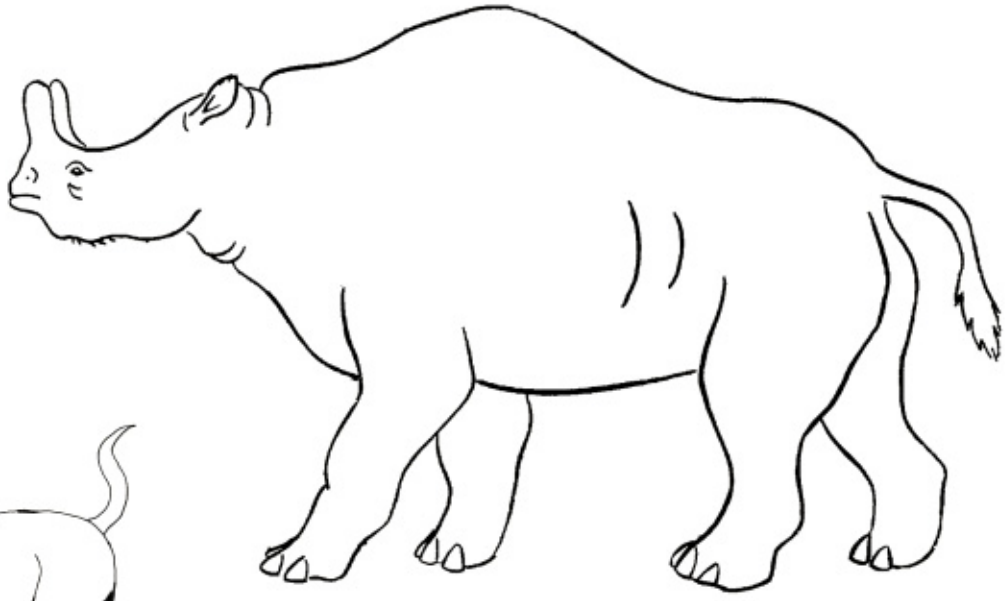
3. Post them around the room so everyone can see them.

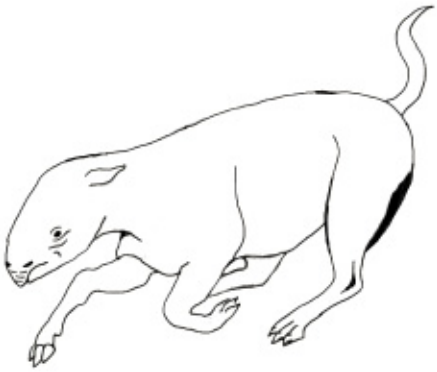
4. The prehistoric mammals found as fossils at Badlands will be discussed during the presentation of the next lessons.

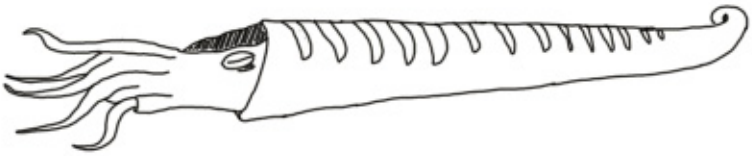
What Color Was I?











Animals In Their Habitat

lesson three

Grades: 1 and 2
Length: 50 minutes

South Dakota Content Standards

- 1st Grade Life Science: Students will describe life needs of animals, including people (food, water, shelter, air).
- 1st Grade Life Science: Students will describe a variety of habitats.

- 2nd Grade Life Science: Students will compare plants and animals in their immediate surroundings with those in other habitats.
- 2nd Grade Life Science: Students will describe similarities and differences of animals.

Primary Theme

Studying and restoring the mixed grass prairie ecosystem and humans' relationship to it will help us understand the changing grassland ecology of the Midwest, and ensure the protection of this fragile and remarkably diverse ecosystem.

Objectives

Define the components that make up a habitat (food, water, shelter, and space).

List some plants and animals that live on the mixed-grass prairie of South Dakota and some that do not.

Point out common animal characteristics that make them able to live in a prairie habitat (i.e. thick fur, camouflage, etc.)

Materials

- Prairie Poster
- Animal Postcards
- Animal Clues
- Animal Pictures
- Slide show
- "Habitat Relay" game

Procedure

1. Ask students, "What do people need to survive?" Write the list on the board.

2. When the words food, shelter, space, and water come up, circle these words. Lead them to these terms if they do not volunteer them.

3. Discuss and list on the board what pets need to survive. Circle the words food, shelter, space, and water when they say them again.

4. Discuss and list on the board what wildlife (animals that live on their own in nature) need to survive. Circle the words food, shelter, space, and water when they say them again.

5. Point out that all living animals need food, water, shelter, and space. That is called a habitat. Habitat is food, water, shelter, and space that a plant or animal needs to survive.

6. Have the students stand up and perform hand motions for each key word: hand over the stomach for food, hand over the mouth for water, hands over the head for shelter, and hands spread out for space.

7. Display the prairie poster. Focus the discussion on the prairie found with the park and seen in the poster. Talk about the importance of food, water, shelter, and space.

8. Using the animal cards, give clues about certain animals and see if the students can guess the correct animal. After the animal is guessed correctly, place the animal card on the prairie poster with velcro.

9. Alternative: Use the animal sounds from the CD as the clues. Use furs, antlers, horns, etc. for the students to handle.

10. When they have mastered this game, change the rules a little Tell them you are going to show them a picture of an animal and they have to tell you if it lives on the prairie or not. If the animal doesn't live on the prairie, then ask where the animal does live.

Habitat Relay

1. Explain the rules of the game.

2. Line the students up. Give each student a picture of an animal. Place one of each box at the head of the line and a large stack of animal pictures.

3. One at a time, the students will pick up the next animal picture and decide whether or not it lives in the prairie, place in into the appropriate box, then proceed to the end of the line.

4. At the conclusion of the activity draw a few animals out of the boxes and ask the students as a group whether it lives in the prairie habitat or not. Then, ask for reasons why it lives in the prairie or not.

5. Review the habitat. Many children like to chant: Food, Water, Shelter, Space, a Habitat, a Habitat!

Badlands National Park is a place where these animals can find a habitat to live in. Please visit Badlands National Park and the wonderful prairie habitat! You can also visit Badlands National Park virtually via the *Views of the National Parks* program.

Resources

Coffield, Tom. The Badlands Coloring Book. Chicken House Press, 1996. ISBN 0-9646577-1-6.

Project WILD activity guide book. www.projectwild.org.

Wallace, Marriane D. America's Prairies and Grasslandds: guide to plants and animals. Fulcrum Publishing, 2001. ISBN 1-55591-992-8.

Views of the National Parks - www2.nature.nps.gov/views
Virtual experiences of national parks and knowledge centers on various natural resource themes.

Get It Together!

Grades: 1 and 2
Length: 50 minutes

South Dakota Content Standards

♦ 1st Grade Life Science: Describe various forms of information left by prehistoric animals and their habitats.
♦ 1st Grade Life Science: Identify characteristics of plants and animals that allow them to live in specific environments.

♦ 2nd Grade Life Science: Compare characteristics of extinct animals with those that are living today.
♦ 2nd Grade Life Science: Explain reasons for the extinction of species.

Primary Theme

The Badlands fossil and geological record reflects changing climates and the diversity of life; its study provides insight into the survival of species.

Materials

- Fossils (choose wisely with objectives in mind)
- Floor puzzles
- Slides
- Projector
- Reconstructed pictures
- Modern animal pictures
- Tub
- Sediments
- Plastic Animal
- Bone
- Water

Kick-off

Focus student attention to the fossilized mammals found in the park by showing a few example fossils. You can do this by holding one and walking around the room or by setting a few fossils around the room. At some point, cover the fact that these are not dinosaurs; they are mammals, like us.

Demonstration

Discuss how fossils are formed as you conduct this demonstration. Put the little plastic animal in the clear tub. Ask, "What happens to an animal when it dies?" It decays, leaving behind the bones. "What happens to the bones?" Some animals chew on the bones, while others are dragged away.

Take out the animal and replace with a bone. In order to become a fossil, this bone has to be protected in some way. Cover the bone with sediments and sprinkle with water. Now if we let it sit for a long, long time (like millions of years) we have a fossil like this one (put out another fossil). Now we are going to discover all the cool things people have learned about extinct Badlands animals by studying their fossils.

Slide Show (see script suggestions on page 22)

Interactive slide show of Badlands today, fossils, and reconstructed pictures of fossilized animals. Compare fossilized animals to familiar animals of today by asking students, "What kind of modern-day animal does this look like?"

Activity

Puzzle activity. Separate the students into groups and spread them throughout the room, with floor or desk space for each group. Make sure to leave a large space in the middle of the group and enough space between groups. Hand each group a fossil and a puzzle. Ask groups to complete the puzzles and look at the real fossil. As the groups are working, visit each group and ask the students to describe what they notice about their fossil and puzzle. Also, give them a picture of what the animal might have looked like with muscles, skin, and hair/fur. Let the groups pass fossils back and forth if time and interest allow.

OPTIONAL Activity (if time allows)
Drawing and inference. Students choose a fossil and draw a detailed reconstruction of what they think the animal looked like.

Conclusion

Conclude the presentation by emphasizing that many fossils of mammals are found in Badlands National Park. Tell them how special the Badlands are because there are lots and lots of fossils that scientists can study and people can enjoy.

Additional Information

National Park Service - www.nps.gov
Information on all of America's National Parks. Includes a special section for students and teachers.

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National Park Service Web Rangers - www.nps.gov/webrangers
Kids can become Junior Rangers from their home or school.

Suggested Slide Show Script **(for the Slide Show on page 20)**
Fossils tell us information about extinct animals. Remember, a slide show script is just a guideline. You, as the presenter, still must decide on yout own approach. The slide show should last 10 to 15 minutes.

Image	Description
1008	Badlands
30	Badlands
1253	Badlands / Grass
849	Badlands
5289	Fossil in-situ with hand
642	Field Paleontologist
5766	Field Paleontologist

Badlands National park is a cool place to visit. People from all over the world travel to South Dakota to see this amazing place. Some people even think it looks like the surface of the moon! But do they realize that as they walk along, their feet are crunching over ancient treasures? These lost treaures are fossils from animals that lived a long, long time ago. Paleontologists (people that study fossils) have found many wonderful fossils in the Badlands. But these fossils are NOT from dinosaurs. They are from other types of animals.

Main point
During this slide show, we are going to discover what these fossils can tell us about prehistoric animals that lived after the dinosaurs went extinct.

Image	Description
1417	Fossilized fish
1412	Fossilized leaf
1442	Fossilized teeth
6130	Jaw
1319	Mesohippus running
5407	Modern horses
1352	Mesohippus herd
1353	Saber-tooth cat leap

What type of animal do you think left this fossil? Right! A fish. Sometimes we can tell right away what a prehistoric animal was like by comparing it to modern animals we know. Not all fossils are of animals! That's right, this is a leaf, from a plant. What do you think this animal might have looked like? Well, it had teeth, and they were flat, and the jaw looks like this. This is a drawing of what this animal looked like. Does it remind you of any animals that are alive today? Modern horses are familiar to us. They are about this big and have

hoofs. Well, the prehistoric horse that left fossils behind was only this big! And, they didn't have one hoof, they had three smaller hoofs like this! (Have students put three fingers together on their desks - if you say "toes" they might think of toes like their own). These prehistoric animals lived in a different environment. Some animals, like the mesohippus horse and this saber-toothed cat, are extinct, but some modern animals remind us of what they might have looked like and what they might have done.

Image	**Description**
4558	Modern turtle
4679	Fossil turtle

Have you ever seen an animal like this? You have? What in the world is it? I haven't ever seen anything like it. Oh. Of course, a turtle! Well, how about a fossil like this? An ancient turtle. Actually, it was a tortoise, which means it lived on dry land.

Image	**Description**
5736	Fossil bones in-situ
1365	Archaeotherium skeleton
1338V	Reconstructed picture of archaeotherium

Wow! This is a mystery! What could it be? Let's see, if we put the skeleton all together like this... Ahhh, here we go... Okay, and now let's add some skin and hair. Now what does it look like? A pig! Wow, I bet this animal would eat anything! It was actually a lot bigger than pigs today.

Image	**Description**
3665	Deer
3797	Modern deer

And here is another picture that paleontologists made to help us understand what these prehistoric animals might have looked like. What animals do they look like? Do you think they look like these modern animals? Yes, they were actually prehistoric deer.

Image	**Description**
3920	Snail in-situ
4554	Ammonite in-situ
1304	Reconstructed picture of an anmmonite
1303	Sea

Here are some unusual animals for South Dakota! Do they remind you of anything? This ammonite is sort of like a clam (well, it's a

mollusk anyway, and kids from South Dakota aren't real familiar with mollusks). We find this fossil in the Badlands, so at one time (really long ago) there was a sea here.

Image	Description
1524	Badlands
5012	Badlands
1428	Fossil teeth
6642	Ancient world

Maybe someday you will go visit Badlands National Park. And as you walk around, look down at your feet because you might be walking past something like this - a fossil which can give us clues about the animals that lived so long ago here. Some of them look familiar and remind us of modern animals, and some look very strange and we have to imagine what they might have looked like. What animals do you see in this picture?

Prairie Mural

Grades: 1 and 2
Length: 30 minutes

South Dakota Content Standards

♦ 1st Grade Life Science: Students will describe life needs of animals, including people (food, water, shelter, air).
♦ 1st Grade Life Science: Students will describe a variety of habitats.

♦ 2nd Grade Life Science: Students will compare plants and animals in their immediate surroundings with those in other habitats.
♦ 2nd Grade Life Science: Students will describe similarities and differences of animals.

Primary Theme

Studying and restoring the mixed grass prairie ecosystem and humans' relationship to it will help us understand the changing grassland ecology of the Midwest, and ensure the protection of this fragile and remarkably diverse ecosystem.

Background

During the "Animals In Their Habitat" lesson students identified many animals that live in the prairie habitat. This follow-up activity will reinforce the concept that "the prairie is a home for many special plants and animals". Additionally, by creating a prairie mural, students will begin to explore the relationships among the various organisms within a habitat.

Materials

♦ Paper

♦ Pencils

♦ Crayons

♦ Books about the prairie

♦ Bulletin board space

Procedure

1. On a classroom bulletin board, post a title that reads "The South Dakota Prairie".

2. Have the students list some of the plants and animals that live on the prairie. Encourage them to choose diverse species. Insects, amphibians, reptiles, birds, mammals, grasses, flowers, and trees all find homes on the prairie.

3. Hand out materials. Have each student cut their paper in half. On one piece draw and color a prairie plant. On the other piece draw and color a prairie animal. All of the pictures will be combined to create a prairie mural.

4. Have students add their pictures to the bulletin board. Allow some students to tell the class about their pictures.

5. Remind the students that all of these animals live on the prairie. They find food and shelter on the prairie to survive. Introduce food webs by asking "What does a coyote eat?" and the pointing to an animal a coyote might eat. Add more questions.

Extension

Leave your prairie mural posted in the classroom. Over the next few days, continue to ask questions about the mural and point out different relationships. By completing this lesson, students will begin to see the prairie as a community of interdependent plants and animals.

Additional Information

National Park Service - www.nps.gov
Information on all of America's National Parks. Includes a special section for students and teachers.

Views of the National Parks - www2.nature.nps.gov/views
Virtual experiences of national parks and knowledge centers on various natural resource themes.

National Park Service Web Rangers - www.nps.gov/webrangers
Kids can become Junior Rangers from their home or school.

Prehistoric Memory

Grades: 1 and 2
Length: 20 minutes

South Dakota Content Standards

♦ 1st Grade Life Science: Describe various forms of information left by prehistoric animals and their habitats.
♦ 1st Grade Life Science: Identify characteristics of plants and animals that allow them to live in specific environments.

♦ 2nd Grade Life Science: Compare characteristics of extinct animals with those that are living today.
♦ 2nd Grade Life Science: Explain reasons for the extinction of species.

Primary Theme

The Badlands fossil and geological record reflects changing climates and the diversity of life; its study provides insight into the survival of species.

Vocabulary

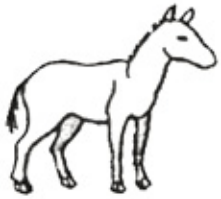
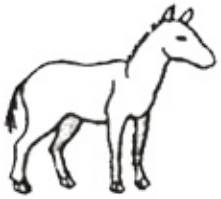
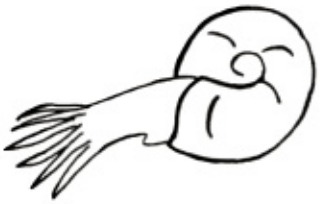
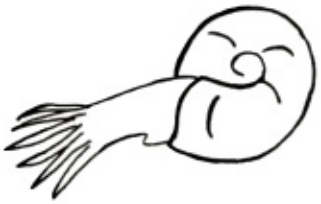
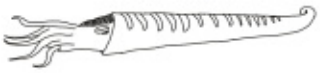
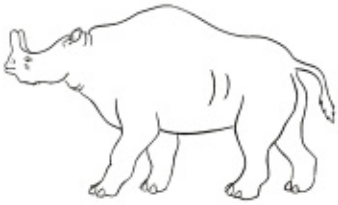
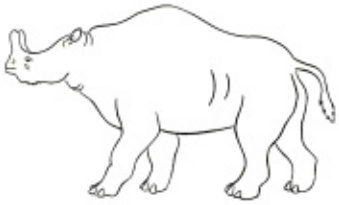
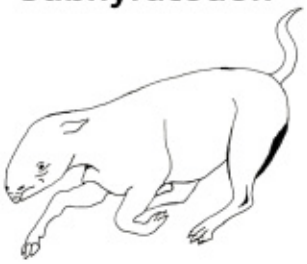
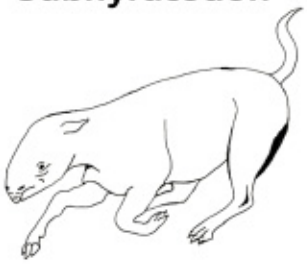
Archaeotherium (Big pig), Ammonite, Baculite, Brontotherium, Mesohippus, Oreodont, Saber-toothed Cat, and Subhyracodon.

Materials

♦ Memory cards

Procedures

1. Copy sets of the memory cards for each pair of students.
2. Have students color and cut out the cards.
3. Pair up students and play.
    a. All cards are placed face-down.
    b. Students take turns flipping over two cards.
    c. If the cards match, they get to keep them.
    d. If not, they are flipped back over.
    e. The winner is the one who collects the most cards.

Mesohippus 	Mesohippus 	Ammonite 	Ammonite 
Oreodont	Oreodont	Baculite	Baculite 
Saber-toothed Cat	Saber-toothed Cat	Brontotherium 	Brontotherium 
Subhyracodon 	Subhyracodon 	Archaeotherium	Archaeotherium

Food Chain Canopy

Grades: 3 and 4
Length: 60 minutes

Objectives

Describe and construct a simple food chain.

Recognize the different feeding relationships within the food web.

Background

This lesson can be used as preparation or reinforcement to other Badlands lessons. During subsequest lessons, attention will be given to the importance of food chains and the overall interconnectedness of the food web. Examples will be used of the plants and animals that live in Badlands National Park and the surrounding mixed-grass prairie ecosystem. Each living thing has survival needs. Plants need the energy of the sun and water to grow. Plant-eaters need the plants. Animal-eaters need the plant-eaters. Age-appropriate vocabulary and pictures will be used to teach these important concepts. Badlands National Park is a place that American people have set aside in order to preserve a place where these plants and animals can live undisturbed by human encroachment.

Modifications

Food chains can be limited to only two or three links.

Vocabulary (carnivore, herbivore, omnivore, food chains, food webs) can be introduced.

Materials

- Construction paper
- Scissors
- Glue or tape
- Pictures of animals, plants, people and food

Procedures

1. Review with students that all animals must eat food to stay alive. We eat food, are we animals? Ask everyone to think of his or her favorite food. Go around the room and have each student share their favorite food. Note certain ingredients as the students list food. For example, if a student says pizza, you might write cheese, flour, and/or tomatoes on the board.

2. Your list should illustrate that animals need plants and other animals to survive.

3. Cut strips of colored construction paper, one color for each category: GREEN = plants, BLUE = plant-eaters, RED = meat-eaters, and BROWN = decomposers. Have students cut out pictures of draw them on the strips to indicate which strip represents which type of organism.

4. Let the students link the strips into food chains. Examples are:

Grass	--->	Prairie Dog	--->	Eagle
Trees	--->	Porcupine	--->	Coyote
Plants	--->	Mule Deer	--->	Bobcat
Seeds	--->	Chicken	--->	Human
Grass	--->	Grasshopper	--->	Squirrel

5. When these are completed, make a larger ring out of yellow construction paper. This represents the sun. Ask everyone if they think the sun needs to be added to the chains (yes).

6. Have the students link their chains to the big sun link. Display them in your classroom, perhaps from the ceiling.

7. When finished, ask the students what would happen if they cut one of the links. Ask them how the loss of grass would effect a meat-eater, even though it doesn't necessarily eat grass. This should demonstrate how each link is necessary to the chain. Cut one that you made to illustrate.

Resources

Earth Child 2000 by Kathryn Sheehan and Mary Waidner

Badlands National Park (www.nps.gov/badl/exp/home.htm)

Badlands Fossil News

Grades: 3 and 4
Length: 30 minutes

South Dakota Content Standards

♦ 3rd Grade Life Science: Students will describe how species depend on one another and on the environment for survival.
♦ 3rdGrade Life Science: Students will explain reasons for the extinction of species.

♦ 4th Grade Life Science: Students will examine how the fossil record, which has occurred over time, provides evidence of change in organisms.
♦ 4th Grade Life Science: Students will describe behavioral and structural adaptations plants and animals have to survive in a given environment.

Primary Theme

The Badlands fossil and geological record reflects changing climates and the diversity of life; its study provides insight into the survival of species.

Objectives

List three prehistoric animals, besides dinosaurs.

Describe two differences between modern and prehistoric horses.

Discuss that the fossilized mammals found in Badlands National Park lived **after** the dinosaurs went extinct.

Materials

♦ "Badlands Fossil Story News" article (page 33 in this packet)

Background

This lesson introduces students to prehistoric animals of Badlands National Park. No dinosaurs roamed here! At the time of the dinosuars, this region was under water. The sea retreated, dinosaurs went extinct, and a diverse variety of prehistoric MAMMALS roamed the land. The attached article highlights some of the more common fossils found within the White River Badlands of South Dakota. Also, it highlights some of the major climate and environmental changes that occurred. Please prepare your students for the *Time Travel lesson* by reading and discussing the article.

Procedure

1. Hand out a copy of the article to every student.

2. Ask the students to read the article OR read it aloud to them.

3. Lead a discussion about the article.

4. Ask the students to write down any questions they may have about the article or prehistoric mammal life for the following lessons.

Resources

Dickinson, Alice. "The First Book of Prehistoric Animals." Franklin Watts, Inc. 1954.

Duggleby, John. "The Sabertooth Cat." Macmillan Publishing Company, 1989. ISBN 0-89686-462-6.

National Geographic Society. "Giants From the Past." 1983. ISBN 0-87044-424-7.

Additional Information

National Park Service - www.nps.gov
Information on all of America's National Parks. Includes a special section for students and teachers.

Views of the National Parks - www2.nature.nps.gov/views
Virtual experiences of national parks and knowledge centers on various natural resource themes.

National Park Service Web Rangers - www.nps.gov/webrangers
Kids can become Junior Rangers from their home or school.

Badlands Fossil Story News

Pre-Historic Life Besides Dinosaurs?!

Millions of years ago, the land you live on did not look like it does today. There were no humans living then, and even the environment looked different. During the time of the dinosaurs, most of what is now South Dakota was covered by a great inland sea. Eventually the waters of the sea drained away and animals started to move into the area. What sorts of animals do you think lived in this area of South Dakota? Let's explore some of the different types of animals who's fossils we find at Badlands National Park!

THE LARGE MAMMALS ARRIVE

Dinosaurs disappeared 65 million years ago, and an amazing variety of mammals appeared in their place. The areas where dinosaurs had lived gradually changed, and so did the kinds of animals that lived there. Swampy lowlands became grassy highlands. In time, huge herds of giant four-legged animals grazed. Saber-toothed cats hunted the grazers. After millions of years, the parade of giant beasts gradually ended. Perhaps the climate became too cold. Perhaps food became scarce. Perhaps too many animals crowded certain areas. Perhaps

humans hunted some mammals into extinction. Scientists are not certain why so many of the giant mammals disappeared. But by the time humans had settled much of the world, 10,000 years ago, almost all the giants were gone.

A BIG PIG

The prehistoric piglike animals on this page grew as big as cows. They lived in North America and Asia between 40 million and 15 million years ago. "They were not the cuddly, three-little-pigs kind of animal you see today," says Dr. Michael R. Voorhies. "They had big heads and long legs, and they were not really pigs."

They looked so much like pigs, however, that the name for one of them is *Dinohyus* (die-nuh-HIGH-us). This means "powerful pig." *Dinohyus* could run fast, but did not depend on speed to attack its prey. In fact, it probably ate the meat of dead animals, rather than killing live prey. It also ate nuts and fruit. "It probably used its long legs to get from one feeding spot to another," says Dr. Voorhies. "It had to cover a lot of ground."

"The large head of *Dinohyus* and its relatives contained a good-size brain. The powerful pig was not as clever as a monkey, but its brain was good enough to keep it going for 25 million years. *Dinohyus* was the last and largest of the giant pigs." Today's pigs, even the wild boars of Europe and Asia, are only distantly related to the early giants. Wild boars found in scattered places in the United States are descended from animals brought to North America from Europe.

HORSES HOW SMALL??

At the dawning of the Age of Mammals, a small horselike animal lived in North America. It was only a foot tall, about the size of a fox terrier. It was so small that one of its enemies might have been a giant bird. The little horselike mammal had four toes on its wide front feet and three toes on its back feet. It padded along the soft ground. North America was warmer then. Forests covered most of the land. Grass was just beginning to appear. The little animal ate leaves from shrubs and small trees. It had a short snout shaped somewhat like that of a dog.

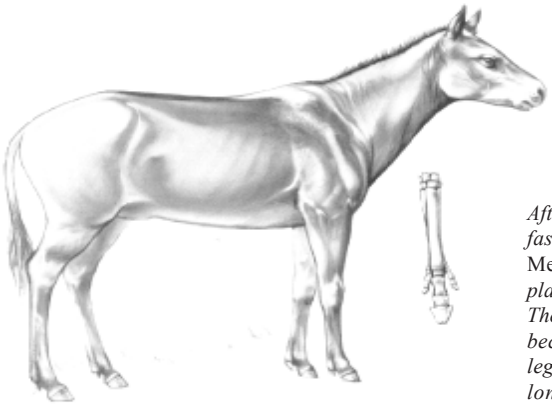
Some scientists call this first known horselike animal *Hyracotherium* (hy-rack-uh-THIH- ree-um). Others call it *Eohippus* (ee-uh-HIP-us) which means "dawn horse." Herds of *Eohippus* probably browsed on gentle slopes where the Rocky Mountains were beginning to rise.

Fossils of this horse have been found in the Rockies, Badlands National Park and in many other places. The fossils help scientists picture how *Eohippus* looked. Over many millions of years, the ancient horses gradually changed, becoming larger and more like the horses of today.

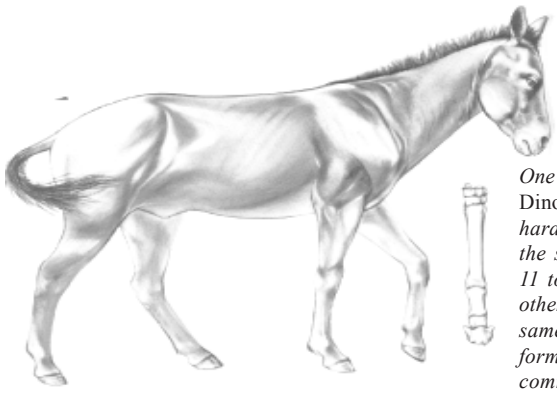
Information adapted from "Giants from the Past." Books for World Explorers, National Geographic Society. 1983.

Forest-dwelling Eohippus *stood only 12 inches tall. It was the first known ancestor of today's horse. The small mammal had four toes on its front feet and three on it back feet. Eohippus lived about 55-51 million years ago.*

An ancient horse named Mesohippus *lived fromabout 38 million to 26 million years ago. Ift grazed in open areas. This horse stood about 2 feet tall at the shoulder. It had only three toes on its front feet. Side toes were not used in running on the hard, grass-covered land where* Mesohippus *lived. It could run faster and farther without the little side toes* Eohippus *had. Hard running had become the horse's way of life.*



After still another 20 million years, a faster running horse called Merychippus *appeared on the plains. It used only its middle toe. The other two toes on each front foot became smaller and smaller. The legs of the horse gradually became longer*



One of the first one-toed horses, Dinohippus *ran especially well on hard ground. It stood 47 inches at the shoulder.* Dinohippus *lived from 11 to 2 million years ago. Many other kinds of horses lived at teh same time. Scientists think some form of* Dinohippus *was the common ancestor of today's horses, zebras, and donkeys.*

Time Travel

Grades: 3 and 4
Length: 50 minutes

South Dakota Content Standards

♦ 3rd Grade Life Science: Students will describe how species depend on one another and on the environment for survival.
♦ 3rd Grade Life Science: Students will explain reasons for the extinction of species.

♦ 4th Grade Life Science: Students will examine how the fossil record, which has occurred over time, provides evidence of change in organisms.
♦ 4th Grade Life Science: Students will describe behavioral and structural adaptations plants and animals have to survive in a given environment.

Primary Theme

The Badlands fossil and geological record reflects changing climates and the diversity of life; its study provides insight into the survival of species.

Objectives

Match fossilized animals to the three ancient environments in which they lived.

Identify Badlands National Park as a place that preserves fossils.

Materials

♦ Poster-sized pictures of the four Badlands environments (Modern Day Prairie, Western Interior Sea, Tropical Rainforest, and Oligocene Flood Plain)
♦ Props to match the posters (buffalo hair, deer antlers, coyote fur, baculite, ammonite, clam shell, titanothere, alligator, mesohippus, oreodont, saber-toothed cat, etc.)
♦ Slides and slide show (suggested script on page 37 in this packet)
♦ Pictures of reconstructed animals

Kick-off

Begin by prompting the students, "Paleontologists start with good observations, so I am going to ask you to make some important observations." Divide into teams of 3 or 4 students. Make sure there is table space between them. Place a variety of fossils on each table. Also put out something that is representative of the modern-day environment. Give the students time to make observations. Circulate through the groups encouraging to compare and contrast different fossils/props. Ask questions like, "Which do you think is fom a modern animal and which do you think is from an ancient animal?", "How did you know?", "What kind of environment do you think this animal lived in and why?", "What did this animal eat?", and "How do you know?"

Lead Discussion With Slide Show (suggested script on page 37)

Ask the students what they noticed about their fossils and/or animals parts. Differentiate between mammals and dinosaurs. Make a chart on the board if necessary. The slide show should compliment your theme - it is not simply a show and tell. Focus on how the animals were adapted to their different environments and what happened as the environment changed. Use the time travel idea by starting with the modern prairie and working backwards. This will support the next activity.

Activity

Arrange the environment posters chronologically along a "Walk Through Time." Say, "This first stop is at the modern prairie environment. Does anyone have something from an animal that lives here now?"Depending on your group management tactics, either choose a student to pull their prop on by the proper poster or collect the prop and place it yourself. Continue for each poster. Give students a chance to get up and go on the "Walk Through Time."

Test Their Knowledge

Have students close their eyes while you move a prop out of order. Model it once or twice, and then call on a student to move the prop back to the correct area. Or, show additional props/pictures of animals or plants and add them to the environment with help from the students.

Conclusion

Resource message: We call people who steal fossils "Thieves of Time." Each time a fossil is stolen, we lose information about that animal.

Suggested Slide Show Script

The Badlands of today are really neat - how would you like to climb through these rugged peaks? However, Badlands is not just these steep, mountain-like formations. There is a grassland, or prairie, environment that lots of plants and animals live in. These animals are pretty familiar to us and we love to watch the deer and the antelope roam across the prairie of today. These animals fit with the prairie - they are adapted to live here. For example, buffalo eat grass, have thick fur, and move around in herds. That works great on the prairie because there is plenty of grass and it is cold most of the year. Do you think a buffalo would live to live in the desert or a tropical rainforest? That is because all animals are adapted to live in a particular environment. Prairie dogs dig burrows and live underground - this is great for the prairie because there are no trees to live in, so they dig. Predators like coyotes and what else (bobcats, hawks, and badgers) also make a home here because they have what it takes to live in this environment.

Within these Badlands formations we were just talking about are clues to a time when these familiar animals did not live here. It was a strange and different world from what we see today. How do we know about this mystery world? We study evidence left behind from millions of years ago to figure out what it was like.

Now get ready and put on your seltbelt - we are about to take a wild ride back through time!

If we travel back in our imaginations 30 to 34 million years ago, then we would noticed things were quite different. The first thing you might notice is there are NO humans. Also, remember, the dinosaurs had already gone extinct. So right now we are in a time after dinosaurs and before people. Let's explore! What do you see? Right, there is a lot of grass and that is like today, but do you notice the trees? Trees need more water than grass to survive, so what does that tell you about this time? Yes, there was more water - rain and rivers. Now, what happened to these animals and this environment? Well, the climate was changing, as less and less rain fell, the trees died and were replaced by new grasses. Some of these animals couldn't survive in the new environment, so they went extinct.

Let's travel further back in time! What does this look like? Wow, if we go even further back in time, to say 35 to 37 million years ago, we see the environment was even wetter and warmer, like a tropical rainforest. Do any of these animals look familiar? Can you imagine alligators living in South Dakota today? No way, because the environment is not right for alligators.

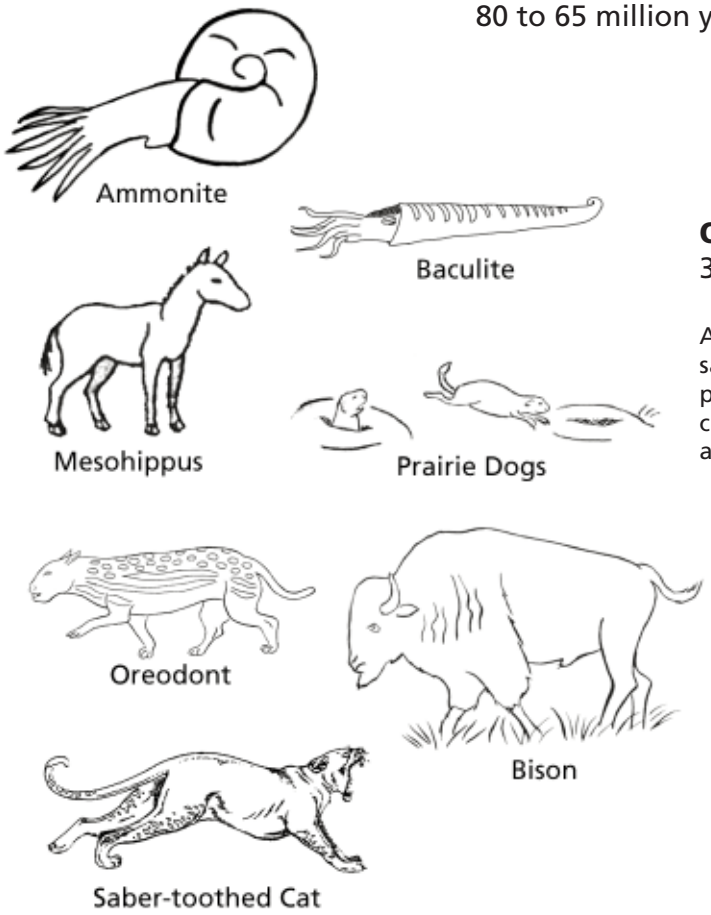
Buckle up! Here we go again! What! This CAN'T be South Dakota! What in the world? Well maybe these clues will help explain: a clam shell fossil and a fossil fish. They tell us that at one time a really, really long time ago - like 65 million years ago - there was an ocean here.

So Badlands National Park is a wonderful place to visit today, with lots of animals to see. Remember, it didn't always look like this and the clues to discovering what it was like so long ago are in the fossils.

Time Travel

Paleontologists piece together stories about ancient environments by studying the fossils of ancient animals. Some animals that once lived went extinct when the climate and environment where they lived changed.

Directions
Draw a line from the animal to the environment and time period it lived in.



Shallow Ancient Sea
80 to 65 million years ago

Oligocene Flood Plain
35 to 25 million years ago

A mild and moist climate supported a savanna-type environment that would periodically flood. Slowly over time, this climate bacame colder and drier. Some animals survived and some went extinct.

Mixed-grass Prairie
Modern day

A dry and harsh climate supports modern prairie animals.

???
The future

What kind of ecosystem do you think might be here in the future?

_____

_____

Fossils of the extinct oreodonts are found in Badlands National Park.

"Oreo" means mountain and "dont" means tooth. Oreodonts had pointy teeth, like little mountain ranges, to help them chew plants.

Oreodont teeth are very common fossils to find in the Badlands. What would you do if you found one?

_____

_____

_____

_____

_____

_____

Animal Adaptations I

Grades: 3 and 4
Length: 50 minutes

South Dakota Content Standards

♦ 3rd Grade Life Science: Students will explain how behavioral and physical adaptations allow animals to respond to life needs.
♦ 3rd Grade Life Science: Students will understand that science involves asking and answering questions and comparing results to what is already known.

♦ 4th Grade Life Science: Students will describe behavioral and structural adaptations plants and animals make to survive in a given environment.

Primary Theme

Studying and restoring the mixed grass prairie ecosystem and humans' relationship to it will help us understand the changing grassland ecology of the Midwest, and ensure the protection of this fragile and remarkably diverse ecosystem.

Materials

♦ Laptop

♦ Projector

♦ Craft box

♦ Recycled or scrap paper

Kick-off

Introduce Badlands National Park. Tell some prairie animal jokes or funny stories. Make sure the jokes are about animals found in Badlands National Park. This is just to warm up the audience. Quickly move on to the slide show and activity.

Some example jokes are:

What holiday do coyotes celebrate in the fall? Howl-ween
What do you call a deer with no eyes? I have no-eye-deer

Slide Show

Present the standard "Animal Adaptations I" slide show. You can change the order of the slides and add/delete slides as long as you follow the general outline and address the themes and standards above.

Activity

Students create an animal that is adapted to live in the Badlands environment. Students can work in pairs or alone. Students can draw and color their animal. Students should be able to describe the adaptations of their animal to the environment. For example, their animal must have adaptations to eat something that exists on the prairie.

Conclusion

Call on a few volunteers to describe their animal. Review the main idea.

How Big Was It?

Grades: 3 and 4
Length: 60 minutes

South Dakota Content Standards

♦ 3rd Grade Math Measurement: Students will estimate and measure length to the nearest 1/4-inch or centimeter.
♦ 3rd Grade Math Measurement: Students will measure and compare objects using measurable attributes.

♦ 4th Grade Math Measurement: Students will develop strategies to make measurement estimates.
♦ 4th Grade Math Measurement: Students will measure length to the nearest 1/8-inch or to the nearest millimeter.

Objectives

Estimate the height and length of prehistoric animals.

Measure the height and length of prehistoric animals.

Observe the size relations between different species and express that relationship mathematically.

Primary Theme

The Badlands fossil and geological record reflects changing climates and the diversity of life; its study provides insight into the survival of species.

Materials

♦ Overhead transparencies

♦ Overhead projector

♦ Meter or yard sticks

♦ Butcher paper (optional)

Background

Students often have the image that all prehistoric animals were very large. While many were, there were also many that were not. The ecological niches that can be found today can also be found in the past. Like the animals of today, prehistoric animals came in a variety of sizes and filled all the different niches available to them.

Procedure

1. Photocopy the figures provided (pages 45 through 47) onto overhead transparency sheets.
2. (Optional) Use butcher paper to create a poster big enough to hold the actual size of the animal.
3. Project the image of the animal onto the paper (or onto the wall) with an overhead projector.
4. Adjust the distance between the overhead projector and the paper until the image is close to the animal's actual size. Obviously, there was some variation among real animals so it does not need to be exact. The following is a guideline for the size of the animals:

Archaeotherium (big pig)	.....	5 feet LONG
Baculite	.....	2 feet LONG
Ammonite	.....	2 feet LONG
Oreodont	.....	3 feet TALL
Mesohippus	.....	2 feet TALL
Saber-toothed Cat	.....	6 feet LONG
Brontothere	.....	8 feet LONG

5. (Optional) Students trace the image onto the paper.
6. Students estimate the height and length of the animals.
7. Students measure the height and length of the animals.
8. Have the students complete different measurement activities and compare the sizes of the different animals. Have students estimate fractions and write formulas to describe what they observed.

Additional Information

National Park Service - www.nps.gov
Information on all of America's National Parks. Includes a special section for students and teachers.

Views of the National Parks - www2.nature.nps.gov/views
Virtual experiences of national parks and knowledge centers on various natural resource themes.

National Park Service Web Rangers - www.nps.gov/webrangers
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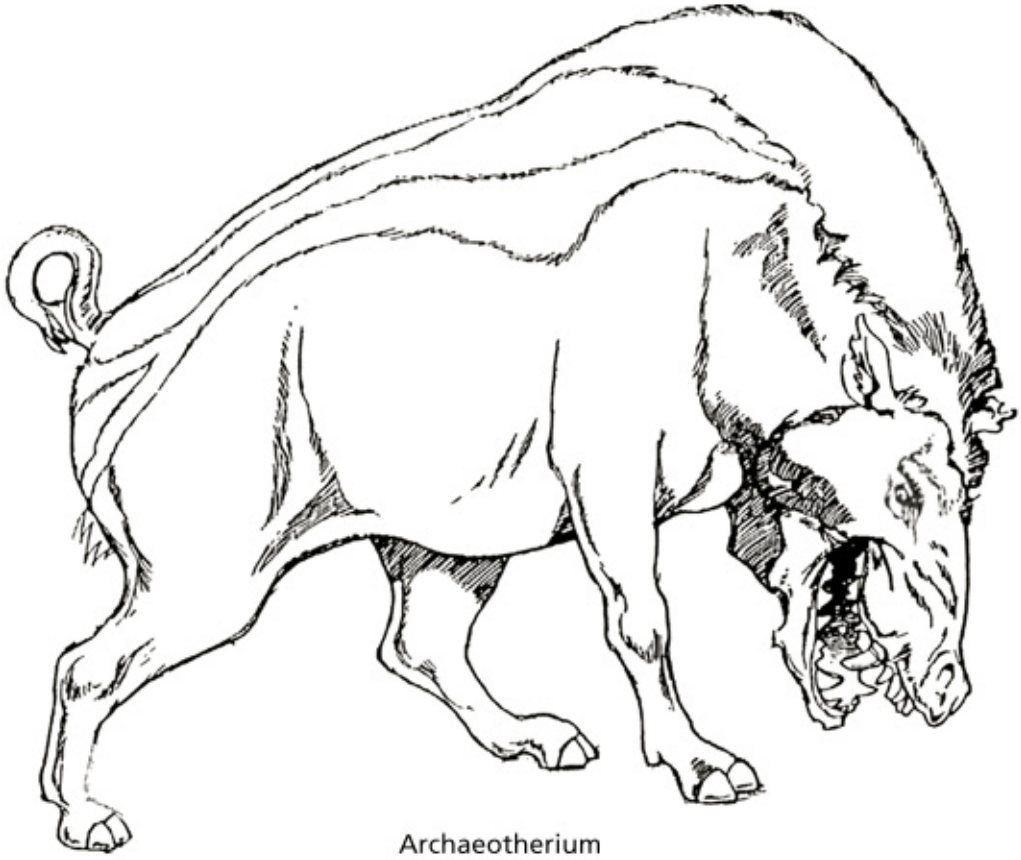
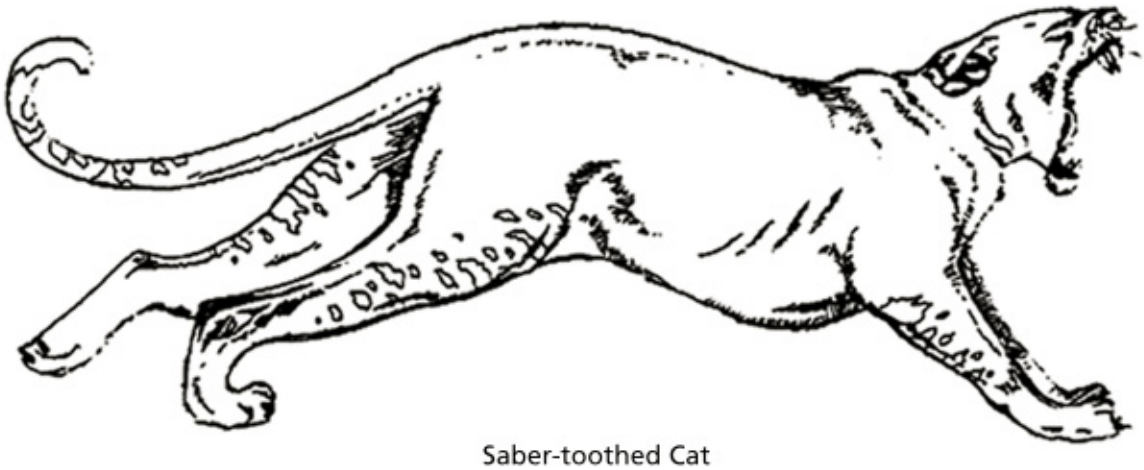
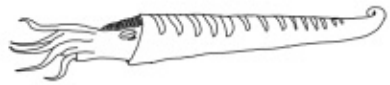


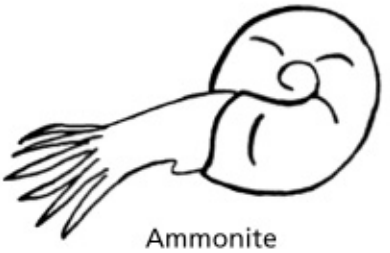
Archaeotherium



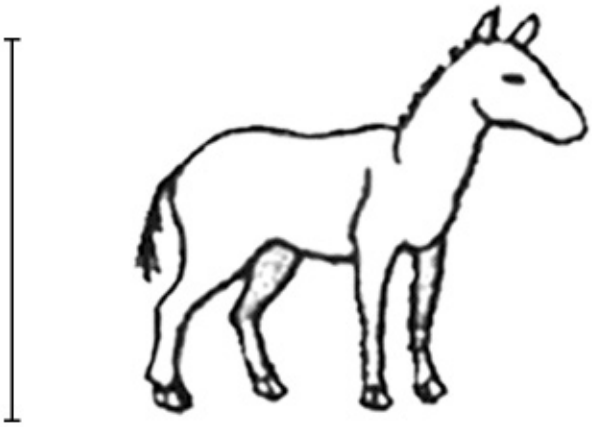
Saber-toothed Cat



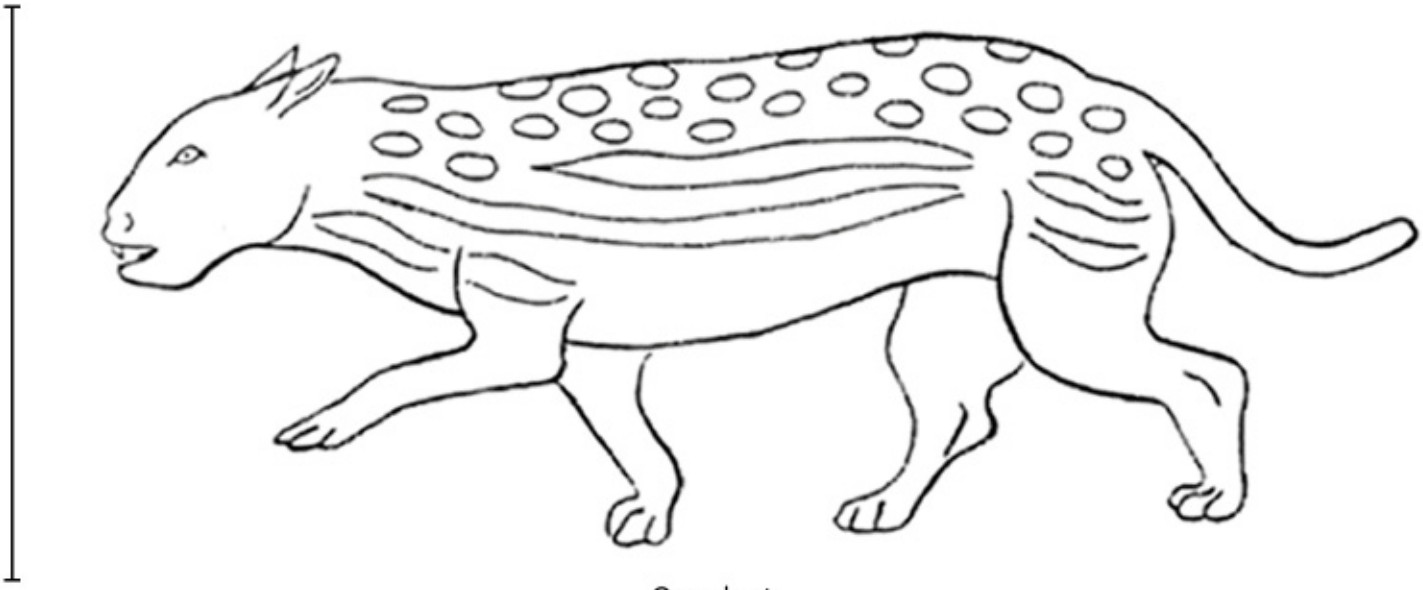
Baculite



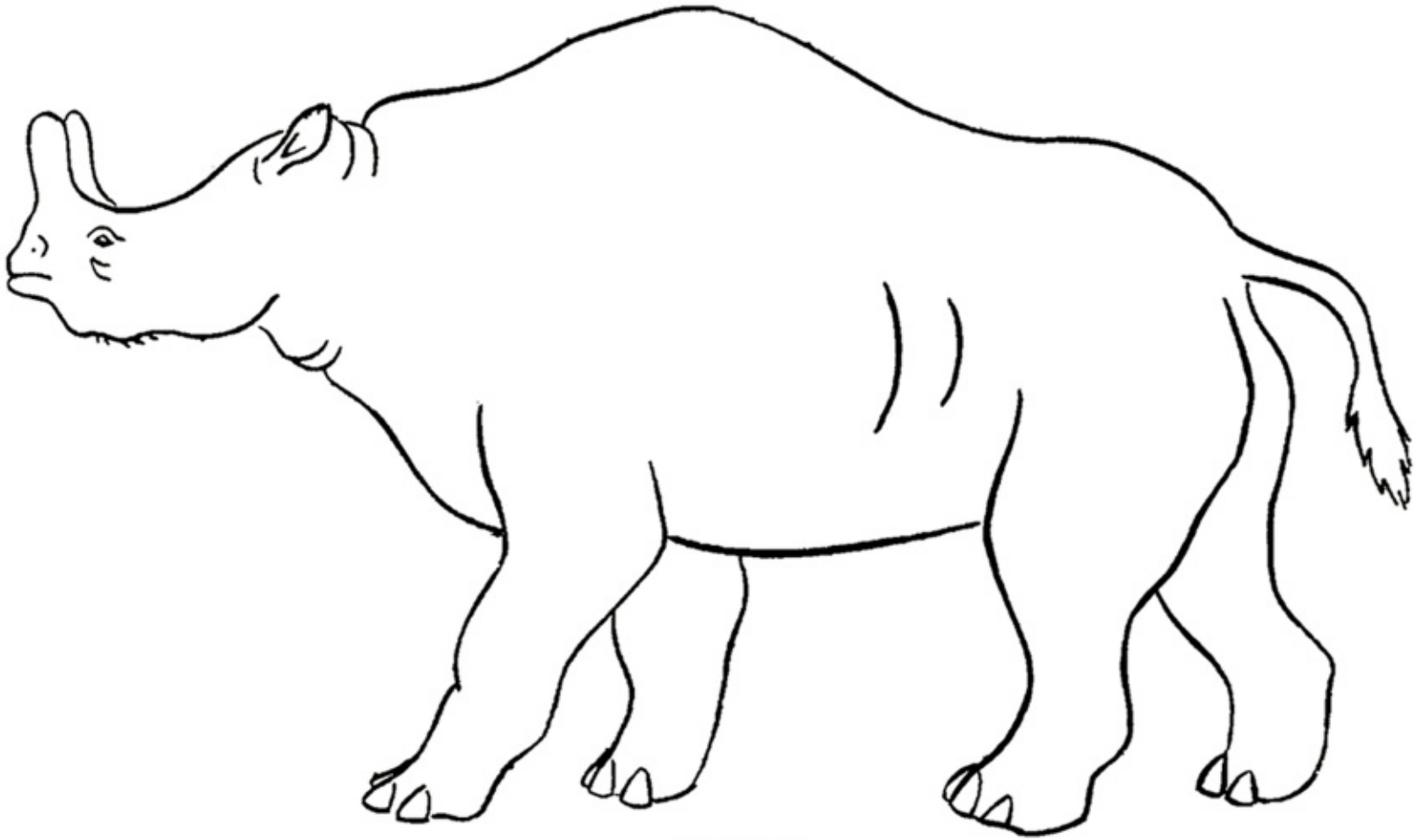
Ammonite



Mesohippus



Oreodont



Brontothere

What They Munch For Lunch: Animal Adaptations II

Grades: 7 and 8
Length: 50 minutes

South Dakota Content Standards

- 7th Grade Life Science: 7, 11, and 12
- 8th Grade Life Science: 10 and 12

National Science Standards

- 5th through 8th: C

Objectives

Define vocabulary words that describe animals diets.

Examine the diets of common prairie animals.

Vocabulary

Herbivore: eats only plants
Carnivore: eats only animals
Omnivore: eats both plants and animals
Insectivore: carnivore that specializes in eating insects
Frugivore: herbivore that specializes in eating fruit

Predator: organism that kills and eats another organism
Prey: organism that is killed and eaten by a predator

Materials

- Resources for research:

  Field guide to mammals
  Internet
  School library
  Public library

Procedure

1. Have the students write a brief definition for each of the following words: herbivore, carnivore, omnivore, insectivore, frugivore, predator, and prey.

2. Review the definitions with the students. Ask questions like "Can something be both a predator and an herbivore?" (Yes - plants are organisms too, so remember that herbivores are their predators), "Can something be an omnivore and a predator?" (Yes), and "Can something be a carnivore and prey?" (Yes)

3. Divide the class into research teams. Have students research the diets of prairie animals native to the mixed-grass prairie of South Dakota.

4. Did all of the animals eat food that students expected they would? Discuss.

5. Encourage the students to come up with vocabulary words that describe the diet of imaginary animals (i.e. ones that eat computers, or garbage, or fast food, etc.) Who can come up with the funniest one?

Additional Information

National Park Service - www.nps.gov
Information on all of America's National Parks. Includes a special section for students and teachers.

Views of the National Parks - www2.nature.nps.gov/views
Virtual experiences of national parks and knowledge centers on various natural resource themes.

National Park Service Web Rangers - www.nps.gov/webrangers
Kids can become Junior Rangers from their home or school.

Animal Adaptations II

Grades: 7 and 8
Length: 50 minutes

South Dakota Content Standards

♦ 7th Grade Life Science; Nature of Science: Students will investigate interactions among populations in a biological community.
♦ 7th Grade Life Science; Nature of Science: Students will interpret to justify conclusions.

♦ 8th Grade Earth/Space Science: Students will investigate how animals adapt to biotic and abiotic factors in a biome.
♦ 8th Grade Earth/Space Science: Students will describe interactions that exist among members of a biological population.

Primary Theme

Studying and restoring the mixed grass prairie ecosystem and humans' relationship to it will help us understand the changing grassland ecology of the Midwest, and ensure the protection of this fragile and remarkably diverse ecosystem.

Vocabulary

Herbivore: eats only plants
Carnivore: eats only animals
Omnivore: eats both plants and animals
Insectivore: carnivore that specializes in eating insects
Frugivore: herbivore that specializes in eating fruit
Monocular vision: each eye looks a different way (on side of the head)
Binocular vision: both eyes look and focus in the same direction (on front of the head)
Predator: organism that kills and eats another organism
Prey: organism that is killed and eaten by a predator

Materials

♦ Laptop
♦ Projector
♦ Variety of skulls
♦ Specimen data sheets
♦ "Animal Adaptations II" slide show

Procedure

1. Introduce Badlands National Park.

2. Quiz! Write (or project) the vocabulary words on the board. Read the definitions. Have students write the difinitions down. Note: 7th and 8th graders should know these words, so use this activity as a warm-up and keep it moving.

3. Present the slide show. Use the notes below and on the slide show to give an interpretive presentation.

4. Discuss that biologists study bones to discover what and how the animals eat or how they move. This lesson will focus on feeding and diets. An animal's tooth structure in very important! By examining the structure of the teeth, we can tell what kind of diet the animal had.

5. Encourage the students to come up with vocabulary words that describe the diet of imaginary animals (i.e. ones that eat computers, or garbage, or fast food, etc.) Who can come up with the funniest one?

6. Ask the students to feel their back teeth with their tongue. What is the chewing surface of your back teeth shaped like? What kind of diet do humans have?

7. Place the five animal specimens around the room. Do not tell the students which animals these are from - only that they are common to the prairie.

8. Divide students into groups.

9. Each group starts at one specimen and fills out their *Specimen Data Sheets* (page 52). After a few minutes at each specimen, rotate the groups. Repeat until each group has worked with each specimen.

10. Have each group talk about one specimen.

11. Discuss their findings.

12. Facilitate the "Peripheral Vision" activity for the students to determine their own peripheral vision.

13. Break the students into their five groups again. Assign each group a skull and have them measure/estimate the animal's scope of vision.

14. Compare the results between specimens and with humans.

15. Review binocular versus monocular vision. Binocular vision means good depth perception, but poor scope. Monocular vision means no depth perception, but excellent scope.

16. Have groups switch specimens. Ask each group to describe their specimen's nasal cavity. Share/discuss how each cavity benefits the specific animal. A short nasal cavity means good smelling and efficient breathing. A long, tapered nasal cavity means excellent smelling, sensitive to minute detail, and efficient breathing.

17. Review and solicit questions.

Additional Information

Searfos, Glenn. Skulls and Bones: a guide to the skeletal structures and behavior of North American mammals. Stackpole Books: Mechanicsburg, PA, 1995.

SPECIMEN DATA SHEET

Description of Teeth and Jaw

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Type of Vision --- monocular OR binocular

Description of the nasal cavity

_____
_____
_____
_____
_____
_____
_____

Do you think this animal was an herbivore, carnivore, or omnivore? Please explain why.

_____
_____
_____
_____
_____
_____
_____
_____
_____

COMMON SKULL ADAPTATIONS OF MAMMALS

	Carnivores	Herbivores	Omnivores
Dentition	Sharp points and serrated edges	Flats molrs and canines are usually not pointed	Combination
Jaw	Curves lower jaw	Long, tapered lower jaw	Combination
Nasal Cavity	Short and blunt OR short and narrow	Long and wide OR long and narrow	Combination
Orbits	Forward or slightly forward	Forward or sideways	Forward or slightly forward
Zygomatic Arches	Large	Small, except for rodents, which are large	Combination
Examples	Cats, weasels, skunks, badgers, and ferrets	Bison, deer, pronghorn, rodents	Humans, dogs, bears, racoons

Human Adaptations

Grades: 7 and 8
Length: 50 minutes

South Dakota Content Standards

- 7th Grade Life Science: 7, 11, and 12
- 8th Grade Life Science: 10, 12, 13 and 14

National Science Standards

- 5th through 8th: C

Objective

Creatively reconstruct the human body to be adapted for the prairie habitat.

Method

Creative writing

Background

In this amusing activity, students will be able to imagine how humans have and could better adapt to prairie life. The purpose of this activity is to get the students thinking further about adaptation, and at the same time, apply it (in a silly way) to their own lives.

Vocabulary

Adaptation

Materials

- Paper
- Pencil
- Imagination

Procedure

1. Plants have specific aspects that help them live on the prairie. So do animals. Brainstorm and discuss the adaptations that humans have made to live on the prairie.

2. Talk about what kinds of adaptations they would like to have for prairie living. Perhaps (as teens) they might want thick hair that doesn't get messed up in the wind, or well-hydrated skin. Note: they CANNOT change the prairie environment, only the human body.

3. Shift the discussion to imagining what it would be like if humands did not build homes on the prairie, but lived more like the animals. How would humans adapt to living in a prairie habitat, completely exposesd to the elements? For instance, would they have incredibly thick skin so as to shield them from the fierce winds? Would they have to run fast to avoid predators? Would their homes be underground?

4. After brainstorming, have the students write what human adaptations they believe would be needed in order to survive life on the prairie. Have them use their imaginations!

5. When time is up, collect all the papers, shuffle them around, and without reading the names of the students, randomly slect papers to read. This activity is intended to get them thinking about the absurd - laughter should be a part of the final reading.

Extension

Encourage the students to use the ideas generated during this activity to create a short story about human life on the prairie.

Additional Information

National Park Service - www.nps.gov
Information on all of America's National Parks. Includes a special section for students and teachers.

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Kids can become Junior Rangers from their home or school.

Homemade Sandstone

Always be sure to get an adult's permission and help before conducting this science experiment!

Materials

- 2 paper cups
- Spoon
- Measuring cup
- Sand
- Warm water
- Epsom salt

How Long Will It Take?

About 20 minutes, then check back after 2 days.

Procedure

1. Pour 1/2-cup warm water into the first paper cup. Dissolve 1/2-cup epsom salt into the water and stir.

2. Fill the other paper cup halfway with sand.

3. Using the spoon, sprinkle drops of the epsom salt solution onto the sand until all the sand is moist. Don't get the sand too wet!

4. Now, put the damp sand in a sunny window and check back after 2 days.

5. What happened to the sand after those 2 days?

What Did You Learn?

Sandstone is a rock that forms slowly, over a long time. How does sandstone form? Well, first there needs to be sand! Then, if conditions are right, that sand gets glued together chemically by a natural process. Minerals in the rainwater glue the individual sand grains together. Imagine your cup of sand was an ancient sand dune and the water you sprinkled on it was millions and millions of years of rain. Eventually, you will be left with *sandstone*. If too much rain falls, then the sand merely gets washed away.

Sedimentation

Always be sure to get an adult's permission and help before conducting this science experiment!

Materials

- 2-liter plastic bottle (or equivalent)
- Bottle cap for the bottle
- Sand, soil, mud, and pebbles
- 3 toothpicks
- Ruler
- Masking tape

How Long Will It Take?

About 40 minutes, then the rest of the day to think about what you learned!

Procedure

1. Set an empty 2-liter bottle on the table. Measure 4 inches up from the bottom of the bottle. Use the masking tape to mark the 4-inch-high point.
2. Find a variety of sand, soil, mud, gravel, and pebbles. Fill the bottle up to the masking tape line with these sediments.
3. Slowly pour water into the bottle. Fill the bottle about 3/4 full with water. Be sure to leave about 1/4 of the bottle unfilled.
4. Securely twist the top onto the bottle.
5. Now, SHAKE, SHAKE, SHAKE the bottle. After it is all shaken up, quickly set it on the table and leave it undisturbed.
6. Make observations of what happens.

Super Scientists

7. Open the bottle and add:
1 full toothpick
1 toothpick broken in half
1 toothpick broken into several small pieces
8. Repeat the SHAKE, SHAKE, SHAKE step. Can you see where the toothpicks end up?

What Did You Learn?

Imagine that your bottle was like a river carrying sedmients (sand, soil, mud, gravel, and pebbles). What happened when the river slowed down, or in this experiment, when the bottle was left undisturbed? Did the sediment settle out and pile up? Want settled out first? What took a while to settle out? This is similar to how the Badlands were formed. Of course it took large rivers and many millions of years!

What is those toothpicks were animal bones? Which ones do you think might become fossils? Why?

A Storm Front

Always be sure to get an adult's permission and help before conducting this science experiment!

Materials

- Large sponge
- Bucket
- Water
- Section of sidewalk or driveway that can get wet

Procedure

1. Fill the bucket 1/2 full of water.

2. Place the bucket at one of the sidewalk/driveway. Dunk the sponge into the bucket, making sure to saturate it with water.

3. Remove the wet sponge from the bucket. Begin walking down the sidewalk/driveway and put a constant pressure on the sponge. Be sure to observe what happens to both the water and the sponge as you walk.

4. Once the sponge is out of water stop and return to the bucket.

5. Try repeating this with various amounts of water soaked into the sponge.

What Did You Learn?

The wet sponge is similar to a saturated air mass that is traveling through the area. Did you notice how heavy the sponge was when full of water? Saturated air masses are heavy too, and once they run into an obstacle, they need to lose some of that weight to continue on. Did you notice how the sponge got lighter as more water dripped from it? That dripping water is precipitation that comes from an air mass (it will be rain in the summer and snow in the winter). Did you also notice that the more water in the sponge, the easier it was to have it drip out?

How Do You Say Sediment?

Sediments are small bits of material that settle out from water or air. Solve these riddles to discover common names for different sediment.

_____ Sediment that falls out of the air onto furniture.

_____ Sediment that falls out of clouds when it is cold outside.

_____ Sediment that floats in some types of orange juice.

_____ Sediment that is left behind in the coffee pot.

_____ Sediment that sticks to your boots on wet days.

_____ Sediment that gets in your shoes while walking on the beach.

Wow, did you know ...

Sedimentary rocks are made up of pieces of sediments all stuck together? All of the rocks found in Badlands National Park are sedimentary rocks.

Time Travel

This program is available to schools with teleconference equipment and as park staff member availability allows.

Grades: 3 to 5
Length: 30 minutes

Main Idea

Fossils in Badlands National Park help us understand ancient times and ancient life.

Procedure

Introduction and Welcome

- Badlands National Park in South Dakota
- What is a national park?
  - A special place preserved for people to enjoy
  - Badlands National Park is special because of the rocks and fossils.
- What is a fossil?
  - Something that tells us about ancient animals that lived long ago.
  - Brief explanation of how fossils formed in Badlands

Camer Pan

- Show the Badlands.
- Explain why it is called the Badlands.
- Paleontologists go out there, climb those rocks, and look for fossils.
  - What do paleontologists do?
  - Why study fossils?
  - What can we learn?

Fossil Detectives - Fossil Mysteries (more than just dinosaurs!)

- Titanothere
  - We can learn about fossils by their size.
- Turtle
  - We canlearn about fossils by *comparing them to modern animals* that are living now.
- Saber-toothed cat
  - We can learn about fossils by looking at their *teeth* (sharp versus flat).

Slide show of reconstructed animals and murals of what it looked like long ago

More Fossil Mysteries

- *Mesohippus*: ancient tiny 3-toed horse.
- Mouse: Some fossils are very tiny!
- Hornless rhino: long ago South Dakota and Nebraska looked very different than today.

Conclusion

Fossils help paleontologists solve the mystery of what life was like a really, really long time ago. National parks protect special places like this so that everyone can enjoy them and learn from them.

Questions and Answers

Layer Cake

This program is available to schools with teleconference equipment and as park staff member availability allows.

Grades: 6 to 8
Length: 30 minutes

Main Idea

You can think of the geologic layers (rocks) at Badlands National Park as being like ancient landscapes frozen in time. From studying each sedimentary rock layer, you can learn about different ancient environments ranging from 70 to 25 million years ago.

Objectives

Students will be able to ...

1. Explain why this area is named "The Badlands".
2. List three different ancient depositional environments that contributed sediments to the Badlands layers (sea, flood plains, rivers, open woodlands, volcanic ash from distant volcanoes).
3. Insert Badlands mammalian fossils on a timeline of Earth's history (between modern times and the time of the dinosaurs).
4. Define erosion.

Procedure

Introduction and Welcome

Camer Pan

- Have students think of descriptive words.
- Give an overview of Badlands National Park. Explain why it is called the Badlands.
    - Meet the Badlands. Now, I don't think it is such a bad place, but let me tell you about how it got its names (rugged terrain, lack of water, lack of vegetation, and extreme climate).
    - "The Wall" is 60 miles longs. What is a town that is 60 miles from where you live? These same formations cover a big area - in fact, these same formations are found in Toadstool State Park in western Nebraska.

- We are going to talk about how these badlands got here and why they look like they do.
- Call on students to list some of their descriptions. Have them share what it looks like around their school. (Is it prairie? Flat? Any rivers nearby?)

Geology Overview

- Ancient sea covered the Great Plains. It drained away and left a basin as the Rocky Mountains uplifted in the West.
- Sediments from the Rocky Mountains wash downhill and fill in the basin.
- Climate dries out and cools.
- Modern rivers begin eroding the sediments, leaving the Badlands standing today.

Close-up of Layers

Explain the depositional environments and sedimentary layers.

- Red stripe = ancient soil horizons
- Sandstone ridges = ancient river channels
- Rockyford Ash = ancient volcanoes
- Mudstone/siltstone = flood plain

Fossils

Show a few skulls that represent the mammals of the Oligocene Epoch.

Erosion

Close-up of rock slide and slump. Explain erosion is the opposite of deposition. White, Bad, and Cheyenne rivers.

Conclusion

The Badlands are a modern environment that look like this. However, the Badlands are also a rock record of ancient environments. What we see today is not just rock - it is an ancient, preserved landscape, including the fossils. National parks protect special places like this so that everyone can enjoy them and learn from them.

Questions and Answers