



Making a difference...together

BEAVER ENGINEEVEER

Educators Guide

Program at a Glance

This program focuses on our national symbol, the beaver. We will begin the program with a dress-up introducing the students to beavers and their adaptations. Students will have the opportunity to have a close-up look at a beaver pelt and skull. Following the introduction, the class will be divided into two groups. Each group will participate in a guided walk to look for signs of beavers at Elk/Beaver Lake Regional Park, including the beaver lodge. Through hands-on activities, including building a model beaver dam and using binoculars, students will learn about the amazing ways in which beavers help create diverse wetlands.



In this program, students will:

- Introduce students to the physical and behavioural adaptations that help beavers survive in their environment.
- Foster an appreciation for beavers and the important role they play in forest and wetland habitats.
- Encourage an awareness of the interconnections between plants and animals in an ecosystem.

Curriculum Connections

Our place-based school programs directly relate to the K-5 science curricula. Below you will find some big ideas, curricular competencies and content that will be addressed on your program.

Big Ideas:

- Water is essential to all living things, and it cycles through the environment (Gr 2)
- Living things have life cycles adapted to their environment (Gr 2)
- Local actions have global consequences, and global actions have local consequences (Gr 2)
- Wind, water, and ice change the shape of the land (Gr 3)

- Living things are diverse, can be grouped, and interact in their ecosystem (Gr 3)

Curricular Competencies:

- Demonstrate curiosity and a sense of wonder about the world
- Observe objects and events in familiar contexts
- Ask questions about familiar objects and events
- Make simple predictions about familiar objects and events
- Make and record observations
- Experience and interpret the local environment
- Identify simple patterns and connections
- Transfer and apply learning to new situations
- Compare observations with those of others
- Compare observations with predictions through discussion
- Consider some environmental consequences of their actions
- Recognize First Peoples stories (including oral and written narratives), songs, and art as ways to share knowledge
- Express and reflect on personal experiences of place
- Questioning and predicting
- Make predictions based on prior knowledge
- Suggest ways to plan and conduct an inquiry to find answers to their questions
- Make observations about living and non-living things in the local environment
- Identify First Peoples perspectives and knowledge as sources of information
- Identify some simple environmental implications of theirs and others' actions

Content:

- Similarities and differences between offspring and parent (Gr 2)
- Metamorphic and non-metamorphic life cycles of different organisms (Gr 2)
- First Peoples use of their knowledge of life cycles (Gr 2)
- Water sources (including local watersheds) (Gr 2)
- Biodiversity in the local environment (Gr 3)
- The knowledge of local First Peoples of ecosystems (Gr 3)
- Energy is needed for life (Gr 3)
- Relationship between humans and their environment (Gr 3)

Suggested Pre-Trip Activities

- Read stories to introduce beavers and the important roles they play in ecosystems
- Draw pictures about your upcoming field trip and make predictions about what your class might see
- On the classroom bulletin board, have students draw pictures of the field trip topic or write predictions about what they might see.
- Create a K-W-L chart (what I know, what I want to know, and what I learned), and fill out the first two categories as they relate to beavers at Elk/Beaver Lake. Have students develop questions they would like to investigate.
- Read stories about beavers, including First Nations stories and historical accounts.

Follow-up Activities

- Share personal stories and experiences about your field trip
- Start a nature logbook for your classroom about mammals that are spotted, including beavers.
- Create a mural featuring animals you saw at the park
- Make a list describing how to protect beavers and their homes
- Return to the class bulletin board to make changes in their drawings or predictions based on their new knowledge gained from the field trip.
- Revisit the K-W-L chart and fill in the “L” (What I learned). Discuss answers to their investigative questions.
- Trace food chains and webs involving beavers.
- Make a model wetland with a beaver dam and lodge and pictures of various plants and animals found there.
- On a map, find your neighbourhood. Trace creeks, lakes and wetlands to map your watershed. More watershed resources found here: <https://www.crd.bc.ca/education/our-environment/watersheds>

Background Information

Beavers:

The beaver is the largest rodent in North America and the second largest rodent in the world after the capybara of South America. Very compact and rotund, the beaver is ungainly and slow

on land but not so in the water. The beaver is a graceful, strong swimmer, both under water and on the surface, attaining speeds approaching 7 km per hour if it is alarmed.

The beaver is a mammal of the scientific Order Rodentia, which are characterized by a single pair of continuously growing front teeth in the upper and lower jaws. Rodents are found almost everywhere in the world and are the most diverse group of mammals, including rats, mice, squirrels, beavers, chipmunks, gerbils, hamsters, lemmings, guinea pigs, and porcupines.

Beavers live in colonies (the parents plus two generations of young) and work together to gather food, repair the dam and the lodge. Beavers can live up to 19 years. Beavers are monogamous. They breed from January – February of every year and gestation lasts 120 days (4 months). Litter sizes are 1-8 kits but on average a beaver will have 4 kits (baby beavers are called 'kits'). Kits are protected and live with their parents until they are 2 years old when they leave to start their own colony away from their parents. At this point they can travel up to 5.6km to find their own territory.

There are a few adaptations beavers have:

- **FUR** - has two layers: long outer guard hairs and a soft inner layer of felt. Felt is made up of tiny, interlocking hairs that stick together and hold their shape. Under the fur is a fat layer insulates the beaver in 32 ° F water in the winter, and streamlines the body for faster travels in water.
- **TAIL**- tail has two physical functions: to store fat in the winter (enlarges up the three times its normal thickness!) and act as a kickstand to balance the beaver as it chews trees upright. Behavioral adaptation: The tail is used as a rudder for steering in the water, and as a paddle to slap against the water as a warning signal.
- **WEBBED HIND FEET** - Webbing between the toes helps to push water as the beaver swims. The fourth toenail on each hind foot is split and has a special purpose. Behavioral adaptation: The fourth toenail is used as a comb to spread waterproofing oils through the fur.
- **FRONT FEET** - front feet have long nails, which give the beaver traction in mud. Front feet are similar to human hands, except the thumb is weakest and the pinkie is strongest. Behavioral adaptation: Nails are used to grasp wood and as a comb for grooming. They will also use their front feet to dig canals between streams, through which they can float branches to add to dams or lodges.

- OIL GLAND - Located near the base of the tail is a waterproofing oil gland. Behavioral adaptation: Beavers spread the waterproofing oil through their fur, similar to the preening of ducks.
- CASTOR GLAND - Located near the tail on the abdomen, this gland contains castoreum. Castoreum was and is still used as a fixative in expensive perfumes. It is NOT related to castor oil, which comes from the castor bean. Behavioral adaptation: From spring-time to mid-June, beavers build mounds of mud with their hands and squirt castoreum on top of them to mark territory and attract mates.
- TEETH - teeth have two layers: a hard orange enamel on the front side and soft white dentine in the back. Beaver teeth grow constantly (like all rodents), so they must constantly chew to keep their teeth the proper length. Beaver teeth are self-sharpening; the dentine wears away faster than the enamel as the lower jaw works against the upper jaw. Behavioral adaptation: Beavers use their sharp teeth to cut down trees small branches. They gnaw vertically on trees, parallel to the trunk, leaving large chips around a fresh cutting. A beaver can cut down a four inch tree in less than 10 minutes. A large tree may take several days to cut. Beavers eat pond plants, ferns, buds, and leaves in summer, and the bark of aspen, willow, birch and alder trees and shrubs in winter
- NICTITATING MEMBRANE - Clear third eyelid that beavers can close, but still see through, while swimming in the water. Protects the beavers' eyes and helps them see.
- SPECIAL INTERNAL FLAPS (NOSE, EARS, MOUTH) - Keep water out of the beaver's nose and ears while diving. The mouth flap is a special inner mouth membrane BEHIND the teeth. Beavers can carry a stick in their teeth and close this membrane so they don't swallow the whole pond while swimming.
- GOOD LUNGS – Beavers can hold their breath for 15 minutes! Beavers' lungs can remove 75% of the oxygen in air, compared to humans' lungs which can remove 15%. They can also tolerate a high build-up of carbon dioxide in the blood, which we cannot.

The beaver is Canada's official national animal. Beavers were also the major reason for westward expansion and the opening of many portions of Canada. Beaver pelts were highly valued and were traded for goods. The pelts were used to make felt top hats that were very much in demand in Europe. In the early 1900's beavers were almost extinct because of extensive logging and fur trapping. With stricter regulations on trapping, aspen regeneration, and low populations of predators, beaver populations have since revived in North America. Now in BC beavers are not a conservation concern and are managed as a fur-bearer. The trapping of

beavers is regulated under the provincial Wildlife Act.

In addition to pressure from trapping, the beavers at Elk/Beaver Lake suffered from loss of habitat when in 1872, Elk Lake was recommended as Victoria's main domestic water source. In 1879, at the recommendation of the provincial government's chief surveyor Thomas Buckley, the water supply system was completed. This \$100,000 project involved clearing the willow swamps and removing the beaver dams that separated Elk Lake and Beaver Lake, laying pipes, and damming Colquitz Creek at the outlet of Beaver lake to join the two lakes and raise the water level. As a result, there were no beavers at Elk/Beaver Lake until 2014 when residents noticed flooding on the trails and a beaver lodge was spotted in the park.

Beavers, being ecosystem engineers, are among the few species besides humans that can significantly change the geomorphology, and consequently the hydrological characteristics and biotic properties of the landscape. Dams built by beavers dramatically alter riparian landscapes leading to the formation of extensive wetland habitat capable of supporting herbaceous plant species and animal species not found elsewhere in the riparian zone. Thus, beavers increase habitat and species diversity. Beaver foraging also has a considerable impact on the course of ecological succession, species composition and structure of plant communities, making them a good example of ecologically dominant species (e.g. keystone species).

Beavers' diet consists of leaves, twigs, bark (Aspen, poplars, alders, willows) sedges, and water lilies. They can chew through 15cm of tree in 15 minutes and consume 14-20 ounces of inner bark/day or 200-300 trees/year. In the fall they stockpile for the winter months - for 5 beavers they need 1.8 tonnes of food.

Beaver lodge:

A beaver lodge is typically a dome-shaped structure built by beavers in the middle of a pond or on the bank of a waterway. Similar to the dam, the lodge is built with sticks, roots, leaves, bark and mud. The lodge serves as a home for beaver family and includes a feeding den, a resting den, a source of fresh air, and usually two underwater entrance tunnels, which allow for a means of escape if a predator enters the lodge through one of the tunnels. The dens are constructed on a platform 10 cm above the water line so that the beavers will remain dry. Most lodges are about 5 m in diameter and about 2 m high. Walls can be up to 1.2m thick aiding in keeping it warm in the winter.

Beaver dam:

A beaver dam is not a home but rather a structure built by beavers to block water from leaving a water body, and instead enlarge the beaver's underwater habitat and create wetland habitat for other animals. The dam is built by layering sticks, rocks, roots, leaves and mud. The result is a stable structure that can withstand strong water pressure and erosion.

Beavers are stimulated to build dams by the sound of rushing water. Dams provide a protective pond and a constant water depth. The high water levels allow beavers to use canals to transport larger trees.

Dams ensure that the water level in the beaver's pond is high enough. Water 1.5-1.8m deep is important to avoid exposing an underwater lodge entrance, and to keep the pond from freezing solid in winter.

Wetlands:

A wetland is any area of land that is covered with water for a part of the day or year. There are two classes of wetlands: freshwater and saltwater. Wetlands perform many essential services as functional ecosystems, such as: water supply and regulation of flows, preventing floods and droughts; water purification; prevention of downstream and shoreline erosion; maintenance of biodiversity; provision of wildlife habitat; recreational, educational and cultural opportunities; and in some cases, production of medicinal and food plants.

Wetlands are one of the most important life support systems on earth. Currently comprising about 5.6% or 5.28 million hectares of British Columbia, they provide critical habitat for fish, birds, and other wildlife. Most wildlife in the province use wetland habitat at some point in their life cycle, and many red- and blue-listed species are wetland-dependent.

The functional contribution of wetlands in helping to minimize or remediate environmental problems is substantial. They absorb and filter sediments, pollutants, and excess nutrients; recharge groundwater; maintain stream flows; control runoff; store flood waters; reduce erosion; stabilize shorelines; and help regulate atmospheric gases and climate cycles. In short, wetlands absorb water quickly and release it slowly with an improvement in quality.

Wetlands provide for commercial and recreational use of wetland-dependent fish and shellfish, enhance agricultural productivity, and support a variety of scientific, educational and recreational opportunities. Environmental economists such as Robert Costanza have used various methods to estimate the economic market and non-market values of the goods and services of various ecosystems. For wetlands, the total value is estimated to be \$19,580 hectare/year (1994 US\$). Using this figure to estimate the goods and services value of wetlands, British Columbia's total wetland surface area of 5.28 million hectares would yield a potential value of over \$100 billion/year. At a local level such as the Fraser Valley, the total wetland surface area of 41,906 hectares would yield a potential goods and services value to society of over \$800 million/year.

There is a growing concern over the escalating rate of wetland losses in British Columbia. In the Fraser Vancouver Island, it is estimated that 50% to 70% of the original wetland habitat has disappeared. In the ecologically critical South Okanagan, wetland losses have reached 85%. Action is required to help reduce wetland losses and provide for coordinated conservation and management efforts. Because wetlands occur across a range of ecosystem types and can be affected by various land use activities, a comprehensive approach is needed to ensure the protection and management of wetlands. It is intended that several initiatives currently under development, including the Biodiversity Strategy, Species At Risk Strategy, the Living Rivers Strategy, as well as ongoing Land Use Planning and Protected Areas management, will all play an important role in protecting, maintaining and restoring wetlands (Canada, BC Ministry of Environment, 2017)

Resources

Backhouse, Frances. *Once They Were Hats: In Search of the Mighty Beaver*. ECW Press, 2015.

Crewe, Sabrina. *Canadian Symbols: Beavers*. Oxford University Press, 2015.

Walters, Eric. *Saving Sammy*. Orca Echoes, 2014 (CHECK- fiction, wildlife rescue/orphaned beaver)

Holland, Mary. *The Beaver's Busy Year*. Arbordale Publishing, 2014.

Runtz, Michael. *Dam Builders: The Natural History of Beavers and Their Ponds*. Fitzhenry and Whiteside Publications. 2015.

Simpson, Caroll. Coastal Spirit Tales: The First Beaver. Heritage House Publishing, 2015.

Westcott, Frank. The Beaver: Nature's Master Builder. Hounslow Press, 1989.