

SEVEN WONDERS OF THE BADLANDS

PROGRAM OVERVIEW

TOPIC: Geology, palaeontology and natural history

THEME: Unlocking the secrets of the Alberta badlands

PROGRAM DESCRIPTION: Rocks that come alive and mysterious popcorn rock are just two of the wonders that you will discover on this hike through the badlands. With expert guidance, students will unlock the ancient secrets of this incredible landscape.

AUDIENCE: Grades 2–12

CURRICULUM CONNECTIONS:

- Grade 3 Science: Rocks and Minerals
- Grade 4 Social Studies: Alberta—The Land, Histories and Stories
- Grade 5 Social Studies: Canada—The Land, Histories and Stories
- Grade 6 Science: Evidence and Investigation
- Grade 7 Science: Planet Earth
- Grade 8 Science: Freshwater and Saltwater Systems
- Grade 9 Science: Biological Diversity
- Grade 10 Science 14: Investigating Matter and Energy in the Environment
- Grade 11 Science 20: The Changing Earth

PROGRAM OBJECTIVES:

1. Students will understand how the badlands were formed through geological processes.
2. Students will recognize that the main 'rock type' found in the badlands is sedimentary.
3. Students will learn to identify different types of sedimentary rock and understand how each formed.
4. Students will discover the palaeoenvironment of this area as it was 70 million years ago, during the Age of dinosaurs.
5. Students will identify modern environmental characteristics, including adaptations of plants such as cactus and sage.

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SUGGESTED PRE-VISIT ACTIVITIES

I. BADLANDS TERMINOLOGY

Introduce these terms to your class prior to your program at the Royal Tyrrell Museum in order to ensure your students are comfortable with the information presented on the hike.

Badlands: Arid terrain where sedimentary rocks have been extensively eroded by water and wind. Canyons, ravines, gullies, hoodoos and other such geological formations are common in the badlands.

Bentonite clay: Clay generated by the alteration of volcanic ash. Its main constituent is *montmorillonite*.

Coal: A mineral resulting from the compression of accumulated peat in ancient swamps. The Drumheller area contains mostly bituminous coal.

Coulee: Coulees are commonly canyons or valleys characterized by steep walls that have been shaped by erosion. The term comes from the French word *couler* meaning "to flow."

Cretaceous Period: The third and latest period of the Mesozoic Era, 144–65 million years ago.

Deposition: An accumulation of sediments.

Erosion: The group of processes that loosen or dissolve rock material and transport it, mainly by water, ice, wind, and gravity.

Erratics: Rocks (mostly igneous or metamorphic) that have been transported through glacial action and deposited after meltwaters have receded.

Fossilization: The process that preserves the remnants, impressions, or traces of an organism in rock, over time.

Geology: The scientific study of the origin, history and structure of the earth.

Glaciation: The scouring and wearing down of the earth through erosion and deposition caused by glaciers

Hoodoo: A mushroom-shaped rock pillar resulting from differential resistance to erosion.

Igneous rock: Rock formed from the solidification of cooled magma (molten rock).

Ironstone: Iron-rich sedimentary rock formed when minerals in groundwater seep through layers of rock, consolidating it.

Joseph Burr Tyrrell (pronounced TEER-uhl): A Canadian geologist, cartographer and mining consultant who, while working for the Geological Survey of Canada in 1884, accidentally discovered dinosaur (*Albertosaurus*) bones near Drumheller, while looking for coal seams.

Metamorphic rock: Sedimentary or igneous rocks that have been altered by heat and/or pressure.

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SUGGESTED PRE-VISIT ACTIVITIES

I. BADLANDS TERMINOLOGY CONT.

Mudstone: Sedimentary rock formed from the deposition of fine particles of mud in low-energy environments (e.g. slow-moving water).

Palaeoenvironment: The environment of the ancient past.

Palaeontology: The study of ancient plant and animal life through the fossil record.

Sandstone: Sedimentary rock formed from the deposition of sand in high energy environments (e.g. fast-moving water). Drumheller sandstone is white in appearance.

Sedimentary rock: Rock formed by the accumulation and consolidation of mineral and organic fragments that have been deposited by water, ice, or wind.

Sedimentation: The deposition of the material from which sedimentary rocks are formed.

Sediments: Solid materials resulting from weathering and erosion.

Stratigraphy: The study of rock layers, their formation, composition, and sequence.

Weathering: The group of processes, both chemical (e.g. air, rainwater, plants, bacteria) and mechanical (e.g. changes of temperature), that change the character of a rock.

II. BADLANDS BRAINSTORM

The badlands are classified as a semi-arid desert, which means they receive very little precipitation. Because of the lack of water, only certain types of plants and animals can live there. As a class, discuss what you might see as you hike in the badlands. What kinds of plants? What types of animals? Which animals might be hiding? What different types of rocks will you see?

www.canadianbadlands.com

III. RULES OF THE TRAILS

The Seven Wonders of the Badlands Hike takes place near the Royal Tyrrell Museum, in Midland Provincial Park. Do you know what sort of rules are in place to protect Alberta's provincial parks? What might be protected in the Park? What are you allowed to do? What are you not allowed to do? How do you stay safe while hiking in a park? What sorts of things should you bring on a hike? Discuss these questions as a class.

Midland Provincial Park is very rich in fossils, which is one of the reasons the Royal Tyrrell Museum was built here. Alberta's Historical Resources Act protects all of the fossils in the province. Do some research to learn about how Alberta's fossils are protected. If you find a fossil, what are you allowed to do with it? What might you not be allowed to do? What would happen if someone broke a law that was designed to protect our province's fossils?

www.tyrrellmuseum.com/research/fossils_law.htm

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POST-VISIT ACTIVITIES

I. SEVEN WONDERS QUIZ

1st Wonder: Rocks

Name three types of sedimentary rocks found in the Drumheller badlands.

1. _____
2. _____
3. _____

Describe the environments in which two of these rock types were formed.

1. _____
2. _____

2nd Wonder: Bentonite Clay/Popcorn Rock

List three uses of bentonite clay.

1. _____
2. _____
3. _____

Where does bentonite clay come from?

3rd Wonder: Hoodoos

Hoodoos are formed through the process of _____. During this process, _____ and _____ gradually wear away the sediments from the surrounding rock.

A hard _____ protects softer rock beneath it, allowing mushroom-shaped hoodoos to form.

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POST-VISIT ACTIVITIES

4th Wonder: Dinosaur Fossils

Name one of the most common dinosaur families found in the Drumheller valley.

How does erosion benefit palaeontologists?

5th Wonder: Sequoia Fossil/Petrified Wood

What does the petrified wood tell us about the ancient environment of the Drumheller area?

Relatives of these ancient trees are still alive today. Where can they be found?

6th Wonder: Glacial Erratics

Where were the glacial erratics found in the Drumheller valley originally formed? How did they get here?

Describe how the Drumheller valley was formed.

7th Wonder: Prickly Pear Cactus

List three adaptations that Prickly Pear Cacti have to survive in their environment.

1. _____

2. _____

3. _____

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POST-VISIT ACTIVITIES

II. LES MAUVAISES TERRES

When the French explorers first came to the Alberta badlands they exclaimed “Ils sont des mauvaises terres à traverser” which translates to “They are bad lands to cross.” Describe some of the features you observed in the badlands that might have led the French explorers to call these lands “bad.”

III. FROM SAND TO STONE ACTIVITY

Sedimentary rock is one of the three major classes of rocks on Earth. It is within this type of rock that fossils are found. There are many different sedimentary rocks around the world today.

REQUIRED MATERIALS: Samples of sand, gravel, and fine soil; large wide-mouthed jar with lid; water.

ACTIVITY INSTRUCTIONS:

1. Fill the jar about one-third full with equal amounts of sand, gravel, and soil.
2. Add water until the jar is about two-thirds full and then seal it.
3. With one hand under the jar and the other over the lid, give the jar 10 vigorous shakes to mix the contents.
4. Sketch the jar and its contents after shaking.
5. Put the jar in a place where the contents can settle undisturbed, for at least one hour.
6. Sketch the jar and its contents again, after the sediments have settled.

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POST-VISIT ACTIVITIES ANSWER KEY

I. SEVEN WONDERS QUIZ

1st Wonder: Rocks

Name three types of sedimentary rocks found in the Drumheller badlands.

1. Sandstone
2. Mudstone
3. Coal

Describe the environment in which two of these rock types were formed.

1. Sandstone—formed in fast flowing waters; river environments
2. Coal—formed in slow flowing waters; ancient swamps

2nd Wonder: Bentonite Clay/Popcorn Rock

List three uses of bentonite clay.

1. Lubricant—used in oil industry
2. Cold creams
3. Cat litter

Where does bentonite clay come from?

Originated as volcanic ash

3rd Wonder: Hoodoos

Hoodoos are formed through the process of erosion. During this process, wind and water gradually wear away the sediments from the surrounding rock.

A hard cap rock protects softer rock beneath it, allowing mushroom-shaped hoodoos to form.

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POST-VISIT ACTIVITIES ANSWER KEY

4th Wonder: Dinosaur Fossils

Name one of the most common dinosaur families found in the Drumheller valley.

Hadrosaurs, also known as duck-billed dinosaurs

How does erosion benefit palaeontologists?

It removes the rock and exposes fossils that are buried within the layers of sediment

5th Wonder: Sequoia Fossil/Petrified Wood

What does the petrified wood tell us about the ancient environment of the Drumheller area?

The petrified wood is from Metasequoia and indicates that this was a warm, wet forest during the time of the dinosaurs (warm temperate environment)

Relatives of these ancient trees are still alive today. Where can they be found?

They can be found in warm temperate environments like the west coast of northern California

6th Wonder: Glacial Erratics

Where were the glacial erratics found in the Drumheller valley originally formed? How did they get here?

The glacial erratics are igneous and metamorphic rocks. Formed in the Canadian Shield and the Rocky Mountains, they were transported to this area by the last glaciers that advanced from the north and west.

Describe how the Drumheller valley was formed.

When the glaciers started melting, around 15,000 years ago, large blocks of ice broke off and formed ice dams that held back massive quantities of water. When the dam in this area broke, the meltwater rushed through and cut down into the soft rock, creating the valley.

7th Wonder: Prickly Pear Cactus

List three adaptations that Prickly Pear Cacti have to survive in their environment.

1. Spines to ward off predators
2. Waxy cuticle on the stem to prevent water loss
3. Ability to produce a natural anti-freeze so their cells will not be damaged during the cold winter

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POST-VISIT ACTIVITIES ANSWER KEY

II. LES MAUVAISES TERRES

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Steep valley walls, bentonite clay that becomes very slippery when wet, sinkholes, uneven terrain

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3. With one hand under the jar and the other over the lid, give the jar 10 vigorous shakes to mix the contents.
4. Sketch the jar and its contents after shaking.
5. Put the jar in a place where the contents can settle undisturbed, for at least one hour.
6. Sketch the jar and its contents again, after the sediments have settled.

How do the two sketches compare?

The first sketch should show a cloudy mixture with the sediments suspended and swirling in the water.

The second sketch, completed after the sediments have settled, should show the gravel, the heaviest sediment, at the bottom of the jar, followed by the sand and then the soil on the top as it is the lightest sediment.

Why did the sediments settle the way they did?

The heaviest sediment in the mixture is the gravel, which requires the most energy to stay suspended in the water. As the water slows down and the energy level drops, the gravel settles to the bottom of the jar, while the two lighter sediments remain suspended and in motion. As the water continues to slow down, the next heaviest sediment, the sand, will settle to the bottom. Lastly the soil, which requires the least amount of energy to be moved, will gradually settle on top of the sand.