BADLANDS HIKE

PROGRAM OVERVIEW

TOPIC: Geology, palaeontology, and natural history of the Alberta badlands

THEME: Unlocking the secrets of the Canadian Badlands

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

AUDIENCE: Grades 2 – 12

CURRICULUM CONNECTIONS

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

PROGRAM OBJECTIVES

Students will be able to:

1. Describe how the badlands were formed through geological processes.
2. Recognize that the main rock type found in the badlands is sedimentary rocks.
3. Identify the different types of sedimentary rocks and understand how they were formed.
4. Describe the palaeoenvironment of this area during the time of dinosaurs (70 million years ago).
5. Identify characteristics of the environment today, including adaptations of plants such as cactus and sage.

BADLANDS HIKE

SUGGESTED PRE-VISIT ACTIVITIES

1. PROGRAM TERMINOLOGY

Here are some terms to introduce to your class before you attend your program at the Royal Tyrrell Museum. These terms will prepare the students so they get the full benefit of the program.

Badlands: an 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: results from the compression of accumulated peat in ancient swamps. The Drumheller area contains mostly bituminous coal.

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

Cretaceous Period: the third and latest period of the Mesozoic Era, from 145 – 66 million years ago.

Deposition: the 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 that are 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 by glaciers.

Hoodoo: a mushroom-shaped rock formation which is caused by 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, converting it into consolidated rock.

Joseph Burr Tyrrell: (pronounced TEER-uhl). He was a Canadian geologist, cartographer and mining consultant who accidentally discovered dinosaur (*Albertosaurus*) bones in Alberta's badlands near Drumheller in 1884. He had been sent to the area by the Geological Survey of Canada to look for coal.

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

Mudstone: sedimentary rock formed from the deposition of fine particles of mud in low-energy environments (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 (fast-moving water). Drumheller sandstone is white in appearance.

SUGGESTED PRE-VISIT ACTIVITIES

(BADLANDS TERMINOLOGY CONT.)

Sedimentary rock: rocks 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: the solid materials that are the result of 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, but does not move it.

2. BADLANDS BRAINSTORM

The Badlands are classified as a semi-arid desert. This means that the area receives 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 along your hike in the Badlands. What kinds of plants will you see? Will there be any animals out and about? Which ones will be hiding from your sight? Don't forget to think about the types of rocks that are found in the badlands.

http://en.wikipedia.org/wiki/Badlands

http://www.canadianbadlands.com/

(Keywords: Canadian Badlands, Alberta badlands)

3. RULES OF THE TRAILS

The Seven Wonders of the Badlands Hike takes place near the Royal Tyrrell Museum, located in Midland Provincial Park. Brainstorm with your class about what sort of rules are in place to protect Provincial Parks. What is 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 should you bring on a hike?

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 these and all other fossils in the province. Do some research to learn about how Alberta's fossils are protected. What are you allowed to do with fossils and what aren't you allowed to do? Are there any penalties for breaking the laws protecting fossils?

http://tpr.alberta.ca/parks/dinosaur/flashindex.asp

http://www.tyrrellmuseum.com/research/fossils_law.htm

(Keywords: Alberta fossil laws, Royal Tyrrell Museum fossil laws, Alberta parks, Midland Provincial Park)

BADLANDS HIKE

POST-PROGRAM ACTIVITIES

1. BADLANDS POP QUIZ

Wonder #1: Rocks

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

1. _____
2. _____
3. _____

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

_____

_____

_____

Wonder #2: Bentonite Clay/Popcorn Rock

List three uses of Bentonite clay.

1. _____
2. _____
3. _____

Where does bentonite clay come from?

_____

_____

_____

Wonder #3: 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.

BADLANDS HIKE

POST-PROGRAM ACTIVITIES

Wonder #4: Dinosaur Fossils

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

_____

Why is erosion good for palaeontologists?

_____

Wonder #5: 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?

_____

Wonder #6: Glacial Erratics

Where were the glacial erratics now in the Drumheller valley originally formed and how did they get here?

_____

_____

Describe how the Drumheller valley was formed.

_____

_____

Wonder #7: Prickly Pear Cactus

List three adaptations that prickly pear cacti have to survive in their environment.

1. _____
2. _____
3. _____

BADLANDS HIKE

POST-PROGRAM ACTIVITIES

2. LES MAUVAISES TERRES

When the French explorers first came to the Alberta badlands they exclaimed "Ce sont des mauvaises terres a traverser" which translates to "They are bad lands to cross". Describe some of the features you observed in the badlands that led the French explorers to call these lands bad.

3. 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; and water.

Activity Instructions:

1. Fill the jar about 1/3 full of sand, gravel, and soil. Use equal amounts of each.
2. Add water until the jar is about 2/3 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 all the contents together.
4. Put the jar in a place where the contents can settle undisturbed (for at least one hour).
5. Complete the following tasks and questions in your notebook: sketch the jar and its contents just after you finish shaking. After the sediments have settled, sketch the jar and its contents again.
    a) How do the two sketches compare?
    b) Why did the sediments settle the way they did?

BADLANDS HIKE

POST-PROGRAM ACTIVITIES ANSWER KEY

1. BADLANDS POP QUIZ

Wonder #1: Rocks

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

1. Sandstone
2. Mudstone
3. Coal

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

Sandstone – formed in fast flowing waters; river environments

Coal – formed in slow flowing waters; ancient swamps

Wonder #2: 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

Wonder #3: 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.

BADLANDS HIKE

POST-PROGRAM ACTIVITIES

Wonder #4: Dinosaur Fossils

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

Hadrosaurs, also know as duck-billed dinosaurs

Why is erosion good for palaeontologists?

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

Wonder #5: 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 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.

Wonder #6: Glacial Erratics

Where were the glacial erratics now in the Drumheller valley originally formed and 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.

Wonder #7: 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-PROGRAM ACTIVITIES

2. LES MAUVAISES TERRES

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

3. FROM SAND TO STONE ACTIVITY

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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 all the contents together.
4. Put the jar in a place where the contents can settle undisturbed (for at least one hour).
5. Complete the following tasks and questions in your notebook: sketch the jar and its contents just after you finish shaking. After the sediments have settled, sketch the jar and its contents again.

    A) 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.

    B) 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.