

PALEO SLEUTHS

— DIGGING DEEPER —

Ashfall Fossil Find

Grade 4-8



This is an inquiry activity that will introduce students to the variety of fossils that can be found at Ashfall Fossil Beds State Historical Park located north of Royal, Nebraska. Students will use what they have learned about describing fossils from previous activities to infer information, and identify cardstock representations of fossils to that of the real fossils at Ashfall through research on the Ashfall website and map of the animals. Students will have four simulation excavation opportunities to investigate and identify some of the animals at Ashfall. This activity is an adaptation of the "Great Fossil Find."

Teacher Background Information

1. Activity length: 1-2 days depending on time needed for research. A simulation of a 4-day dig is done in this activity, however it should not take 4 days to do this activity.
2. Grades 4-8 can experience this activity. Some extensions for Grades 6 - 8 are noted.
3. This activity uses the 5 E Instructional Model:
 - Engage - create curiosity, access prior knowledge, ask open-ended questions
 - Explore - examine thinking and understanding, test predictions and hypothesis
 - Explain - share possible solutions, explain evidence, develop new understandings
 - Elaborate - add new information and build new explanations, propose solutions
 - Evaluate - answer open-ended questions, demonstrate and communicate understanding
4. This activity uses a science and engineering format found in *A Vision and Plan for Science Teaching and Learning, An Educator's Guide to a Framework for K-12 Science Education, Next Generation Science Standards, and State Science Standards* which involves Gathering, Reasoning, and Communicating.
 - Gathering - defining a problem, asking questions, using models to organize data
 - Reasoning - evaluating data, constructing ideas using math to solve a problem, using evidence as support for or against an explanation
 - Communicating - using written or oral forms to explain how evidence supports the reason

Teacher Materials

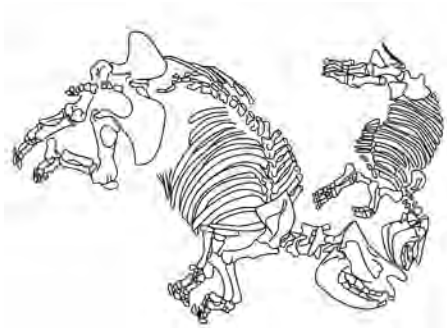
1. Nebraska map to identify where Ashfall is located.
2. Envelopes - one per team (for the Ashfall Skeleton Fossil Fragments cardstock cut-out copies).
3. Ashfall Skeleton Fossil Fragments worksheet - a set per team (copy on cardstock).
4. Ashfall Fossil Beds Skeleton Map and Ashfall Fossil Beds Brochure.
found online at <http://ashfall.unl.edu/> - students download copies, save to desktop
5. Ashfall Skeleton Fossil Fragments Map Key for teacher use with 3 skeletal bone fragments from each of the following animals:
 - #2 Large 3-toed Stallion "Cormo": 3-toed hoof, skeletal head and partial neck bones, upper leg bone
 - #3 Adult Female Rhino "Sandy" with baby "Justin": Sandy's hoof, Justin's hoof, Sandy's rib
 - #7 Scavenged Camel: head, tail, neck
 - #22 Small 3-toed horse "Socks": leg and 3-toed hoof, tail bones, upper leg bone

Ashfall Skeleton Fossil Fragments Map KEY

#2 Large 3-toed Stallion, "Cormo"



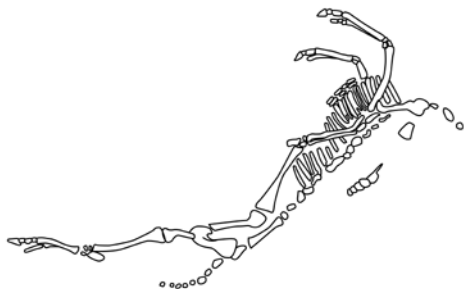
#3 Adult Female Rhino "Sandy" with Baby "Justin"



#7 Scavenged Camel

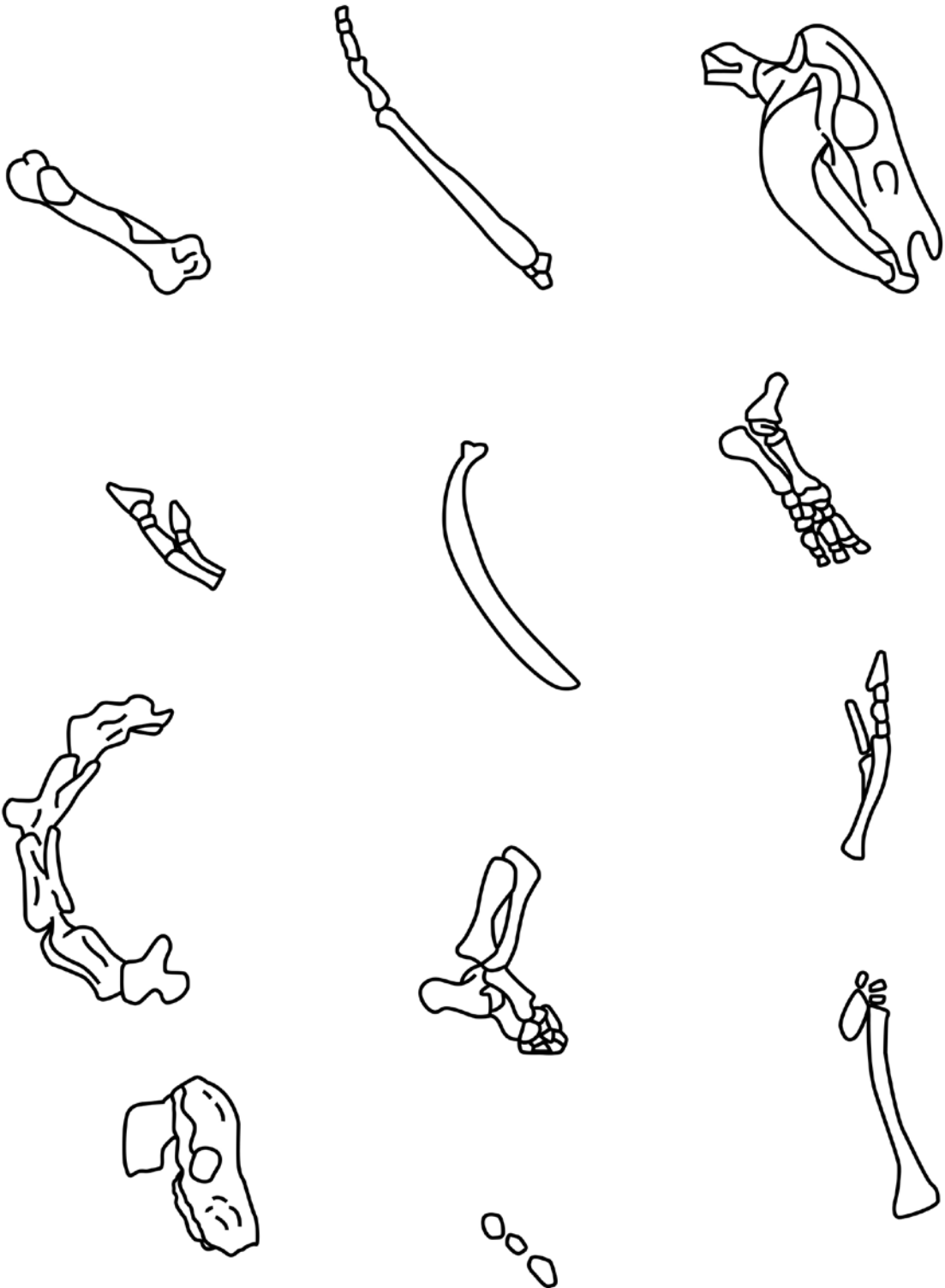


#22 Small 3-toed horse, "Socks"



Ashfall Skeleton Fossil Fragments

Make one cardstock copy per each student team. Cut each piece out, label with numbers to keep in sets.



Teacher Procedures:

1. Make copies of the Ashfall Skeleton Fossil Fragments worksheet (12 skeleton fossils) on cardstock, one worksheet set of 12 fossils per student team.
2. Cut around each fossil fragment and number each piece on back to keep sets together during the lesson.
3. Place each set of fossil fragments into an envelope, one envelope for each team and number envelopes to correspond with the numbered fossil fragments.
4. Place students into teams of 3-4.
5. Read: A Story to Share from the first day activity to set the stage about the activity and connection to Mike Voorhies and his discovery at Ashfall.
6. Make copies of the Ashfall Fossil Find Student Instructions for each team or create a PowerPoint for each "Day of Excavation" instructions. Students follow Excavation Instructions for each of four simulated days as suggested in Ashfall Fossil Find Student Instructions. These instructions will not take 4 days to complete. This activity simulates a 4-day dig.
7. After each round of excavations, teams complete a set of instructions to help guide them through the process of investigation and answer questions to help identify the animal fossils found at Ashfall. They will check with the teacher to be sure they have completed the Day of Excavation instructions before moving onto the next day.
8. Assign each envelope to each team and write this list down. The teacher can keep the envelopes for teams as they work through the 4 Excavations in the activity or if teams have their own envelope, make sure they do **NOT** look at the other fossil fragments inside the envelope until told to do so.
9. Culminating activity: a Paleontology Conference coordinating all information on a Paleontology Chart. Students will
 - Gather and conduct investigations about the fossils from Ashfall that will lead to descriptions of relationships between evidence and explanations
 - Use research to identify fossil evidence
 - Communicate reasoning supported by evidence that draws conclusions about what animals the fossils represent
10. The next day, reveal what fossils were found at Ashfall from their envelopes. Don't reveal the answers the same day or students will share results with friends before other classes do the activity.

Example of a Class Discover Chart During the Paleontology Meeting

Team	Claim We believe these fossils represent....	Reason because...	Evidence supported by our evidence of..	Questions and/or Answers

Extension for Grades 6-8:

1. When students are collaborating in their excavations, they are encouraged to create their own questions throughout this inquiry activity.
2. Students research the devastation of the ash cloud on these animals. Marie's Disease, the abnormal bone growth that occurs with lung diseases, was found in the bones of these animals to contribute to their death.
3. Students research the layering of animals that died in the waterhole and design a map showing the animals in those layers as they were positioned one on top of another.
4. Students research the various animals found in Ashfall, communicating information with their peers.

National and State Standards

Next Generation Science Standards

Middle Level MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

Nebraska State Standards

Grade 3-5 SC5.1.1 Students will plan and conduct investigations that lead to the development of explanations.

SC5.1.2 Students will describe how scientists go about their work.

SC5.1.2.a Recognize that scientific explanations are based on evidence and scientific knowledge

Grades 6-8 SC8.1.1 Students will design and conduct investigations that will lead to descriptions of relationship between evidence and explanations.

SC8.1.2 Students will apply the nature of science to their own investigations.

SC8.1.2.a Recognize science is an ongoing process and the scientific community accepts and uses explanations until they encounter new experimental evidence not matching existing explanations

SC8.4.4 Students will use evidence to draw conclusions about changes in Earth.

SC8.4.4.a Recognize that Earth processes we see today are similar to those that occurred in the past (uniformity of processes)

SC8.4.4.b Describe how environmental conditions have changed through use of the fossil record

Activity Resources

1. Ashfall Fossil Beds State Historical Park <http://ashfall.unl.edu/index.html>

Downloads

- Ashfall Fossil Beds Brochure
- Ashfall Fossil Beds Skeleton Map

2. NEBRASKAland Magazine's *The Cellars of Time* - Paleontology and Archaeology in Nebraska

3. *ASHFALL Fossil Beds* - State Historical Park & National Natural Landmark, Present View of an Ancient Past, Book found on website: <http://ashfall.unl.edu/>

4. NET Paleo Sleuths website

5. Museum of Paleontology fossil photos <https://umorf.ummp.lsa.umich.edu/wp/>

6. Animal Diversity Web fossil photos <http://animaldiversity.org/>

7. Nebraska Map to identify location of Ashfall - digital or real



Ashfall Fossil Find Student Instructions

Activity

Read: A Story to Share

Picture yourself in the sandhills of Nebraska, rolling hills of grass covering crystals of sand that were laid down millions of years ago by oceans, part of the plains of today. You and a group of friends are hiking through a gully, a low area between two sandhills, a place where water may have flowed at one time, when one of you spot an object protruding from the hillside. You all investigate further to find...

This scenario is similar to the actual encounter of a man and a fossil in 1971. The man was Mike Voorhies, a Nebraska paleontologist, and the fossil, a rhino skull he located in the sandhills, which is now a State Historical site known as Ashfall Fossil Beds.

When Mike Voorhies discovered this first fossil, it lead him to think about how others could view fossils preserved in the positions they were found. Leaving fossils in the ash, and excavating around them, tells a story of the way in which these various animals died, all together in one waterhole. Find out more about Mike Voorhies on his Paleo Sleuths webpage.

What made these animals all come to the waterhole? Survival? Water? A safe place? What caused their demise? These are some of the questions paleontologists considered when they first found this site. Now, this State Historical Park is available for everyone to discover, people all over the United States and from cities around the world travel to Ashfall to see what occurred here 12 million years ago.

It is your turn to investigate a trail of bones to identify some of the rare animals that lived around Ashfall and how they came to be all together in one waterhole. As a team, you will simulate a 4-day dig as paleontologists, gathering data, using reasoning with supporting evidence to discern the types of animals fossils represented from your fossil find, and complete some research in order to communicate your evidence to your colleagues about what you believe to be the types of animals in this activity.

Day 1 Excavation

Engage

On your first day at this site, your team is excavating an ash bed uncovering 3 fossil bones.

Action:

1. Take out only 3 fossil bones from your envelope.
2. Return the envelope to your teacher or if you keep the envelope, make sure **NOT** to look at the other bones inside the envelope until told to do so.

Explore, Explain

As a team:

- Examine each new fossil fragment describing what you see.
- Determine if these fossils are related or not.
- Write at least 2 questions your team has about the fossils you found.

Remember any observations and questions you have are important to uncovering the identity of the fossils, so write down all information you collect as a team. Once you have made some conclusions about this first day of excavation and written down some questions you have, show your teacher your written information and move onto Day 2 Excavation.

Day 2 Excavation

Engage, Elaborate

On your second day at this site, your team uncovers 3 more fossil bones.

Action:

1. Take out 3 more fossil bones from your envelope.
2. Return the envelope to your teacher or if you keep the envelope, make sure **NOT** to look at the other bones inside the envelope until told to do so.
3. After the second day of excavation, you can choose to compare your fossils with another team of paleontologists to see if you can discern more information to uncover the animal(s) these fossils represent.

As a team:

- Examine each new fossil fragment describing what you see.
- Determine if these fossils are related or not to the 3 fossils from Day 1 Excavation.
- Add any new fossil information you obtained from another team of paleontologists.
- Review the questions your team had from Day 1 Excavation and compare your new information.
- What questions does your team still have regarding the fossils you found today or about the information you received from the other team of paleontologists?
- Write a claim about the type of animal(s) your team believes these fossils represent and give evidence for your reasons why.

Explain

Once you have recorded Day 2 information, made claims with evidence, stated reasons, and shared this information with your teacher, move onto Day 3 Excavation.

Day 3 Excavation

It is your third day of excavating the ash bed. Your team should review your data and questions from Day 2 and the information you received from another team.

Explore, Elaborate

Consider these questions before beginning Day 3 Excavation:

- How have you revised your claim after Day 2?
- What questions does your team still have regarding the fossils you found?
- What does your team know for sure about the fossils you have discovered?

Action

1. Take out 3 more fossil bones from your envelope.
2. Return the envelope to your teacher or if you keep the envelope, make sure **NOT** to look at the other bones inside the envelope until told to do so.

As a team:

- Examine each new fossil fragment describing what you see.
- Determine if these fossils are related or not to the 6 previous fossils from Day 1 and 2 Excavations.
- Review the questions your team had from Day 2 Excavation and compare your new information.
- Write questions your team still has regarding the fossils you found.

Engage, Explore, Elaborate

Action

1. Access an online website about the Ashfall fossil site <http://ashfall.unl.edu/index.html> and research the history, the environmental conditions that caused these animals to become fossils, and the animals that have been found at this site.
2. Use these questions to help you make claims about your fossil finds as you research the website:
 - What types of fossils have been found at Ashfall?
 - What were the relationships between the animals found in the waterhole?
 - What environmental conditions contributed to the formation of these fossils at Ashfall?
 - What questions does your team still have regarding the fossils you found?
 - What conclusions can you draw from your investigation about the fossils?
 - What evidence do you have to determine the identity of the fossils from your excavations?

Explain

Write a claim about the type of animal(s) your team believes these fossils represent, give evidence and reasons why.

Day 4 Excavation

It is your fourth day of excavating the ash bed. Review your data, questions, and new information found from the website from Day 3. After the fourth day of excavation, you will prepare a presentation with your team drawing conclusions identifying the types of animals fossils you have investigated.

Engage, Explore

Consider these questions before beginning Day 4 Excavation:

- How have you revised your claim after Day 3?
- What questions does your team still have regarding the fossils you found?
- What does your team know for sure about the fossils you have discovered?

Action

1. Take out the last 3 fossil bones from your envelope.

Explain

As a team:

- Examine each new fossil fragment describing what you see.
- Determine how all the fossils fragments are related or not to each other.
- Use the website, skeleton map and brochure to aid in your decisions about the types of fossil animals you have located among the animals at Ashfall.
- Review the questions and your answers.
- Write down any remaining questions about the fossils.
- Write a claim about the type of animal(s) your team believes these fossils represent and give evidence and reasons why.

Evaluate

Share your team's findings with each other by coordinating all information on a Paleontology Chart.

Each team will:

- State a claim about what animals their fossils represent.
- Communicate evidence for their claim and reasons with supporting evidence.
- Discuss, collaborate, and conclude the identification of the animal fossils you found.

Example of a Class Discover Chart During the Paleontology Meeting

Team	Claim We believe these fossils represent...	Reason because...	Evidence supported by our evidence of..	Questions and/or Answers

Conclude the conference with the reveal of the fossils you found.