

U.S. Department of the Interior
Bureau of Land Management



Big Cedar Ridge

Fossil Plant Area

JUNIOR RANGER



Worland
Field Office
Wyoming

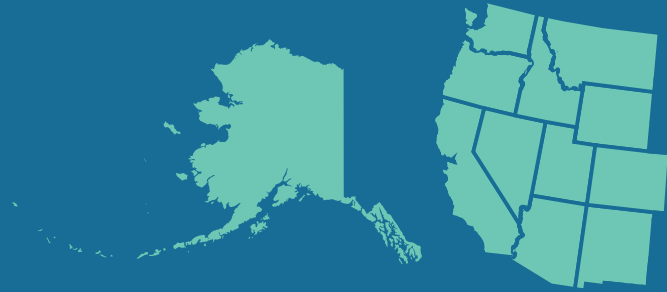
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BLM/WY/GI-18/007+1220

Bureau of Land Management



245 MILLION ACRES

mostly in 12 western states

NEARLY
10,000 BLM EMPLOYEES

MORE THAN
62 MILLION
PEOPLE

visit BLM-managed lands each year

Become a Junior Ranger!

The Junior Ranger program introduces young adventurers like you to the lands and resources managed by the BLM. We invite you to join the adventure!



What is BIG CEDAR RIDGE?

Big Cedar Ridge Fossil Plant Area (Big Cedar Ridge) is famous for its abundant plant fossils. One day millions of years ago, a mudflow of volcanic ash suddenly entombed the entire landscape around what is now Big Cedar Ridge. The plants were preserved where they were growing by many layers of sediment. Eventually, these layers of sediment were hardened into rock through the natural forces of compaction and cementation.



Scientists have found these plants buried and learned what Big Cedar Ridge looked like when dinosaurs lived here. During the Late Cretaceous, 73 million years ago, a lush, diverse flora occupied this area of Wyoming. The weather during the Cretaceous was much different than today. At that time, the Bighorn Basin was relatively close to sea level. Now, Big Cedar Ridge is over 4,000 feet above sea level. Then, it was warm year round, averaging 75 degrees, and wet. Many plants and animals thrived in this area at that time.



Today the area is arid to semi-arid with less than 9 inches of rainfall each year. Also, temperature shifts are dramatic, ranging from subzero temperatures to those well above 100 degrees.

Since the site's discovery in 1990 by paleobotanist Dr. Scott Wing of the

Smithsonian Institution in Washington D.C., scientists have identified thousands of specimens, representing about 175 species of plants. Many of these species were not previously known to paleontologists, and are still being described. Scientists have also distinguished at least five different types of insects that fed on the plants at Big Cedar Ridge.

The cover of this booklet shows what Big Cedar Ridge looks like today. The volcanic ash mudflow, which contains the fossils, is preserved as a blue-gray tuff layer of a rock known as the Meeteetse Formation. This unit contains sandstones, shales, and claystones that were deposited in a lowland floodplain. This formation is only found in Wyoming, and contains duck-billed dinosaurs at other sites.

For More information on Big Cedar Ridge Fossil Plant Area, visit:
<https://goo.gl/jqATPo>

WHAT IS A FOSSIL?

Fossils are the preserved remains, impressions, or traces of an organism that lived in the geologic past. Any plant or animal (vertebrates or invertebrates) can become a fossil under the right conditions. The locations of fossils within layers of rock help us understand the age and development of living things long ago. Fossils also help us understand how the Earth's environment has changed.

Types of Fossils

Invertebrates are animals without a backbone. These include oysters, squids, insects, and corals.

Vertebrates are animals with a backbone. These include dinosaurs, fish, turtles, and humans.

Plant fossils can take the form of leaves, cones, and seeds. The most common plant fossils at Big Cedar Ridge are leaves.

Trace fossils preserve evidence of past life activities. Examples are burrows, footprints, and evidence of insect feeding on leaves.



Find your own fossil!



Old Bottle

On BLM land, reasonable amounts of common plant and invertebrate fossils can be collected for personal use. Vertebrate fossils and archeological artifacts cannot be collected without a permit from the state BLM office.

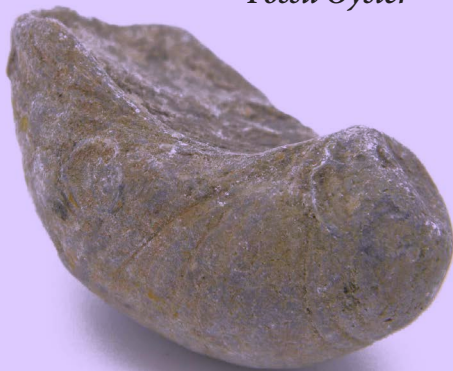
Look at the pictures and circle the objects that can be collected during your visit to Big Cedar Ridge or other sites across Wyoming. Cross out the ones you will leave on the ground.

Fossil Leaf with traces of insect feeding



Arrowhead

Fossil Oyster



Fossil Mammal Jawbone



Tools for the job

Look at the pictures below and unscramble the words to discover items you should bring for a day of exploration at Big Cedar Ridge.

1. aht _____

2. hvelos _____

3. crko mhrema _____

4. tltieo eppra _____

5. waret _____

6. ignmksa pate _____

7. senernucs _____

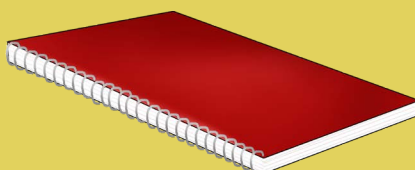
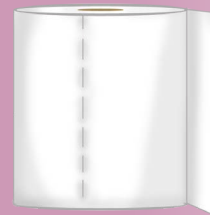
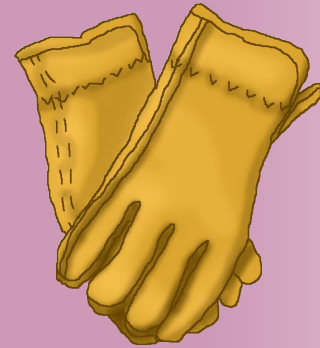
8. slvgeo _____

9. nsu lesgssa _____

10. ooetnkob _____

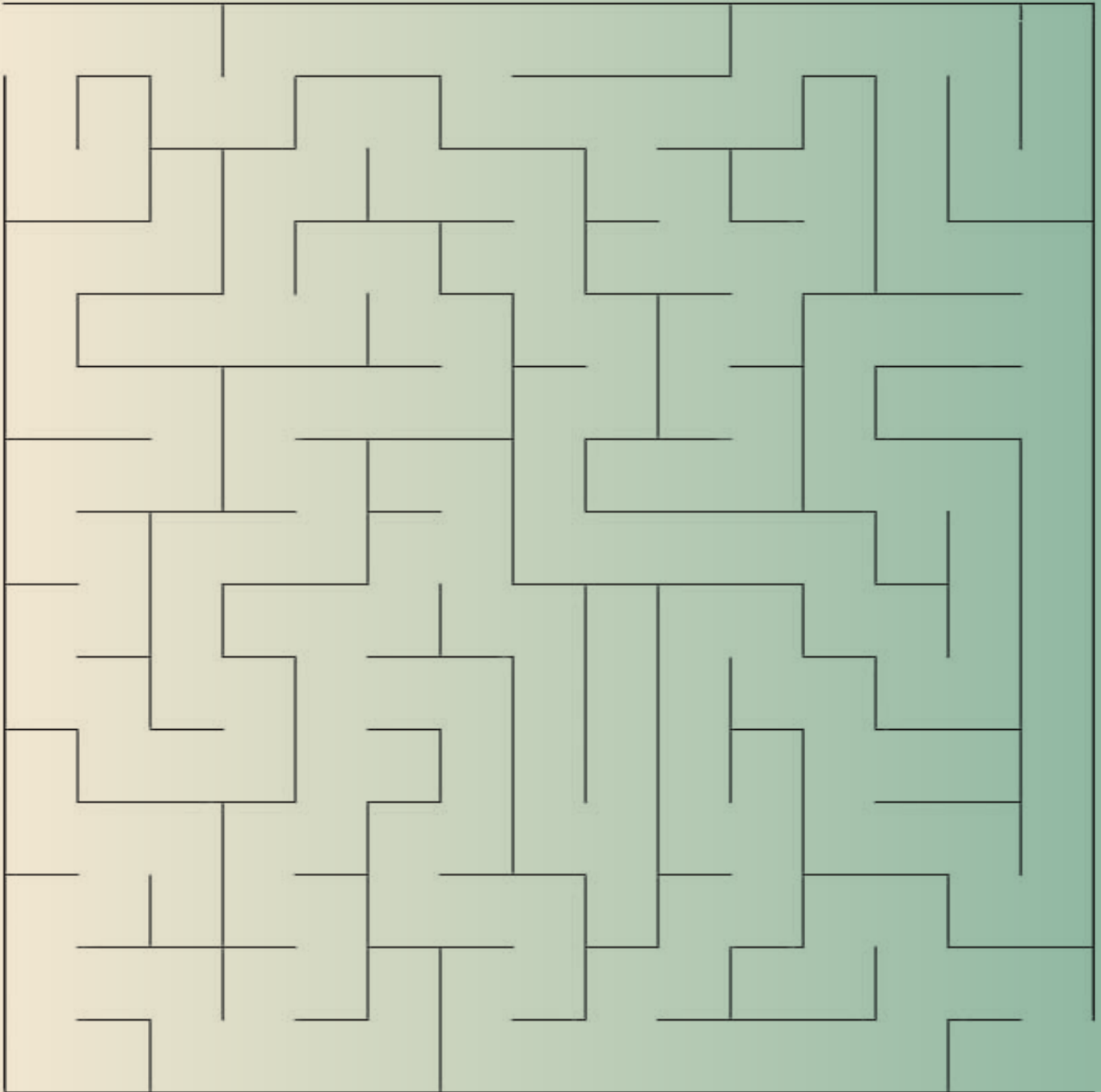
11. mraace _____

12. ngyginmafi gssal _____



Finding fossils is hard work!

Make your way through the maze to find a plant fossil from Big Cedar Ridge.



How to collect fossils

The plant fossils at Big Cedar Ridge are not lying on the surface. It takes hard work and patience to find a fossil and not everyone who visits Big Cedar Ridge will find one.

Step 1: Find a fossil area.

The fossils are located in the blue-gray ribbon of tuff (a volcanic, light porous rock) running across the middle of the ridge. Visitors are asked to search only existing fossil pits and refrain from digging new exploratory holes.



Step 2: Look for the fossils.

Open a small pit with your shovel and remove the overburden (dirt covering the zone containing fossils).



Step 3: Collect the fossils.

Cut horizontally and lift out blocks of the fossil-rich rock. Split the rock with your rock hammer along the line on its side. The rocks tend to split where there is a fossil.



Step 4: Document & Preserve the fossil. Take photos and make notes about your fossil. Make sketches in your notebook. Wrap the fossils you would like to keep in several layers of toilet paper. The toilet paper will keep the rock from breaking and allow it to dry slowly. After drying for two weeks the fossil is stable and can be displayed on your bookshelf.

Identify the fossil

Step 5: Identify your fossil. Finding, collecting, documenting, and preserving your fossil are not the last steps. The final step is identifying what you found. Though extinct, many of the fossil plants found at Big Cedar Ridge are related to modern, living plants. Below are some of the common fossils from BCR. Can you match them to their modern relative?

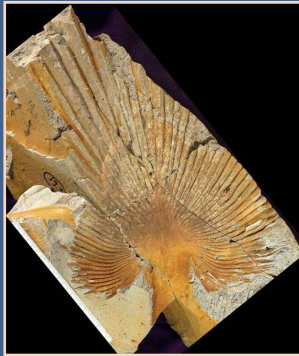
A. Fern



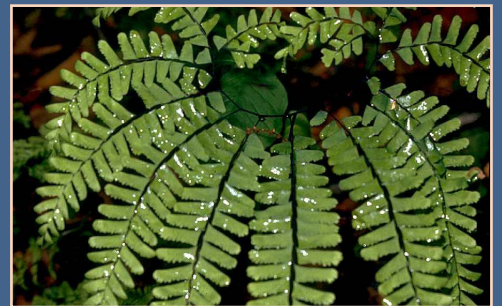
B. Conifer



C. Palm



D. Flowering Plant



ANCIENT VEGETATION

The fossil deposits at Big Cedar Ridge show us that several types of vegetation grew in central Wyoming about 8 million years before the end of the Age of Dinosaurs. Three main types of vegetation communities have been described; Fern Wetland, Palmetto Thicket, and Streamside Thicket.

Fern Wetland

This reconstruction shows the fern marsh vegetation growing on peat soil. Most of the ferns belong to a species that is largely found in the tropics today. There are also scattered cycads and flowering plants related to buttercups.



Palmetto Thicket

Here we see vegetation dominated by palms similar to some that grow in the southern United States today. The palms were growing on a slightly drier organic-rich soil.

Streamside Thicket

In areas that were wet, but that had recently been disturbed by flooding, we find vegetation composed largely of flowering plants (also called angiosperms). The most common species had leaves similar to blackberries, but we don't yet know if the fossil species was closely related to living blackberries.



Environmental reconstruction

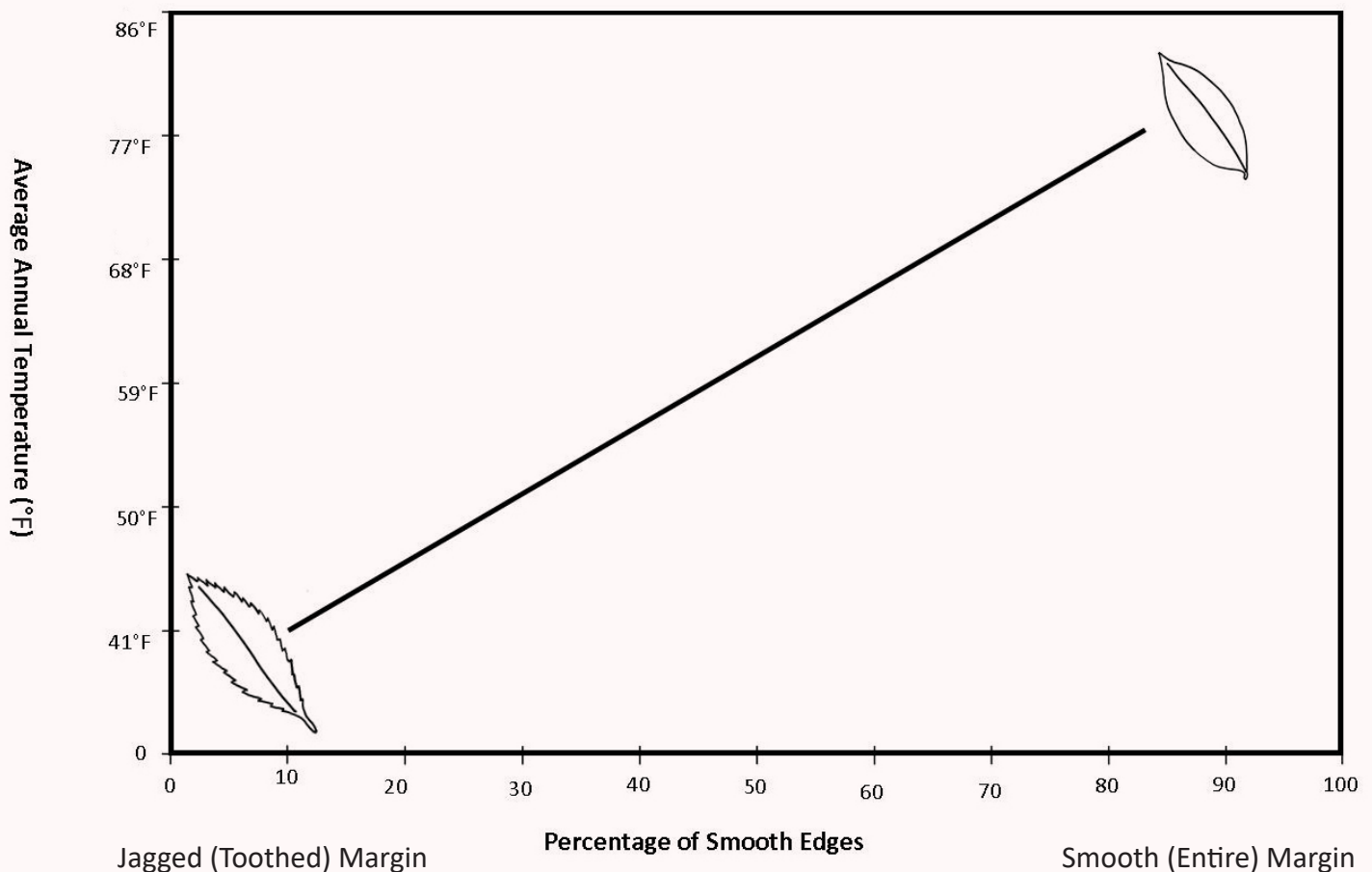
The plants and plant communities found at Big Cedar Ridge tell us 73 million years ago the climate was mild and humid with an average temperature of 75° F. There was a mixture of flowering plants, ferns, palms, and conifers. Use your imagination to color this page!



Using leaves to tell the temperature

The Earth's climate has changed dramatically over millions of years. How do paleontologists know what the weather was like 73 million years ago at Big Cedar Ridge? One way is to use fossil leaves. **Here are the steps:**

- 1) Studies of living forests show that there is a strong relationship between the average temperature at a location and the shapes of the leaves on the plants that live there. Where temperatures are high, like in a tropical rainforest, most species of flowering plants have leaves with smooth (aka entire) margins. Margin is another word for edge of the leaf. Where temperatures are lower, like in the northeastern part of the United States, most species of flowering plants have leaves with jagged (aka toothed) margins.
- 2) Collect several fossil leaves and determine how many species they represent.
- 3) Calculate what percent of the fossil species in your sample have smooth margined leaves. Your teacher or parent may be able to help you calculate percentages.
- 4) Look at the graph and see what average temperature corresponds to that percent of species with smooth margined leaves.
- 5) Assuming you have a good sample, you now know the average temperature at the time the fossil leaves were growing!



You can be a paleontologist too!



Finding fossils is fun, but the knowledge that can be gained from fossil discoveries can be even more thrilling. New species of plants and animals, as well as new information on known species, continue to be discovered each year.

These discoveries expand our knowledge on the fascinating story of the Earth, giving us glimpses of the life and times of a past world.

To become a paleontologist, stay especially focused in your math and science classes.

Remember to stay curious!

Test your skills by locating the terms in the word search below.

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

FOSSIL
FERN
PALEOBOTANIST
CORAL
CONIFER
PLANTS
PALM
LEAVES
INVERTEBRATE
ARTIFACT
PALEONTOLOGY
VOLCANO
INSECTS
SHOVEL
ROCKS

Personal reflections

Share some of your thoughts about Big Cedar Ridge. What do you hear, see, touch, and smell? How does this place make you feel? Are you visiting other fossil sites in Wyoming after you visit BCR?

What are some things you can do to protect the fossil area and other special places like it?

Over 150 plant species are known fossils in this area. Using photographs of plants shown throughout this book, draw one of them here or one of the fossilized plants you may have found.

Glossary

Archaeologist: a scientist who studies human history and prehistory through the excavation of sites and the analysis of artifacts and other physical remains.

Artifact: an object created by a human being, typically an item of cultural or historical interest.

Conifer: a tree or bush that produces cones and evergreen needle-like leaves.

Coral: marine invertebrates that often live in colonies and deposit hard calcareous skeletons. They are important reef builders.

Cycad: an evergreen plant that lives in tropical and subtropical regions with large feathery leaves and resembles palm trees.

Fern: a flowerless plant with feathery or leafy fronds and reproduces by spores. Ferns are found in tropical and temperate regions.

Fossil: any preserved remains, impressions, or traces of an organism that lived in the geologic past.

Invertebrate: an animal lacking a spinal column.

Paleontology: science focusing on the study of fossil plants and animals.

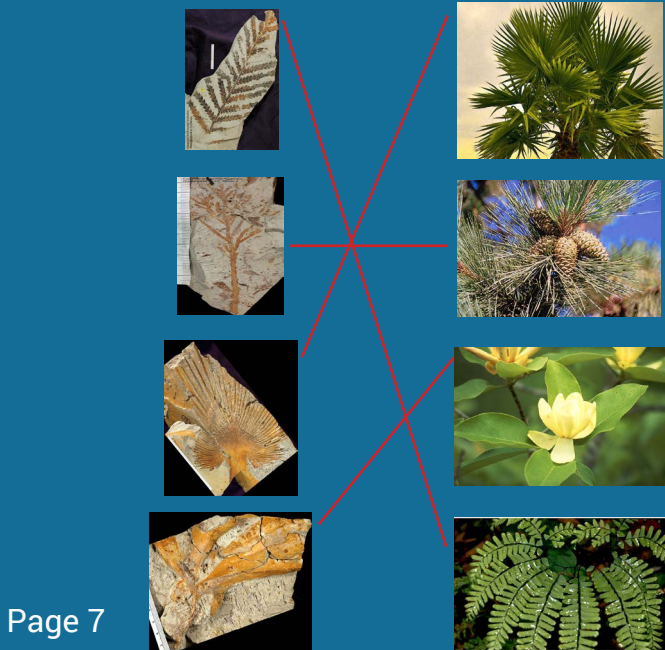
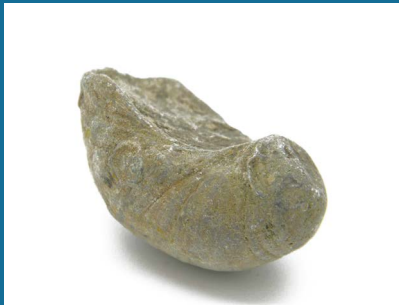
Paleobotanist: a botanist that specializes in fossil plants.

Paleontologist: a scientist that studies life of the geologic past, partly through plant and animal fossils

Vertebrate: an animal with a spinal column

Answer Key

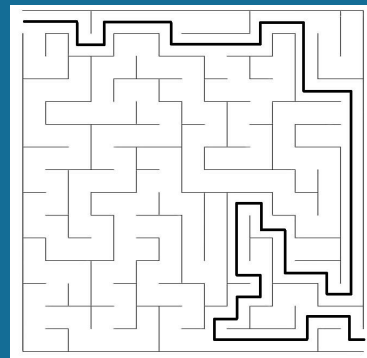
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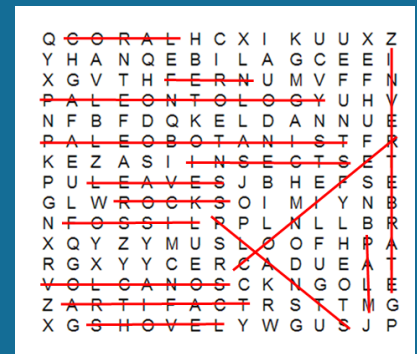
Page 4

1. hat; 2. shovel; 3. rock hammer; 4. toilet paper;
5. water; 6. masking tape; 7. sunscreen; 8. gloves; 9. sun glasses; 10. notebook;
11. camera; 12. magnifying glass

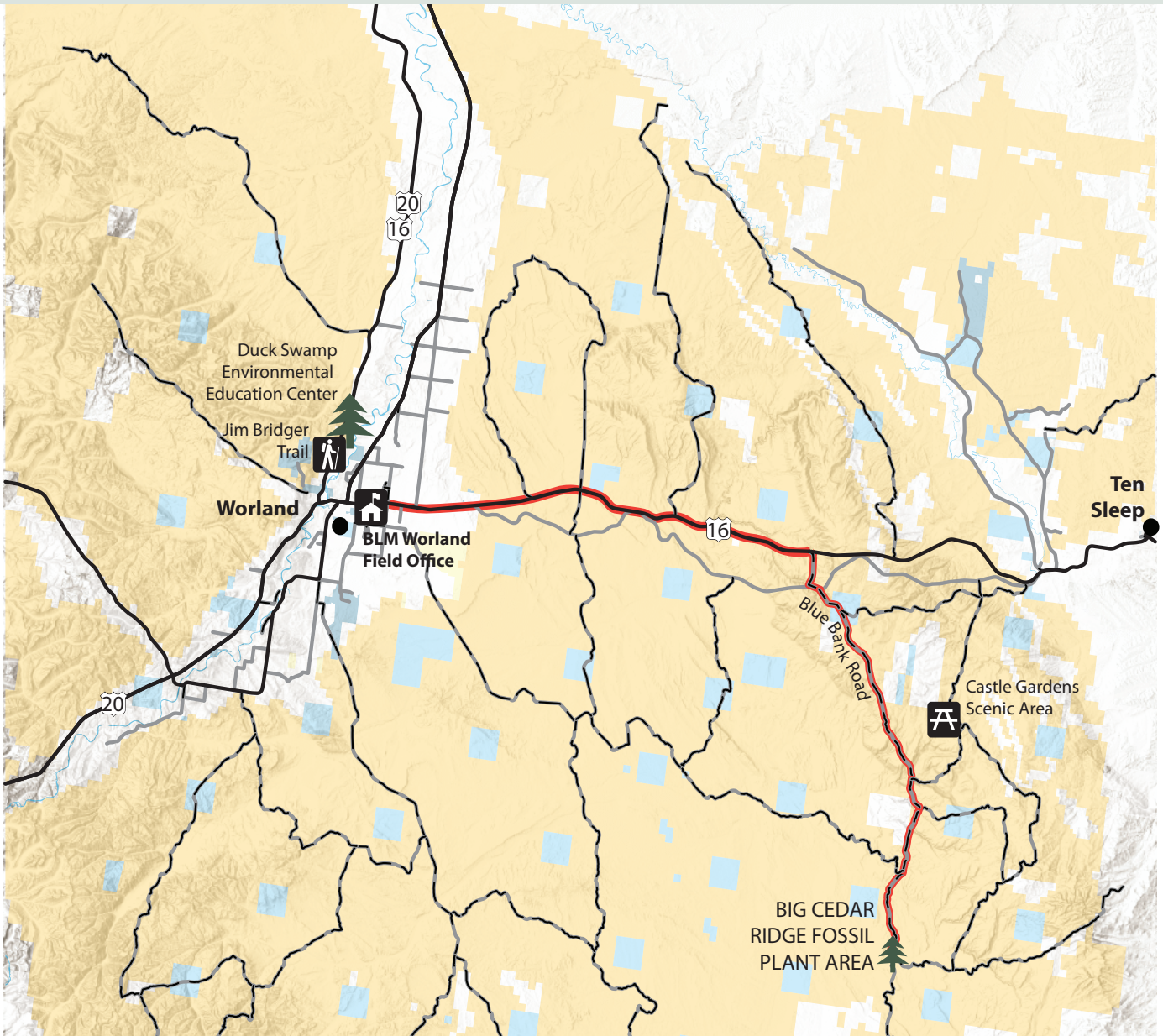


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How to get here



BIG CEDAR RIDGE FOSSIL PLANT AREA

Big Cedar Ridge is located in Washakie County in northwest Wyoming. To drive there, from the Worland Field Office, travel east out of Worland on US Highway 16 for 17.5 miles, then turn south onto BLM Road 1411 (Blue Bank Road). Follow Blue Bank Road for 14.5 miles. The roads highlighted in red show the route.

LEGEND

BLM Office	Natural Education Area	BLM Land
Picnic Area	Town	State Land
Hiking Trail	BLM Road	Private Land
	State Highway	
	County Road	



For more information, contact the BLM Worland Field Office in Worland:
101 S. 23rd Street, Worland, WY 82401, (307) 347-5100.

Big Cedar Ridge



BLM Junior Ranger Certificate

As a Bureau of Land Management Junior Ranger, I promise to:

- Do all I can to help preserve and protect the natural and cultural resources on our public lands
- Be aware of how my actions can affect other living things and the evidence of our past
- Keep learning about the importance of nature and our heritage
- Share what I have learned with others

Junior Ranger signature

Date

Notes & Observations

Notes & Observations

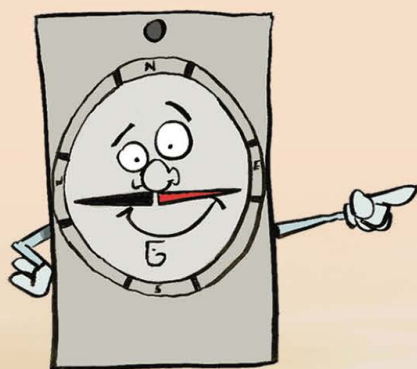
Leave No Trace:

7 Principles of Outdoor Ethics

Discover the 7 Leave No Trace Principles.

They'll help prepare you for your next adventure on public lands.

Visit <https://lnt.org/teach/peak/peakonline> to play Leave No Trace games.



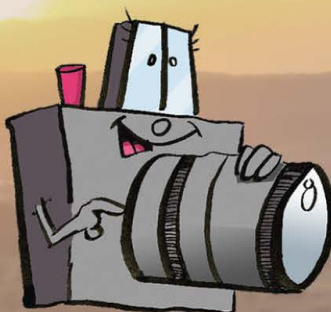
Know Before You Go



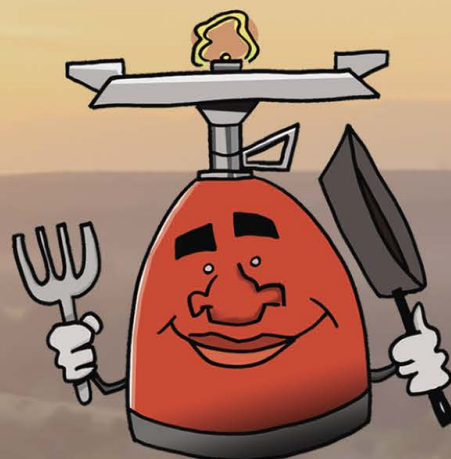
Choose The Right Path



Trash Your Trash



Leave What You Find



Be Careful With Fire



Respect Wildlife



Be Kind To Other Visitors

