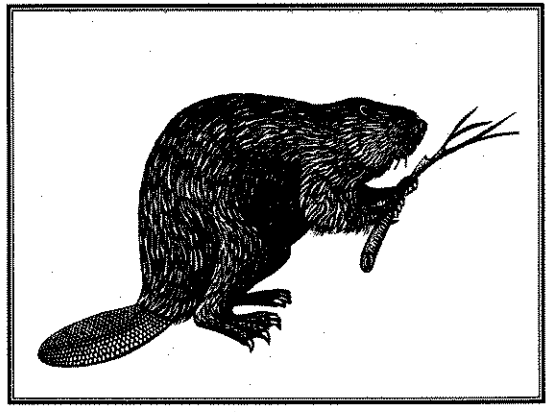


# BEAVERS

An illustrated guide to nature's greatest engineers for use with the IMAX®/OMNIMAX® motion picture *BEAVERS*

# CONTENTS

### *About this Guide*

*This illustrated guide has been prepared to help educators integrate the IMAX®/OMNIMAX® motion picture* ***BEAVERS*** *into school curriculums. The material has been aimed to provide easy reading for grades 7, 8 and 9, but is intended to include primary grades with teacher assistance.*


*Written by*
Susan Serapiglia

*Illustrations by*
Robert Verrall




The beaver is a typical example of how an animal's body can adapt over many thousands of years to suit the conditions in which it lives.

The beaver is born with the instinct to build; it uses its skills as a builder to change its environment and create a new habitat more suited to its aquatic needs.

Water is very important to this amphibious mammal; it provides a means of transportation (for heavy branches) and a place of refuge (from predators).

When the beaver builds a dam and creates a pond, it provides a fine aquatic habitat, not only for itself, but for many other living things.

This is a supplementary page for use by teachers who wish to extend the idea of **physical adaptation** to include a wider discussion of all mammals and their ability to adapt to almost any conditions on earth.



The IMAX®/OMNIMAX® motion picture ***BEAVERS*** is produced and distributed by Stephen Low Productions Inc. as a presentation of the Chubu Electric Power Company, Inc., Japan.

Printed in Canada

*Produced in the giant screen IMAX®/OMNIMAX® format,* ***BEAVERS*** *plunges viewers into the rich aquatic habitat of one of nature's greatest engineers for an intimate look. Set in pristine forests and waters in the heart of the Canadian Rocky Mountains, this film follows the story of a family of beavers as they grow, play and transform the world around them. Leaving the shelter of an overcrowded colony, a young pair of beavers set out over land in search of a location for their new home. A site is found and the beavers begin a monumental project: the total transformation of the surrounding area to suit their needs as water dwellers. Filmed principally in the Kananaskis region of Alberta, Canada,* ***BEAVERS*** *depicts the life of these amphibious animals, from tree-felling and dam-building, to the rearing of young and the hazards of the forest.*

# INTRODUCING THE BEAVER

The word "beaver" comes from the old Anglo-Saxon word "beofor" which referred to the European beaver. In addition to their common name in each language, scientists have given all animals and plants a scientific name, in Latin, that can be recognized all over the world. The scientific name for the North American beaver shown in the *IMAX®/OMNIMAX®* film is *Castor canadensis*. Although native to North American forests (from Alaska and Labrador down to the Rio Grande), *Castor canadensis* can now be found in Europe, along with its European relative, *Castor fiber*. It has also been introduced to small areas of Mongolia and China. *Castor fiber* used to dwell in all the forested regions of Europe, and in areas of Asia and Mongolia. It is now restricted to Eastern Europe, remote regions of Scandinavia, Finland, Siberia and Mongolia. The two species, *Castor canadensis* and *Castor fiber* are distinct, but they can interbreed.

**Order *Rodentia***

The beaver has fur and as a baby it drinks milk from its mother. These are two *characteristics* unique to all mammals.

Biologists have sorted all the different kinds of mammals into groups called *orders*. The beaver belongs to an order called *rodents* (order *Rodentia*). There are more kinds of rodents in the world today than there are members in any other order of mammals. Other rodents you might know are: mice, rats, squirrels, gerbils, hamsters, guinea pigs and porcupines.

The beaver is the largest rodent in North America and the largest in the world, except the capybara of South America. An adult beaver usually weighs somewhere between 18 and 30 kg (40 to 65 lbs), although one was caught in Wisconsin, U.S.A., that tipped the scales at 50 kg (110 lbs)! A large beaver may measure 1.3 metres long (4 ft), including its 30 cm (1 ft) tail.

The beaver is an *amphibious* rodent. This means that it can live both on land and in the water. On land, however, the beaver appears fat, humpbacked, awkward and slow moving. It cannot easily escape from its natural predators such as the wolf, the bear, the fox, the wolverine or the coyote.

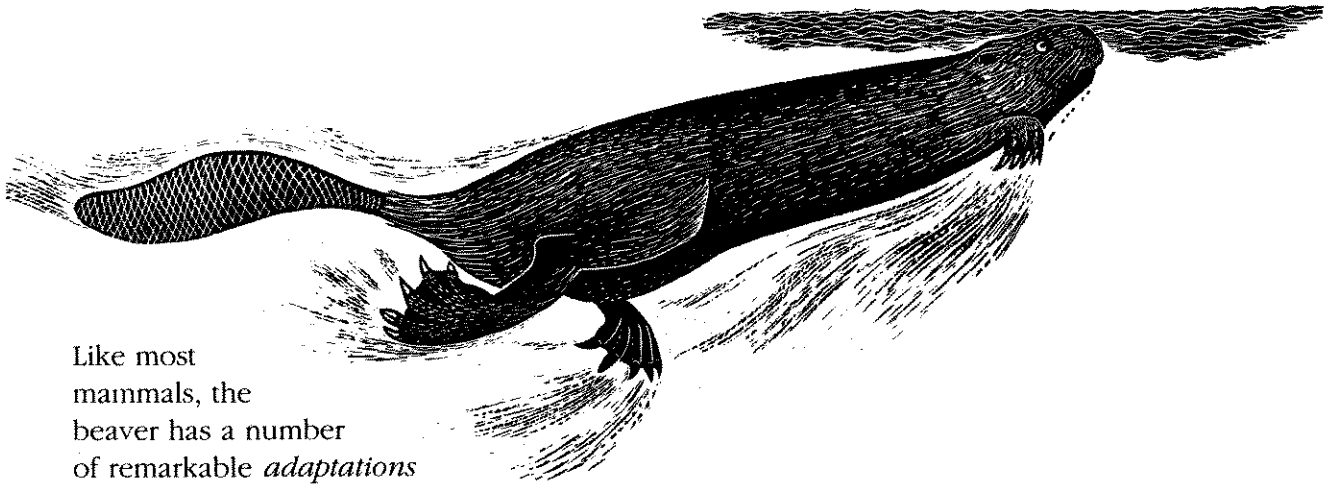
The beaver's life span can be from 15 – 20 years. However, with the dangers of predators and disease, most beavers will not survive beyond five years of age; many will die within their first year.

**Prehistoric beaver**

Prehistoric beavers inhabited the earth in the Pleistocene era (3 million years ago), and they survived until about 10,000 years ago. *Castoroides ohioensis*, a prehistoric beaver, was about the size of today's black bear – it weighed over 320 kg (700 lbs) and measured about 2 metres long (6 $^{1}/_{2}$ ft).

It is believed that the beaver's ancestors were land-based mammals, and *they adapted to an amphibious (land/water) habitat over many thousands of years.*

# PHYSICAL ADAPTATION



Like most mammals, the beaver has a number of remarkable *adaptations* which help it to survive.

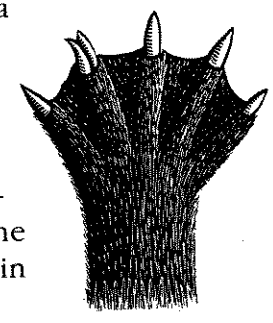
While awkward and slow on land, the beaver is more at home in water, where its *streamlined* shape enables it to move both swiftly and gracefully. Beavers are outstanding swimmers and divers. They have large and extremely efficient lungs and they can slow their heartbeats in order to *conserve* oxygen in their bloodstreams. These adaptations enable the beaver to hold its breath and remain submerged for up to 15 minutes. Seals and whales are the only mammals able to submerge for longer than a beaver. In contrast, the otter, another aquatic mammal, can stay under water for only four minutes.

**How does hair help the beaver stay warm?**

Beavers live mostly in northern climates with very cold winter temperatures. The water they swim in is often near freezing. How do they stay warm in this severe environment? Like all mammals, beavers are warm-blooded. In addition, like many other mammals living in a cold climate, they have two specialized layers of hair. The outer layer consists of coarse **guard hairs**, which are long and stiff and serve to protect the inner layer of hair called **underfur**. The underfur is short, soft and densely packed and it traps air to act as an *insulator* against the cold.

The beaver waterproofs its fur with oil obtained from its **oil glands**. These are located under the skin at the base of the beaver's tail. The beaver distributes the oil through both layers of fur by constant grooming. The oil from these glands helps waterproof the beaver by repelling any water on its fur. This protects the beaver when swimming, especially in cold winter temperatures.

Beavers spend hours grooming themselves and each other. To do this, they use the double claw or "split toenail" located on the second toe of each hind foot. These specialized claws act as a "comb" and are used for distributing the oil obtained from the oil glands. Grooming is a very important activity since it keeps the fur waterproofed and in perfect condition.



### Tail

The beaver is perhaps most famous for its unusual tail. It is flattened in shape and covered with scaly, leathery skin. The beaver's tail has important uses both in the water and on land. In the water the flat tail acts as a rudder – by turning it at an angle the beaver can steer a direct course even when carrying heavy, unbalanced loads of timber. Under the water, the beaver pumps its tail up and down for propulsion. When frightened, the beaver slaps the surface of the water with its tail, making a noise like a pistol shot. This warns all beavers in the area that danger is near. On land, the tail acts as a prop to balance the beaver when it is sitting or standing upright on its hind legs. It also helps to balance the beaver when it walks in an upright position carrying sticks and branches between its chin and front paws. In summer the beaver's tail acts as a radiator by releasing excess heat from the beaver's fur-clad body.

### Ears

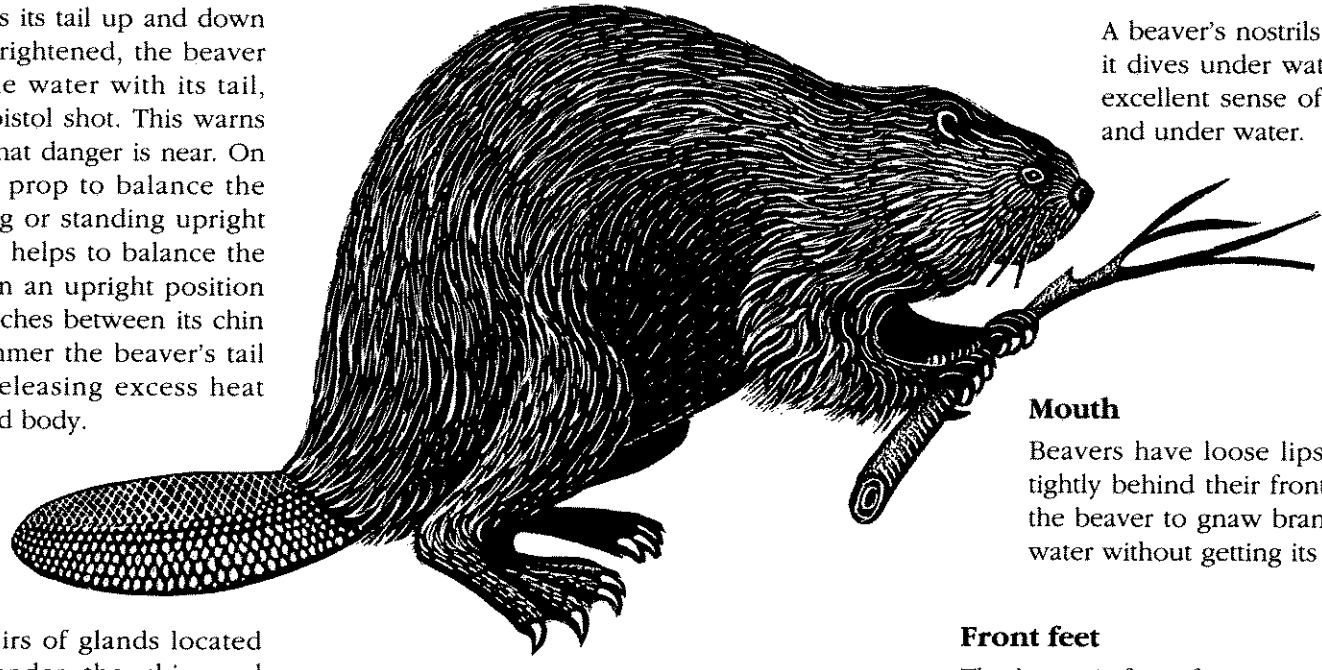
Beaver ears are small and have a special valve to shut out water when submerged. The beaver has excellent hearing both in and out of the water.

### Eyes

A transparent inner eyelid covers and protects the beaver's eyes when it is swimming under water. (Despite this adaptation, the beaver has poor eyesight).

### Nostrils

A beaver's nostrils close up as soon as it dives under water. Beavers have an excellent sense of smell both on land and under water.



### Mouth

Beavers have loose lips that can be closed tightly behind their front teeth. This enables the beaver to gnaw branches or bark underwater without getting its mouth full of water.

### Specialized glands

The beaver has two pairs of glands located next to each other under the skin and between the hind legs. The **oil glands** are the smaller pair and they secrete the oil which is used for oiling and waterproofing the fur. The second, larger pair, are the **castor glands**. The castors are scent glands, and they *secrete* a thick, yellow-orange liquid called **castoreum**. Beavers use this perfume to anoint small piles of mud on the shores of their ponds. This lets any stray beaver know that the pond is already occupied, and warns it to stay away.

### Hind feet

The beaver's hind feet are very large with five long toes which are *webbed* for swimming. When spread out they work like a paddle and help to propel the beaver through the water.

### Front feet

The beaver's front feet are small and delicate, with five long fingers and sharp claws. They are very *flexible* and beavers use them in the same way we use hands. With them, the beaver can hold and manipulate sticks with great dexterity (it can turn twigs delicately like a corn on the cob, while it strips the bark with its teeth).

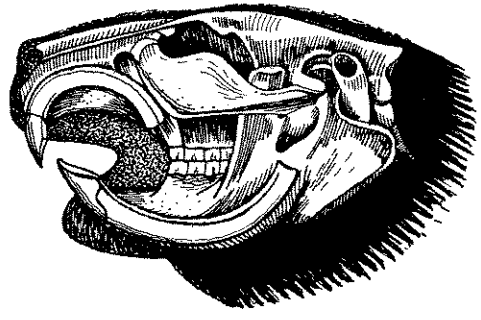
## Gnawing Mammals

Rodents are found all over the earth, including the Arctic; they have climbed trees, entered the water, and burrowed under ground. They can look very different from each other (compare the beaver or a spiny porcupine to a mouse or a squirrel), but they have all been put together in the same group: order *Rodentia.* This is because they have something important in common; they all have the same kind of *dentition* (teeth). All rodents have four big *incisors* (front teeth) – two at the top and two at the bottom. These teeth keep growing throughout the rodent's life. Their teeth have developed like this because of the kind of food they eat. For example, beavers and porcupines gnaw bark and squirrels gnaw nuts. *Rodents are mammals with teeth specially designed for gnawing.*

## Beaver Teeth – adapted for a woody diet

The beaver is a rodent and has dentition typical of other members of this order. Altogether, the beaver has 20 teeth – four enlarged incisors and 16 molars. The four incisors (two top and two bottom) never stop growing and must be worn down by constant gnawing. They are hardened on the outside with an orange/red enamel.

The front incisors are used to cut trees, strip bark and break branches and twigs. They also provide the beaver with a formidable weapon for fighting. The side teeth (molars) are short and square and they are used for grinding and mashing the beaver's hard, woody food. Although beavers share their always growing, self-sharpening teeth with other rodents, it is the beaver that puts them to the most dramatic test – cutting down trees.



*The inner surface of the front incisor teeth is softer and wears down more quickly when gnawing on branches and tree trunks. This maintains the sharp, chisel-like edge which provides the beaver with such an exceptional tool for cutting down trees. The beaver also sharpens its teeth by grinding the upper and lower incisors against each other.*

## What do beavers eat?

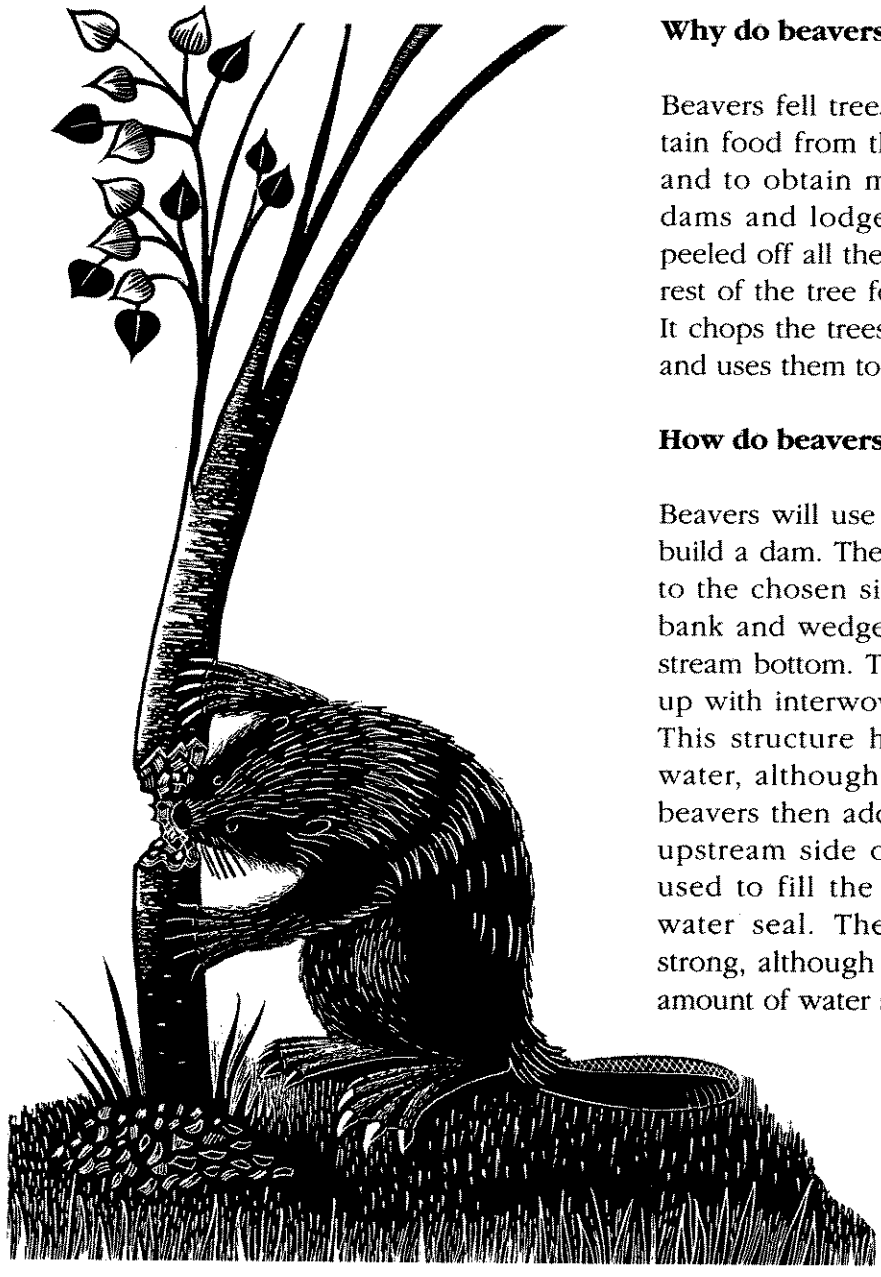
Beavers are *herbivorous* (vegetarian). They eat mainly bark and leaves, preferably from aspen, but also from willow, white birch and other deciduous trees. They will eat evergreens, but only when nothing else is available. Beavers also fell many alder trees, but they are used as a source of building material, not for food.

Although bark is their main source of food, in summer beavers often never go near trees, preferring instead to feed on the plentiful aquatic vegetation in the beaver pond.

## Beavers eat their food twice

This is because their diet of bark and fibre is very hard to digest. They have a large appendix where the cellulose is broken down and digested by special bacteria. This partially digested food is then excreted in a moist state. It is re-eaten so that the nutrients can be fully absorbed by the beaver's digestive system. This time, the waste product is dry and hard and is usually ejected directly into the water. This process of eating food twice to get as much nutrition as possible is a characteristic shared with other animals such as the rabbit.

# NATURE'S ENGINEERS



**Why do beavers fell trees?**

Beavers fell trees for two reasons: to obtain food from the bark of top branches, and to obtain material for constructing dams and lodges. After the beaver has peeled off all the bark it wants, it uses the rest of the tree for construction purposes. It chops the trees into convenient sections and uses them to build a dam or a house.

**How do beavers build dams?**

Beavers will use any available material to build a dam. They drag logs and branches to the chosen site at the stream or river bank and wedge them into place on the stream bottom. The dam is gradually built up with interwoven sticks and branches. This structure holds back some of the water, although a lot still escapes. The beavers then add stones and mud to the upstream side of the dam. The mud is used to fill the spaces and to act as a water seal. The finished dam is very strong, although there is always a certain amount of water seepage.

Dams are usually 1 to 1.5 metres high (3 to 4 ft) and vary in length from 1 to 30 metres (3 to 100 ft), although they can be much bigger. They come in many shapes and sizes because they conform to the site where they are built; some are narrow and high, others may be wide and low. A dam built by beavers in Saskatchewan, Canada, averaged 3 metres high (10 ft) and measured over 1,500 metres in length (almost a mile)! The dam used in the *IMAX®/OMNIMAX®* film ***BEAVERS*** was about 90 metres in length (300 ft).

**Dam Bursts**

While it is true that beaver dams can break and cause damage to public property such as roads and railways, this is not often the case. Beaver dams are built as an interlocking weave of sticks, mud and other debris, and, as such, they are more likely to spring a series of small leaks, rather than break in one big burst. Most of these leaks can be quickly repaired, unless there is a particularly heavy rainfall.

**Why do beavers build dams?**

Beavers build dams across small rivers or streams to make the river or stream spread out behind the dam into a deep pond. Although the beaver can live on land, it

prefers to be in water where it can move quickly and escape easily from predators. The water behind the dam spreads out to reach the trees on the shoreline, making them more accessible to the beaver for food and for construction material. The beaver can transport heavy or awkward loads of timber more easily in the water than on land. Beavers only build dams if they need to enlarge their available water habitat. They rarely build dams on lakes since these are deep enough already. Large lakes, or ones with greatly fluctuating water levels, are generally avoided by the beaver, as are fast flowing rivers.

**Beaver Canals**

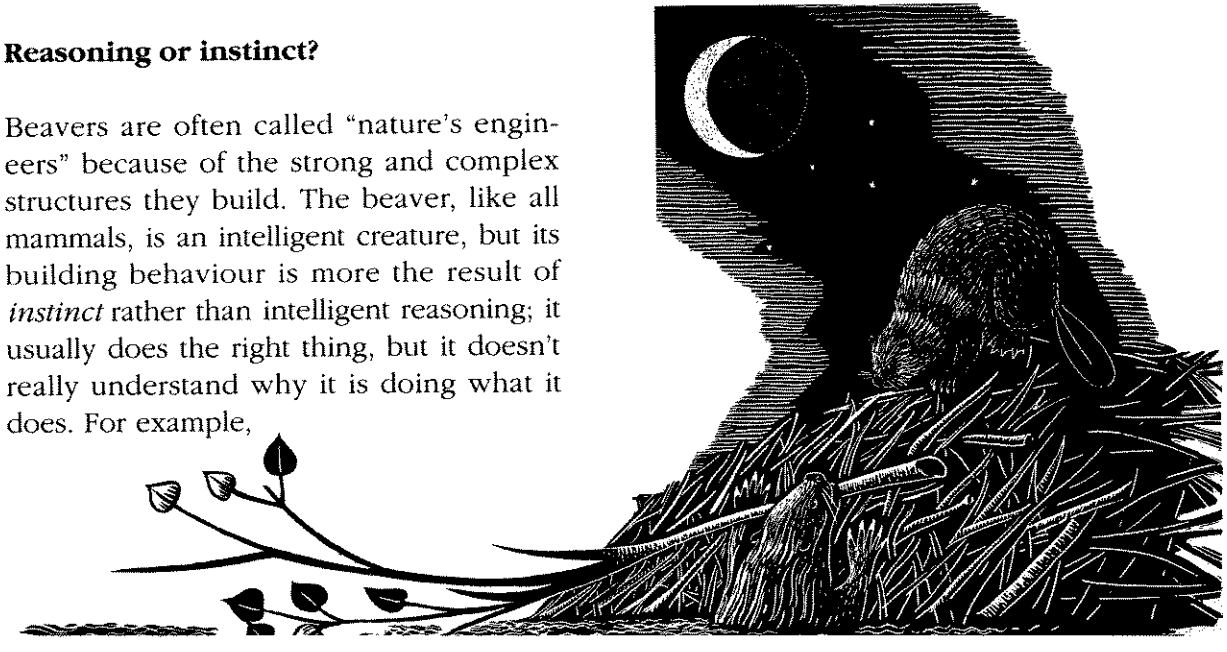
These are another impressive engineering feat of the beavers. They are built into the bank at the side of the pond and lead back into the wooded area where there are trees for food. They are used to float logs and branches to the pond. Canals are especially important when the beaver has eaten all the available food supply close to the pond, and must venture farther from the safety of the water in search of trees. The beaver is able to move quickly and easily in the canals and is safer from the danger of predators. The dam is increased in size while the canals are being constructed, so that enough water is backed up to fill the canals. Each canal is about 60 to 90 cm wide (2 - 3 ft) and contains about 45 cm (18 in) of water throughout. Canals can be as much as 100 metres (over 300 ft) in length.

**When do beavers work?**

Beavers are nocturnal as they are active mostly at night. However, they can often be seen working both in the morning and evening. They are most active in the autumn, when they cut trees and store food for the winter. At this time they also repair the dam and reinforce the lodge. Beavers are not very active during the winter months, when they become lethargic and eat less food. However, beavers *do not* hibernate and they often leave the lodge on warm winter days.

**Reasoning or instinct?**

Beavers are often called "nature's engineers" because of the strong and complex structures they build. The beaver, like all mammals, is an intelligent creature, but its building behaviour is more the result of *instinct* rather than intelligent reasoning; it usually does the right thing, but it doesn't really understand why it is doing what it does. For example, many people believe that the beaver is intelligent enough to fell a tree in any direction it chooses, just like a lumberjack. In reality, this is not true. Many trees it cuts often fall towards the water only because they are already leaning that way; others get caught up in nearby trees and are lost to the beaver. The instinct to build a dam is so strong that a pet beaver, living with a human family, will build a dam across a room with clothing, shoes, books or anything else it can find. Whether reasoning or instinct, this does not change the fact that beavers are wonderful builders. It is also a fact that *no other creature on earth, except the human being, makes such large scale changes to the environment to suit its own needs.*



# THE BEAVER POND

The pond is the beaver's refuge and it provides a safe place to build a house.

**The Lodge – the beaver's fortress**

Like many other animals, the beaver constructs a house, or lodge, for warmth and for protection against predators and to provide a place to give birth to young.

The lodge is usually built in the pond behind the dam, like an island, or it can be attached to the bank. The entrances are always underwater, safe from most enemies, but the interior living quarters are high and dry above the level of the water. One room is usually reserved for eating, another for sleeping, and perhaps another for storing food.

The lodge begins as a large mound of sticks and mud piled up by the beaver. When the pile is about one metre above the water, the tunnels and chambers are *excavated*. Finally, the entire outer surface – except for the very top of the lodge – is plastered with mud. The unplastered area at the top is for ventilation and forms a breathing hole (in winter, the water vapour rising from this hole lets you know that the lodge is occupied). Beaver lodges are extremely strong, especially in winter when the outside covering of mud freezes solid and forms an impenetrable barrier against predators. The frozen mud also acts as a layer of insulation against the cold; snug inside, the beaver's body heat is enough to keep the lodge interior warm and to stop the water in the entrance tunnels from freezing.

Sometimes, if there are high soft banks by the pond, the beaver may decide to build a **bank den** instead of a lodge in the water. These bank dens can be hollowed out far into the bank, and are connected to the water by a tunnel. European beavers, in particular, tended to build this kind of home.

Every autumn, beavers in northern latitudes construct **food piles** for the winter. Each food pile is an accumulation of the beaver's favourite woody food items placed in deep water close to the lodge or bank den. The branches are often anchored into the mud at the bottom of the pond to keep them from floating up. The water keeps the bark soft and juicy.

In winter, a beaver pond in northern latitudes will be covered by a layer of ice. The dam is used to make sure that the pond is deep enough not to freeze right to the bottom. This enables the beaver to swim under the frozen ice to get twigs from the nearby food pile and return to the lodge to eat, all in perfect safety from predators.

During the summer months, the beaver pond creates a *reservoir* for plant food, which the beaver is able to eat without

ever having to leave the safety of the water.

**The beaver family**

Beavers live together in small family groups called **colonies.** Beavers are *monogamous*, which means that one male mates with one female. They stay together until some tragedy separates them. The male beaver is called a buck and the female a doe. The **kits** are born in early May. The average *litter* is 3 to 4 kits. At birth they have a full covering of baby fur and their eyes are open. They will be able to swim when they are only four days old. Kits nurse for about 1-2 months. After this they are *weaned* and eat an adult diet. The young beavers can stay with their parents for several years, but they do not breed.

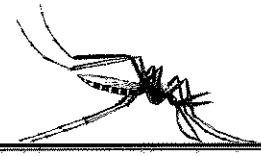
Within the colony, the oldest male is "boss", but all members work together as a family unit; for example, in the autumn young beavers help with collecting and storing winter food, and building dams and lodges. As with most mammals, they learn from their parents and from experience. Although all beavers are born with the instinct to build, they must practise in order to perfect their skills.

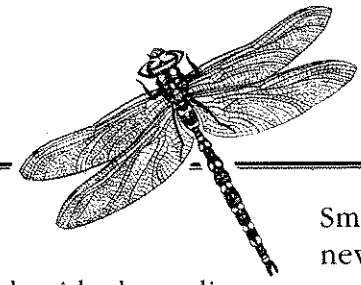
Beavers are very protective of their territory; they mark their boundaries carefully by building mounds of mud which they anoint with castoreum, a scent unique to beavers. Should any stray beaver from another colony enter their territory, they are prepared to fight to the death if necessary.

**Leaving home**

When the offspring are mature enough (at one or two years of age), they usually leave home so they can start a family of their own. If there is plenty of food available, they will simply build another lodge in the same pond, and live co-operatively with members of the original colony, helping to maintain the dam. If there is a shortage of the right kind of trees, they will have to search for a suitable site to build a dam and make another beaver pond of their own. Their journey is filled with danger, especially from predators. They can also face danger from other beavers.

# HABITAT





A habitat is the place where an animal or plant naturally lives and grows. There are many different kinds of habitat on earth. Each habitat supplies different kinds of food and different kinds of living conditions for its inhabitants. Each animal has its favourite food and must live where it can get what it needs. That's why, everywhere in the world, some kinds of plants and animals always live together. Animals and plants that share the same habitat form a *community*. This is rather like a human society where people live together and have different occupations, but all depend upon each other. Animals that live in the same habitat compete with each other for the available food supply, but they may also act in ways that help individuals of other species.

**The beaver pond –**
**a freshwater forest habitat**

The beaver is a very unusual animal because it can alter an existing habitat (a small stream or river) and create another one more suitable to its aquatic needs. When beavers create a forest pond, they provide a fine freshwater habitat, not only for themselves, but for many other living things.

**Flora**

The beaver pond provides ideal conditions for a variety of aquatic plants, including algae and duckweed. The water-lily, in particular, has an interesting relationship with the beaver, since the beaver pond creates a habitat in which water-lilies can grow. In turn, the water-lilies provide nutritious and easily obtainable food for the beavers all through the summer months. Water-lilies are also the favourite food items of the beaver's relatives, the muskrat and the water-vole. These aquatic plants give out oxygen which keeps the animals that live in the pond alive. Plants can also be a home or a hiding place. Some animals lay their eggs on the plants.

**Fauna**

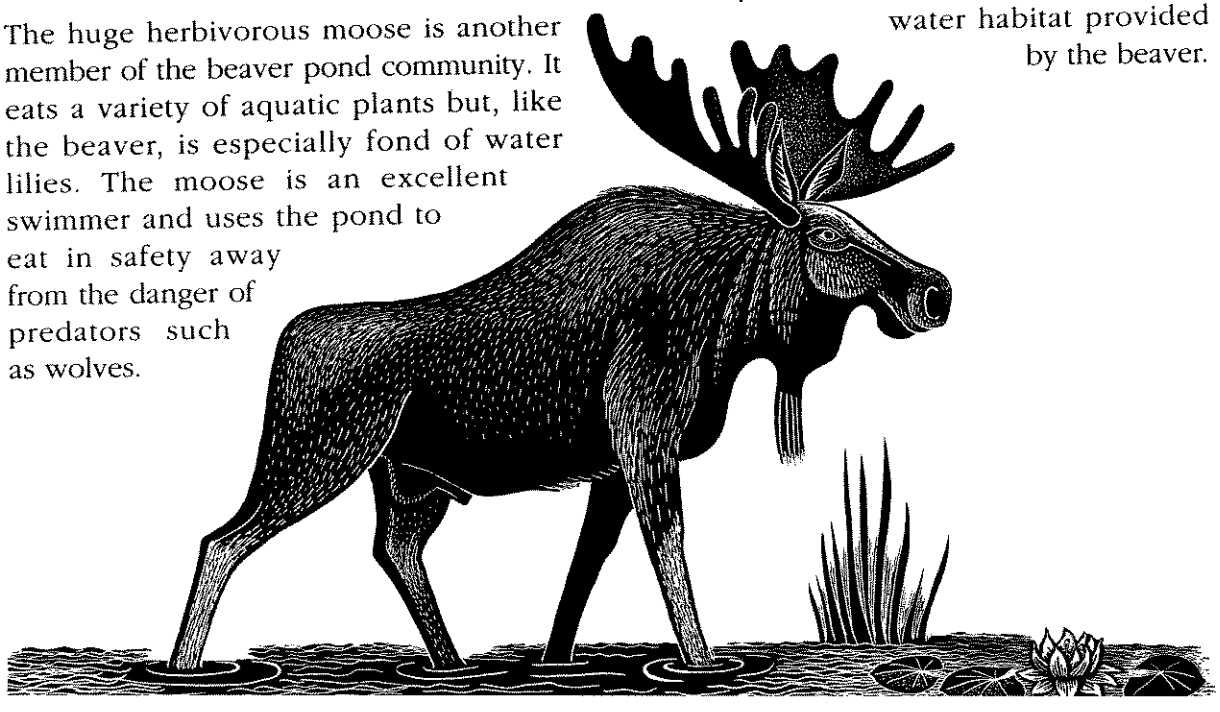
There are thousands of insects of many kinds at the beaver pond. Some insects live in the pond all the time, but others, such as the mosquito and fruit fly, lay their eggs in the pond water and then fly away. Dragon flies are always about, looking for mosquitoes to eat.

Small *amphibians* such as frogs, toads, newts and salamanders, find the beaver pond an ideal habitat. There are plenty of insects, insect larvae and water plants for them to eat and the pond provides a watery environment in which they can swim and lay eggs. The baby tadpoles swim in the water and eat little plants until they grow up into adult frogs and toads. They share their home with small *reptiles* such as turtles and snakes. The latter find frogs a tasty food item!

A variety of fish of all sizes take up residence in the pond. Birds such as the great blue heron come to the pond looking for fish to eat. Animals such as the muskrat, the otter and the raccoon also find the pond an ideal fishing spot. In its first years, the deep, cool water of the beaver pond provides an ideal habitat for trout.

Waterfowl come to the pond to breed. Trees that have been killed by the flooding of the pond now provide useful sites for roosting and nesting for birds such as owls, woodpeckers and swallows.

The huge herbivorous moose is another member of the beaver pond community. It eats a variety of aquatic plants but, like the beaver, is especially fond of water lilies. The moose is an excellent swimmer and uses the pond to eat in safety away from the danger of predators such as wolves.



The pond provides the otter with a safe refuge from predators and also with a fine variety of food in the form of crayfish, small turtles, fish, eels, water rats and frogs. The otter also hunts the beaver, and is one of the few animals that can enter the beaver's underwater entrance and swim into the lodge to attack defenceless kits.

Animals such as the deer come to the pond at night to drink. Predators, such as the wolf, the fox and the bear, come there to hunt and to benefit from the abundant supply of food. All of these animals are directly or indirectly dependent upon the water habitat provided by the beaver.

**Will the beaver pond last forever?**

No. Beavers use their pond to get as close as possible to their food supply of trees. As the years go by, the growing beaver colony usually eats the available trees faster than they can replace themselves. The beavers must now go further and further from the pond to find food and, in doing so, they expose themselves more and more to the danger of predators. Eventually they abandon the pond and move elsewhere.

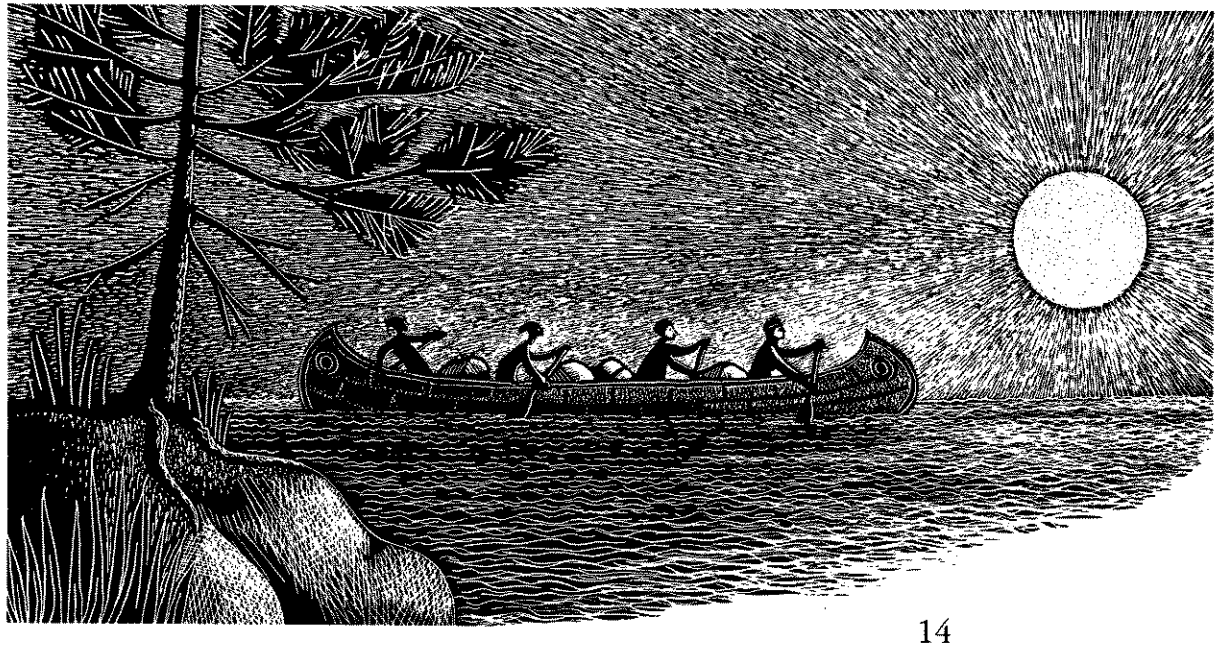
# THE BEAVER & CIVILIZATION

### North American Indians

North American Indians trapped beaver for food and to use its fur as a source of winter clothing. Indians viewed the beaver as they viewed all of nature, as a "gift", to be treated with great respect. Their religious beliefs taught them to take from nature only what they needed in order to survive; they believed that if they took more than they needed they would be punished by their gods. As a result, Indian hunters never trapped too many beavers, at least until the arrival of European traders.

### The European Fur Trade

Early Europeans, unfortunately, did not share the Indian's great respect for nature. Fur-bearing animals of all kinds were trapped in huge numbers so that important members of society could wear their furs as a status symbol denoting wealth and rank. Beaver skins were highly valued, especially as a source of felt for the hat making industry. By the 13th Century, as a result of *over-trapping*, the beaver was extinct in Britain and quickly disappearing in the rest of Europe. European fur traders now had to start looking elsewhere for furs.



### Exploration of North America

It is not surprising that the beaver is the national emblem of Canada and New York State's official mammal; the desire for furs was a reason for much of the development of Canada and of the United States. Fur trappers were willing to risk the dangers, both from natural hazards and Indians, of penetrating further and further into the interior of the vast North American continent. European countries, greedy for the wealth that came from furs, competed with each other for access to these fur-trading routes. In Canada, the adventurous *coureurs de bois* opened up many of these fur trading routes using knowledge they had learned from the Indians.

Beavers were so over-trapped that by the beginning of this century they were in danger of extinction in North America, as well as in most of Europe.

**Beaver protection**

Now, thanks to careful management and public awareness, wildlife authorities claim that there are more beavers on the North American continent than ever before. Many European countries have also increased or re-established their beaver populations.

In the past, the beaver has been appreciated only for its commercial value (for its fur and its castors); today people are becoming more aware that this creature has an important influence on our total environment.

**The beaver helped make our farmlands**

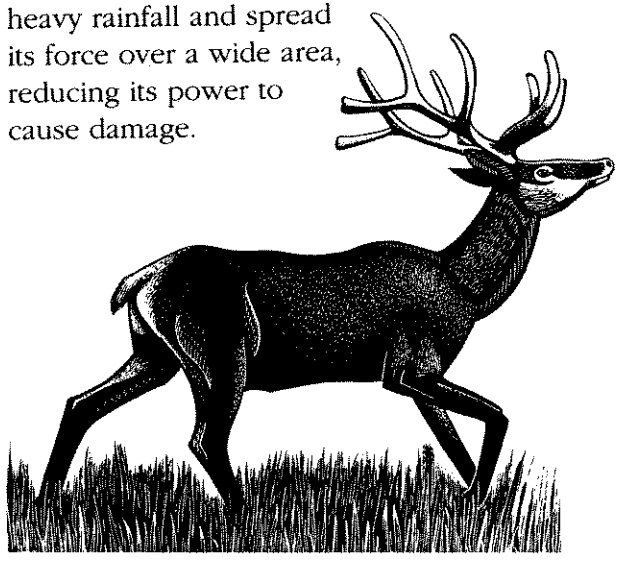
Once the beaver pond is abandoned, the unattended dam falls into disrepair and the pond drains. The muddy area where the pond used to be is quickly transformed into rich and fertile grassland. This **beaver meadow** now provides a new habitat for a different community of animals. Much of the rich soil on today's farms was once created by beaver ponds.

**The beaver helps conserve water**

The industrious beaver plays an important role in maintaining our fresh waterways. By holding water in the beaver pond, beaver dams prevent water run-off, especially after a heavy rainfall. Water that might otherwise have been lost is now saved and available to the plants and animals in the area. This is particularly important in times of drought, when small, beaverless ponds, dry up. In addition, the water that is saved in the beaver pond is spread over a wide area and now has time to soak down into the ground and recharge the local water table.

**Beaver dams can prevent floods**

Although the pond created by a dam can spread out and cause flooding on roads and railways, more often than not beaver dams actually prevent floods. A series of beaver dams along a stream or river can slow the rapidly flowing water after a heavy rainfall and spread its force over a wide area, reducing its power to cause damage.



**Do beavers harm our trees?**

Beavers usually fell softwood trees or small, fast growing hardwood (such as the alder and the willow). They do not often harm commercially important hardwoods such as the oak.

**Is the beaver a nuisance?**

Although the beaver is no longer in danger of *extinction*, it often comes into conflict with humans. While people may accept damage to public property, such as roads and railways, with a sense of humour, private home and cottage owners are not so amused when their property becomes the target of these industrious, sharp toothed creatures! In the world of nature, beaver ponds and dams provide a useful service to the environment. It is only in the world of humans that the beaver is considered a nuisance. As people move into areas naturally inhabited by beaver, there is increasing conflict of interest between the two. Floods that can be a beneficial source of water in the world of nature are costly and damaging in the world of humans. However, with careful management and a little compromise, it should be possible for humans to share the environment and live in harmony with the beaver and other wildlife.

# THE BEAVER IS A MAMMAL

The beaver belongs to a group, or *class*, of animals called Mammals. Altogether there are five classes of *vertebrates* (animals with a backbone) in the Animal Kingdom. The five classes are: Fish, Amphibians, Reptiles, Birds, and Mammals. Biologists sort (or *classify*) animals like this to make them easier to study. The animals in each group are put together because they share certain characteristics.

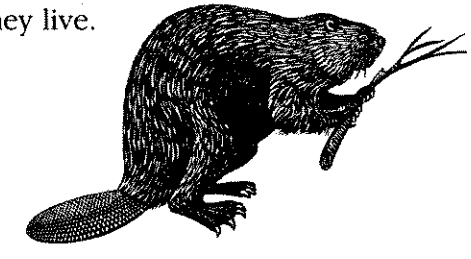
**Mammals (Class *Mammalia)***

You are probably more familiar with mammals than with any other kind of animal. Dogs and cats are mammals, and so are monkeys, kangaroos, whales and beavers. Even more important – YOU are also a mammal! But what is a mammal? How does this class differ from all other animal classes? There are some important *characteristics* that are *unique* to mammals. For example, all mammals have the ability to produce milk from special glands, which is nursed to their young. (Human mothers nurse their babies with milk that is produced in their breasts). Another characteristic unique to mammals is that they all have hair on their body at some stage of their growth. Mammals such as porpoises and whales are almost totally hairless when fully grown, but all mammals, at some stage of their lives, have hair. Mammals also have another very important characteristic: they have a highly developed brain. This means they are more intelligent than other animals; they can remember and learn from their experiences (this is why many mammals can learn to perform tricks). Chimpanzees for example, can learn to use a stick as a tool to reach a bunch of bananas. Humans have the most highly developed brains of all animals.

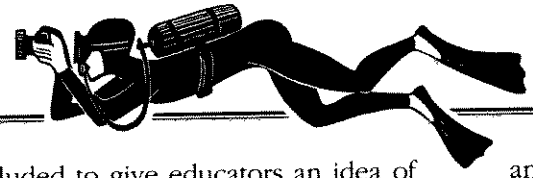
Mammals are also all *warm-blooded*. This means that a mammal's body can stay at almost the same temperature whatever the outside temperature is like. This is very important because it means that a mammal can adapt to almost any climate – even if it is very cold or very hot. Polar bears, reindeers and walruses live in some of the coldest places on earth. Camels and kangaroo rats live in the desert, which is extremely hot. The beaver is able to keep a normal body temperature in a climate which is very cold in the winter, but can be hot in summer. Members of the bird class are also warm-blooded.

Most mammals (with the exception of a few primitive orders) give birth to live young. The babies are often helpless and dependent upon their parents for protection and their mother's milk for nourishment. Mammals, as a group, give more attention to their young than any other animals; the young usually stay with their parent (or parents) long enough to learn special survival skills.

Mammals are the youngest class of animals; they evolved from reptiles. They are found in more places in the world than any other kind of animal. Most mammals live on the land; the beaver, the platypus and the walrus are *amphibious*; whales, dolphins and porpoises live in the ocean; bats fly in the air; moles and pocket gophers spend practically their entire lives underground. All these animals are mammals, but they look and behave very differently from each other because over millions of years they have *adapted* to the conditions in which they live.



# ACTIVITIES



The following activities have been included to give educators an idea of the range of topics that can be developed from this guide. Most of these activities can be adapted for use with a wide range of grade levels.

**1.** The scientific name for the North American beaver is *Castor canadensis*. Have students find the scientific name for *dog, cat* and *human.*

**2.** What are two characteristics unique to all mammals? Younger students could find pictures of different mammals nursing their young. (Include a picture of a human mother nursing her baby, to show that humans are also mammals). Talk about fur and hair – point out to younger students that they have hair all over their bodies, not just on their heads. It helps to trap air and keep them warm when the weather is cold.

**3.** Humans, like beavers, are mammals. Beavers are rodents; what order do humans belong to? What are the characteristics of this order and what animals share this order with humans?

**4.** A diver needs to use special equipment: mask; flippers; air tank; mouth piece; wet suit. Compare these to the beaver's natural aquatic adaptations.

**5.** Set a timer for 15 minutes while students work. Remind them that the beaver can hold its breath all this time. Discuss the difference in capacity between human and beaver lungs. Point out to students that beavers do NOT breathe under water; they hold their breath by conserving oxygen. Compare the beaver, as a mammal with lungs, to a fish that can breathe underwater with gills.

**6.** Whales, dolphins, seals, sea lions and walruses are all sea mammals that descended, millions of years ago, from land animals. Members of the order *Cetacea* have lived in the sea the longest and have made the most adaptations (ie., nostrils have moved to the top of the head; they can give birth in the water). Find out about members of this order and compare them to members of the order *Pinnipedia* (seals, sea lions and walruses), animals that have not lived as long in the sea and have not adapted to a life completely in water. How do sea mammals keep warm?

**7.** Compare the beaver's skull and teeth with the teeth of carnivores such as lions, tigers, wolves. How are they different? Ask students which teeth are missing in rodents (canines). Compare the teeth of lions, tigers, wolves – why do these animals need such big canines? (For stabbing and holding prey). Why don't rodents need them? Look for similarities and differences in pictures of many skulls and teeth. (Omnivores such as humans, raccoons and bears have a variety of different teeth because they eat a varied diet). Baleen whales do not have any teeth; they have baleen! The earth's largest animals eat the ocean's smallest animals.

**8.** The squirrel is another rodent. It has the same kind of teeth as the beaver. In what other ways is it similar to the beaver (front limbs – why?); in what ways is it different? (Compare hind limbs and tail – why are they different? What does each animal use them for? Why are the tails, in particular, so different?) What kind of home does the squirrel build? Where is it located? Why? (This theme could extend to a discussion about animal homes in general – younger students could collect pictures; remind them that birds are animals too). Have students draw a picture of the squirrel and the beaver in their different habitats.

**9.** Many state/national parks have organized well explained "beaver pond trails". If possible, take the class to visit one of these, where they can see a dam, a lodge and a beaver pond at first hand. If this is impossible, take students to a local creek or small stream and have them build their own dam, using branches, leaves, stones and mud. This should give them some idea of the way a dam works. *Remember to have them clear away the dam afterwards.* It would also be useful to take students to visit a local man-made dam where they can have a guided tour. They will see the impounded reservoir of water, and can compare this to the (smaller) beaver pond. This water is often used as a source of drinking water for humans; the beaver pond provides drinking water for many animals.

**10. Food Chains:** Explain or remind students that green plants (plants containing chlorophyll) can make their own food using the sun's energy, plus water and carbon dioxide. This food making process is called *photosynthesis.* Plants are called *producers* because they produce all the food energy that is passed up through the food chain to animals. Animals, both herbivores and carnivores, are *consumers* because they must eat the plants or other animals to obtain food energy. Have students make food chains for the beaver pond. They can include animals and plants that live in and near the pond, as well as animals that come there to hunt. Remind them to start with a green plant and that insects are animals. Older students can combine the food chains into a food web of the beaver pond habitat. If the links in the food chains have been nicely illustrated in circles, they can be arranged on the wall, with a central sun radiating energy to all life.

**11. Project:** Students can individually, or in groups, make a project entitled: **The Beaver Fur Trade**. The project should begin with European fur fashions (especially beaver hats) and explain how beavers were the catalyst for exploration of the North American continent. With all the information available, this has the potential to be a very creative project with lots of opportunity for illustrations and maps.

**12.** There are five different classes of animals, including mammals. Find out about the other four classes and what the characteristics are of each. Younger students can collect pictures to illustrate these different characteristics (ie., birds with feathers, lay eggs; reptiles have scales or bony plates, hatch from eggs laid on land; amphibians live on land/in water, have slimy skins, hatch from eggs laid in water or wet places; fish have scales, gills to breathe, hatch from eggs laid in water).

**13.** The beaver is *amphibious,* but not an *amphibian.* Can you explain the difference?

**14. (Grades 7 - 9 only)** The beaver, like all mammals, is unable to digest cellulose; it needs the help of special bacteria located in the appendix. Compare the relative size of a human appendix to that of the rabbit and/or beaver. Why is the human appendix small by comparison? Could a beaver or rabbit survive without its appendix, as humans can? Why do beavers and rabbits need to "re-eat" their food, after it has been broken down by the bacteria in the appendix? Have students find out how cows and sheep handle cellulose digestion. How do they differ from beavers and rabbits?

**15.** Most mammals give birth to live young. Ask the class to find out about the two orders of *primitive* mammals that do not share this characteristic. (Monotremes lay eggs very similar to the reptiles from which mammals evolved and marsupials keep their underdeveloped young in a pouch). Younger students can collect or draw pictures of some of these unusual animals. Older students can find out more about the reproduction of these animals and compare them to *placental* mammals. What advantages do placental babies have? Why are most members of these two orders found in Australia or nearby regions? (The exception is the opossum, which is found in North and South America). It might be interesting to have students compare the amphibious duck-billed platypus (a monotreme from Australia) with the amphibious beaver (a rodent from North America).

**16.** The blue whale and the elephant are very large, the shrew and the mouse are very small. What advantage does the size of each animal give it in its ability to survive in its particular habitat?

**RECOMMENDED ADDITIONAL READING**

RYDEN, Hope. *Lily Pond: Four years with a family of beavers*
New York, William Morrow, 1989

RYDEN, Hope. "The Beaver is One Smart Rat"
*Audubon Magazine* (September 1988): 98 - 104

WESTCOTT, Frank. *The Beaver, Nature's Master Builder*
Willowdale, Ontario, Canada, Hounslow Press, 1989

# THE BIGGEST DAM MOVIE YOU EVER SAW.

# BEAVERS

Produced by
STEPHEN LOW PRODUCTIONS, INC.,
for Chubu Electric Power Company, Inc., Japan.