BADLANDS UNBOXED

Teacher Resource Guide

Program Overview

TOPIC: The importance of the Drumheller badlands.

THEME: The badlands teach us many things—geologically, palaeontologically, culturally, historically, and ecologically.

PROGRAM DESCRIPTION: We can learn a lot from the badlands! We'll look at this incredible landscape from the perspective of four scientists: a geologist, a palaeontologist, a botanist, and a zoologist. Working in groups, students will look at actual specimens, and discover what the rocks, fossils, plants, and animals tell us about this environment, in the past and the present.

AUDIENCE: Grades 6 - 9

Curriculum Connections

Grade 6 **Science:** Ecosystems; Scientific Explanations

Grade 7 **Science:** Interactions and Ecosystems; Planet Earth

Grade 8 **Science:** Freshwater and Saltwater Systems

Grade 9 **Science:** Biological Diversity

Program Objectives

Students will be able to:

1. Observe the natural environment using the scientific method.
2. Discover natural history using different learning methods, including observation, illustration, and hands-on tactile engagement.
3. Gain new perspectives on palaeontology in Alberta by discovering diverse voices in the field of palaeontology.

4. Identify rocks (sandstone, mudstone, ironstone, coal, glacial erratics) and some minerals.

5. Explain or demonstrate how a fossil forms and how the badlands formed.

6. Identify some of the badlands' modern flora and fauna.

Suggested Pre-Visit Activities

1. PROGRAM TERMINOLOGY

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

Adaptations: The traits, characteristics, or behaviours that enable living organisms to survive and thrive in their specific environments. They are the result of evolutionary processes over extended periods of time, driven by natural selection.

Ammonites: A group of extinct marine molluscs that lived from the Devonian Period to the end of the Cretaceous Period. They are known for their distinctive spiral shells, which often exhibit intricate and beautiful patterns. Ammonites were widespread and diverse, with a wide range of shell shapes and sizes. They played important roles in marine ecosystems as predators and prey. Ammonite fossils are valuable for dating and correlating rock layers, and provide insights into the ancient marine environments in which they lived.

Bentonite: A type of clay composed mainly of minerals formed from ancient volcanic ash. Bentonite has a high water absorption capacity and swells when in contact with water. Its properties of fluid retention, lubrication, and binding make it useful in various industries such as drilling, construction, and cosmetics.

Biology: The scientific study of living organisms and their interactions with their environments. It encompasses the exploration and understanding of various aspects of life, including the structure, function, growth, evolution, and distribution of living organisms.

Botany: A branch of biology that focuses on the scientific study of plants. It encompasses the investigation of plant structure, growth, reproduction, physiology, classification, and evolution. Botany covers a wide range of plant-related topics, including plant anatomy, morphology, genetics, ecology, and plant interactions with their environments.

Coal: A black or brownish-black combustible sedimentary rock composed primarily of carbon, along with elements such as hydrogen, sulfur, oxygen, and nitrogen. It forms from the remains of ancient plants that have undergone geological processes over millions of years. Coal is a significant source of energy and has been used for centuries as a fuel for heating, electricity generation, and industrial processes.

Coyote: A species of canine native to North America. Coyotes are highly adaptable and can be found in diverse habitats, including forests, grasslands, deserts, and urban areas. Coyotes are known for their yipping and howling vocalizations. They are opportunistic predators and scavengers, feeding on small mammals, birds, reptiles, and even fruits and vegetables.

Creeping Juniper: A low-growing evergreen shrub native to North America, characterized by its trailing branches, scalelike foliage, and blue-green or silver-grey colouration. It is often used as a ground cover in landscaping due to its ability to form dense mats and tolerate various soil conditions.

Curiosity Cabinet: Also known as a cabinet of curiosities or a wunderkammer (German for "wonder chamber"). A collection or display of various unusual, rare, and intriguing objects or specimens. It originated in the Renaissance and gained popularity among scholars, scientists, and wealthy individuals as a means of highlighting their curiosity and fascination with the natural world.

Dichotomous Key: A classification tool commonly used in biology to help identify and categorize organisms, plants, animals, or other objects based on their observable characteristics.

Dromaeosauridae: A family of meat-eating dinosaurs that flourished in the Cretaceous Period. Dromaeosaurs had birdlike features, feathers, a slender, lightweight build, sharp claws on their hind limbs, and a long, stiff tail.

Fossil: The preserved remains or traces of ancient organisms (plants and animals) that lived in the past. Fossilization preserves the remains, impressions, or traces of an organism in rock through various physical and chemical changes over time.

Gar: A type of fish with an elongated, cylindrical body, a long snout filled with sharp teeth, and ganoid scales, which are thick, and diamond-shaped. Gars are typically found in freshwater habitats such as lakes, rivers, and swamps, and are known for their ability to breathe in both water and air.

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

Glacial Erratic: A rock or boulder that has been transported and deposited by a glacier in an area that is different geologically from its original source. Glacial erratics can vary in size from small stones to large boulders, and are significant evidence of past glacial activity.

Igneous Rocks: Formed when magma cools and crystallizes, either on the surface or underground.

Ironstone: A type of sedimentary rock that is rich in iron minerals. Characterized by its high iron content, which gives it a distinctive reddish-brown or rusty appearance. The formation of ironstone occurs through the deposition of iron-rich sediments in marine or freshwater environments. These sediments may accumulate in layers or concretions, resulting in the formation of solid ironstone rock. Ironstone deposits can vary in size, ranging from small nodules or concretions to extensive beds or formations.

Magpie: A bird known for its striking black-and-white plumage and long tail. Magpies are found in various parts of the world, including Europe, Asia, North America, and Australasia. Magpies are highly intelligent and social, often displaying complex behaviours and vocalizations. They are opportunistic omnivores, feeding on a wide range of food including insects, fruits, seeds, and small animals.

Metamorphic Rocks: Formed from the transformation of pre-existing rocks under high heat and pressure, causing changes in their mineralogy and texture.

Mineral: A naturally occurring, inorganic solid substance with a specific chemical composition and a defined crystalline structure. Minerals are the building blocks of rocks, and are formed through geological processes over millions of years.

Mosasaurs: Large, predatory marine reptiles that lived during the Late Cretaceous. They had streamlined bodies, powerful tails, and limbs adapted for swimming. Mosasaurs were apex predators, feeding on fish, squid, and other marine animals. Fossils found in the Bearpaw Formation have provided valuable insights into the diversity and biology of these ancient marine reptiles.

Mudstone: A fine-grained sedimentary rock composed mainly of mud-sized particles. It forms from the consolidation of mud, which is a mixture of silt, clay, and other organic and inorganic materials. Mudstone is typically smooth, compact, and easily split into thin layers. It commonly occurs in environments such as lakes, river deltas, and deep marine basins.

Mule Deer: A species of deer found in various habitats in western North America. Known for its large ears and distinctive jumping gait. These herbivores contribute to the ecological balance of their ecosystems. Males grow antlers that they shed and regrow annually.

Myledaphus: An extinct genus of ray fish that lived during the Cretaceous Period. *Myledaphus* had a flattened body with winglike pectoral fins and a long, whiplike tail. It is believed to have fed on small fish and invertebrates, using its specialized teeth to crush and consume its prey.

Ornithomimid: A meat-eating dinosaur that lived during the Cretaceous Period. Characterized by birdlike adaptations such as long, slender legs, a toothless beak, and sometimes feathers. Ornithomimids were fast and agile runners, likely adapted for pursuing small prey or scavenging. They had elongated arms with sharp claws, which they might have used for defense or manipulating objects.

Owl: A nocturnal bird of prey known for its upright stance and large eyes. Owls have specialized adaptations for hunting, such as silent flight, keen hearing, and sharp talons. A wide range of owl species are found in diverse habitats worldwide.

Palaeontology: The scientific study of prehistoric life and the history of life on Earth. It involves the examination of plant and animal fossils, as well as other evidence of past life, to understand the evolution, biodiversity, and ecological dynamics of ancient organisms.

Plesiosaur: A marine reptile that lived during the Mesozoic Era. Characterized by a long neck, barrel-shaped body, and four flippers. Some species reached lengths of up to 40 feet (12 metres).

Prickly Pear Cactus: Also known as Opuntia, prickly pear cacti are native to the Americas. Characterized by flattened pads covered in spines, and producing edible fruits called prickly pears.

Rabbit: A small mammal belonging to the family Leporidae, known for its long ears, hopping gait, and herbivorous diet. Rabbits are found in various habitats worldwide.

Raven: A large, black bird belonging to the genus Corvus, with glossy black feathers, a stout body, and a wedge-shaped tail. Ravens are highly intelligent birds and are found in various habitats across the Northern Hemisphere.

Red Fox: A carnivorous mammal with reddish-brown fur and a bushy tail, found in various habitats across the Northern Hemisphere. Red foxes are skilled hunters. Their diverse diet includes small mammals, birds, insects, and plant matter. They are highly adaptable and have successfully colonized both urban and rural environments.

Red-Tailed Hawk: A large bird of prey found in North America, with broad wings, reddish-brown plumage, and a red tail that becomes more visible when it soars through the sky.

Richardson's Ground Squirrel: A small diurnal (daytime) rodent species native to North America, primarily found in grasslands and open areas. Recognized by its sandy brown fur, short legs and ears, and high-pitched warning call.

Rock: A naturally occurring solid composed of minerals. Rocks are classified into three main types: igneous, sedimentary, and metamorphic.

Sandstone: A sedimentary rock composed mainly of sand-sized mineral particles or grains that are bound together by natural cementing materials. It is formed through the process of lithification, where loose sand accumulates, undergoes compaction, and is cemented over time.

Scientific Method: A systematic approach scientists use to investigate and understand the natural world. It involves making observations, formulating hypotheses, conducting experiments, analyzing data, and drawing conclusions based on evidence.

Sedimentary Rocks: Formed from the accumulation and compaction of sediments, which can include fragments of other rocks, minerals, and organic matter.

Silver Sagebrush: A shrub species native to North America, found in arid and semi-arid regions. It is characterized by its silvery gray foliage, which helps reduce water loss through reflection and acts as a defense mechanism against herbivores.

Snake: A limbless reptile characterized by a long, cylindrical body, scaly skin, and the absence of legs. Snakes are found in various habitats around the world, ranging from forests and deserts to grasslands and water bodies. Garter snakes and bull snakes are found in the Drumheller badlands.

Softshell Turtles: A family of freshwater turtles characterized by a unique flattened, leathery shell, lacking the bony plates found in other turtle species. Softshell turtles originated in the Early Cretaceous and are still alive today. They thrive in various freshwater habitats, displaying adaptations such as streamlined bodies and snorkel-like snouts for efficient swimming and breathing.

Swainson's Hawk: A medium-sized raptor known for its graceful flight and long, slender wings. Swainson's Hawks have variable plumage, ranging from light to dark morphs. These migratory birds travel long distances between breeding grounds in North America and wintering grounds in South America. They are important predators in their ecosystems, and primarily feed on small mammals, birds, reptiles, and insects.

Traces: Fossilized evidence or signs of animal activity that can be observed in the environment. Traces provide valuable information about the behaviour, movements, and presence of animals, even if the animals themselves are no longer present.

Turkey Vulture: Known for its distinctive red, featherless head and large wingspan. This bird is a skilled soarer, using thermal air currents to glide through the sky. Turkey Vultures use their keen sense of smell to find their food source: decaying animals. By cleaning up carcasses and aiding in the recycling of nutrients, Turkey Vultures play an important ecological role.

Tyrannosauridae: A family of large, carnivorous dinosaurs characterized by their massive size, powerful jaws, sharp teeth, and two-fingered hands. The most well-known member of this family is *Tyrannosaurus rex*, often referred to as the "king of the dinosaurs." Tyrannosaurs were apex predators in the Late Cretaceous.

Vole: A small rodent known for its stout body, short tail, and burrowing behaviour. These herbivorous creatures primarily feed on plant material such as roots, stems, and seeds. They inhabit grassy or wooded areas, playing a role in ecosystem dynamics and serving as prey for various predators.

Zoology: The scientific study of animals. It encompasses the investigation of various aspects of animal life, including their structure, classification, behaviour, physiology, evolution, and ecology.

2. BADLANDS BRAINSTORM

Badlands are semi-arid terrain in areas that 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 kinds of plants and animals live in badlands. Also consider the types of rocks that are found there.

- *Canadian Badlands | Canada's Alberta*
- *Canadian Badlands | Alberta Parks*
- *Badlands - Wikipedia*

Post-Program Activities

1. SCIENTIFIC ILLUSTRATION

Focus Question: What makes a good scientific sketch?

- An accurate sketch should convey the true nature of an object, including its size, shape, texture, etc.
- The sketch should be adequately sized to allow for clear visibility of details. It should not be crammed into a corner of the page, which makes it more difficult to discern.
- Whenever possible, enhance your sketch by incorporating colours.
- Use words and drawings to add intricate details to your sketch. These fine details distinguish the specimen being studied from others like it.
- Include labels, questions, and conjectures about what you observe. These annotations help explain your sketch more thoroughly.

Application: Have students create their own scientific sketches. This could be done outdoors in nature, on a visit to a museum, or in any other environment you choose.

2. DICHOTOMOUS KEY ACTIVITY

Continue learning how scientists classify organisms with this dichotomous key exercise using shells.

https://www.naturalhistory.si.edu/sites/default/files/media/file/dichotomouskeyworksheet.pdf

3. LEARN MORE ABOUT THE FOSSIL HUNTERS

- Irene Vanderloh
  bulletin251.pdf
- Jane M Colwell-Danis
  Jane Colwell-Danis - Trowelblazers
- Philip Currie
  https://www.alberta.ca/aoe-philip-currie.aspx
- Ramon S. Nagesan
  Paleontologist - The Influential Team
- Takuya Konishi
  UC paleontologist describes Wakayama 'blue dragon' that ruled prehistoric waters off Japan | University of Cincinnati

  https://youtu.be/fjw_mwh2-aw
- Betsy Nicholls
  PowerPoint Presentation

  A discovery of colossal proportions: uncovering the ichthyosaur | Canadian Geographic

  https://youtu.be/UEWaInxB4aI?t=217