Educator's Guide to

Maryland's Furbearers

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Wildlife and Heritage Service

Revised September 2022

Why Care About Furbearers?

Furbearers are mammals and are a part of Maryland's natural heritage. Species classified as furbearers in Maryland include both rodents and carnivores. These species are managed through strict trapping regulations. In the USA, the value of the fur industry at retail level was $1.8 billion in 2003-2004.

Maryland contains 14 species managed as furbearers, 13 of which are common and abundant. Bobcats are currently considered to be uncommon in Maryland, so trapping seasons for this species are closed. This kit is designed to provide hands-on learning activities to teach students about furbearers and their importance. In addition to this background section, information and activities are broken up into three main units:

Unit 1) Examining the history of the fur trade in the US and Maryland
Unit 2) Examining the biology and ecology of furbearers in Maryland and
Unit 3) Examining conservation and management of furbearers in Maryland

Image by: John White

Furbearer Facts

Furbearer is the name given to mammals that traditionally have been hunted and trapped primarily for fur. Furbearers are a diverse group, including carnivores, omnivores and herbivores. There are 14 species of furbearers in Maryland:

- Beaver
- Bobcat
- Coyote
- Fisher
- Gray fox
- Long-tailed weasel
- Mink
- Muskrat
- Nutria
- Opossum
- Raccoon
- Red fox
- River otter
- Skunk

Furbearers that are legally harvested for human use are always common and abundant.

Not all kinds of furbearers are hunted and trapped in every state as furbearers plentiful in one state might be scarce in another.

Fur is a renewable resource. People have continuously used furbearers in North America for clothing, food and religious ceremonies for the past 11,000 years.

Many cities in North America were founded by the fur trade. Fur-founded cities include New York, St. Louis and Chicago.

Furbearers provide important ecological services as some furbearers are predators and other are prey. Some furbearers like Beaver also create wetland habitat.

Most furbearers possess two layers of fur:

- Underfur: dense, soft fur that provides insulation and water-repellent qualities
- Guard hairs: outer layer of long, glossy hairs that grow through the underfur and protect it from matting and abrasion

Wild fur

- Represents about 15% of the world's trade in fur
- No endangered species are used and trapping is highly regulated
- An international agreement is in place between the European Union and the main wild fur producing countries to ensure that only the most humane trapping systems are used
- In USA, the value of the fur industry at retail level was $1.8 billion in 2003-2004.

Furbearer Pre-Test

This mini-test is designed to examine your existing knowledge of Maryland's furbearers.

1. **What is a furbearer?**
   _____
   _____

2. **Name three furbearers found in Maryland**
   _____
   _____
   _____

3. **Furbearers have two types of fur called _____ and _____.**

4. **List two products that come from furbearers:**
   _____
   _____

5. **List two problems caused by furbearers**:
   _____
   _____

6. **List ways that society benefits from trappers**:
   _____
   _____
   _____
   _____

Furbearer Pre-Test Answers

This mini-test is designed to examine your existing knowledge of Maryland's furbearers.

1. **What is a furbearer?**
   A mammal which has been traditionally hunted or trapped primarily for their fur.

2. **Name three furbearers found in Maryland**
   Beaver, bobcat, coyote, fisher, grey fox, long-tailed weasel, mink, muskrat, nutria, opossum, raccoon, red fox, river otter and skunk

3. **Furbearers have two types of fur called** underfur **and** guard hairs**.**

4. **List two products that come from furbearers:**
   Furs, meat and by-products such as perfume and fishing lures

5. **List two problems caused by furbearers**:
   Crop depredation, property damage, flooding, disease vectors, habitat destruction

6. **List ways that society benefits from trappers**:
   Disease control, population control, habitat protection, endangered species protection, property protection, wildlife restoration and wildlife research

Furbearer Resources

The following list of resources provides more in-depth information on the ecology and management of furbearers.

Association of Fish and Wildlife Agencies (http://www.fishwildlife.org)
- Information on sustainable use of US fish and wildlife populations

United States Fish and Wildlife Service (http://www.fws.gov/)
- Information on US fish and wildlife populations, including rare, threatened and endangered species

Maryland Department of Natural Resources (http://www.dnr.state.md.us/wildlife)
- Information on MD's wildlife, their habitats and how DNR manages it

Furbearers of Maryland
(https://dnr.maryland.gov/wildlife/Pages/hunt_trap/furbearers.aspx)
- Information on Maryland's furbearer species

Maryland Fur Trappers, Inc (http://www.marylandtrappers.com)
- Information on MD's furbearers as well as trapping guidelines

Furbearers Unlimited (http://www.furbearers.org)
- Brief introduction on furbearers around the United States as well as species profiles

Illinois Furbearer Guide
(https://www2.illinois.gov/dnr/conservation/wildlife/Pages/IllinoisFurbearersGuide.aspx**)**
- Brief introduction on furbearers within Illinois as well as species profiles

National Trapping Association (http://www.nationaltrappers.com)
- Information on furbearers and trapping throughout the United States

North Carolina Furbearer Guide
(http://www.ncwildlife.org/trapping/Trap_Furbearer_Management.htm)
- Comprehensive guide to NC's furbearers and their management

Photo and Video Resources for Educators

Beaver
- https://animaldiversity.org/accounts/Castor_canadensis/

Bobcat
- https://animaldiversity.org/accounts/Lynx_rufus/

Coyote
- https://animaldiversity.org/accounts/Canis_latrans/

Fisher
- https://animaldiversity.org/accounts/Martes_pennanti/

Gray Fox
- https://animaldiversity.org/accounts/Urocyon_cinereoargenteus/

Long-tailed Weasel
- https://animaldiversity.org/accounts/Mustela_frenata/

American Mink
- https://animaldiversity.org/accounts/Neovison_vison/

Muskrat
- https://animaldiversity.org/accounts/Ondatra_zibethicus/

Nutria
- https://animaldiversity.org/accounts/Myocastor_coypus/

Opossum
- https://animaldiversity.org/accounts/Didelphis_virginiana/

Northern Raccoon
- https://animaldiversity.org/accounts/Procyon_lotor/

Red Fox
- https://animaldiversity.org/accounts/Vulpes_vulpes/

Northern River Otter
- https://animaldiversity.org/accounts/Lontra_canadensis/

Striped Skunk
- https://animaldiversity.org/accounts/Mephitis_mephitis/

Image by: Bob Coury/ Paintnet Inc.

Unit 1:

History of the Fur Trade in the United States and Maryland

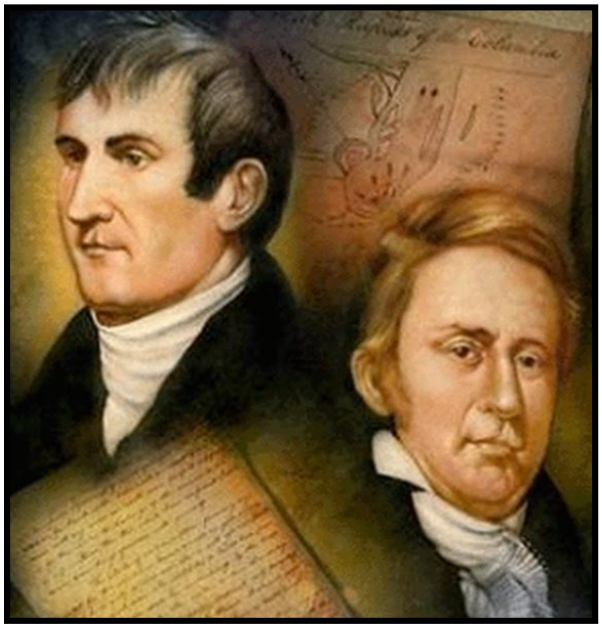
Brief History of the Fur Trade in the United States

The history of trapping dates back to the earliest days of mankind. For as long as people have tried to protect themselves from the elements, they have used the skins of furbearing animals. When the first humans arrived in North America, during the Ice Age some 11,000 years ago, much of the continent was covered by glaciers. These people would not have survived without their fur clothing.

North America has always provided a wealth of furbearing animals. The first European settlers to reach these shores quickly observed this. Fur became an article of trade in North America in the late 1500s and early 1600s. In 1534, **Jacques Cartier** was the first documented European to trade furs with the Native Americans. In 1608, **Samuel De Champlain**, a French explorer, established the first North American fur trading post at Quebec.

Many wars and battles were fought over the fur trade. During the 1600s, the Iroquois Nation frequently battled other native tribes in Canada and the Ohio Valley to gain control over land where furbearers lived. This period of time is known today as the **Beaver Wars**.

In the year 1670, the **Hudson's Bay Company** was established in what is now Canada. The aim of this company was to buy fur pelts. This makes the harvest of furbearing animals one of the oldest industries in North America.



Lewis and Clark

The furbearing animals, and the trappers who followed them, played a large role in the development of this country. In 1804, President Thomas Jefferson commissioned **Merriwether Lewis** and **William Clarke** to explore the land acquired through the **Louisiana Purchase**. One purpose of the Lewis and Clarke expedition was to report on the natural resources available in this region. They discovered a large number of furbearing animals in these lands.

The beaver was one of the most sought after furbearers during this period. The trappers who pursued these animals were largely responsible for opening up the western half of the United States for European settlement. These were the famous "Mountain Man" trappers. These trappers were often the first non-native people to visit and explore the vast wilderness. Their travels mapped the trails that settlers would later follow. Numerous cities such as **New York**, **Chicago**, and **St. Louis** started as trading posts.

As the country became more settled, trappers continued to harvest furbearing animals for their pelts. However, trappers began to play another equally important role. As more and more people spread out across the land, problems between humans and wildlife became more common. Trappers helped control the population of some wild animals that might otherwise have caused damage to the settlers' crops and livestock.

The fur trade declined over time, reaching a low about 1850. Habitat destruction and unregulated killing made furbearers scarce. By the mid-1850s, almost 60-80% of the land in the Northeast had been cleared for pasture lands, agriculture and buildings. Unfortunately, many species that had been abundant before the Europeans arrived had become scarce or were **extirpated** (locally extinct). At this time, Europeans also favored silk over beaver felt, and Native American fur suppliers had declined due to disease, warfare, and displacement from their homelands.

In 1892, Ontario closed trapping seasons for beaver, otter and fishers for 5 years due to the decline in the populations. This law was not properly regulated, so furbearer populations continued to decline. In 1916, licenses were required for trapping beavers and otters. In order to sell pelts, trappers also had to attach coupons issued with their licenses. This helped decrease unregulated trapping.

Beaver felling a tree by: Steven Wayne Rotsch/Painet Inc

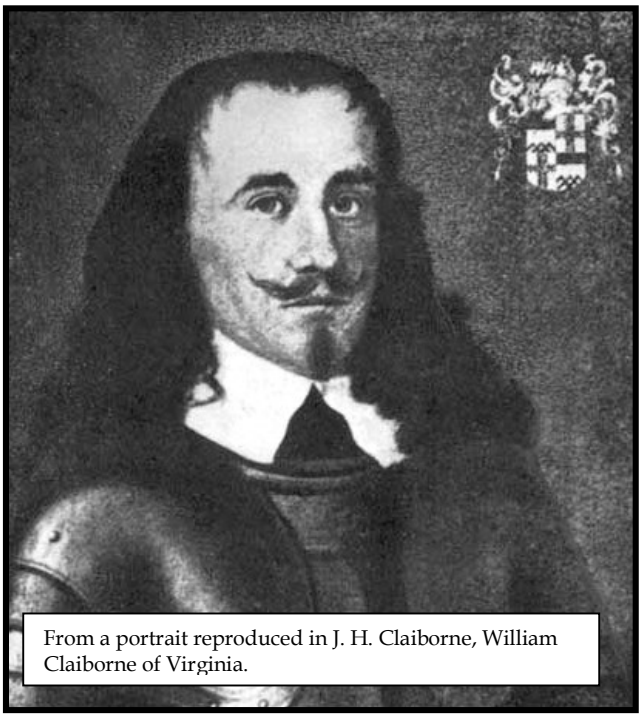
While the days of expansion and settlement in this country have passed, trapping still serves two important purposes. First, regulated trapping provides a method for harvesting and using the pelts of furbearing animals. These animals are a **renewable natural resource**. Renewable natural resources are ones that can be replaced in a relatively short period of time. Secondly, trapping provides a way to help control the population of certain animals. This helps reduce conflicts between these animals and mankind.

Today, trapping provides a good source of outdoor recreation for many individuals. Also, as it was for trappers in the past, the sale of pelts provides a source of income. The public also benefits from trapping because it reduces the frequency of disease and damage that may come with an overpopulation of animals.

Note: Modified from the Ohio Division of Wildlife Trapper's Education Guide and the Maryland Department of Natural Resources Trapper's Education Guide

Furs in Maryland's History

In the early 1500s, Europeans had been documented within the area now known as Maryland. Giovanni da Verrazano, an Italian explorer, was the first European to see the shores of Maryland. In 1603, the Englishman, Bartholomew Gilbert arrived, and in 1608, the famous John Smith sailed up the Chesapeake. Despite these visits, the first European settler, William Claiborne, did not arrive in Maryland until 1631.



From a portrait reproduced in J. H. Claiborne, William Claiborne of Virginia.

On May 16, 1631, King Charles I granted Claiborne a patent for trading privileges with the Indians. Using this patent, Claiborne set up a fur trading company on Kent Island with William Cloberry and other London merchants. William Claiborne soon established a good trade relationship with the Susquehannock Indians who sold him high quality beaver pelts.

At the same time Claiborne's fur post was flourishing, in 1634, King Charles I of England granted the land now known as Maryland to Lord Baltimore. William Claiborne refused to allow Kent Island to become part of Maryland, so hostility arose between Claiborne and Lord Baltimore. On April 23, 1635, a fight broke out between the Marylanders and the Kent Island colony which resulted in the deaths of four men. Both sides regularly raided each other's vessels and stole trading goods. In 1637, George Evelyn was sent by Claiborne's partners to replace Claiborne. However, Claiborne had Evelyn promise not to give up Kent Island to Maryland until Claiborne returned to England to plead his case with the King. Thomas Cornwaleys later led an attack on Kent Island, and Evelyn gave up Kent Island to become part of Maryland.

John Hans Steelman was one of the first to trade in present Frederick Co., Md. Jacob Young also traded furs in the western region of the state and spent many years as an interpreter for the Native Americans.

During the Beaver Wars, 1649 to 1656, the Susquehannocks formed an alliance with Maryland to acquire rifles and successfully fought the much larger Iroquois Confederacy. A brief peace followed then the Susquehannocks again waged war with the Iroquois until suffering a major defeat in 1675.

What is Fur Used For?

Modified from the International Fur Trade Commission

Beaver (*Castor canadensis*)
This large, semi-aquatic, wild animal is from North America. The long guard hairs are very dark brown to reddish or blonde. Beaver is often plucked or sheared by designers to show the soft underfur and reduce the weight of the item. It is often used for trimmings on coats and hats as well as for full fur garments.

Bobcat (*Lynx rufus*)
Also known by the name of lynx cats in the fur industry, the pelts are used for coats and jackets and for trimming other fur garments, but it does not wear as well as the fur of mink or sable.

Coyote (*Canis latrans*)
This abundant North American wild fur-bearer produces long, dense fur ranging in color from cream to dark grey, typically black-tipped. The fur is used for full coats and trims and is particularly popular for men's coats. Coyote fur is also popular for fur-trimmed boots.

Fisher (*Martes pennanti*)
Fisher is a marten. The fur ranges from brown to black. The females, which are smaller than the males, have softer and silkier pelts. The fur is very durable and is used for coats, "little" furs, and scarves. In coats it may be let out, like mink. The best fisher is a chocolate brown in color.

Gray fox (*Urocyon cinereoargenteus*)
Gray fox fur resembles red fox fur but gray foxes contain more grayish colorations. The fur is coarse, thin and used only for collars and trimming on inexpensive coats.

Long-tailed weasel (*Mustela nivalis*)
This fur-bearer has shorter guard hair than mink, with very lightweight leather and flatter, soft fur. They are used for full coats and trim in both natural and dyed colors. They may also be plucked and sheared for use as a lightweight spring fur.

Mink (*Mustela vison*)
This is the most commonly farmed species, producing dense, lightweight fur. There is a wide range of natural colors from white to black, taking in pearl, violet and sapphire, demi-buff (medium brown) and ranch (very dark brown). The fur can be worked in many ways, including shorn, knitted and also dyed in many different colors. It is a very versatile fur and is used for coats, jackets, trimmings and accessories like scarves.

Muskrat (*Ondatra zibethicus*)
A semi-aquatic mammal, which is very prolific, the muskrat is found wild throughout North America and Europe, the former Soviet Union and China. It is also known as musquash. It has thick, waterproof underfur with a long, glossy over layer of guard hairs. The color varies from light brown to black. Muskrat is used for coats, jackets and trimmings.

Nutria (*Myocastor coypus*)
A large, semi-aquatic rodent, mainly found wild in Argentina and southern USA (Louisiana), the nutria is also farmed in Poland and the Czech Republic. It has dense, grayish underfur and long glossy guard hair and varies in colour from dark brown to yellowish brown. It is used either long-haired or plucked for garments and trim.

Opossum (*Didelphis virginiana*)
The common opossum, a cousin of the Australian possum, is common across North and Central America. It has long, silvery gray guard hairs and a thick white underfur with black tips. The hair should be silky and thick and the color good.

Raccoon (*Procyon lotor*)
This wild fur-bearer is very abundant throughout the USA and southern Canada. Raccoons from northern areas are more highly furred. It is a long-haired fur with grey and black markings. Raccoon is mainly used for trimmings including collars and cuffs.

Red fox (*Vulpes vulpes*)
This is the most common and well known of the wild foxes, found in North America, Europe, Asia and Australia. The North American pelt has long, soft red hair whereas the European fur is flatter and less silky. It is used for trimming and for full fur garments like the coats.

River otter (*Lontra canadensis)*
Like most aquatic animals, otter has a sleek, flat, lustrous fur with dense underfur. Its natural color is brown, and it wears well. Otter may be left natural or plucked and sheared, giving it a variety of looks. Otter, because of its sturdy wear and good looks, makes attractive sports furs and appeals to men as well as women.

Striped skunk (*Mephitis mephitis*)
Skunk fur has been used in the fur industry as early as the mid 1800's, gradually increasing in popularity into the 1900's when it exceeded production of the most traded fur – Muskrat. The fur is currently used for handbags, throws and long, sweeping coats.

Activity: What You Wear Is What They Were

Grade Level: 5-8

Setting: Indoors

Objectives:
Students will be able to (1) Identify principal resources from which their clothing is made. (2) Distinguish between renewable and nonrenewable natural resources.
(3) Recognize environmental consequences of clothing preferences

Method:
Students draw, label and analyze their clothing according to the natural resources from which they are derived. Then, they make assessments about appropriate uses of such natural resources using criteria that they establish.

Materials:
- Drawing materials

Background:
In all but the most tropical of climates, people need an outside covering to keep warm. When ice floes receded after the last Ice Age, approximately 10,000 years ago on the North American continent, people used fire for part of their warmth. Skins from wild animals were also used. Saber tooth tigers, bears, wooly mammoths and wolves were among the animals hunted for meat and clothing.

Native American tribes have used animals for food and covering, and some still do as a part of their present lifestyle. Elk, deer, bear, buffalo, seal and almost all animals killed for food also provided valuable skins for clothing.

When European settlers came to the North American continent, they brought with them a tradition of making clothing out of spun fibers such as linen and wool.

Today, we have coats and other clothing made from many natural materials. We can divide the sources of those materials into two categories: renewable and nonrenewable natural resources. Definitions of renewable and nonrenewable resources are commonly used within the natural sciences. (Use of these terms is intended to describe inherent biological attributes, not to imply value judgments.)

Renewable natural resources are living things with the capacity for regeneration. Trees and wildlife are examples of renewable natural resources. However, even renewable

resources have limits. For example, although animals have the capacity for regeneration

by mating and bearing offspring, they cannot do this if their habitat is destroyed, or if environmental or human-caused pressures are too great to permit successful reproduction.

Nonrenewable natural resources are non-living things. Minerals and fossils are examples of nonrenewable natural resources. Although such resources may be replenished over time by natural processes, the time span is enormously long as, for example, in the case of accumulations of fossils from which to derive products such as petroleum. Cotton (from the cotton plant) and linen (from the flax plant) are two major clothing products derived from renewable natural resources - in this case, both from plants. Some clothing products come from animals. Wool, for example, comes from shearing the fleece off sheep and does not require killing the animals. Other domesticated animals, like cattle, provide clothing products, like leather, and also provide food products. Geese and ducks provide feathers for down jackets.

In scientific terms, animals can be considered a renewable resource. In some cases, however, animal populations are endangered or threatened. In such cases, killing of these animals is forbidden by law. It is also illegal to hunt many animals that are not threatened. Of those animals that are hunted, they are hunted only under laws and regulations. Some people raise ethical questions as to the appropriateness of the use of animals, particularly wild ones, for products such as clothing, food, tools, medicines, cosmetics, jewelry and other ornaments.

Most synthetic clothing materials are derived from nonrenewable natural resources like fossil-based petroleum products. Some people raise ethical questions as to the appropriateness of the use of nonrenewable resources such as fossil fuels in consideration of questions such as their essentially finite availability as well as costs to humans, wildlife and the environment often derived from their mining and processing. There are many aspects aside from whether or not a resource is renewable, which are considerations in evaluating whether or not to use a particular material for clothing. For example, some materials (e.g., cowhide, petroleum-based synthetics) are derived as byproducts from the development of resources for other, primary purposes (e.g. food, energy). Other sources (e.g. furs) tend to be developed primarily or solely for manufacture of clothing. In addition, nonrenewable resources, such as fossil fuels, are used in obtaining, manufacturing and distributing clothes made from renewable as well as nonrenewable natural resources. The pros and cons of appropriate uses of renewable and nonrenewable natural resources are difficult and complex – and may raise social,

economic, ethical and political as well as biological questions. Even the concept that wildlife and other animals is a renewable resource raises ethical objections from some people who feel it encourages the treatment of wildlife as a commodity to be used like food crops such as corn, without regard for the animals themselves.

The major purpose of this activity is for students to distinguish, in scientific terms, between renewable and nonrenewable natural resources used as sources of clothing for people.

Procedures:

1. Begin this activity with a discussion of where clothing comes from. Ask each student to look at what he or she is wearing. Using a piece of notebook or drawing paper, ask each student to draw a simple picture of himself or herself, including the major exterior clothing being worn – from head to toe. Ask them to label each piece of clothing according to the major thing or things it is made of (e.g., *cotton* shirt, *polyester* shirt, *leather* shoes).
2. Now, turn the discussion to the concept of natural resources. *Webster's New World Dictionary* defines natural resources as, "Those actual and potential forms of wealth supplied by nature." We define a resource as "a portion of an environment upon which people have placed or assigned value, or see as being available for use." Such definitions are intended to be descriptive without intent to make moral or ethical judgments about the appropriateness or inappropriateness of use of portions of the environment which are designated as resources. Ask students to define in scientific terms what might be considered *renewable natural resources* and what might be considered *nonrenewable natural resources.* Using the brainstormed list of natural resources, put an "R" by those which can be considered renewable and an "N" by those which can be considered nonrenewable.
3. Returning again to their drawings, ask students to label the clothing parts of their drawings according to the natural resources from which they are derived, also indicating whether the resources are renewable or nonrenewable.
4. Ask students to divide renewable resources into plants and animals. Then ask students to divide each of these categories into those which require killing the individual organism for use as a clothing resource contrasted with those which do not.
5. Discuss the students' findings. Consider questions such as:
    a. What kinds of impact do our preferences in clothing sources have on individual living organisms? On populations of organisms?
    b. What kinds of impact do our preferences in clothing sources have on different aspects of the cultural and natural environments, e.g., on local economies, international trade, cultural tradition, global resources, wildlife habitat, agricultural lands, water quality, oil shale development?

c. In our judgment – as individuals, or as a group – which sources of clothing seem to us to be most appropriate? Under what conditions?

Ask students to establish some criteria for their judgments, explaining their reasoning.

Extensions:

1. Have the students inventory their clothes closet. Tally the number of garments by each natural resource. Make a personal graph showing proportions of cotton, polyester, leather and so on. Have them assess the number of clothes in their closet. What impact does the amount of clothing have on the environment?
2. Have the students write an environmental impact statement about the effect of their personal clothing preferences.

Evaluation:

What effects do clothes made from renewable or nonrenewable resources have on the environment?

History of the Fur Trade Word Find

W	N	M	B	E	A	F	G	E	L	B	A	W	E	N	E	R	Q	O	P
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W	O	R	T	Y	F	G	T	O	P	L	D	K	W	A	R	A	Y	E	T
I	T	R	A	C	V	B	I	R	E	N	T	Y	B	L	Q	E	R	F	R
S	Z	X	C	Y	R	T	Y	G	A	Y	B	I	G	H	O	B	T	P	H
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D	U	D	Y	K	H	I	Z	O	M	I	S	I	G	W	D	F	K	M	S
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Y	Q	H	B	O	R	N	E	M	T	A	L	V	U	H	I	O	D	M	I
U	E	S	I	J	E	O	Y	S	R	K	T	R	E	C	B	Y	J	K	U
J	S	U	S	Q	U	E	H	A	N	N	O	C	K	C	E	B	E	U	Q
K	H	T	E	G	N	O	T	S	Y	P	D	L	Y	O	C	T	T	R	Y

1. Beaver Wars
2. Chicago
3. Claiborne
4. Furbearer
5. Hudson Bay
6. Kent Island
7. Lewis and Clark
8. Pelt
9. Quebec
10. Renewable
11. Susquehannock
12. Trapping

History of the Fur Trade Word Find Answers

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Image by: Gary Kramer, USFWS

Unit 2:

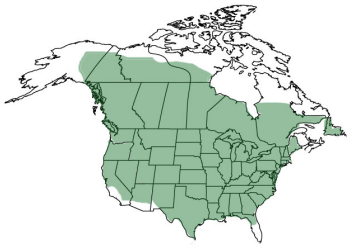
Biology and Ecology of Maryland Furbearers

Beaver

Castor canadensis

Description:

Beavers are the largest rodents in North America and the second largest rodent in the world. Beavers can weigh from 30-60 pounds and can get up to 40 inches in length (including their tail). Their body is covered with thick, reddish-brown fur. Beavers have hairless, paddle-shaped tails that are used for steering when swimming. Beavers also store fat in their tails for the winter and slap their tails against the water to warn other beavers of potential predators.



Distribution and Abundance:

Beavers were hunted almost to extinction in the mid-1800s. However, beavers are now common throughout Maryland and the rest of the United States.

Habitat:

Beavers live near rivers, streams, ponds, small lakes and marshes. Beavers cut down small-medium trees to dam up streams and rivers to create ponds. One beaver can cut down 216 trees in a year. Beavers live in lodges which include a feeding den, a resting den, a source of fresh air and two underwater entrance tunnels, which allow for a means of escape if a predator enters the lodge

Beaver Lodge by: USFWS

Habits:

Beavers are social animals that tend to live in colonies consisting of a breeding pair and two generations of their offspring. Once the young, called kits, reach two years old, they are driven out of the colony to find their own territory. Beavers mark their territories with musk from their scent glands. Beavers are active from dusk until dawn.

Foods:

Beavers are herbivores, and their diet changes with the seasons. During the winter months, beavers prefer woody vegetation such as sweet gum, ash, willows, poplar,

cottonwoods, pines and fruit trees. In the spring and summer, beaver tend to eat lush aquatic plants and shoots of young plants. Beavers, like other rodents, have incisors that continue to grow throughout their life.

Reproduction:

Beavers are monogamous, meaning they have one mate for the breeding season and usually for life. Beavers breed in midwinter and, after a gestation period of 100 to 110 days, a single litter of two to five kits is born in May or early June. At birth, the kits possess fully developed teeth and lots of fur. At two to three weeks of age the kits begin to eat vegetation and are weaned by about six weeks. The young remain with the adults as a family group or colony until their second year.

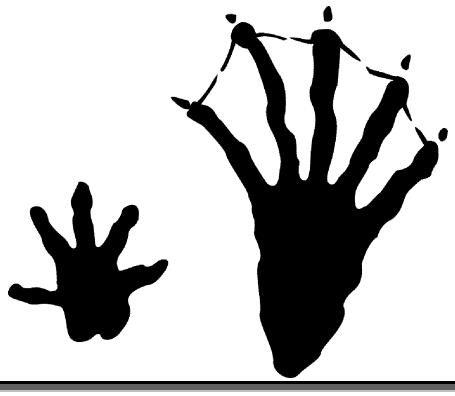
Management:

Annual hunting and trapping seasons for beavers have been established in Maryland. Beavers are managed as fur-bearing animals.

Beavers and People:

While beavers are great at engineering new habitat for other species, human conflicts can sometimes arise. Beavers can flood areas, damage fruit and landscaping trees and can impair drainage systems.

Scats and Tracks:

	
Scat- oval pellets made of wood chips that are 1 to 1 1/4 inches in length and 3/4 of an inch in diameter	**Tracks-** has 5 toes; the hind tracks are about 6 inches long and webbing is visible

Did You Know?

Beavers have transparent eyelids that help them see while swimming underwater. Beavers also can close up their ears and nose to prevent water from getting in while swimming underwater. Beavers also use their large black claws to groom their coats.

Bobcat

Lynx rufus

Image by: David Westphalen/Painet Inc.

Description:

Bobcats are medium-sized wild cats with a distinct "bobbed" tail. Bobcats can weigh from 10-30 pounds and can get up to 50 inches long. They have wide faces with tufts of black fur on their ears in addition to spotted stomachs. Bobcat fur is a tawny color and contains patterns of stripes and spots.

Distribution and Abundance:

In the late 1800s, the dramatic destruction of forests in much of Maryland reduced the bobcat population to extremely low levels. As forests have regenerated, bobcat numbers have increased. Bobcats are mainly found in western Maryland, but they can also occasionally be seen in the Piedmont and very rarely on the Coastal Plain. Bobcats are elusive, solitary animals and sightings are uncommon in Maryland.

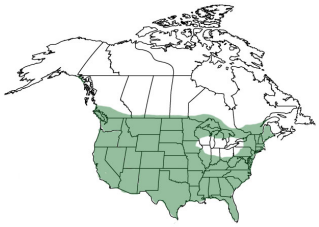


Image by: David Westphalen/Painet Inc.

Habitat:

Bobcats live in mixed deciduous-conifer forests and hardwood forests. Bobcats also tend to prefer brushy and rocky woodlands broken by fields, old roads and farmland. Rocky ledges are used many times for courtship and den sites.

Habits:

Bobcats are usually active from dusk until dawn. Bobcats are typically solitary aside from females taking care of their young. Territories for female bobcats do not overlap, but some males will have overlapping territories. Bobcats are very patient and stalk their prey.

Foods:

Bobcats mainly eat cottontail rabbits, woodchucks, squirrels, chipmunks, mice, voles, snowshoe hares and birds. Occasionally, bobcats will eat old, sick or young deer. Bobcats tend to be opportunists and will feed on most small mammals.

Reproduction:

Bobcats breed between January and May. After a gestation period of 60-62 days, two to three kittens will be born. The kittens will stay with the female for a year. Females will have several dens within her territory, with one main den and several auxiliary dens to use for temporary shelter. Male bobcats do not help raise the young.

Management:

Due to low population numbers in Maryland, trapping seasons for bobcats are currently closed.

Bobcats and People:

Bobcats tend to be secretive and avoid people. Occasionally, bobcats will prey on farm animals such as fowl or domestic cats. Bobcats are not known to attack people or carry rabies.

Scats and Tracks:

	
Scat- Scat is up to 4 inches long and 3/4 of an inch in diameter, segmented with blunt ends. Evidence of scratched leaf litter and soil with scat in the scratched out area will indicate cat droppings.	**Tracks-** has 4 toes and no claws; tracks are about 2 inches across

Did You Know?

Bobcats can jump up to 10 feet! Bobcats sometimes cache their food by covering it with leaves, snow or sticks to eat it at a later time. While bobcats have great vision, they have a very poor sense of smell.

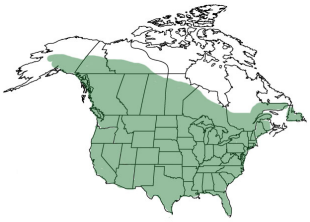
Eastern Coyote

Canis latrans

Image by: Doug Herr/Painet Inc.

Description:

Coyotes look a lot like a thin German shepherd, but they hold their tales in a downward position. Its coat is covered with coarse, outer hairs that are tipped in black while the rest of the fur is typically a light gray to yellow color. The average length of an adult coyote is 44 to 54 inches, including a 15 to 17-inch tail. During the fall and winter, coyotes tend to weigh between 30 and 40 pounds.



Distribution and Abundance:

Historically, coyotes were only found west of the Mississippi. However, coyotes have been expanding their range and were first documented in Maryland in 1972. Coyotes can now be found throughout Maryland with the largest populations residing in western Maryland.

Habitat:

In Maryland, coyote occupy most of the state's habitat types. The highest densities currently occur in intermixed woodland/farmland areas. However, it is possible that population densities will continue to increase in other types of habitats.

Habits:

Coyotes are active at any time of the day or night, but they tend to be the most active at dawn and dusk. Coyotes tend to live in family groups. These groups have an average home range size of 15 square miles, but the members of the group will focus most of their activity within a core area of 4 to 8 square miles. The family group is territorial and will defend the core home range from other coyotes.

Foods:

Coyotes have extremely broad food habits. Food items range from plants and insects to deer and domestic animals. Although small mammals (mice, rabbits, etc) and birds are typically the most important food items, coyote are opportunistic feeders. During certain time periods, insects and plants may dominate a coyote's diet, while carrion or livestock may be preferred at other times.

Reproduction:

Coyotes reach sexual maturity by 1 year, and normally remain fertile throughout their life. Coyotes breed from late January through March, with peak activities occurring during February. Gestation periods extend approximately 60-63 days, and litters average 5-6 pups.

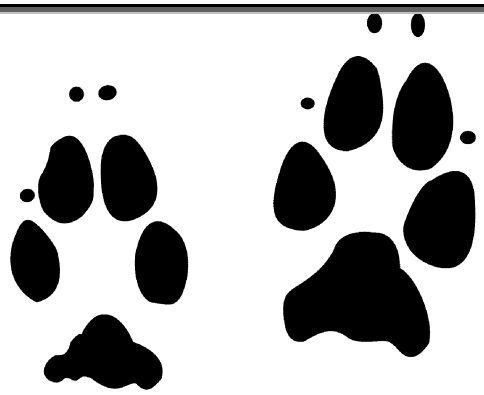
Management:

Annual hunting and trapping seasons for coyotes have been established in Maryland. Coyotes are managed as fur-bearing animals.

Coyotes and People:

Coyotes generally avoid people. However, Coyotes have trouble distinguishing between pets and natural prey. So, many negative interactions with coyotes in Maryland involve Coyotes attacking pets such as cats. Coyote attacks on dogs generally occur if the Coyote perceives the dog to be a threat to its territory, mate or young.

Scats and Tracks:

	
Scat- Very similar to fox, but larger. A large fox and a small coyote may have identical scat	**Track-** has 4 toes with claws; toe pads are large; tracks up to 3" long

Did You Know?

Coyotes "sing" in order to keep track of their family members and to communicate with other coyote groups. In addition, the Latin name '*Canis latrans*' means barking dog.

Fisher

Martes pennanti

Image by: Erwin Bauer

Description:

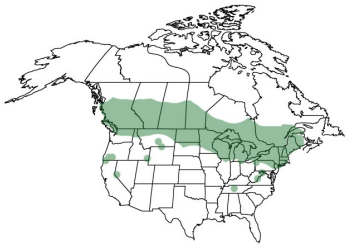
Fishers are a dark brown-black color. They have a long body characteristic of the weasel family in addition to a bushy tail and short legs. Fishers are large members of the weasel family. The males are typically between 36 to 40 inches while females are 30 to 36 inches. Male fishers can weigh up to 12 pounds while females can get up to 8 pounds.

Distribution and Abundance:

Fishers were almost extirpated (locally extinct) from Maryland in the 1850s due to loss of much of its forested habitat. Fishers have made a tremendous comeback in Maryland and now occupy much of western Maryland. Fishers are common in the Northeast and Midwest but are rare in the Northern Rockies and Northwest.

Habitat:

Fishers live in large tracts of coniferous or mixed hardwood-softwood forests containing large trees for denning. Fishers prefer habitat with dense overstories for cover and hunting.



Habits:

Fishers are solitary, nocturnal animals. Fishers don't stalk their prey, rather they rely on surprising prey. Fishers hunt by zig-zagging through areas of thick, regenerating forest. They also traverse areas with little ground cover in a relatively straight line, hardly changing direction. Fishers can climb trees and will often den in tree cavities or in dense conifers.

Foods:

Fishers feed on a variety of small mammals such as squirrels, rabbits, mice and voles. In addition to small mammals, fishers are one of the few animals that eat porcupines. Fishers will flip porcupines over to eat them. Fishers also eat carrion, fruits, mast (primarily beechnuts), birds, and frogs.

Reproduction:
Fishers mate in March through April, but gestation will take 51 weeks. Female fishers will den in hollow trees and will give birth to 2-4 young in late February through March. The young will stay with their mother until Fall.

Management:
Annual hunting and trapping seasons for fishers have been established in Maryland. Fishers are managed as fur-bearing animals.

Fishers and People:
Conflicts between fishers and people are uncommon although fishers have been known to prey upon unprotected poultry.

Scats and Tracks:

	
Scat- resembles that of a Mink but has a larger diameter. Scat is brown to black in color & are twisted with tapered ends 3/8 to 5/8 of an inch in diameter & folding over	**Track-** has 5 toes with claws; tracks are 2.5 inches across

Did You Know?
Despite their name, fishers rarely eat fish! It is believed the name fisher came from the English word "fitch" which meant polecat. English settlers may have mistaken fishers for polecats. When a fisher is upset, it will produce loud growls and hissing coughs!

Gray Fox

Urocyon cinereoargenteus

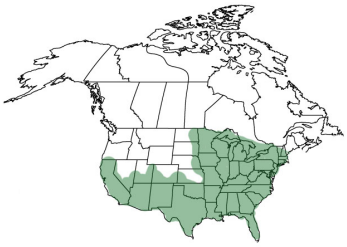
Image by: Steve Wayne Rotsch/Painet

Description:

The gray fox is somewhat stout and has shorter legs than the red fox. Its coat is mostly grizzled-gray with some reddish fringes throughout its body. The cheeks, throat, inner ears and most of the underside are white. The upper part of the tail, including the tip, is black. The gray fox ranges from 30 to 44 inches in total length and can weigh from 8 to 15 pounds. Red foxes have a white tip on their tail.

Distribution and Abundance:

Gray foxes are common animals that can be found throughout Maryland and much of the eastern and southern United States.



Habitat:

Gray foxes typically live in dense forests with some edge habitat for hunting. Their home ranges typically are 2-4 miles. Gray foxes can also be found in suburban areas.

Habits:

Gray foxes tend to be active from the late evening hours until dawn (nocturnal). Because of this, they are seen much less than red foxes. They will readily climb trees, jumping from branch to branch while hunting or for protection. Red foxes cannot climb trees. Gray foxes are generally very territorial but have small home ranges. They are less vocal than red foxes and will occasionally bark or yap.

Foods:

Gray foxes are omnivorous, meaning that they can eat both plants and animals. Prey items frequently eaten by gray foxes include rabbits, mice, squirrels, rats and insects. Game birds are frequently eaten, including quail, turkeys and ruffed grouse. Gray foxes will also eat carrion and plants including fruits, nuts and berries.

Reproduction:

Foxes breed from January through March with the gray fox tending to breed 2 to 4 weeks later than the red fox. After an average gestation period of 53 days, the female

fox gives birth to a litter averaging 4 or 5 pups. The gray fox usually does not use an underground den but, instead, dens in dense brush, cavities in stumps and trees, rock crevices or under out-buildings such as barns and sheds.

Management:

Annual hunting and trapping seasons for gray foxes have been established in Maryland. Foxes are managed as fur-bearing animals.

Gray foxes and People:

Generally, gray foxes are not aggressive towards people unless they are infected by rabies. Any mammal can be infected with rabies. In Maryland, foxes comprise approximately 10% of the confirmed rabies cases. Once an infected animal exhibits signs of the disease, the disease is often fatal within 10 days. It is important to avoid physical contact with wild animals and immediately report any animal bites to your local health department.

Gray foxes also will prey on domestic animals like chickens and cats. In addition to rabies, gray foxes can also carry distemper. This is a potentially fatal disease which can be easily transmitted to domestic dogs, so never let your dog near a wild fox! Gray foxes, unlike red foxes, are resistant to mange (a skin disease caused by mites).

Scats and Tracks:

	
Scat- about 2 ½ inches long, ½ inch in diameter, segmented, tapered at one end, sometimes both and often covered with find rodent fur; typically contains more seeds and berries than Red fox scat	**Track-** has 4 toes with claws; tracks are 1-1.5 inches long

Did You Know?

The gray fox is the only member of the dog family which can climb trees? Also, if gray foxes have too much food then they will cache the leftovers, mark it with pee and come back to it later.

Long-tailed weasel

Mustela frenata

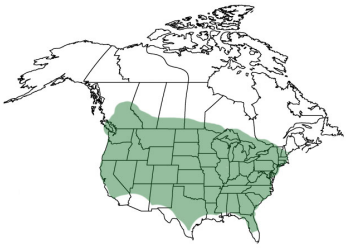
Image by: Rob Simpson/Painet

Description:

Long-tailed weasels are relatively small animals, with slender and elongated bodies. Body sizes range from 11 to 17 inches long. Males tend to be significantly larger than females. The overall color of long-tailed weasels is brown with a yellowish white neck and underside. In the Northern United States, Long-tailed weasels molt in the fall and their fur becomes totally white and remains that color until they molt again in the spring and it returns to brown. In the mid-Atlantic region (including Maryland) and farther south they remain brown throughout the year.

Distribution and Abundance:

Long-tailed weasels are relatively common and can be found throughout Maryland and much of the United States.



Habitat:

Long-tailed weasel can live in a fairly broad range of habitat types. In Maryland marshland, woodlands, intermittent grasslands and rocky outcrops are all long-tailed weasel habitats. The long-tailed weasel also inhabits open areas covered with brush or tall grass near water. Weasels live in dens made from hollow logs, tree stumps, among rock piles or in burrows that it has taken over by killing the former occupants.

Habits:

The long-tailed weasel uses a variety of calls such as screeches and squeals, rapid trills, and purrs when content. During the mating season, females give a reedy, twittering call.

Long-tailed weasels can swim and climb quite effectively. They are active throughout the year and can be found hunting rodents during the day and at night. Like other weasels, the long-tailed runs by a series of bounds, with its back humped at each bound and its tail trailing backward.

Foods:

Weasels feed extensively on mice and other small mammals, but weasels will also eat birds, rabbits and amphibians when available. When hunting, it follows a zigzag

pattern, moving from burrow to burrow. Weasels are valuable in controlling populations of rodents, including rats.

Reproduction:

The long-tailed weasel breeds in July and August. The gestation period may cover 205 to 337 (average 279) days. The newborn young are blind, furless, about 2.5 inches long, and weigh less than a tenth of an ounce. They soon develop a soft, white fur which is replaced in three weeks by adult fur.

Image by: Robert Barber/Painet Inc.

Management:

Annual hunting and trapping seasons for long-tailed weasels have been established in Maryland. Long-tailed weasels are managed as fur-bearing animals.

Long-tailed weasels and People:

Long-tailed weasels can be aggressive towards people, particularly when they are cornered or feel threatened. However, most people rarely encounter weasels in the wild. Weasels benefit people by keeping populations of rodents low. Unfortunately, weasels are a big problem for chicken and other poultry farmers. Weasels are known to go on killing sprees and can kill an entire coop of chickens.

Scats and Tracks:

	
Scat- brown or black, long, slender and segmented, often tapering at one end	**Track-** has 5 toes with claws but sometimes only toes visible in tracks; tracks rounded and up to an inch across

Did You Know?

Long-tailed weasels are the largest weasel of the weasel family and often will attack prey nearly two times larger. The Long-tailed weasel uses a variety of vocalizations. It may screech and squeal, utter a rapid trill and purr when content.

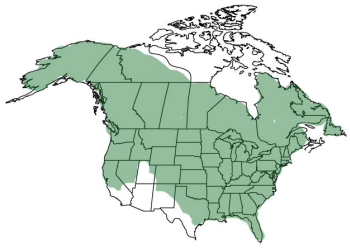
American Mink

Mustela vison

Image by: Robert Barber/Painet

Description:

American minks are approximately the size of a small housecat. They are covered with thick, dark brown fur and have a distinct white patch under their chin. Like other members of the weasel family, American minks have a long, slender body and short legs. Males can weigh up to 3 pounds while females only get up to about 2 pounds. From head to tail, male minks can get up to 28 inches in length while females can be up to 25 inches.



Distribution and Abundance:

American minks are common throughout Maryland except on the Eastern shore. They also can be found throughout much of the United States and Canada.

Habitat:

American minks live along lake shores, along wetland edges and along river banks, especially in areas with dense brush or those with a lot of trees. American minks require a permanent water source within their habitat. American minks will occasionally use dens throughout their travels, including those built by muskrats.

Habits:

American minks are solitary animals. Typically, the males defend a territory of 1.2 to 3 miles on a river. This territory comprises the territories of several females. American minks are most active at night and do not hibernate. Mink may hiss, snarl, screech and/or excrete a stinky fluid from their scent glands if they feel threatened.

Foods:

American minks eat muskrats, mice, rabbits, small rodents, waterfowl, marsh nesting birds, crayfish, aquatic beetles and fish. Mink can hunt both on land and in water and will climb trees to find prey or will dive underwater to capture food. The mink's diet can change with the seasons and with availability of prey. In the summer, much of its diet consists of small mammals, frogs, rodents, fish, and waterfowl. However, in the winter, the mink relies more on other mammals.

Reproduction:

American minks breed in late February to April. American minks, like other weasels, will experience delayed implantation in which the fertilized egg will not implant for up to a month after breeding. After the implantation, gestation takes up to 75 days. Two to ten young, known as kits, are typically born in April. Males don't participate in raising young. The young are weaned at 6 weeks, but stay around the birth den until Fall, when they disperse to find their own territory.

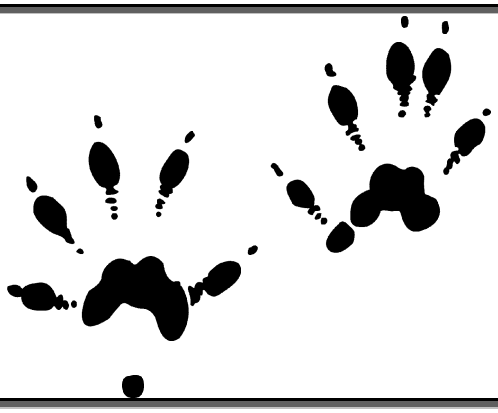
Management:

Annual hunting and trapping seasons for mink have been established in Maryland. American minks are managed as fur-bearing animals.

Minks and People:

American minks can be aggressive towards people, particularly when they are cornered or feel threatened. However, most people rarely encounter minks in the wild. American minks benefit people by keeping populations of rodents low. Unfortunately, minks are a big problem for chicken and other poultry farmers. American minks are known to go on killing sprees and can kill an entire coop of chickens.

Scats and Tracks:

	
Scat- long and twisted resembling a braided rope, black to light in color with tapered ends and may fold over itself	**Track-** 5 toes with claws; has long, skinny toes; tracks are about 1.5 inches across

Did You Know?

Despite having excellent vision and hearing, mink have a poor sense of smell. The soft fur of minks has an oily coating which makes it waterproof. American minks also molt twice a year- once in April and another time in August or September.

Muskrat

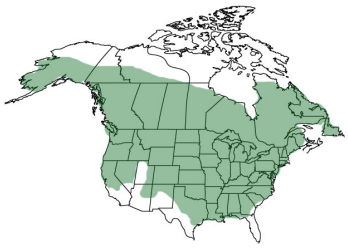
Ondatra zibethicus

Image by: John White

Description:

Muskrats are the only species in the genus *Ondatra*. They are medium-sized rodents that are covered in waterproof, brown fur and have a thin, rudder-like tail covered in scales. The hind feet of muskrats are large and webbed to aid in swimming. Muskrats are 16 to 24 inches long and weigh up to 4 pounds. Muskrats are named after the musky odor produced by their scent glands.

Distribution and Abundance:



Muskrats are common throughout Maryland and the rest of the United States, except for particularly dry regions.

Habitat:

Muskrats live in both brackish and freshwater lakes, ponds, streams, rivers, swamps and marshes throughout much of North America.

Habits:

Muskrats are active throughout the day and night. These semi-aquatic rodents spend much of their time in and around water. Muskrats build dens in river banks or construct lodges similar to beavers. Both dens and lodges consist of underwater tunnels and dry chambers. During the winter, muskrats spend the majority of their time in their dens. Sometimes, if the den or lodge is not warm enough, then the muskrat will have to relocate.

Muskrat lodge by: Kerry Wixted

Foods:

Muskrats primarily eat aquatic plants, including cattails, sedges, water lilies, arrowheads and duckweeds. In some areas, muskrats will feast on mats of algae. Occasionally, when food is scarce, muskrats will consume other animals such as crayfish, snails, mussels, frogs, insects and fish. Muskrats often construct feeding platforms in the marsh to sit and eat food they have collected.

Reproduction:

Muskrats can breed year round, but most breed in March-May. After breeding, gestation lasts about a month, and a litter of 5-10 young are born. The young are born blind and have little hair. By two weeks of age, the pups will be fully furred and will have open eyes. By six weeks of age, the pups are fully independent, and the female usually has another litter on the way. A female can have up to 5 litters of young per year.

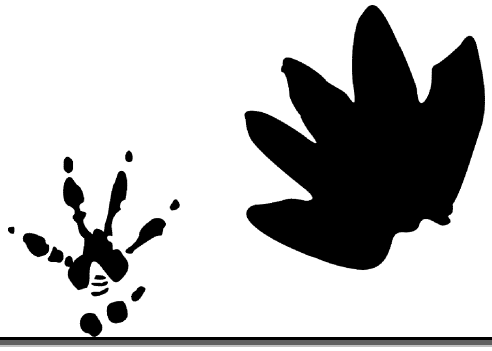
Management:

Annual hunting and trapping seasons for muskrats have been established in Maryland. Muskrats are managed as fur-bearing animals.

Muskrats and People:

Muskrats can sometimes become nuisances if they feast on gardens or crops. Because they have a small home range, people can avoid conflicts by planting at least 200 yards from a wetland or by erecting a small fence. Occasionally, muskrats can damage ponds by burrowing into the banks which allows the water to drain out.

Scats and Tracks:

	
Scat- composed of little pellets stuck together, although sometimes the pellets are separate	**Tracks-** has 5 toes with claws; hind foot is about 3 inches long

Did You Know?

Because muskrat fur has commercial value, they were introduced in Japan, South America, Scandinavia and Russia. Muskrats can also stay underwater for up to 20 minutes by reducing their heart rate and relaxing their muscles.

Nutria

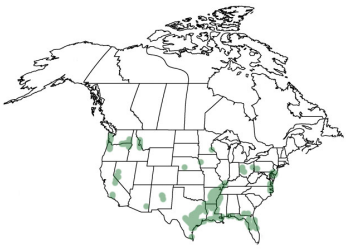
Myocastor coypus

Photo by: Dan Dzurisin

Description:

Nutria are large rodents that look like beavers with long, thin tails similar to muskrats. Nutria may weight up to 20 pounds and reach about 24 inches from tip of nose to tip of tail. Nutria have thick brown fur and orange front teeth. They are designed for aquatic life, with webbed feet and eyes, nostrils and ears located high on their heads to enable them to expose as little of their bodies as possible when breathing at the surface of the water.

Distribution and Abundance:



Nutria are native to South America and now can be found in 22 states. Nutria were introduced to Blackwater National Wildlife Refuge in 1943, where they were farmed for fur. Currently, nutria can be found on the Eastern Shore of Maryland as well as in the Potomac and Patuxent rivers on the Western Shore.

Habitat:

Nutria can be found within wetlands such as fresh and brackish marshes, rivers, bayous, farm ponds, freshwater impoundments, drainage canals, swamps.

Habits:

Nutria spend much of their time in the water. They are colonial species which tend to live in groups consisting of a dominant male with 2-3 females and their offspring. These groups live in dens and are most active at night. If food is limited, then nutria will become active during the day to feed.

Foods:

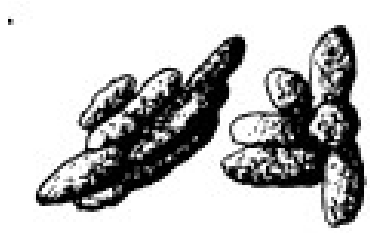
Nutria are herbivores, so they feed entirely on plants. Nutria eat wetland plants such as Saltmarsh hay and Smooth cordgrass. Nutria can consume 25% of their body weight per day and tend to eat the roots of wetland vegetation, often causing erosion in wetlands. Occasionally, nutria will feed on crops.

Reproduction:
Nutria breed year round and have a gestation period of 130 days. Males are able to reproduce at 4-9 months of age while females can reproduce at 3-9 months of age. Nutria can have 1-13 young per litter, and females can breed the day after they give birth to a litter.

Management:
Nutria are considered invasive species in Maryland due to their destructive feeding habits on marshes. Currently, a nutria eradication program is in progress to eliminate the species from Maryland.

Nutria and People:
Nutria are not aggressive towards people, but they are considered pest species due to their destructive nature. Nutria can destroy marshes as well as ornamental shrubs and plantings near wetlands.

Scats and Tracks:

	
Scat- only vegetable matter and is tapered at both ends; similar to muskrat	**Track-** 5 toes with claws; 4 of the 5 toes on the hind foot have webbing

Did You Know?
About 2 million nutria pelts are harvested in the United States every year. Nutria also have valves in their nostrils and mouth that seal out water while swimming, diving or feeding underwater. The female nutria's teats are located high on her sides to allow the young to suckle while in the water.

Virginia Opossum

Didelphis virginiana

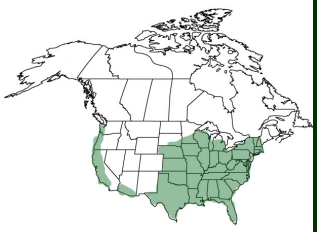
Image by: Bob Gress

Description:

Virginia opossums are the only marsupial, or pouched mammal, native to North America. Virginia opossums are grayish white in color and fur covers the whole body, except for its ears and tail. The opossum has a long, scaly prehensile tail, which is adapted for grasping and hanging. These marsupials can weigh anywhere from 4 to 13 pounds, and their body can range from 15 to 20 inches long with a 9 to 20 inch long tail.

Distribution and Abundance:

Virginia opossums are common and abundant throughout Maryland and the eastern United States. They also can be found in parts of Arizona, California, Washington and Oregon.



Habitat:

Virginia opossums can be found in a variety of habitats. Virginia Opossums naturally prefer deciduous woods near water but can also be found in farmlands or marshes. Virginia opossums can also be found throughout urban and suburban environments.

Habits:

Virginia opossums are nomadic and never really establish their own territory. They are primarily nocturnal and will wander throughout areas in the night in search of food. During the day, opossums will seek refuge in hollow trees, under porches, in brush piles, other animal's burrows, etc.

Virginia opossums use several techniques to avoid predators. In one technique, opossums will freeze to avoid being seen by a predator. Virginia opossums also will fake illness by drooling excessively and swaying back and forth. Many predators will avoid sick prey.

Foods:

Virginia opossums are omnivores. This means they eat a varied diet of insects, worms, frogs, birds, fruits, nuts and carrion (dead animals). They will also eat small rodents,

voles, shrews and moles. Virginia opossums are often seen feeding at compost piles, garbage cans and bird feeders.

Reproduction:

Virginia opossums breed from January to July. Twelve to thirteen days after breeding, the young will be born. Baby opossums are only the size of a honeybee at birth and will live and nurse in the mother's pouch for two months. When the young leave the pouch, the female will often carry the young on her back.

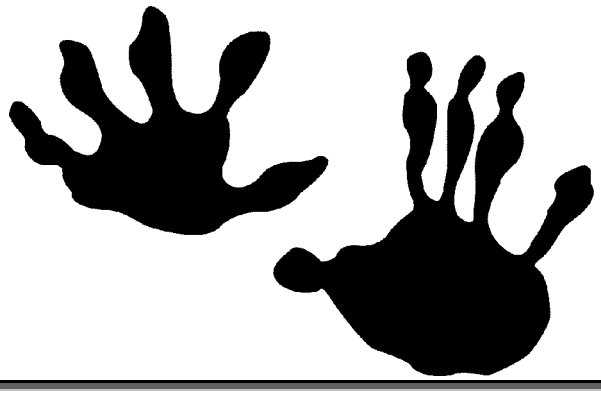
Management:

Annual hunting and trapping seasons for opossums have been established in Maryland. Virginia opossums are managed as fur-bearing animals.

Opossums and People:

Virginia opossums can sometimes be a nuisance for people. They often get into trash cans, bird feeders and/or pet food left outside. Virginia opossums can sometimes be aggressive towards domestic dogs and cats. Some opossums can also get into chicken coops and attack chickens and their eggs.

Scats and Tracks:

	
Scat- Uneven and variable due to changing food sources. May have hair or berries. Smaller in general than fox, and smaller sections too. Different shape than raccoon; hard to ID	**Track-** has 5 toes with hand-like appearance; front tracks have widely spaced toes; tracks are about 2 inches wide

Did You Know?

Virginia opossums are highly resistant to diseases such as rabies because of their efficient immune system and lower body temperature. Virginia opossums can't hang upside down by their tail, but use their tail to climb. Virginia opossums have exactly 50 teeth which is more than any other North American land mammal. The opossum also has opposable thumbs on its hind feet for holding onto branches.

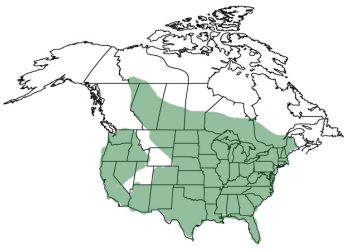
Northern Raccoon

Procyon lotor

Image by: Bob Gress

Description:

Northern raccoons are stocky mammals that have short front legs and long back legs. They have a striped tail with a black "mask" on their face. They have grayish-black fur and rounded ears. Males are known as boars and females are known as sows. Adult raccoons generally measure 20 to 30 inches long from their nose to the tip of their tail and weigh from 10 to 35 pounds.



Distribution and Abundance:

Northern raccoons are abundant throughout Maryland and the rest of the United States aside from higher elevations.

Habitat:

Northern raccoons can be found in riparian areas along streams, lakes, marshes, swamps, farmland, and in suburban neighborhoods. Northern raccoons also can be found in urban areas where they can find adequate food water, and shelter.

Habits:

Northern raccoons generally are solitary, though some related females will share similar territories. Raccoons typically den in hollow trees, ground burrows or brush piles, but will readily use barns, attics or abandoned buildings. Northern raccoons are most active from Spring until Fall in Maryland but will emerge from their dens during the winter to feed. They are considered nocturnal but will readily forage during the day when conditions allow.

Northern raccoons have well developed sensory nerves on the bottom of their feet. They will feel their food items with their paws and will remove unwanted parts.

Foods:

Northern raccoons are omnivores, meaning that they eat both plants and animals. They relish plums, gooseberries, blackberries, blueberries, dogwood berries, wild cherries, currants, wild grapes, apples, and hawthorns. They also find acorns, hazelnuts and

beechnuts appealing when in season. Northern raccoons also eat crayfish, fish, turtle eggs, snails, and clams.

Reproduction:

Northern raccoons breed in from the end of January through mid-March. After a gestation of 65 days, raccoons will give birth to 2-5 young known as kits. Kits will remain with the female until Fall. Males take no part in raising young.

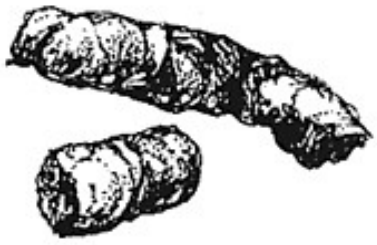
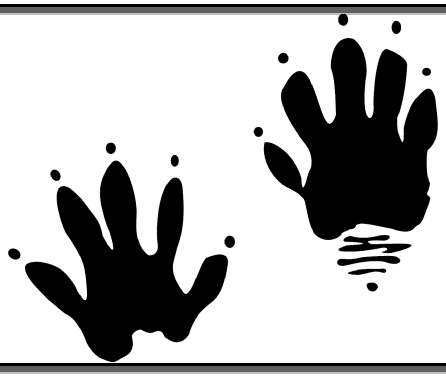
Management:

Annual hunting and trapping seasons have been established for raccoons. Northern raccoons are managed as furbearers.

Raccoons and People:

Northern raccoons can be nuisance wildlife. They are well adapted to urban and suburban areas and can easily get into houses, basements, and attics. In addition, raccoons often raid trash cans and pet food left outside. Northern raccoons furthermore are responsible for 60% of the rabies cases in Maryland and can also transmit canine distemper and parvovirus to domestic dogs.

Scats and Tracks:

	
Scat- note blunt ends and uniform thickness, like a tootsie roll. Scat will have berries, seeds, corn and perhaps crayfish parts. May find anywhere	**Track-** has 5 toes with claws; hind foot is about 4 inches long and toes finger-like

Did You Know?

The scientific name for the Northern raccoon is *Procyon lotor* and in Latin, *lotor* means "one who washes". They are known for their habit of "washing" their food in water. Wildlife biologists believe that raccoons have very sensitive fingers and as they forage for food in water (crayfish, tadpoles, frogs, etc.), they actually feel what they are doing rather than see what they are about to eat. Northern raccoons are known for their intelligence, and studies have shown that raccoons can remember how to solve tasks for up to three years.

Red Fox

Vulpes vulpes

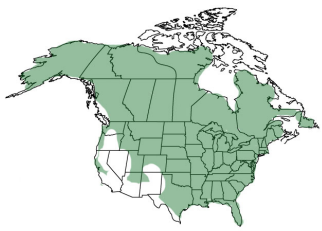
Image by: Bob Coury/ Paintnet Inc.

Description:

Red foxes are small (10 to 14 pound), dog-like animals with a sharp pointed nose, erect ears and a bushy tail. Although they can come in colors from black to blonde, they are usually red, with black legs and a white tipped tail. Gray foxes can also be found in Maryland, but they have a black tipped tail.

Distribution and Abundance:

Red foxes can be found throughout Maryland as well as much of the United States. Like many other wildlife species, they have become "urbanized" and do quite well in urban and suburban environments.



Habitat:

Red foxes prefer to live in areas that have a mix of forests and fields. They use the transition zone or "edge" between these habitats as hunting areas. Red foxes are also highly adaptive and can be found in suburban and urban areas.

Habits:

Red foxes tend to be solitary, usually hunting alone. They can be active at any time of day, but hunt most often during dawn and dusk (crepuscular). It is not unusual to observe foxes during daytime. Red foxes remain active all year and do not hibernate.

Foxes can be quite vocal, and they make barks, howls, and whines. The sounds vary from a short, sharp "yap" or bark, followed by a "yap, yap," to a combination of screeches, yells, and long howls.

Foods:

Red foxes are omnivorous, which means they eat both plants and animals. Their varied diet includes insects, birds, mice, snakes, rabbits, nuts, berries and fruits.

Reproduction:

The red fox breeding season is from January through March. After a gestation period of 51 to 53 days, females give birth to a litter averaging 4 or 5 pups. Red foxes may dig

their own burrows, but they usually improve an abandoned groundhog burrow. It also is common for foxes to den in the crawl space under decks and sheds.

Management:

Annual hunting and trapping seasons for red foxes have been established in Maryland. Foxes are managed as fur-bearing animals. The silky, dense fur of the red fox is more valued than the fur of the gray fox, which is coarse and thin.

Red foxes and People:

Generally, red foxes are not aggressive towards people unless they are infected by rabies. Any mammal can be infected with rabies. In Maryland, foxes usually comprise approximately 10% of the confirmed rabies cases. Once an infected animal exhibits signs of the disease, the disease is often fatal within 10 days. It is important to avoid physical contact with wild animals and immediately report any animal bites to your local health department.

Red foxes also will prey on domestic animals like chickens and cats. In addition to rabies, red foxes can also carry sarcoptic mange. The mange is spread by microscopic mites, and the foxes lose all of their hair in the process. Red foxes can transmit both rabies and mange to domestic dogs, so never let your dog near a wild fox!

Scats and Tracks:

	
Scat- ropey, tapered, and partly segmented shape; often has a musky scent	**Track-** has 4 toes with claws; feet are hairy, so tracks may look blurry; tracks are up to 2.5 inches long

Did You Know?

There are over 27 species of foxes worldwide, and the red fox is one of the most common species. Red foxes are also brown or gray when born and get their red coats at around 1 month of age.

River Otter

Lontra canadensis

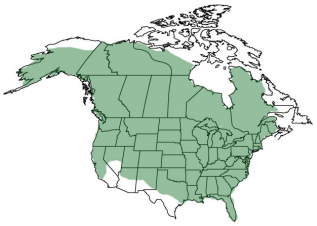
Image by: John White

Description:

The river otter is the largest member of the weasel family (Mustelidae). It has a long, slender body covered in brown, water proof fur. On average, otters range from 36 to 50 inches long from their head to the tip of the tail. They can also weigh anywhere from 11 to 30 pounds. Otters have sharp claws on their feet to catch prey.

Distribution and Abundance:

Otters are common throughout tidal areas of Maryland but can also be seen in other parts of the State. Otters are also abundant throughout much of the United States and Canada.



Habitat:

River otters, despite their names, can live in a variety of habitats including streams, rivers, lakes, and freshwater and saltwater marshes. Otters prefer to live in marshes and along wooded rivers and streams with pools and overhanging rocky banks. They also will use dens made by beavers, muskrats or groundhogs.

Habits:

River otter are active at almost any time of the day, but tend to be most active at night. River otters are not social, but sometimes a female and her young will remain in a group. River otters regularly use latrine sites where they deposit scat, urinate, scent mark and groom. Throughout their territory, river otters will have a number of den sites which are usually leftover by beavers, muskrats or groundhogs.

River otters do not hibernate and tend to be more active during the winter months than the summer.

Foods:

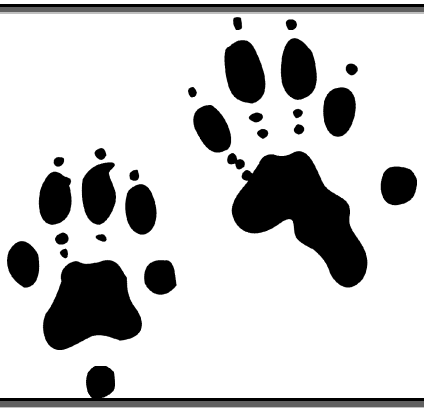
Otters are primarily carnivorous and will feed on fish, frogs, crayfish, shellfish, and sometimes aquatic insects, snakes, turtles, salamanders, earthworms, small birds and small mammals.

Reproduction:
River otters begin breeding at 2 years of age and mate in March-April. The young, called kits, are born the following winter/spring due to delayed implantation. River otters give birth to 2-6 young in early spring, and the young are blind until about 5 weeks of age. Kits are weaned after 4 months, and they leave the female when they reach 12-13 months old.

Management:
Annual hunting and trapping seasons for otters have been established in Maryland. River otters are managed as fur-bearing animals.

Otters and People:
River otters can sometimes be nuisances to pond owners or to commercial fish hatcheries. Electric fences around ponds or hatcheries can sometimes help with problems.

Scats and Tracks:

	
Scat- typically contains fish scales, bones and insect exoskeletons; found along water edges	**Track-** 5 toes with claws; hind foot is webbed; tracks about 3 inches across

Did You Know?
Otters can dive to a depth of 60 feet and can stay underwater for up to 4 minutes. With eyes adapted for underwater vision, otter's are nearsighted above water. Sound, touch, and smell are very important senses that otter's use to communicate with each other.

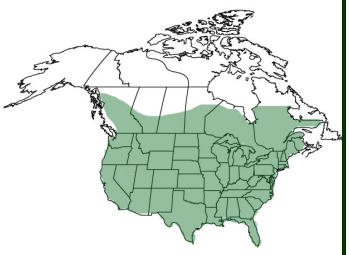
Eastern Striped Skunk

Mephitis mephitis

Image by: Erwin C. Nielsen/Painet Inc.

Description:

Eastern striped skunks are about the size of a house cat. Striped skunks weigh up to 8 pounds. They have a small, white stripe on their forehead which splits and expands down the sides of its back. They have a long, bushy tail made up of white and black hairs. The Eastern spotted skunk can also be found in Maryland, but it is highly rare and has a spotted appearance.



Distribution and Abundance:

Eastern striped skunks are relatively common throughout the United States and can be found throughout Maryland.

Habitat:

Striped skunks like habitats with a variety of woods and open areas like fields. They are considered habitat generalists and can be found in an assortment of areas, especially in and around edges. Striped skunks do need to live within at least 2 miles of a water source, though.

Habits:

Striped skunks are primarily nocturnal animals which lead solitary lives aside from occasional communal denning. Striped skunks do not hibernate but will spend multiple days sleeping during inclement winter weather.

When threatened, striped skunks will try to run away or will stomp their front feet as a warning signal. However, if those tactics do not work, then the skunk will stand on its front feet and spray a foul smelling liquid (butyl mercaptan) out of special scent glands in its behind.

Foods:

Striped skunks are omnivores, meaning that they eat both plant and animal materials. Striped skunk diet includes insects (especially grubs), small mammals, earthworms, snails, grains, nuts, fruits, reptiles, vegetation, amphibians, birds, eggs, carrion and garbage.

Reproduction:
Striped skunks mate in late-February through early March. Gestation typically takes 62-68 days, after which an average of 6 helpless young are born. At 3 weeks old, the young skunks can open their eyes and crawl around. The skunks are unable to venture out of the den and spray until they are 7 weeks old. Young skunks leave their mother in the Fall.

Management:
Annual hunting and trapping seasons for striped skunks have been established in Maryland. Striped skunks are managed as fur-bearing animals.

Skunks and People:
Skunks typically are docile and attempt to avoid people. However, some may burrow under buildings, raid garbage cans, dig holes in lawns while hunting for grubs and sometimes raid poultry pens or bee hives.

Skunks, like many other mammals are susceptible to contracting rabies. Once an infected animals exhibits signs of the disease, the disease is often fatal within 10 days. It is important to avoid physical contact with wild animals and immediately report any animal bites to your local health department.

Scats and Tracks:

	
Scat- Uneven and variable	**Track-** 5 toes with claws; hind foot is 2-3 inches long while front foot is 1-2 inches

Did You Know?
Skunks can shoot an accurate spray up to 10 feet and a less accurate spray up to 16 feet! Skunks are also resistant to snake venom and can survive 10 times the venom needed to kill an animal of the same size.

Activity: Quick, Frozen Critters

Grade Level: 5-8

Setting: Indoors in a large area like a gym or outdoors

Objectives: Students will (1) describe adaptations related to predator and prey relationships, (2) explain the importance of adaptations in predator and prey relationships and (3) describe how predator and prey relationships limit wildlife populations.

Method: Students will play an active game of "freeze tag".

Materials:

- Food tokens (poker chips, pieces of cardboard, etc)- make enough for 3/student
- Bandanas or other labeling device for predators
- Cones or other markers to mark boundaries of playing field
- 3-5 hula hoops to serve as "habitat"

Background:
Predators are animals that kill and eat other animals for food. Conversely, **prey** are animals that are killed and eaten by other animals for food. Many times, prey are **limiting factors** for predators. Limiting factors are factors which prevent a population from growing larger. For example, if not enough food is available to feed a population of black bears, then some bears will starve due to the limited amount of food available.

Animals display a variety of behaviors

Procedure:

1. Talk to students about the concepts of predators and prey. Have them name animals in each category. After they have named different predator and prey species, have the students identify adaptations that those species have to either catch their food or to prevent being caught.
2. Identify students as either predators or prey for a version of freeze tag. There should be approximately one predator per every four to six prey. You can either let the students choose what type of animals they want to be or choose a predator-prey relationship such as those listed below.
    a. Cottontail rabbits vs. coyotes
    b. Squirrels vs. hawks
    c. Quail vs. foxes
    d. Crayfish vs. raccoons
    e. Fish vs. river otters

3. Designate one end of the playing field as the "food source" and the other end as the "permanent shelter." The size of the playing field will depend on the number of students playing and their athletic level – 15 yards wide by 30 yards long may be good to start with.
4. Four or five "temporary shelters" or "cover" should be available in the open area between the shelter and the food. These can be the hula hoops or whatever you choose to represent as the shelter.
5. Food tokens (poker chips) are placed in the food source zone on the ground. Allow three food tokens for each prey animal.
6. Clearly identify predators by using bandannas or other means.
7. Use a whistle or another signal to start each round. When a round begins, have the prey students start from their permanent "shelter". The task of the prey animals is to move from the permanent shelter to the food source at the other end of the field. When they reach the other end of the field, they have to collect one food token and return to the permanent shelter. To survive, the prey must collect three food tokens. Travel is hazardous, though. Prey animals need to be alert to possible predators. If they spot a predator, they can use various appropriate prey behaviors, including warning other prey that a predator is near. All prey have two ways to prevent themselves from being caught by predators: they may "freeze" any time a predator is within 5 feet of them, or they can run to cover (hula hoops, etc). Frozen prey may blink, but otherwise should be basically still and silent.
8. Predators start the activity anywhere in the open area between ends of the field and thus are randomly distributed between the prey's foods and permanent shelter. Predators attempt to capture prey to survive, tagging only moving (not "frozen") prey.

Note: Establish a ground rule for student behavior: behave in ways not harmful to other students, even when simulating prey behavior.

9. Set a time limit of 5-7 minutes for each round of the game. (Captured prey on the sidelines will become restless if rounds are too long). Remind prey that they can remain frozen for as long as they like, but if they do not have enough food at the end of the activity, then they will starve to death. In nature, an animal must balance the need to find food with the sometimes conflicting need for safety.
10. Play several rounds, allowing each student to be both predator and prey. You can vary up the rounds by adding extra predators, decreasing habitat (to simulate habitat loss), etc. You can also experiment with injured prey (aka, make one student hop during the game).
11. At the end of the game, discuss with the students ways they escaped capture when they were prey. Which ways were the easiest? Which were the most effective? What means did they use as predators to capture prey? Which ways were the best? What did the predators do in response to a "frozen" prey?

In what ways are adaptations important to both predator and prey? If you had an abundance of predators, then how did that effect the game? If you had injured prey, ask them how their experience was different. Ask the students to summarize what they have learned about predator-prey relationships. How do predator and prey relationships serve as natural limiting factors?

Variations:

1. Conduct the activity for three or four rounds, recording the number of captures each playing period. Have the students who are captured become predators, and have each predator that did not acquire enough food in one round to become a prey animal the next round. This feature quickly develops the concept of dynamic balance as prey and predator populations fluctuate in response to each other.
2. Have the students walk or assign different modes of locomotion to each animal.

Aquatic Extensions:

1. Conduct this activity using aquatic predator and prey species.
2. "Swim" toward your food while portraying fish species.
3. If possible, then conduct the activity in the shallow end of a real swimming pool.

Evaluation:

1. Choose any predator and its prey. Describe each animal's adaptations.
2. Explain the importance of adaptations in predator and prey relationships. What role do predator and prey relationships play in limiting wildlife populations.
3. Draw an imaginary animal that can escape the following:
    a. A fast flying predator
    b. A stalking predator
    c. A pouncing predator

    Have the students justify their decisions.
4. Write about a predator that can capture the following prey:
    a. A well camouflaged prey
    b. A species with excellent eyesight
    c. A species which has body armor or quills

    Have students justify their decisions.

Reading the Woods

Tracking wildlife is a fun activity that everyone can enjoy. One of the most important items for tracking wildlife is a field journal. By keeping a field journal, you can record observations you have made and preserve your finds. You can also write down crucial information that may be helpful for identifying animal tracks and signs when you return home. Animals leave many clues as to where they have been and what they have done. The next few pages will focus on two main animal signs: tracks and scat.

Animal Tracks

When examining animal tracks, it is important to look for answers to the following questions:

- How many toes each animal have on each foot?
- What foot is larger? Front or rear?
- Which track is from the left and which is from the right?
- What are the general pad shapes?
- What was the animal's gait?
- Can you see claw marks in the print or not?

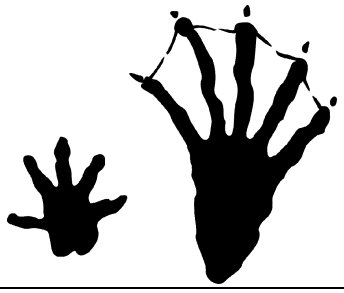
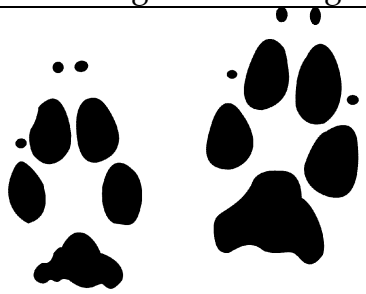
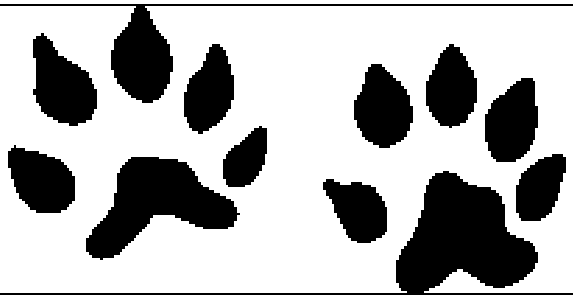
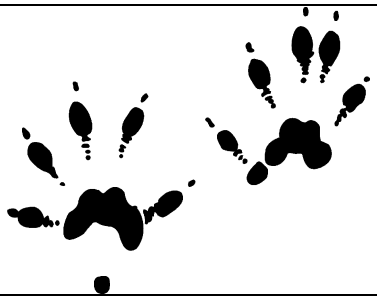
Track patterns:

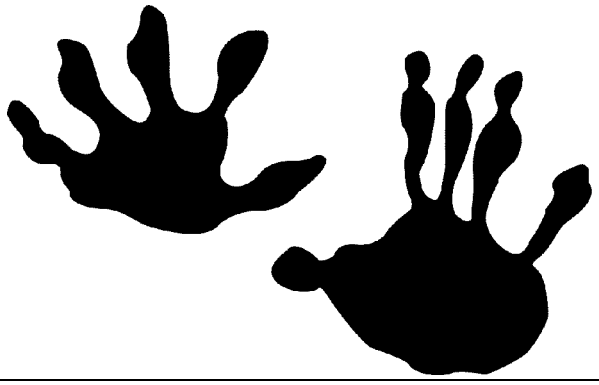
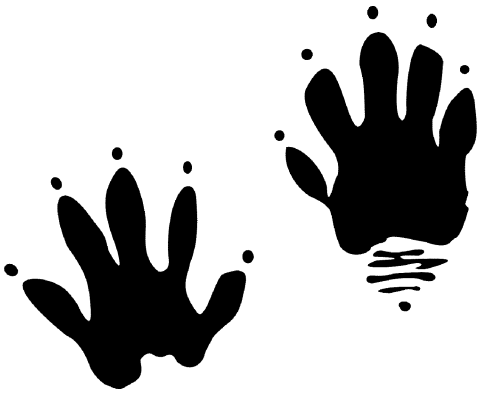
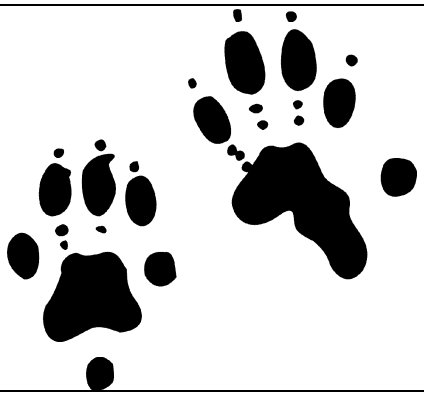
By examining the patterns of animal tracks, you can sometimes figure out what group of animals made it.

- Diagonal walkers - (cats, dogs and hoofed animals) Move opposite limbs together, right foreleg with left back leg.
- Bounders - (most weasels except skunks, badgers and wolverines) Hop in steady series of jumps, forelegs first and back legs pulling right behind them
- Gallopers - (most rodents and rabbits) these animals hunch down and bring hind legs in front of back legs.
- Pacers - (wide bodied animals such as raccoons, opossums, bears, beavers, porcupines, porcupines, wolverines, badgers and skunks). They shuffle along, but move from pacing to bounding as they go faster.

Note: The best tracks are found in mud or soft soil or sand. Snow, on the other hand, can melt and make the tracks appear larger than they are naturally. Most times the tracks you find will be overlapping and incomplete, but don't be discouraged!

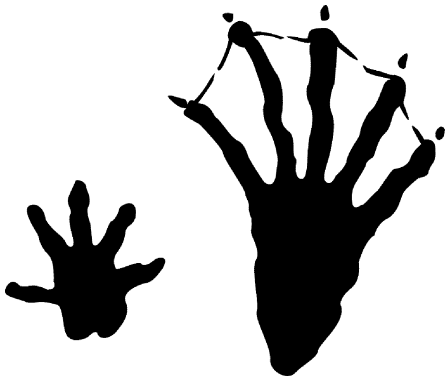
Quick Track Guide to MD Furbearers

	
Beaver- has 5 toes; the hind tracks are about 6 inches long and webbing is visible	**Bobcat-** has 4 toes and no claws; tracks are about 2 inches across
	
Coyote- has 4 toes with claws; toe pads are large; up to 3" long	**Fisher-** has 5 toes with claws; tracks are 2.5 inches across
	
Gray Fox- has 4 toes with claws; tracks are 1-1.5 inches long	**Long-tailed weasel-** has 5 toes with claws but sometimes only 5 toes visible in tracks; tracks rounded and up to an inch across
	
Mink- 5 toes with claws; has long, skinny toes; tracks are about 1.5 inches across	**Muskrat-** has 5 toes with claws; hind foot is about 3 inches long

	
Nutria- 5 toes with claws; 4 of the 5 toes on the hind foot have webbing;	**Opossum-** has 5 toes with hand-like appearance; front tracks have widely spaced toes; tracks are about 2 inches wide
	
Raccoon- has 5 toes with claws; hind foot is about 4 inches long and toes finger-like	**Red fox-** has 4 toes with claws; feet are hairy, so tracks may look blurry; tracks are up to 2.5 inches long
	
River otter- 5 toes with claws; hind foot is webbed; tracks about 3 inches across	**Skunk**- 5 toes with claws; hind foot is 2-3 inches long while front foot is 1-2 inches

<u>Activity:</u> What Animals Made These Tracks?

Look at the tracks below and write down the name of the animal that made them!



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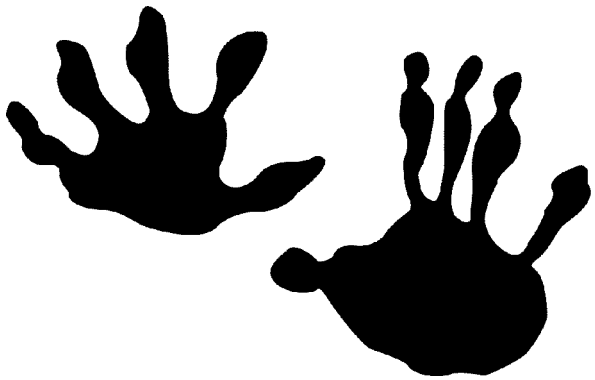

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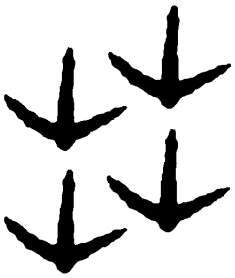


W_ _ d T_ _ _ _y

Animal Detective's Animal Tracks Journal

Detective_____ Date:_____

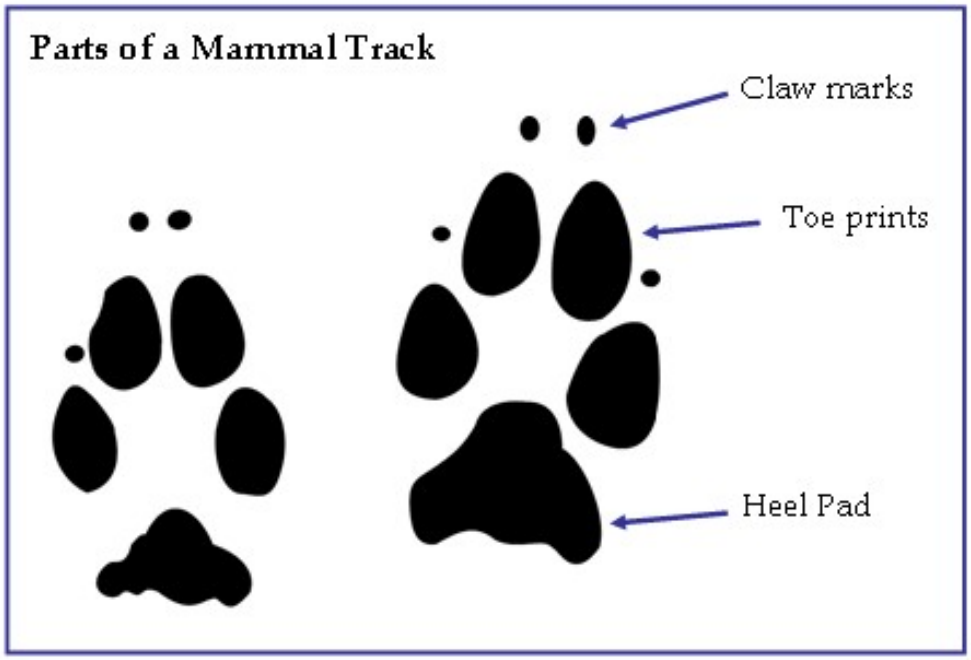
Weather:_____

Take a trip outside and look for signs of animals. In the boxes below, draw the tracks you observe during your trip. Be sure to write where you were when you saw each track.

Track #1	Where were you? _____ _____ What animal do you think this is from? _____ Notes: _____ _____ _____
Track #2	Where were you? _____ _____ What animal do you think this is from? _____ Notes: _____ _____ _____
Track #3	Where were you? _____ _____ What animal do you think this is from? _____ Notes: _____ _____ _____

Simplified Key to Common Mammal Tracks

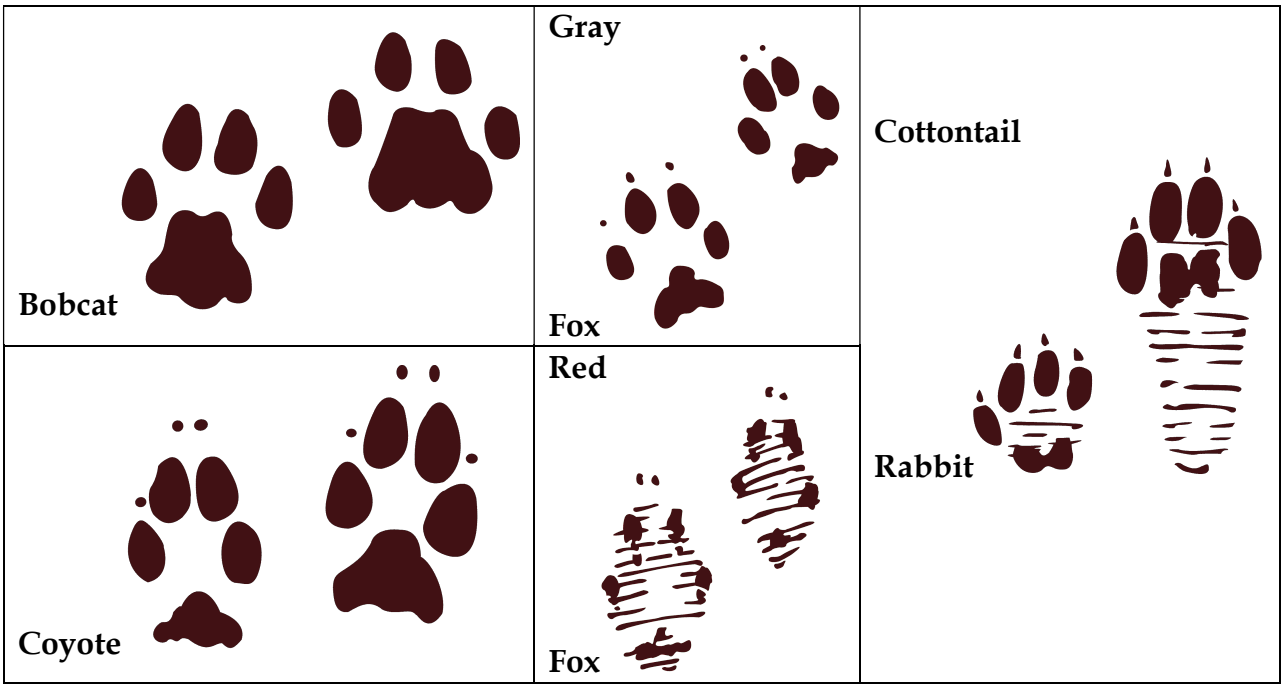
1. Two toes per foot
    a. **White-tailed Deer**
2. More than 2 toes per foot
    a. Four toes per foot
        i. **Go to Section 1: Canids, Felids and Lagomorphs**
    b. 4-5 toes per foot
        i. 4 toes in front and 5 toes in back
            1. **Go to Section 2: Rodents**
        ii. 5 toes per foot
            1. Hind track webbed
                a. **Go to Section 3: Semi-Aquatic Mammals**
            2. Hind track not webbed
                a. **Go to Section 4: Other Mammals**



Section 1: Canids, Felids and Lagomorphs

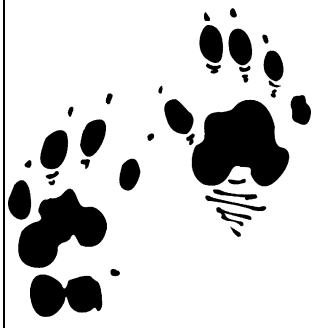
Animals in the Canid (Dog and Fox) and Felid (Cat) families tend to have a diagonal track pattern while those in the Lagomorph (Rabbit and Hare) family have a galloping track pattern.

1. Four toes per foot without visible claw marks; two notches on top of pad
    a. Foot prints 1″ long by 1″ wide
        i. **House cat**
    b. Foot prints greater than 1″ long by 1″ wide
        i. **Bobcat**
2. Four toes per foot with visible claw marks; typically one notch on top of pad
    a. Front foot larger
        i. Tracks 1-1.5″ long
            1. **Gray Fox**
        ii. Tracks larger than 1.5″ long
            1. Tracks up to 2.5″ long and occasionally blurry
                a. **Red Fox**
            2. Tracks larger than 2.5″ long
                a. Oval track with well defined X-pattern made by pads
                    i. Coyote
                b. Rounded track without X-pattern made by pads
                    i. Domestic dog
    b. Hind foot larger
        i. **Eastern cottontail rabbit**



Section 2: Rodents

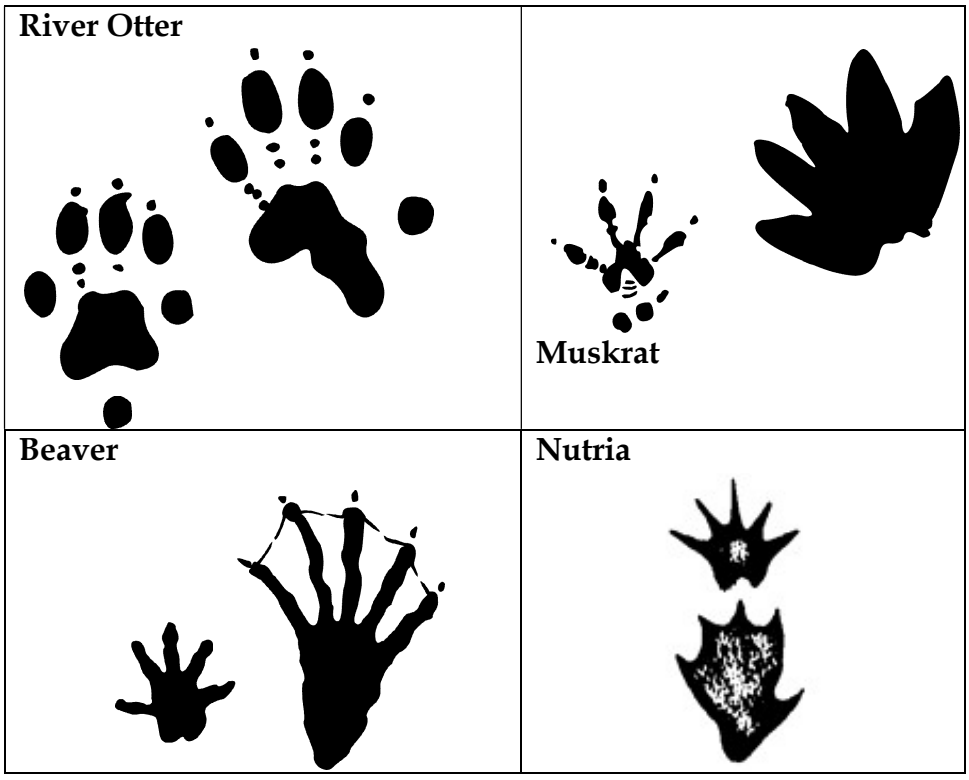
1. Tracks less than 0.5″ long by 0.5″ wide
    a. Tail mark often seen running in between tracks
        i. **Mouse**
    b. Tail mark absent between tracks
        ii. **Vole**
2. Tracks greater than 0.5″ long by 0.5″ wide
    a. Front foot greater than 2″ long
        i. **Groundhog**
    b. Front foot less than 2″ long
        i. **Eastern gray squirrel**

Mouse 	**Vole** 
Groundhog 	**Eastern gray squirrel** 

Section 3: Semi-aquatic Mammals

Semi-aquatic mammals are adapted to living in and around water, so their feet tend to be webbed to aid with swimming. Semi-aquatic rodents like muskrats, nutria and beavers tend to have a pacing track pattern while weasels like the river otter have a bounding track pattern.

1. Hind track nearly as wide as long; tracks appear webbed
    a. **River Otter**
2. Hind tracks clearly longer than wide
    a. Hind tracks 2.5-3.2" long, often drag mark from tail by prints
        i. **Muskrat**
    b. Hind tracks larger than 5" long
        i. Hind track with 5 webbed toes
            1. **Beaver**
        ii. Hind track with 4 webbed toes and one, smaller toe on side
            1. **Nutria**



Section 4: Other Mammals

1. Claws clearly visible on front prints and less so (or not at all) on hind prints
    a. **Striped skunk**
2. Claws clearly visible on both front and hind prints
    a. Front print 1-1.6″ wide
        i. Front print less than 1″ wide
            1. **Long-tailed weasel**
        ii. Front print 1.2-1.6″ wide
            1. **Mink**
    b. Front print greater than 1.6″ wide
        i. Toes finger-like
            1. Hind print with "thumb" angled away from other toes
                a. **Opossum**
            2. Hind print not as above
                a. **Raccoon**
        ii. Toes not finger-like
            1. **Fisher**

<table>
<tr>
<td>Striped Skunk
  </td>
<td>Long-tailed Weasel
  </td>
<td>Mink
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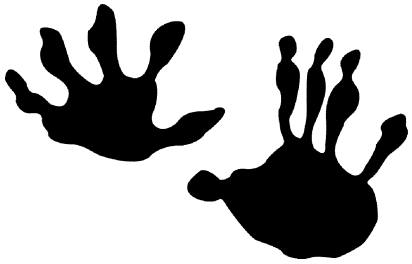
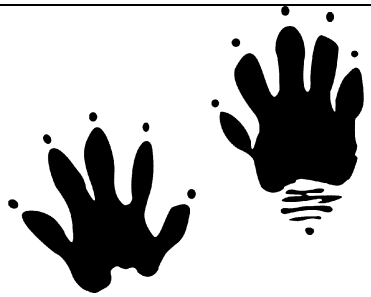
<tr>
<td>Opossum
  </td>
<td> 
Raccoon</td>
<td>Fisher
  </td>
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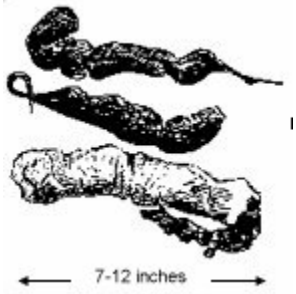
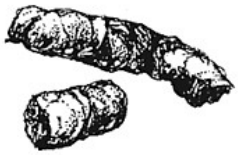
Scat Guide

Scat, also known as poop, is a great way to identify animals and to learn about their food habits. Scientists can study scat to learn about the health of an animal and to learn more about their diets in the wild. Predator scat often contains large amounts of hair and bones from their prey. In contrast, animals that eat plants, aka herbivores, often have lots of plant material in their scat.

	
Beaver- oval pellets made of wood chips that are 1 to 1 1/4 inches in length and 3/4 of an inch in diameter	**Bobcat-** Scat is up to 4 inches long and 3/4 of an inch in diameter, segmented with blunt ends. Evidence of scratched leaf litter and soil with scat in the scratched out area will indicate cat droppings.
	
Coyote- Very similar to fox, but larger. A large fox and a small coyote may have identical scat	**Fisher-** resembles that of a Mink but has a larger diameter. Scat is brown to black in color & are twisted with tapered ends 3/8 to 5/8 of an inch in diameter & folding over
	
Gray Fox- about 2 ½ inches long, ½ inch in diameter, segmented, tapered at one end, sometimes both and often covered with find rodent fur; typically contains more seeds and berries than Red fox scat	**Long-tailed weasel-** brown or black, long, slender and segmented, often tapering at one end

	
Mink- long and twisted resembling a braided rope, black to light in color with tapered ends and may fold over itself	**Muskrat-** composed of little pellets stuck together, although sometimes the pellets are separate
	
Nutria- only vegetable matter and is tapered at both ends; similar to muskrat	**Opossum-** Uneven and variable due to changing food sources. May have hair or berries. Smaller in general than fox, and smaller sections too. Different shape than raccoon; hard to ID
	
Raccoon- note blunt ends and uniform thickness, like a tootsie roll. Scat will have berries, seeds, corn and perhaps crayfish parts. May find anywhere --- in thickets, stream banks, on rocks, outside of dens	**Red fox-** ropey, tapered, and partly segmented shape; often has a musky scent
	
River otter- typically contains fish scales, bones and insect exoskeletons; found along water edges	**Skunk** -Uneven and variable.

What Can Skulls Tell You?

You may have gone for a walk through the woods and found a skull from an animal on the ground. Skulls can tell you a lot about the animals they come from. This unit provides background information on skulls and what you can learn from them in addition to activities for students.

Eye See You

The size and position of eye sockets in skulls can tell:

- if the animals are predators or prey
- what time of day the animals are most active.

Predators typically have eyes situated in the front of their skulls. This helps them see prey easier by producing a binocular or stereoscopic vision. This binocular vision allows predators to see and judge depth in order to pursue and track prey. In contrast, prey have eyes on the sides of their skulls. This helps prey see predators lurking on the side or behind them.

"*Eyes in the front, the animal hunts. Eyes on the side, the animal hides.*"

In addition to eye socket placement, the size of the eyes in relation to the rest of the skull can also reveal clues about the animal. Animals with larger eyes typically are nocturnal, or are most active during the night.

Tasty Teeth

You can tell a lot about an animal by looking at its teeth. Teeth can stab, slice, crush and grind food. By examining the size, shape and arrangement of teeth, you can determine basic eating habits of animals. There are four types of teeth in mammals:

- Incisors: flat, chisel-shaped teeth at the front of the mouth (behind the lips) that are used in biting, cutting, nibbling and stripping
- Canines: teeth located on the cheek-side of the mouth, next to the incisors; canines are cone-shaped and used for seizing, piercing and tearing
- Premolars: transitional teeth between canines and molars; premolars have 1 or more cusps (points) and are generally used for grinding and crushing
- Molars: have 3-5 cusps and are located in the back of the mouth on the cheek sides; these teeth function in grinding and crushing

Animals can generally be assigned to three categories with respect to their diet: carnivores (meat eaters), herbivores (plant eaters) or omnivores (plant and meat eaters).

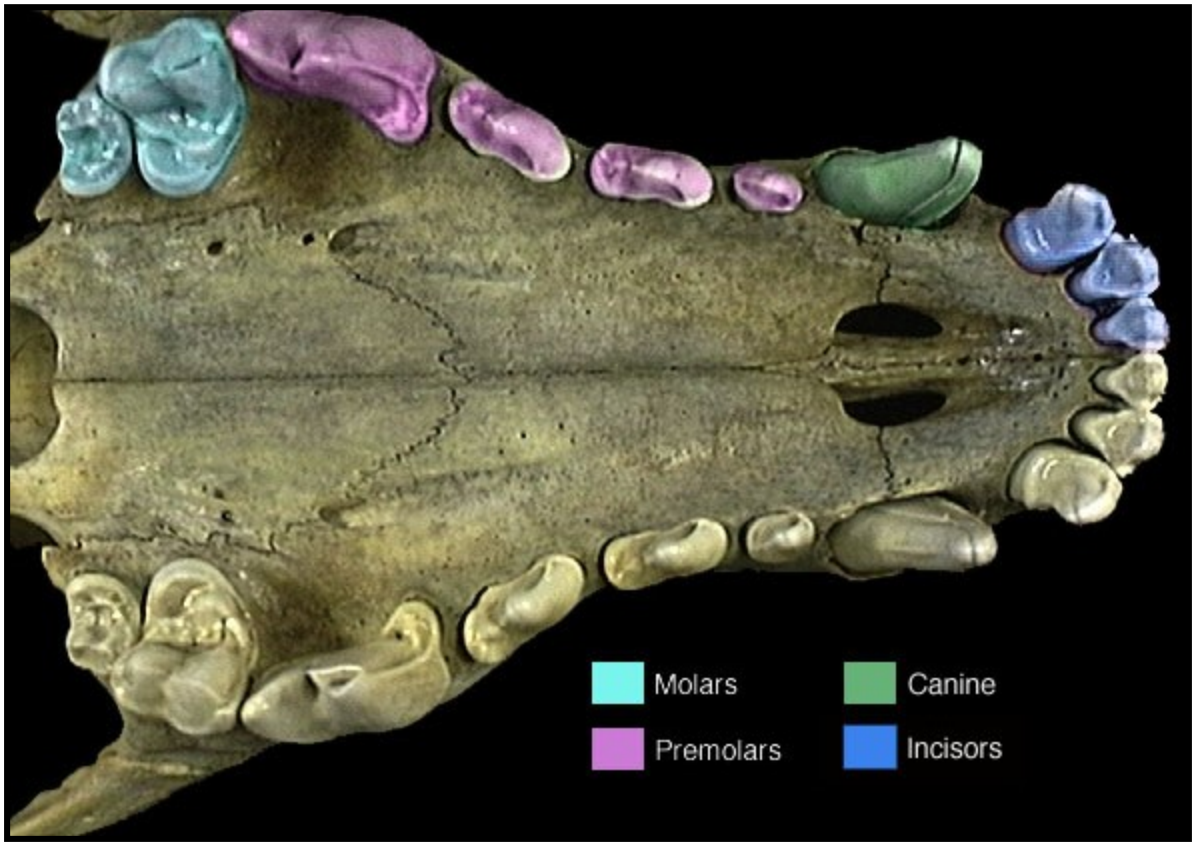


Image by: Animal Diversity Web, University of Michigan, http://animaldiversity.ummz.umich.edu

Carnivores are predators and tend to have large, slicing canines in the front of their mouth. The roots of their teeth also tend to be long. The last upper premolar and first lower molar of carnivores are called carnassial teeth. These teeth act like scissors to shear flesh. The cusps on carnivore's molars tend to be pointed for tearing meat.

In contrast, herbivores have tall and broad molars. Herbivore molars tend to have flat upper surfaces with small ridges used for grinding plant material. Many herbivores can also move their jaws side to side to grind good. Incisors on herbivores tend to be blunter and non dagger-like compared to carnivore incisors. In many herbivores, the incisors grow continuously to allow the animals to maintain optimal tooth length.

Omnivores have a combination of teeth designed for eating flesh and plant material. Omnivores have sharp, long canines for grabbing animal prey in addition to wide molar teeth with low, bumpy crowns. The molars are designed tear meat and grind plant material.

The condition of teeth can also tell you a little about the animal's age and history. For example, if teeth are heavily worn down, damaged and/or cracked then the animals is likely older. A few chipped or broken teeth may also indicate the animal was in a fight or an accident. Sometimes, biologists can age animals using their teeth by counting rings on canines or looking at patterns of tooth replacement.

The Nose Knows

The length of an animal's nose can also tell you about its sense of smell. If an animal has a short nose, then it doesn't have a good sense of smell and relies on other senses to find food. In contrast, animals that have long noses like Coyotes have very good sense of smell. When examining the length of a nose, always compare the length of the nose (from the tip of the nose to the edge of the eye socket) to the overall skull length.

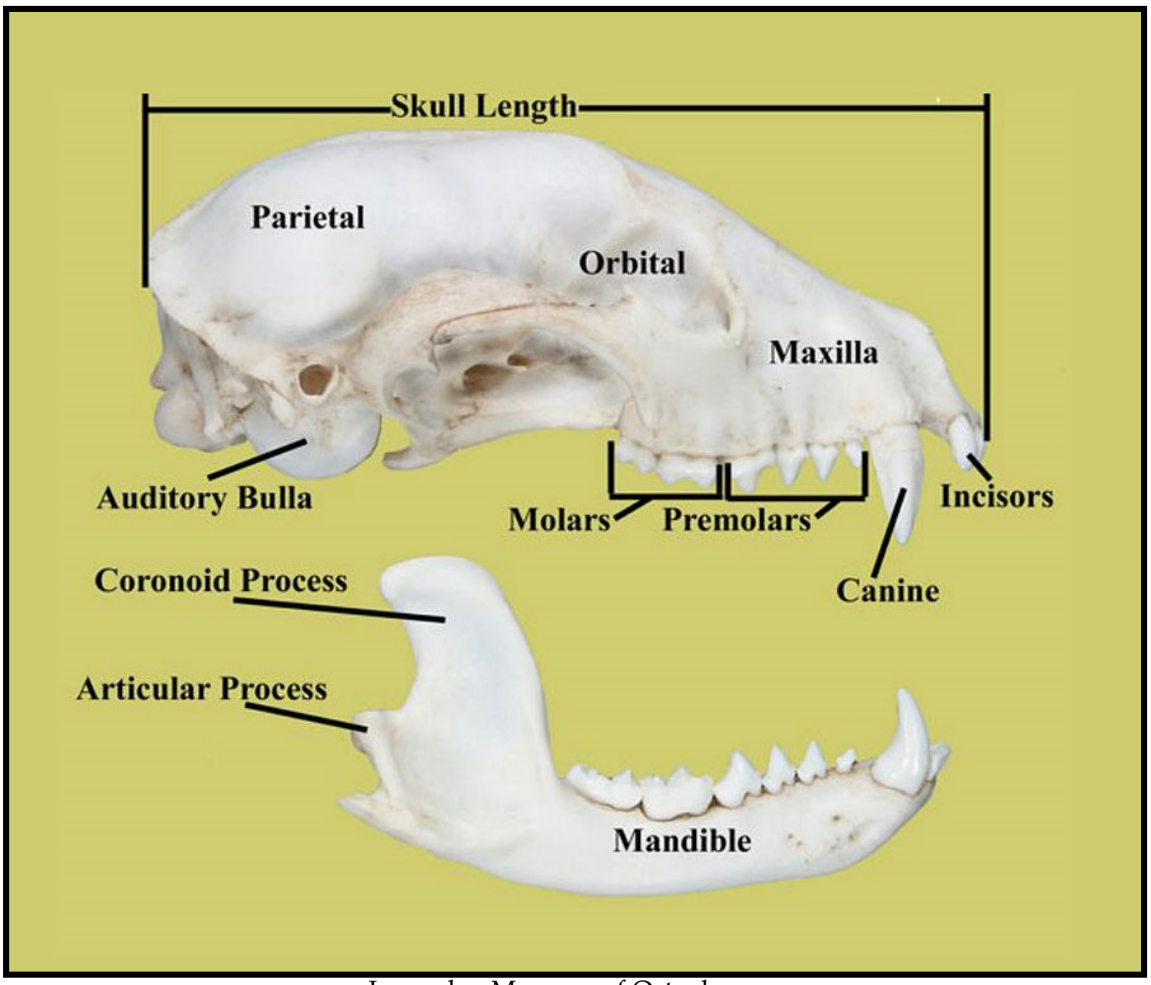


Image by: Museum of Osteology

Activity: Every Skull Tells a Story

Grade Level: 3-5

Setting: Indoors

Objectives:
Students will examine a variety of furbearer skulls to determine food habits.

Materials:
- Furbearer skulls
- Staple removers
- Cottons balls
- Leaves,
- Flat rocks

Background:
Read the "What can skulls tell you" document.

Procedures:
1. Teach students about the differences between predators and prey. Have students list different types of predators and their associated prey
2. Go over concepts covered in the 'Eye See You' section of the background document. Have students determine if they are predators or prey based on the position of their eyes. What happens to their vision if they cover one of their eyes and walk around the classroom?
3. Discuss student's results, and then tell them they are going to be detectives to figure out what different animals eat by examining animal skulls.
4. Break students into groups of 2-3 and hand them one of the labeled skulls.
5. Have the students determine if the skull of their animal is a predator or a prey based on the position of the eyes. Have students record their results.
6. For the next part of the lesson, teach students about carnivores, herbivores and omnivores and have them write down animals they know in each category.
7. Hand each group a cotton ball, staple remover, flat rock and leaf.
8. Tell the students that the staple removers represent the teeth of carnivores and the flat rocks represent the teeth of herbivores. Have the students experiment with "eating" the leaves and cotton balls with the different sets of "teeth". (Note: you can use a variety of food items for this activity).
9. Have the students discuss which type of "teeth" was most effective for the different types of "food". Why were the two flat rocks better with the leaf versus the cotton ball?
10. Have the students reexamine their skulls to determine the following information:

a. Does the animal eat meat (carnivore), plants (herbivore) or both (omnivore)? Why?

11. Have the students record their results and then present their findings to the rest of the class.
12. Next, have students look at all of the different skulls. Have students compare and contrast the sizes of structures like the animal's noses, their ears (looking at the auditory bulla) and the eyes of the animals. Is there anything else the skull might tell them about how that animal lives?

Extensions:

1. Have each student choose a furbearer and research its diet. Have the students create a restaurant menu with food items for their animal.
2. Have students construct food webs for a furbearer.
3. Have students design a fictitious animal and label how different characteristics can help it survive. For example, if the animal has a really large nose, then it has a good sense of smell or if its feet are webbed, then it is good at swimming.

Note: Activity modified from "Teacher Suggested Activity #1 for Skulls and Teeth" designed by Joanna Smith, Jenny Alvey, and Emily Wilburn provided by Biology in a Box series (http://eeb.bio.utk.edu/biologyinbox)

Activity: Skull Detectives

Grade Level: 9-12

Setting: Indoors

Objectives:
Students will make inferences about an animal's diet based on skull morphology and will use a dichotomous key to identify animals by their skulls

Materials:
- Furbearer skulls
- Copies of dichotomous keys

Background:
Read the "What can skulls tell you" document. Skulls can tell you a lot about the organisms they represent. For example, by looking at types of teeth in an animal skull, then you can discern whether or not the animal was a carnivore, herbivore or omnivore. The size and placement of eye sockets, nostrils and ear canals can also tell you a lot about an animal. You can also identify animals based on their skulls.

A **dichotomous key** is a method for determining the identity of something (like the name of a butterfly, a plant, an animal or a rock) by going through a series of choices that leads the user to the correct name of the item. Dichotomous means "divided in two parts". At each step of the process of using the key, the user is given two choices; each alternative leads to another question until the item is identified. Dichotomous keys are used frequently in biological sciences and can be used for identification of mammal skulls.

Procedures:
1. Before beginning the activity, go over the basic parts of the skull labeled on the attached sheet as well as the different types of teeth and their functions.
2. Break students into groups or hand them each their own skull to identify.
3. Before using the key, have the students write down answers to the following questions:
    a. Is the animal an herbivore, carnivore or omnivore? Why?
    b. Is the animal a predator or a prey species? Why?
    c. Does this animal have a good sense of smell? Why?
4. Have students use the dichotomous key to identify the skulls.

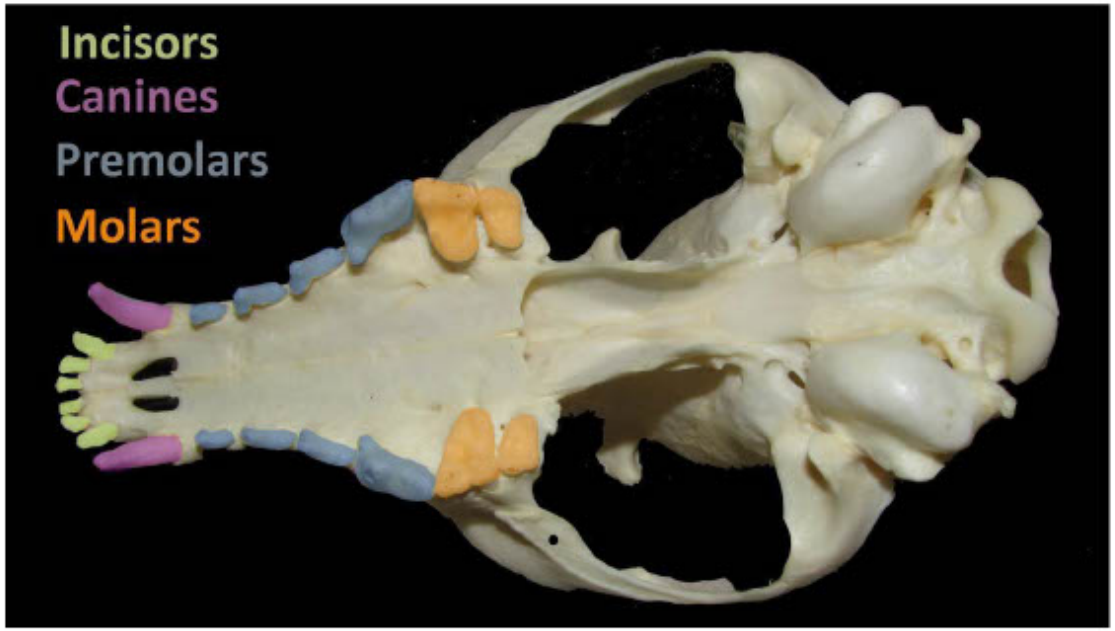
Key to Common Maryland Mammal Skulls

Kerry Wixted

Introduction to Mammal Teeth

Teeth can tell you a lot about an animal, including their main diet. In some animals, like black bears, you can also use teeth to age the animal. There are four main types of teeth, and the number of each type is often written as a fraction known as a dental formula.

- **Incisor**- anterior-most teeth (front teeth) of mammals; used for biting
- **Canine-** elongate, unicuspid tooth; used for grabbing flesh
- **Premolar-** bicuspid teeth situated between canines and molars; used for tearing and grinding
- **Molar-** teeth, typically with 4 cusps, located after premolars; used for grinding
- **Dental formula-** numerical representation of the number of each kind of tooth on one side of the upper and one side of the lower jaw
    - **Example:** The statement 'incisors 5/4' means that there are 5 incisors on top and 4 incisors on the bottom for <u>each side</u> of the jaw
- **Carnassial teeth-** pair of bladelike teeth (last upper molar and first lower molar) that exhibit a shearing action
- **Cheek teeth-** combination of premolars and molars

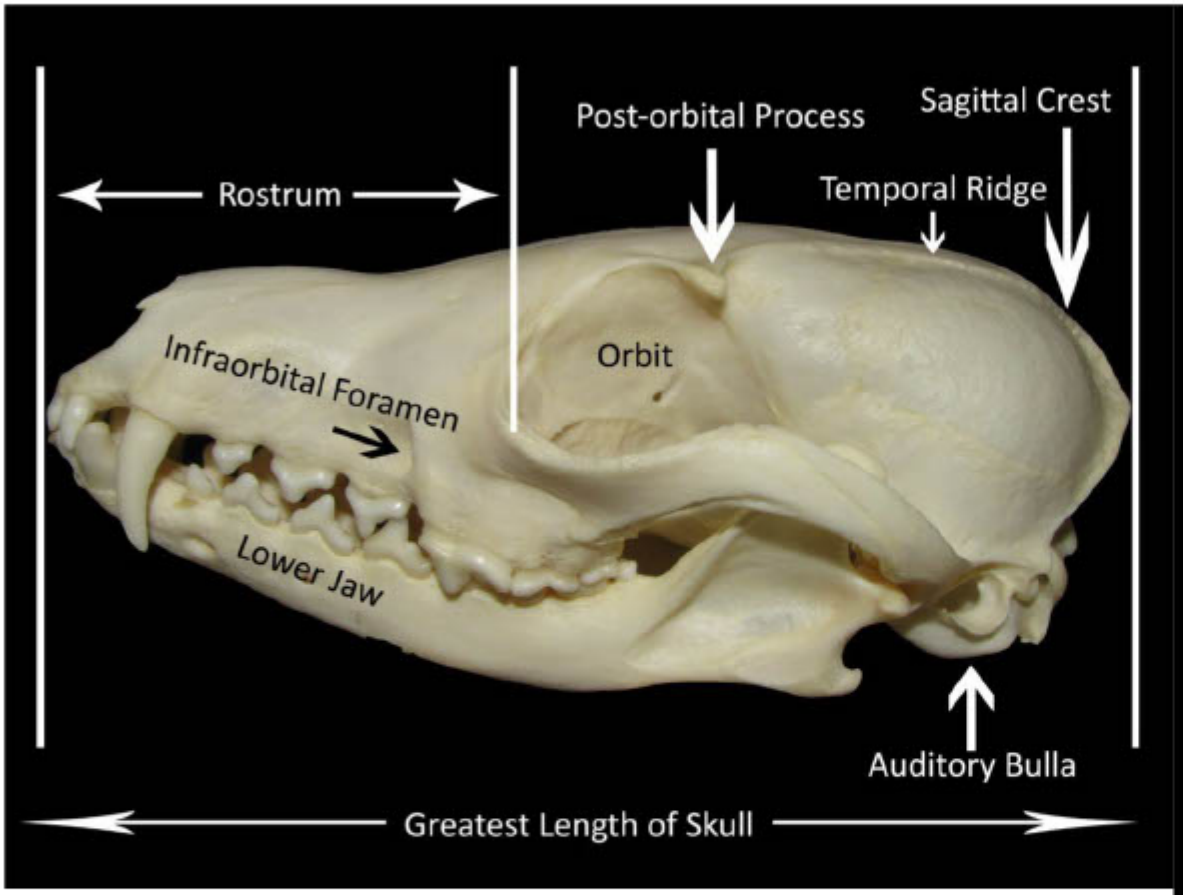


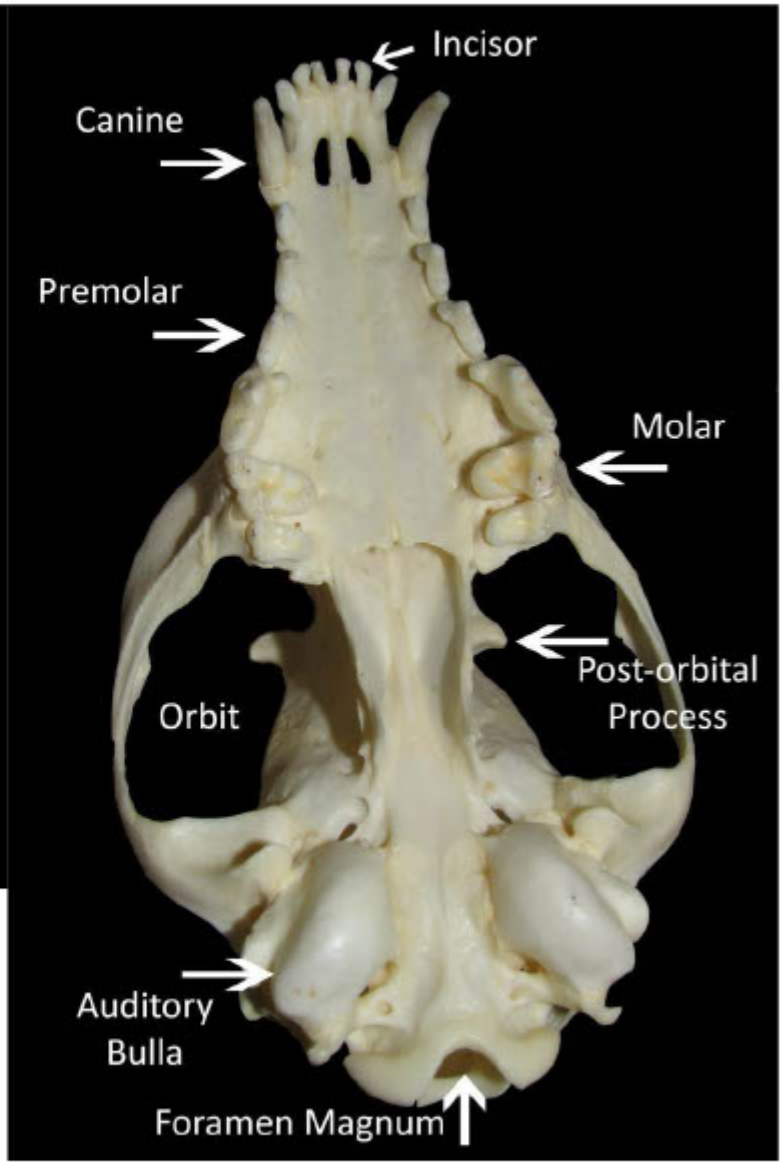
Introduction to Common Mammal Skull Terms

There are many parts of a skull. Below are definitions for vocabulary words you may encounter with this key:

- **Anterior-** front of skull or lower jaw
- **Auditory bulla (or bullae)-** bony capsule enclosing middle ear
- **Diastema-** a gap or space in the jaw between teeth; used most often to denote gap between incisors and cheek teeth in rodents
- **Foramen-** openings or holes in bone where nerves, blood vessels, and muscles can pass through
- **Foramen magnum-** large opening at the back of a skull which the spinal cord goes through
- **Greatest length of skull-** length from tip of rostrum to the posterior most part of the skull
- **Infraorbital foramen-** opening below the eye; aka infraorbital foramen
- **Mandibular mental foramen-** foramina (openings) located on the anterior surface of the mandible
- **Orbit-** eye socket
- **Paraoccipital process-** a downward-projecting spur from the base of the skull which attaches the muscle used in opening the lower jaw
- **Posterior-** back of skull or lower jaw
- **Post-orbital process-** bony projection by the rear of the orbit
- **Rostral fenestra-** holes on the side of the rostrum; in rabbits, this can look like lacy bone
- **Rostrum**- distance from end of nostrils to orbit (aka nose)
- **Sagittal crest**- raised bony ridge on middle of cranium; well developed in carnivores
- **Temporal ridge**- any of four nearly parallel curved ridges or lines situated two on each side of the skull and chiefly on the parietal bone

Introduction to Common Mammal Skull Terms





Eyes: Forward-facing eyes indicate the mammal is likely a predator while eyes on the side indicate the mammal is likely prey.

Rostrum: A long rostrum and/or well developed nasal cavity indicate a good sense of smell.

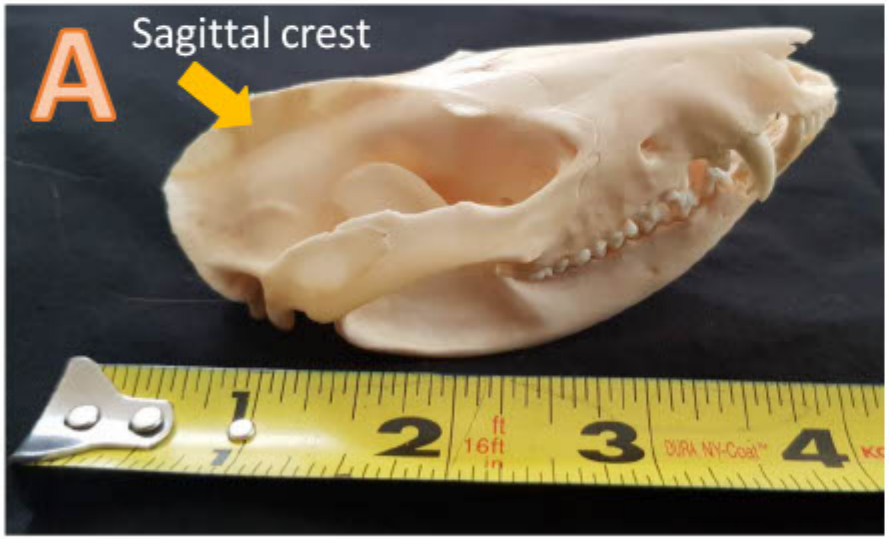
Auditory bullae (singular= bulla): These help house the inner ear bones which assist with hearing and with balance.

Key to Common Maryland Mammal Skulls

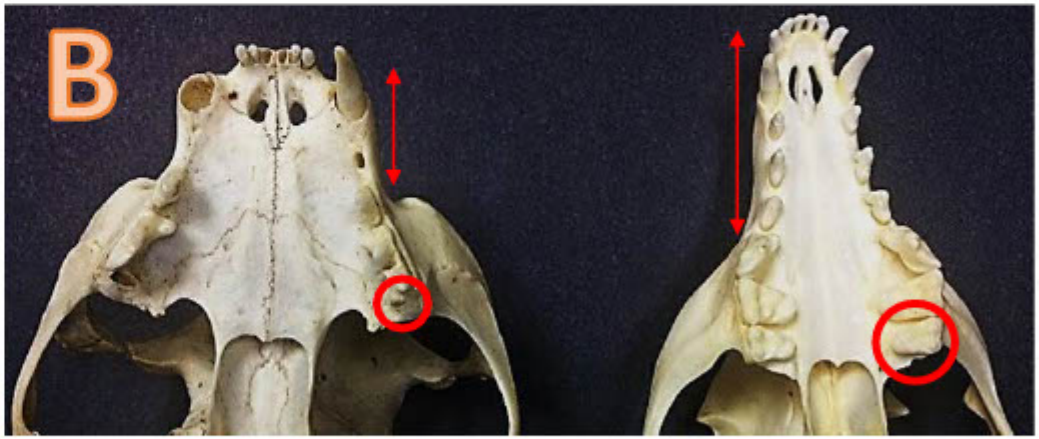
1. Canines present..... 2
1. Canines absent .....**Section A**

2. Incisors $^{5}/_{4}$ [dental formula] and large sagittal crest present (Figure A)... .....**Opossum**
2. Incisors not $^{5}/_{4}$.....3

3. Rostrum (nose) short. Rear, upper molar small and peg-like (Fig. B, left) 4
3. Rostrum short or long. Upper molar(s) not peg-like and robust (Fig. B, right)... 5



Virginia opossums have 50 teeth, a large sagittal crest and a small braincase.

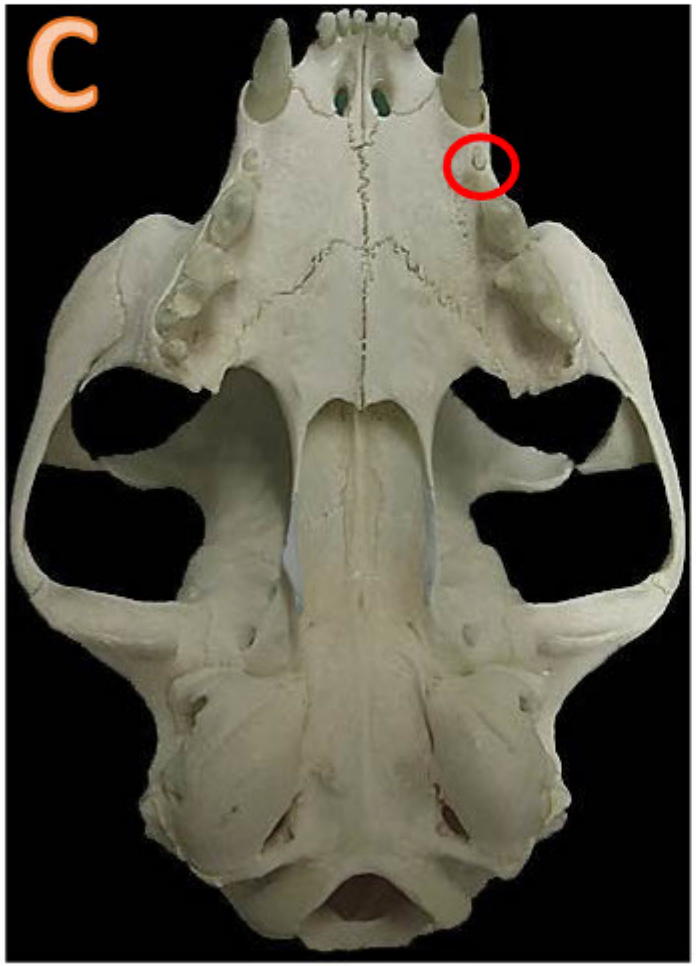


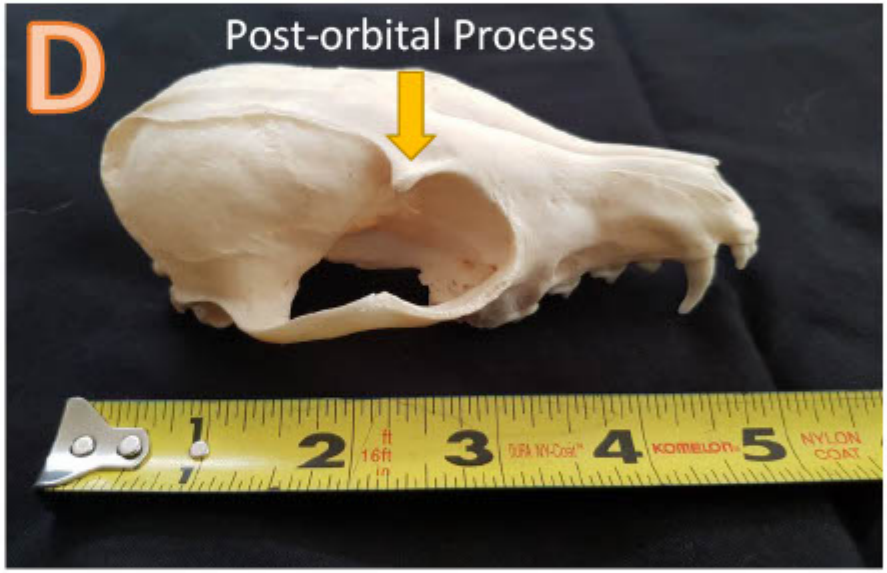
Felines (left) have short noses and a tiny peg-like molar behind their premolars. Canines (right), have longer noses and larger and more robust rear molars.

Key to Common Maryland Mammal Skulls

4. Has tiny premolar (Fig. C) behind canine; greatest length of skull 77-101 mm (~4”).....**House cat**
4. Lacks tiny premolar behind canine; greatest length of skull over 101 mm (> 4”)…..**Bobcat**

5. Post-orbital process in front of skull midpoint…..... 6
5. Post-orbital process at or near skull midpoint (Fig. D)..... **Section B**





Housecats (Fig. C) have a small premolar behind their canines. Often, this premolar will fall out in skull specimens but the hole behind the canine will be a sign a tooth was once there.

Mustelids (weasels) and raccoons have a short nose and large braincase, but canines have a more evenly distributed skull with the post-orbital process falling close to the middle of the total length of the skull.

Kerry Wixted 2022

Key to Common Maryland Mammal Skulls

6. 4-5 upper cheek teeth with less than 40 teeth total (Fig. E) ..... **Section C**
6. 6 or more upper cheek teeth with 40-42 teeth total 7

7. Greatest length of skull less than 200 mm (~7.8") .....**Raccoon (Fig. F)**
7. Greatest length of skull more than 200 mm (>7.8").....**Black bear**

Weasels and other mustelids tend to have smaller numbers of molars and premolars than black bears and raccoons. Photo by: Phil Myers CC by NC SA 3.0

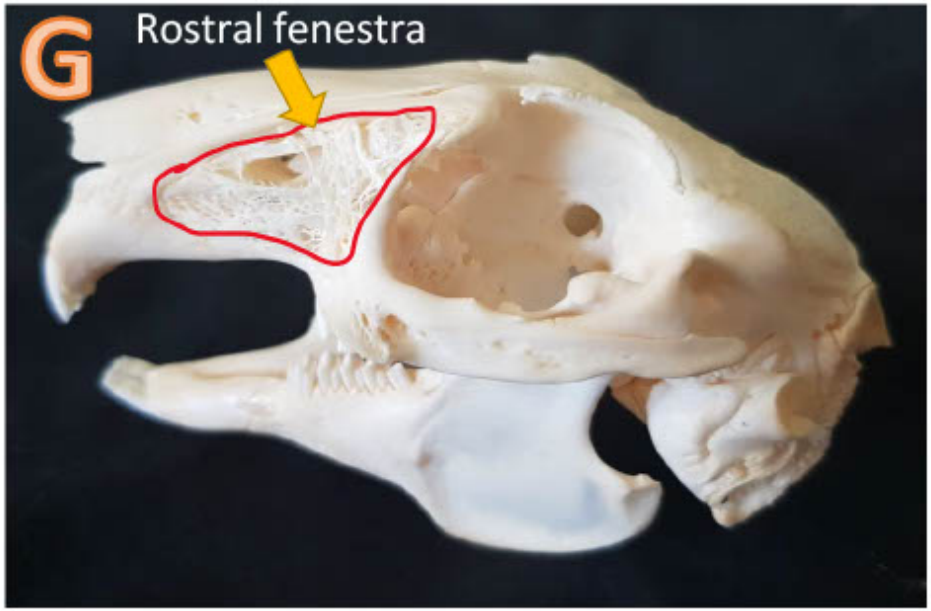
Raccoon skulls are one of the most common types of skulls you will find in Maryland. They look comparable to black bear skulls, though the two species are not related.

Key to Common Maryland Mammal Skulls:
Section A: Deer, Rabbits, and Rodents

1. Upper incisors present… 2
1. Upper incisors absent… ..... **White-tailed deer**

2. Upper incisors 4 or 6; rostral fenestra present (Fig. G)… ..... **Eastern cottontail**
2. Upper incisors less than 4; rostral fenestra absent 3

3. Post-orbital process sharply pointed (Fig. H. top) 4
3. Post-orbital process not sharply pointed or absent (Fig. H. bottom) 6



Rabbits (Fig. G) have a peg-like set of upper incisors behind the larger, front set of incisors. Juveniles have 3 sets of upper incisors.

Members of the squirrel family (Fig. H, upper photo) have large post-orbital processes.

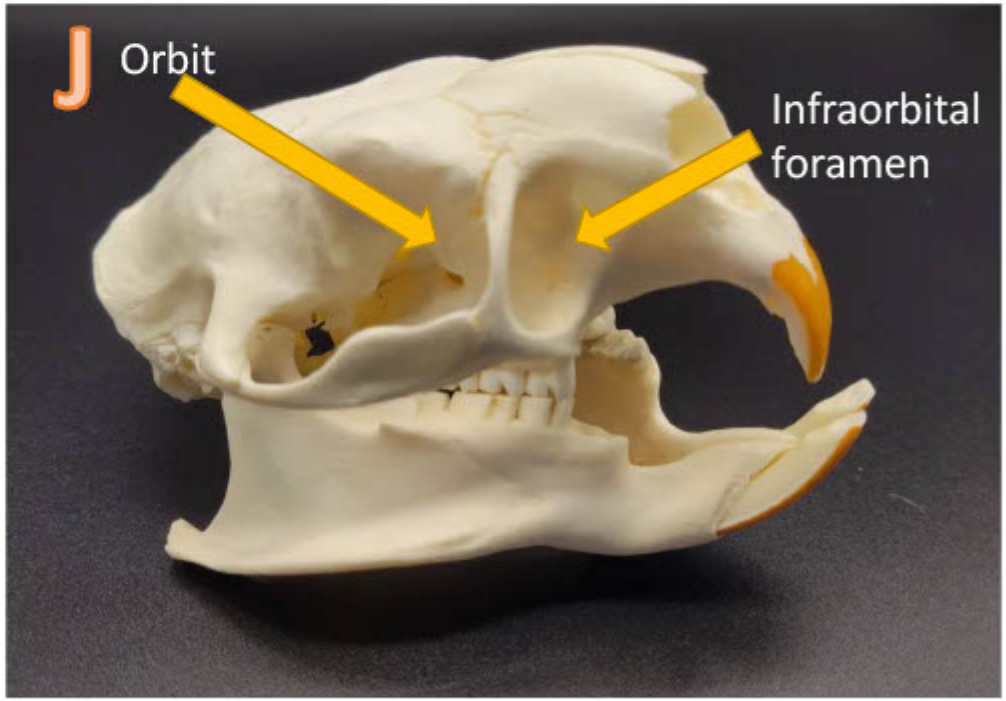
Key to Common Maryland Mammal Skulls:

Section A: Deer, Rabbits, and Rodents, Cont'd

4. Greatest length of skull greater than 76 mm (~3")..... **Groundhog**
4. Greatest length of skull less than 76 mm (<3")... 5

5. Developed temporal ridges form a small sagittal crest (Fig. I)..... **Eastern fox squirrel**
5. Temporal ridges not developed; sagittal crest absent... ..... **Eastern gray squirrel**

6. Infraorbital foramen round and almost as large as orbit (Fig. J)..... 7
6. Infraorbital foramen often slit-like and smaller than orbit..... 8

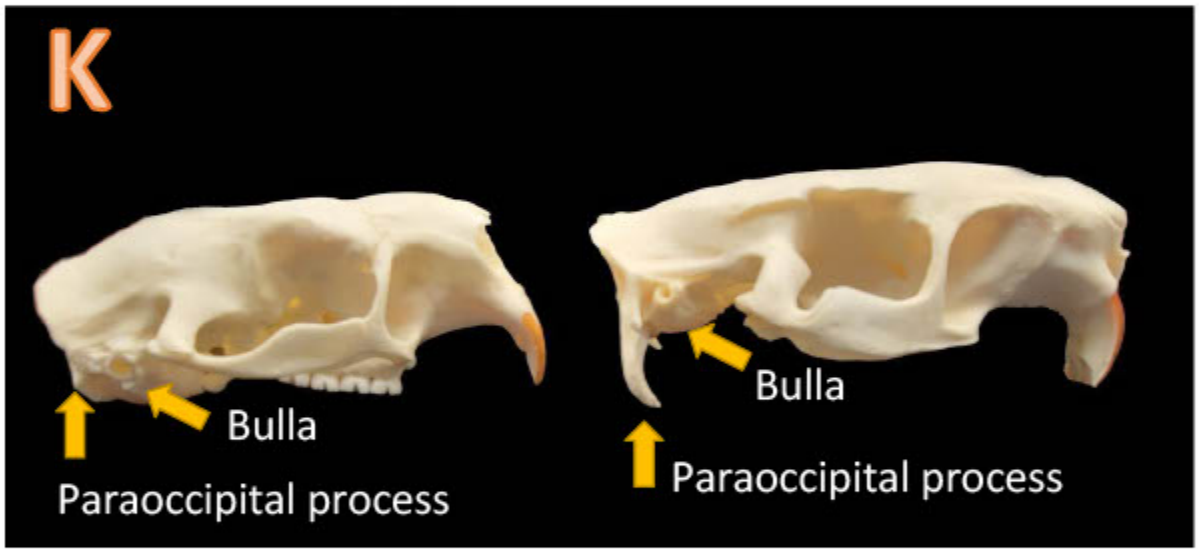


Key to Common Maryland Mammal Skulls:

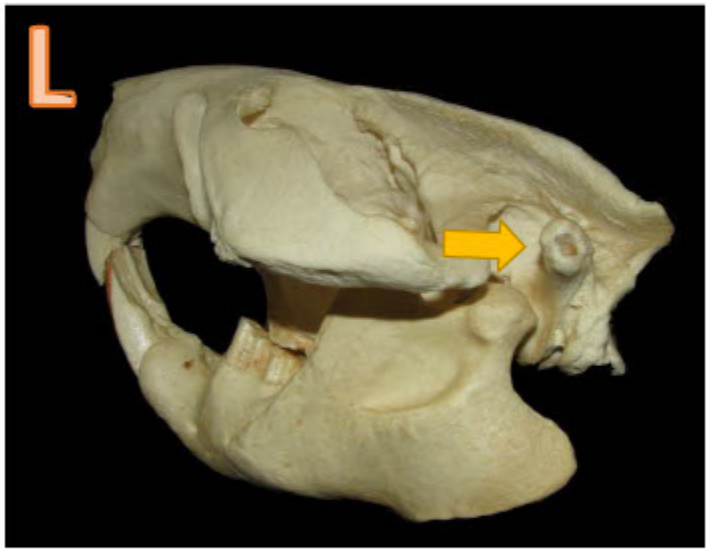
Section A: Deer, Rabbits, and Rodents, Cont'd

7. Paraoccipital process does not extend beyond auditory bullae (Fig. K; left) ..... **Porcupine**
7. Paraoccipital process extends beyond auditory bullae (Fig. K; right) ..... **Nutria**

8. Ear canals long and pointed upward (Fig. L)... ..... **Beaver**
8. Ear canals short and not pointed upward... ..... **Muskrat**



All rodents on this page have orange incisors due to iron minerals in their enamel. This makes the teeth strong and allows them to chew on wood and other hard materials.



Beavers are well adapted for an aquatic lifestyle. They have lips behind their incisors which allows them to carry twigs underwater without getting water down their throat! They also have transparent eyelids that act like built-in goggles and can close their ears when they dive underwater.

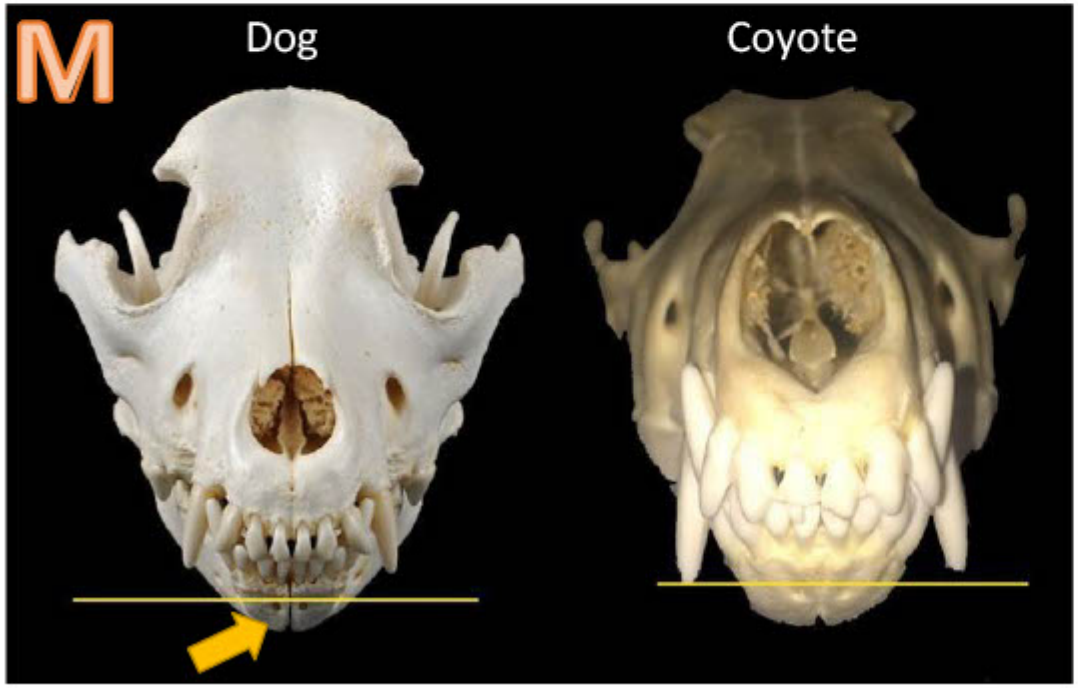
Key to Common Maryland Mammal Skulls:

Section B: Canids (Dogs, Coyotes & Kin)

1. Greatest length of skull greater than 170 mm (>~6.7”).....2
1. Greatest length of skull less than 170 mm (<~6.7”) 3

2. Canines do not reacg the mandibular mental foramina (Fig. M, left).....**Domestic dog**
2. Canines at past mandibular mental foramina (Fig. M, right)..... **Coyote**

3. Temporal ridges on top of skull form a V-shape (Fig. N, left).....**Red fox**
3. Temporal ridges on top of skull from a U-shape (Fig. N, right)... .....**Gray fox**



While the mandibular mental foramina is a good ID trait, many domestic dogs also have sloping foreheads, and some have shortened noses.

Key to Common Maryland Mammal Skulls:

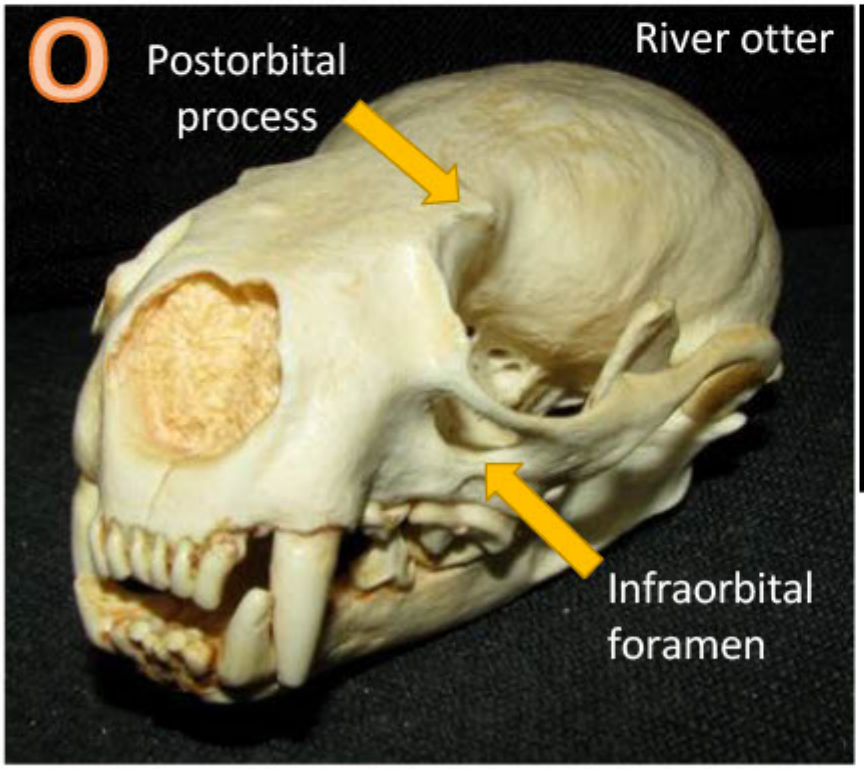
Section C: Mustelids, Cont'd

1. Post-orbital process well developed; infraorbital foramen greater than 8mm in diameter (Fig. O) … ..... **River otter**

1. Post-orbital process lacking to moderately developed; infraorbital foramen less than 8mm in diameter 2

2. 5 upper cheek teeth per side; premolars 4/4 (Fig. P) ..... **Fisher**

2. 4 upper cheek teeth per side; premolars 2/3 or 3/3… 3



As fishers mature, the sagittal crest forms. As males age, the crest becomes more prominent and can be used to determine the sex of the animal based on its measurements.

Key to Common Maryland Mammal Skulls:

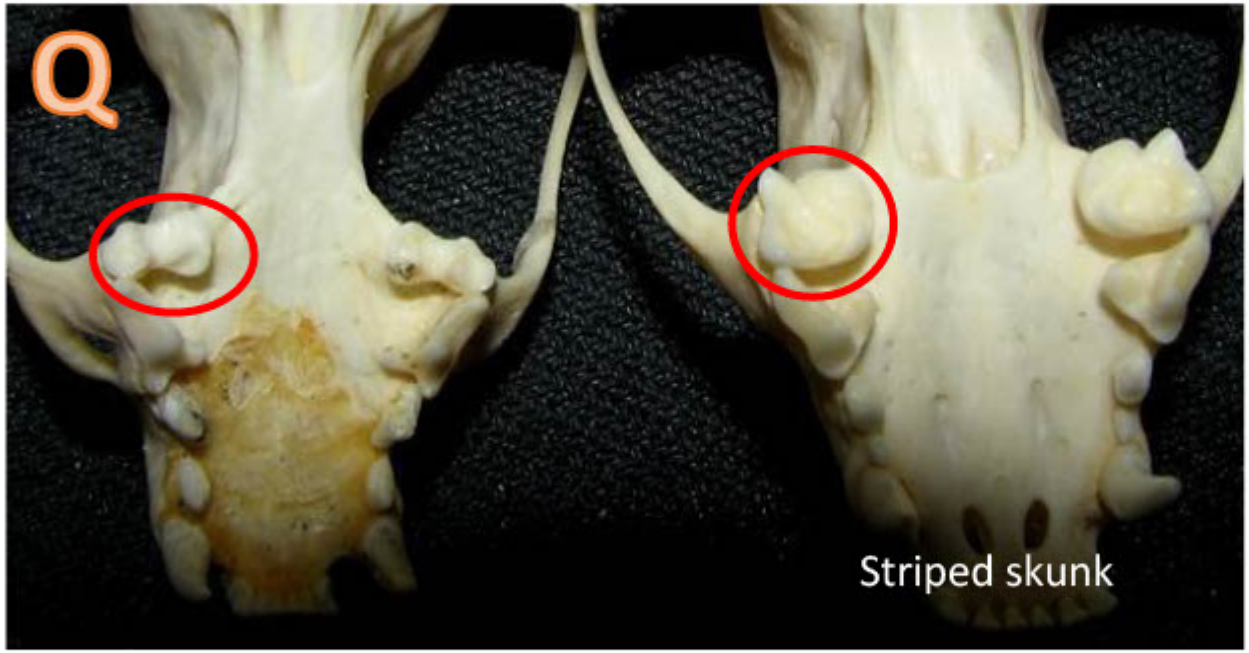
Section C: Mustelids, Cont'd

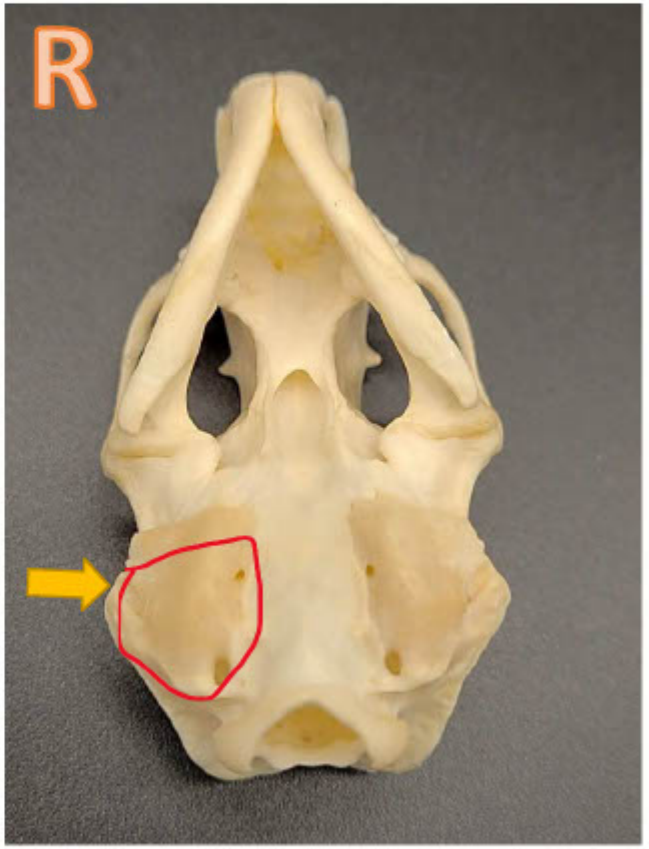
3. Upper molar dumbbell-shaped (Fig. Q, left); auditory bulla prominent, elongated (Fig. R) 4

3. Upper molar rectangular-shaped (Fig. Q, right); auditory bulla flat and not elongated
… ..... **Striped skunk**

4. Skull over 58mm long (>2.2") ..... **Mink**

4. Skull 40-58mm long (~1.5-2.2") ..... **Long-tailed weasel**





Skunks were once grouped with weasels in the Mustelidae family but now belong to the Mephitidae family. Skunks have teeth more in line with omnivores as evidenced by their flatter, final upper molar. Occasionally, nematodes will infect skunk and mustelid sinuses, causing damage to the sinus bones.

Key to Common Maryland Mammal Skulls:
Size Comparisons

Kerry Wixted 2022

Activity: Playing 'possum

Grade Level: PK-5

Setting: Indoors or Outdoors

Objectives:
Students will be able to understand adaptations and why they are important. In addition, students will be able to identify different types of adaptations and how they serve different animals.

Materials:

- Poker chips (or other objects to simulate food like pipe cleaners)
- Music
- Paper bags (optional to carry "food")

Background:
Animals use a variety of adaptations to help them survive. *Adaptations* are any behavioral or physical characteristics of an animal that help it to survive in its environment. These characteristics fall into three main categories: body parts, body coverings and behaviors. Any or all of these types of adaptations can play a significant role in the survival of an animal.

Adaptations can be either physical or behavioral. A physical adaptation is some type of structural modification made to a part of the body. A behavioral adaptation is something an animal does – how it acts - usually in response to some type of external stimulus. An example of a behavioral adaptation used by some prey species is 'playing dead'. Animals such as opossums will freeze when they encounter a predator to discourage the predator from eating it.

Procedures:

1. Introduce the concept of defense mechanisms in nature and how some animals prey on other animals. Explain to the students that these defenses are known as adaptations.
2. Have students list different types of defenses that animals use. You may want to show your students pictures of animals and ask them about what features the animals use to survive (like quills on porcupines, etc). Be sure that students understand why it is important for these animals to have these defense adaptations.

3. Tell your students they will be simulating opossums for this activity. Let them know how opossums freeze or 'play dead' to avoid predators.
4. Distribute poker chips around the classroom or in an outdoor setting, and tell the students they will be collecting poker chips ("food"). You will play music while they collect the chips, but when the music stops, they will have to freeze like scared opossums. Any students which fail to freeze will be "eaten" by a predator and will have to leave the game.
5. Begin the activity and allow students to 'forage'. When you stop the music, students which are still collecting poker chips will be out (or "eaten"). Repeat for several rounds to see who is the best at playing 'possum. You can also count poker chips to see who was most successful at gathering food while also avoiding predators.

Extensions:

1. Have students research animal adaptations and write a report on an interesting animal and what it uses to survive. If working with older students, then have them identify whether or not the adaptation is a behavioral or physical adaptation.
2. Have students design their own creatures with special adaptations. You can let students choose their own creature features or give them categories like adaptations that allow animals to live in rocky environments, to eat fish, etc. Encourage students to be as creative as possible! ☺
3. Opossums are a marsupial which means that they use a pouch to carry their young. Generally, opossums will have 13 or more young in each litter. To make this activity more challenging, have students design pouches using paper and tape. Have the students attach the pouches to themselves using tape and then hand them 13 dried beans. Tell the students that the beans represent their young and have each student place the beans in their pouches. Run the activity as described above and see how well the students are at foraging, avoiding predators and protecting their young in the pouches. If any bean-babies fall out during foraging, then the parent 'possums cannot return them to their pouches.

Activity: Nuisance Nutria

Grade Level: 5-8

Setting: Indoors (in large area like a gym) or Outdoors

Objectives:
Students will be able to (1) understand that invasive species compete with native species for food, water, shelter and space; (2) Understand that invasive species are often aggressive and may quickly crowd out native populations once introduced. (3) Understand that removal of invasive species by hand pulling, introduction of natural predators or disease and passing legislation to prohibit sale of some non-native species are methods that can be used to control non-natives.

Background
One of the most serious threats to native plants and animals today is the introduction of non-native species by humans. When a certain non-native or exotic species is allowed to invade an ecosystem, the results can be devastating for the natives. Often natural diseases or predators are not brought with the species to their new homes, thus causing a great growth in population size. This can lead to a decrease in native plant and animal diversity in a region as these invasive species increase in number. The invasive species often out-compete natives in obtaining the essential requirements for growth.

This decrease in native species' diversity affects many different food chain and may lead to a mono-culture of species and animals where once there was variety. Loss of endemic or native plant and animal species may mean loss of valuable genetic material which could someday provide valuable medicines or foods

One invasive mammal in Maryland is nutria. Nutria are large rodents that look like beavers with long, thin tails. Nutria may weigh up to 20 lbs and reach about 24 inches from tip of nose to tip of tail. Nutria have thick brown fur and orange front teeth. They are designed for aquatic life, with webbed feet and eyes, nostrils and ears located high on their heads to enable them to expose as little of their bodies as possible when breathing at the surface of the water. Nutria were introduced to Blackwater National Wildlife Refuge in 1943, where they were farmed for fur. Nutria are native to South America and can be found in 22 states, including the Eastern Shore of Maryland. Nutria eat wetland plants and prefer the roots, rhizomes and tubers. Nutria will eat entire plants and will exploit wetlands in fresh, brackish and salt water. In Maryland, nutria currently pose the greatest threat to salt marshes in the lower eastern portion of Maryland's Chesapeake Bay, including Dorchester, Wicomico, Somerset, and Worcester Counties and are specifically impacting three-square bulrush. When nutria remove entire sections of bulrush from the marsh, the sediment supporting the plants erodes away and the level of sediment falls, preventing establishment of new native plant

colonies. Nutria also fragment the marsh by creating deep swimming channels, preventing less mobile, marsh-dependant species from using all available habitat.

This game will introduce your students to the dilemma of invasive species.

Materials:

- 4 cones or other markers to mark edges of playing field.
- 3 different colored playing pieces (poker chips work well). The total number of pieces will vary with the size of the group. Provide one playing piece of each color per player so that each player is able to survive the first round.
- 1 arm band for each player (all the same color)
- 3 arm bands of a different color than those used above
- 3 soft balls (Nerf type)
- Whistle to signal the end of each round

Procedure:

1. Before play begins, designate a playing area by placing cones at edges/corners of the playing field. (A 30 foot by 60 foot area works well for 20 students). Scatter playing chips throughout the area. Each color represents a different need for the species.
    a. Color 1 - space and appropriate shelter
    b. Color 2 - mineral needed to make food
    c. Color 3 - water
2. Be sure to provide enough chips so each player may collect one chip of each color during the first round.
3. Round 1: All players will be native species (like Muskrats) that populate a specific area. Everyone will line up along edges of the playing field at the start of each round. At the sound of the whistle players will enter the field, collect one chip and return to the edge of the playing field. After they reach the sideline, they return to the playing field and collect another chip of a different color. Once again they go to the sideline and then return for a chip of the third color.
4. After all three colors have been collected by a player, he/she moves to the sideline to wait for the signal to end the round, all players should survive.
5. Evaluate: notice that the "habitat" had ample food, minerals, water, and space for everyone to survive.
6. Round 2: This round will be played the same but will now include the invasive Nutria. Two players will wear an arm band to show that they are Nutria. The Nutria are more aggressive and will be allowed to collect two chips per trip into the playing field. The Nutria will also be allowed to return to the field as often as they are able, but must collect three different colors in order to survive. Native muskrats will be considered a survivor if he/she has collected three chips of different colors as done in round 1.
7. Sound the whistle to end round 2 and identify the survivors.

8. Evaluate: compare population sizes and impact the non-native species had on the native species.
9. Round 3: Native species that did not survive round 2 become Nutria for this round. Give each new Nutria an arm band. Continue play as in round 2. At the end of this round, most - if not all - of the natives should no longer be surviving.
10. Evaluate as in round 2.
11. Round 4: Choose three players to be population controls for the Nutria: "trappers" to remove Nutria. Give each an arm band (different color than the Nutria). The population controls will join this round and begin removing Nutria with a ball, which is gently tossed and aimed below the waist. After a non-native is hit, he/she returns the gathered chips to the playing area then moves to the sideline to remove the arm band. The player immediately returns to the game as a native plant species. Native species are NOT to be tagged by the population controllers. After all chips have been collected identify the survivors.
12. Evaluate the effect population controls have on the native and non-native populations.
13. Round 5, if needed introduce more population controls and repeat round 4.

Evaluation:

1. What do non-native species compete with the native species for?
2. What can non-native species do to populations of native species? How?
3. What can be done to control non-native species?
4. Would passing laws to prevent sale of non-native species that may cause threats to an area if they escape be a good idea? Why?
5. Discuss the advantages and disadvantages of introducing natural but non-native predators and disease to an area to help eliminate the non-native plant species.
6. Discuss the effects trappers may have on the bio-diversity of an area if used to eliminate non-native species.

Note: Activity modified from "Deadly Plant Invaders Game" designed by Karen Bacula and Dave Kronk as part of the Wildlife Management Activity Guide for Teachers.
http://www.nps.gov/piro/forteachers/deadlyplants.htm

<u>Activity:</u> Creeping Coyotes

Grade Level: 5-8

Setting: Indoors

Objectives:
Students will discuss adaptability and qualities which are advantageous to adaptation. Students will interpret graphs and map of coyote population dynamics. Students will hypothesize how coyote populations may change

Materials:
See attached graphs and figures

Background:
The coyote (*Canis latrans*) is a relative newcomer to the East. Over the last fifty years, coyotes have naturally expanded their historic range to now include every state east of the Mississippi River. Coyotes are very versatile and can easily adapt to various food sources and habitat types. As a newcomer to the East, their presence may affect other wildlife populations.

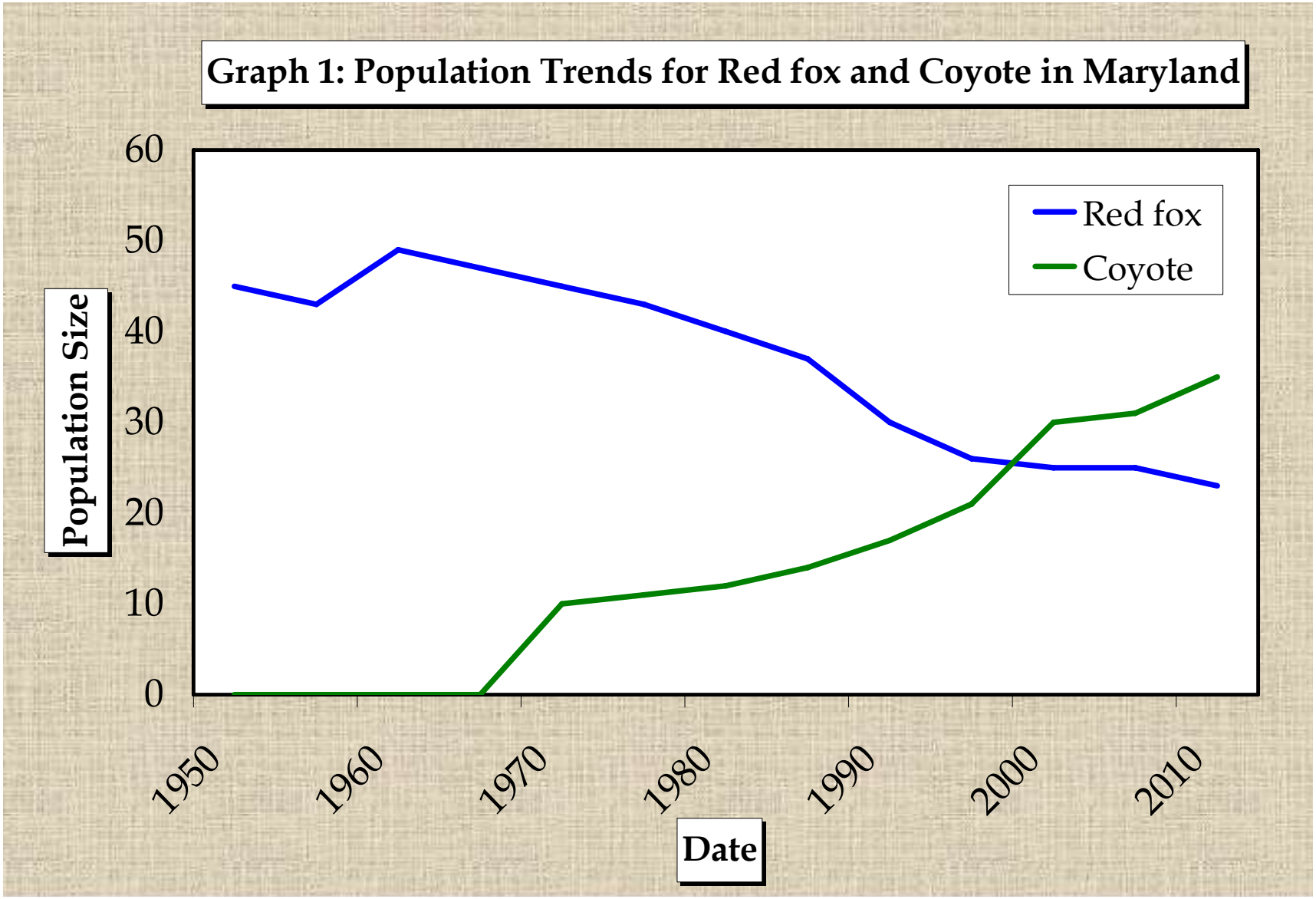
Procedure:
Show students Figures A, B, C and Graph 1 to answer the following questions.

1. What do you notice about the abundance of coyotes over the last several decades?
2. What may have caused the expansion of coyotes across the United States?
3. How does the arrival of the coyote in the East seem to have affected Red fox populations?
4. How might the abundance of coyotes in the East change if large predators like Gray wolves and Mountain lions were reintroduced?

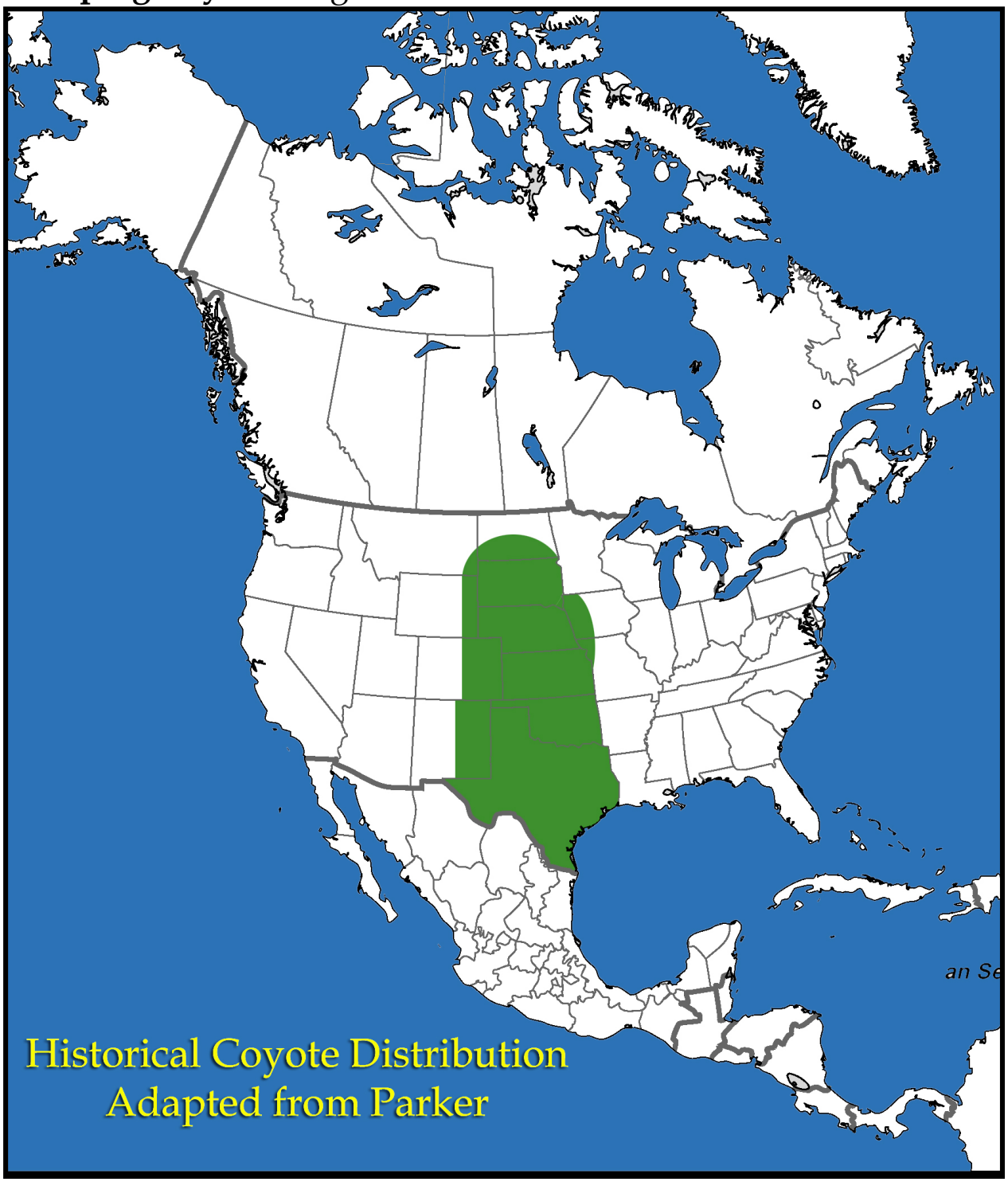
Extensions:

1. Red foxes and Gray foxes occupy similar habitat and share the same food sources. Gray foxes differ from Red foxes in their ability to avoid coyotes by climbing trees. How might a growing coyote population affect a Gray fox population?
2. Eastern coyotes vary in size and coloration from their western cousins. One theory suggests the variation is due to their lineage with the Gray wolves of Canada. Since the Eastern coyote is a successful migrant, how might Western coyotes change over time?

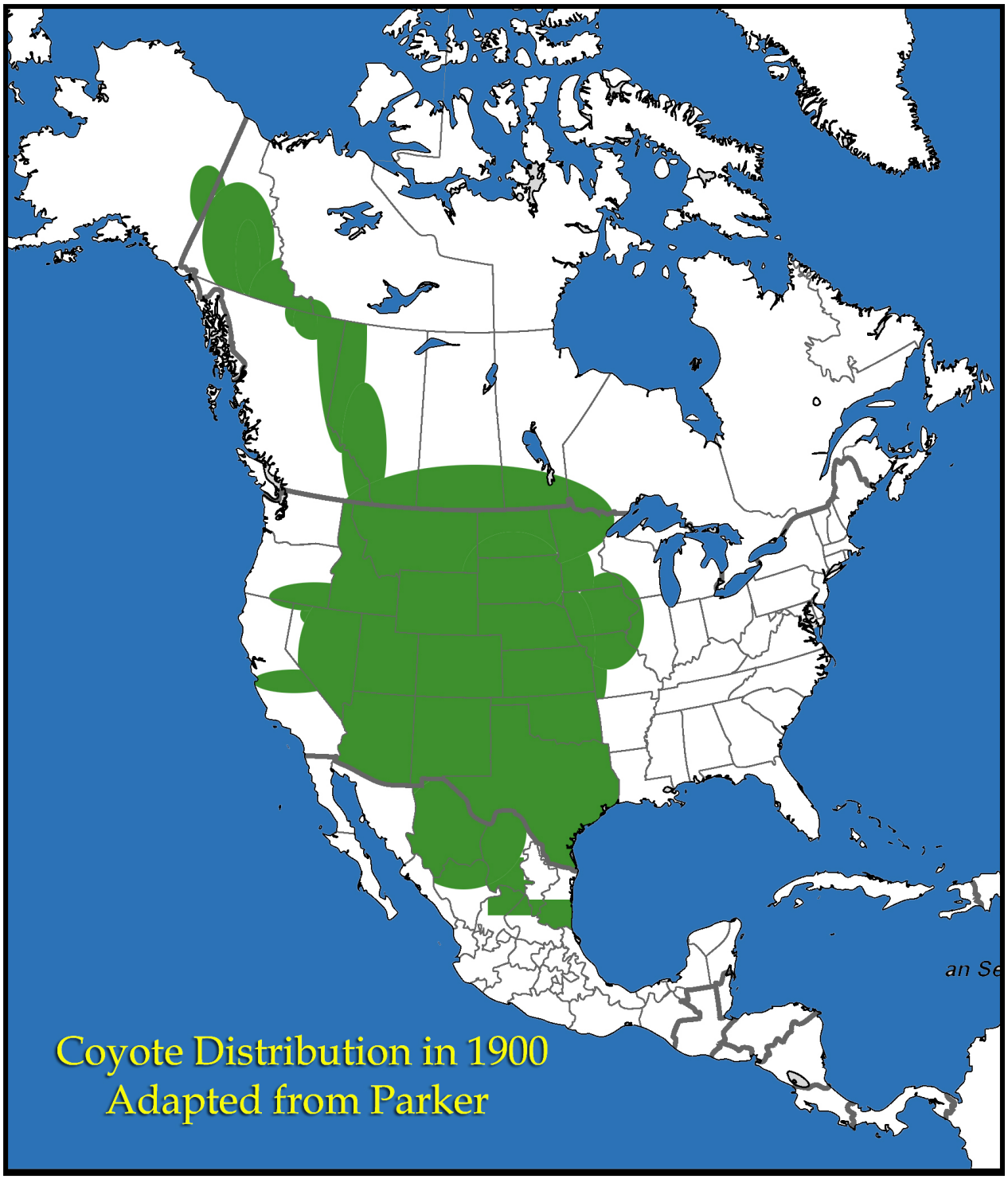
Creeping Coyotes



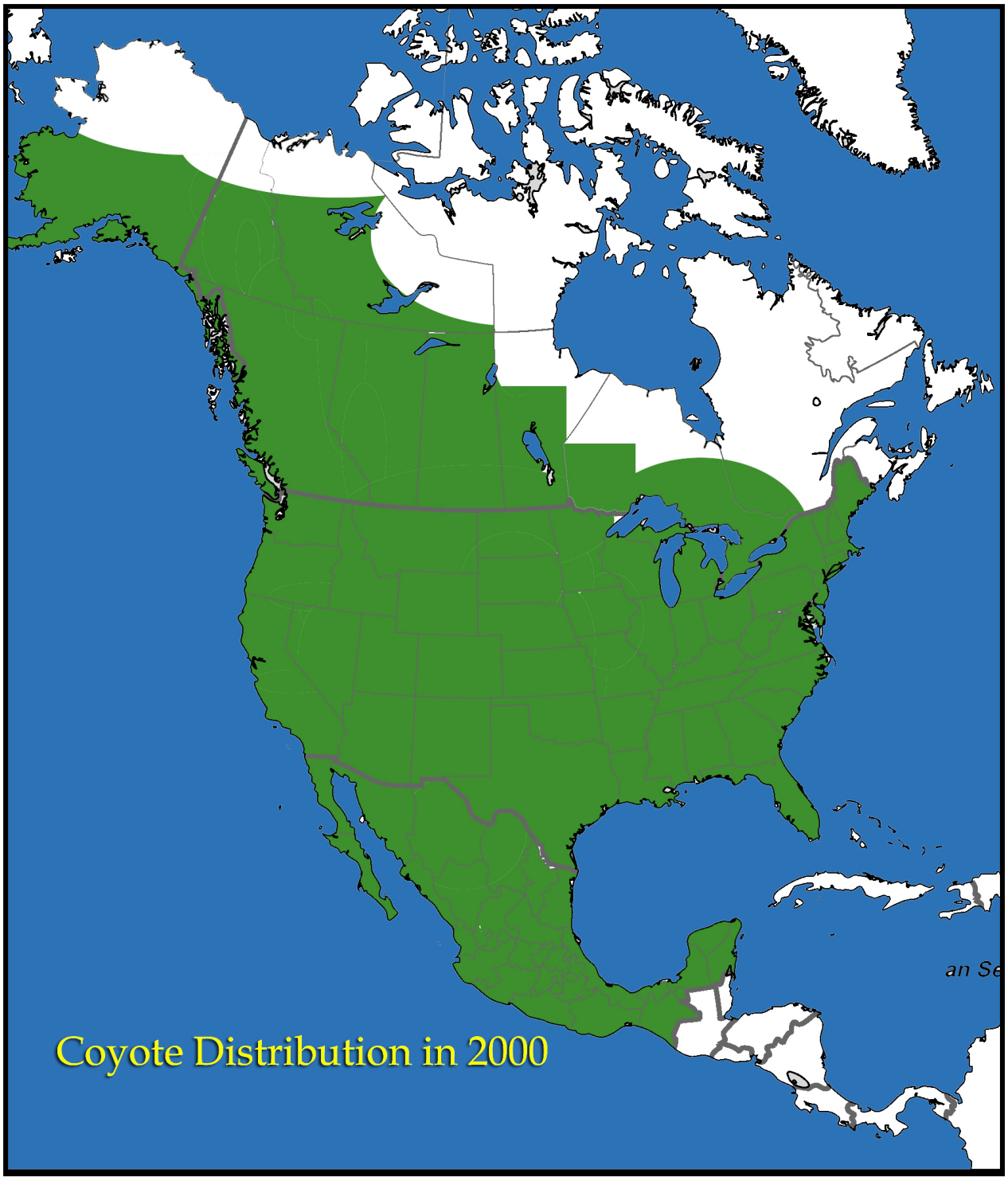
Creeping Coyotes: Figure A



Creeping Coyotes: Figure B



Creeping Coyotes: Figure C



Activity: The Otter Game

Grade Level: 5-8

Setting: Indoors (in large area like a gym) or Outdoors

Objectives:
Upon completion of this activity, students will be able to (1) Explain how nature regulates otter populations; (2) Describe the relationships between otter populations and their food supplies; (3) Explain the effects of habitat changes on otter populations (4) Educate students on issues related to hunting and trapping of otters

Materials:
- Instructions
- Food cards (5 crayfish, 12 fish, 6 snakes, 12 frogs, 4 turtles, 8 invertebrates)
    - Note: a set of 47 cards should be used for groups of 4-5 students
- Stop watch

Background:
This simulation game teaches the player(s) about factors affecting the survival of river otters. It introduces the idea of **carrying capacity**, or how many animals an ecosystem can support. It also examines the issues of overpopulation, pollution and controlled trapping or hunting as a means of managing population size.

River otters are carnivores, and are opportunistic feeders. They prefer crayfish and fish, but will eat snakes, frogs, and other available food. Otter fur is very durable and warm, and was highly coveted by early American settlers. As a result, river otters were extirpated (locally extinct) in Maryland by the 1800s. Trapping regulations eventually allowed otter populations to rebound on the Eastern Shore, but populations in the western region of the State did not bounce back. In 2003, river otter were reintroduced to western Maryland, and today, otter populations throughout the state are stable.

As top-level predators, adult otters require a certain density of prey species to survive. They also have habitat needs and other resource requirements. The number of otters an ecosystem can support is called the **carrying capacity**. Otter populations in Maryland are still growing, which means they have not yet reached carrying capacity, but their populations are still being managed by regulated trapping. Why? They are already high enough in numbers to cause property damage, and there are also enough otters to allow for trapping without causing a threat to the population.

Methods

1. Round 1: Hand each group of 4-5 students a set of 47 Otter Game Cards (food cards) and a stop watch.
2. Assign one member of each group to be the "dealer." The rest of the students are "otters."
3. Explain to the students that this game is about otter populations and how large a population one ecosystem can support.
4. This game is played in separate rounds. Round 1 should involve only the dealer and one otter. The other rounds should have at least 2 otters playing, plus the dealer.
5. Instruct the dealer to spread out the food cards face up on the table.
6. Tell the group members to look at the cards to learn about what otters like to eat. Point out that fish and crayfish are their favorite foods, but that they are opportunistic feeders that will eat whatever is available.
7. Tell students that it is winter and that each otter needs to gather 60 pounds of food to survive for one month in the winter. (You might point out that otters don't gather and store their food; they would normally hunt for a couple of pounds of food each day. This is just a simulation.)
8. Tell the first otter that he or she has 15 second to gather food. S/he may pick up the cards one at a time and place them in a pile in front of him/her, but can only use one hand.
9. Say "Go!" and have the dealer in each group time the first otter. After 15 seconds, say "Stop!" and have the students who participated in the first round count the food cards they've collected. Most players playing alone should be able to gather the food they need.
10. You can repeat Round 1 with other students in the group, if they'd like.
11. Round 2: Now we will increase the otter population size. Now, two or more students have 15 seconds to gather their food. You can do this in multiple trials (2 students, then 3 students, then 4, etc.) with all remaining "otters." When the 15 seconds are up, see who survived and who would be starving. Ask students, "What does this tell you about the number of otters an ecosystem can support?" (*It's a limited number, etc.)* Point out that just because the population of otters increases, that does not mean the *food supply* increases. Tell the students that this is called **carrying capacity**. If multiple people are playing, choose one to be the "trapped" otter. Tell them they have been trapped by a hunter and cannot play the next round. Ask the group if it would make it easier for the remaining otters to survive, i.e. find the necessary food (*yes, fewer otters looking for food.)* Play another round to show this or move on to Round 3.
12. Round 3: Now we will pollute the water. Ask for ideas about how water gets polluted. (*e.g., litter, pesticide runoff, etc.)* When water gets polluted, animals often can't live in it. So take away 3 crayfish cards and 6 fish cards. Have the players play again using various numbers of otters (1, 2, or 3). Now that there is less

food, fewer people should gather food successfully. This is why fewer otters can survive when there are unclean rivers. You can also point out that the same is true when habitat is destroyed by land development.

13. Wrap up: Remind the students that this simulation has taught them about carrying capacity of ecosystems and what affects the success of otters and other animal populations within their ecosystems

Evaluations

Have the students discuss the following questions in their groups. Then reinforce with an all-class discussion to check comprehension. Possible answers are in italics.

1. What is one of the things that otters need for their survival?
2. Where do they get their food?
3. Which is more harmful to otters and other animals, trapping or pollution/habitat destruction?
4. How would nature control populations of animals?
5. Would we have more otters if trapping were stopped?
6. Why do we have laws regulating otter trapping?

River otter image by John White

Note: The Otter Game modified from activity designed by Saint Louis Zoo.
http://www.stlzoo.org/education/forteachers/teacherlessonplans/

Red fox image by John White

Unit 3:
Examining Conservation & Management of Furbearers

Brief History of Wildlife Management

Prior to 1900, few laws or regulations were imposed on hunting wild animals in the United States. Even species now considered to be **nongame** (non-hunted) were harvested during all seasons of the year. Market hunters harvested hundreds of thousands of animals to sell to a growing nation. They killed animals and sold the meat for food, hides for clothing or trading, and feathers for decoration. This unregulated hunting soon led to the extinction of species such as the Passenger Pigeon as well as local extinctions (**extirpation**) of many large mammals.

At the same time market hunters were harvesting huge scores of wildlife, settlers were altering wildlife habitat. They plowed prairies, drained wetlands and built towns. As settlements expanded, predators such as weasels, cougars, coyotes, foxes and wolves were shot on sight due to perceived threats to farm animals and people. During this time, gray wolves and eastern cougars became extirpated in Maryland.

By the late 1800s, Maryland's "big game" or large animal species (e.g., bison, elk, white-tailed deer) had virtually disappeared. Intensive trapping and deforestation that followed European colonization eliminated beavers from this region by the early 1700's and from far western Maryland and Virginia by 1800. River otters were extirpated from the state in the 1800s while turkeys and fishers were nearly extirpated.

An example of market hunting white-tailed deer

Due to dramatic declines in formerly abundant wildlife, laws were enacted to protect game (hunted) animals by limiting hunting. In 1900, the **Lacey Act** became the first federal law to protect wild game. This law prohibits the interstate shipment of illegally taken wildlife and importation of species. In 1918, the **Migratory Bird Treaty Act** was passed which protected migratory birds between Canada and the United States. The Migratory Bird Treaty Act makes it illegal for people to "take" migratory birds, their eggs, feathers or nests. The Migratory Bird Treaty Act also laid forth regulations for hunting migratory birds such as ducks and geese. The loss of wetland habitat and its effects on waterfowl populations later prompted the passing of the **1934 Migratory Bird Hunting Stamp Act**, aka the "Duck Stamp Act", which requires waterfowl hunters to buy a duck stamp in addition to hunting licenses. The proceeds from the stamp go towards purchasing and protecting wetlands crucial for waterfowl. Three years later, in 1937, the **Federal Aid in Wildlife Restoration Act**, aka the "Pittman-Robertson Act" was passed. This Act places an 11% federal excise tax on the sale of guns and ammunition in order to provide funds for wildlife habitat restoration funds and research. The **Endangered Species Act** was later passed by Congress in 1973 to protect endangered plants, animals and their critical habitats.

Proceeds from the sale of Duck Stamps go directly into conservation

Note: Adapted from Iowa DNR Wildlife Management, Unit 3 http://www.iowadnr.gov/Education

Conservation and Management of Wildlife

Wildlife management is a science used by wildlife biologists. The purpose of wildlife management is to maintain populations of wild animals at levels that are good for wildlife and for people. Some wildlife biologists work with specific species like furbearers or deer.

Many agencies are involved in wildlife management. The U.S. Fish and Wildlife Service, U. S. Forest Service, Bureau of Land Management and the National Park Service are agencies that are involved at the national level in wildlife management. Each of the 50 states also has an agency responsible for wildlife within its borders. In Maryland, the Maryland Department of Natural Resources has this job.

What do wildlife biologists do?

Wildlife biologists are responsible for managing wildlife populations and their habitats. Population management can entail reducing populations through hunting or controlling problematic non-native (aka invasive) species. Sometimes, wildlife populations need to be enhanced. For example, river otter were extirpated from Maryland in the 1800s. Eventually, laws protecting river otter allowed the population to recover on the Eastern shore, but otters were still absent in the western region of the state. So, in the 1990s, biologists relocated otters from an abundant Eastern shore population to an area in Garrett County. Today, river otters can now be found throughout the state.

Wildlife biologists also conduct research on wildlife species to gain insight on their natural history and population status.

In terms of habitat management, wildlife biologists work to create and enhance habitat through measures like prescribed burns, planting food crops and restoring wetlands.

Who funds wildlife biologists?

In the United States, most funding for wildlife management comes from two sources: hunting and trapping license revenues, and federal excise taxes on firearms, ammunition and archery equipment (federal aid). Most wildlife management is not funded with general tax dollars. Federal aid comes from the Federal Aid in Wildlife Restoration Act (also known as the Pittman- Robertson Act) of 1937. Federal funds and the assistance of certain federal agencies are also available for wildlife damage management programs within each state.

Wildlife Management: Furbearer Trapping

Trapping is a wildlife management tool that is also part of our North American heritage. First-time trappers in many states and Canadian provinces must complete a trapper education program covering skills, regulations, and trapping's role in wildlife management. Trapper education programs teach basic techniques with a strong focus on the responsible treatment of animals, legal methods, safety, selectivity, and ethical trapper behavior.

Trapping is a highly regulated activity because the public is concerned about wildlife conservation and the welfare of wild animals. Regulations are designed to help manage furbearing animals using safe and selective equipment and techniques.

Safety - Animal Welfare - Responsibility - Furbearer Conservation
Trapping takes a lot of time and dedication. Trappers spend time studying wildlife, scouting, preparing traps, working with landowners, setting traps, running traplines, and preparing pelts. When trapping season starts, trappers must check the traps every day until they are removed. Society, trappers and non-trappers alike, will not accept illegal or unethical behavior.

Today, fur products and trapping are still of cultural and economic importance. Furbearers continue to be used and managed as valuable, and renewable, natural resources. The following list details the values associated with furbearers.

- Economic - Positive values includes furs, meat, and by-products such as perfume and fishing lures. Examples of negative values include crop depredation, property damage, and flooded roads.
- Ecological - Furbearers have positive value as predators and prey in functioning ecosystems. Excessive numbers of furbearers can have negative values if they harm habitats or prey on endangered animals.
- Cultural - Trapping is valued by many people as part of their cultural heritage. Trapping involves outdoor skills, knowledge and respect for wildlife, and family activities. Some people look to nature or the land to provide vegetables, firewood, venison, and furbearers. Trapping provides these people with needed food and clothing.
- Biological - Furbearers have positive values that help us understand human health and the effects of environmental pollutants. Negative biological values include human exposure to disease and parasites.
- Aesthetic - Furbearers have many positive aesthetic values for fur and wildlife watching.

In addition to the values of furbearers, responsible trapping can also provide multiple benefits to society such as:

- Disease Control - When trappers reduce local furbearer populations, it helps reduce the spread of diseases among animals and people.
- Habitat Protection - When furbearers overpopulate they can destroy habitat. For example, the harvest of nutria in Louisiana helps protect 3.6 million acres of coastal wetlands.
- Endangered Species Protection - Foothold traps help protect many rare and endangered species from predators. Examples include the desert tortoise, sea turtles, whooping cranes, black-footed ferrets, and piping plovers.
- Property Protection - Farmers and other landowners benefit when trappers remove excess furbearers that threaten property and crops.
- Wildlife Restoration - Trappers use foothold traps to harmlessly capture species such as river otters in states where they are plentiful so they can be released in other states to re-establish populations.
- Wildlife Research - Foothold traps and cable devices are the only effective means for catching elusive species such as wolves, coyotes, and foxes. Wildlife biologists depend on traps and trappers to help study many species of wildlife.

Trapping is an individual privilege, not an individual right

In most states, trapping is an individual privilege available to all citizens who choose to follow regulations and behave responsibly. Trappers who violate laws can lose their privilege to trap. If trappers as a group do not behave responsibly, then citizens could decide to stop all trapping. Some states have made it a collective right to hunt, fish, and trap. This protects the activity of trapping for future generations. It does not protect trapping privileges for people who violate trapping regulations. Judges can, and do, suspend trapping privileges for serious violations.

Trappers have formed state and national organizations to help address issues related to trapping and furbearer management. Two national groups include the National Trappers Association and the Fur Takers of America.

The National Trappers Association (NTA) has the following purpose statement:

- To promote sound conservation, legislation, and administrative procedures;
- To save and faithfully defend from waste the natural resources of the United States;
- To promote sound environmental education programs; and
- To promote a continued annual fur harvest using the best tools presently available for that purpose.

The Fur Takers of America (FTA) has the following purpose statement:

- To promote interest in and accumulate and disseminate knowledge concerning the trapping of fur bearing animals among persons interested therein.

You can find out more about the NTA and FTA at their Web sites:

- http://www.nationaltrappers.com/
- http://www.furtakersofamerica.com/

The Web sites also link to state trapping associations, online bulletin boards, and other helpful organizations.

There are many benefits to membership in trapping organizations. You will learn new techniques to become more successful, be invited to meetings and other activities, gain a greater understanding of wildlife management, and learn about issues affecting trapping.

Each state regulates the types of traps that are legal. States consider animal welfare, efficiency, selectivity, and safety when they select legal traps. Some types of traps, including traps with teeth and snares, are prohibited in Maryland. Legal traps for Maryland furbearers include foothold traps without teeth and body-gripping traps.

Best Management Practices (BMPs) have been developed by wildlife biologists, trappers, researchers, trapping organizations and veterinarians for regulated trapping in the United States. Trapping BMPs are documents that provide information to help trappers practice safe, humane, and efficient techniques. BMPs describe different types of traps, how they work, how traps should be set, and what training may be needed for people who use BMP traps. Five criteria are considered when developing BMPs:

1. Animal welfare
2. Trap efficiency
3. Trap selectivity
4. Trapper & public safety
5. Practical application

BMPs provide guidance to wildlife agencies and help responsible trappers make decisions in the field.

Note: Adapted from Maryland Trapper Education Manual
https://dnr.maryland.gov/Documents/Maryland_Trapper_Education_Student_Manual.pdf

Activity: Pay to Play

Grade Level: 5-8

Setting: Indoors

Objective:
Students will (1) distinguish between consumptive and nonconsumptive uses of wildlife; (2) describe the sources of funding for wildlife areas; (3) relate usage to increased financial demand on managed wildlife areas, and (4) describe the impact of increased human usage on wildlife habitat.

Method:
Students act as either consumptive or nonconsumptive users of wildlife as they move around a game board and land on designated private or public lands.

Materials:
- Dice
- Play money -$500 for each player (2- $100, 2- $50, 5- $20, 8- $10, 4- $5), plus at least $3000 in the Public Bank in various denominations
- One game board per 4-5 players
- One playing token/player
- Activity cards
- Different colored paper for 2 decks of cards
- 3"x5" cards- 1 for each player

Background:
Consumptive uses of wildlife resources involve activities such as hunting, fishing and trapping as well as activities such as berry picking and collecting shells.
Nonconsumptive uses of wildlife include watching birds, shooting photographs, hiking and canoeing and do not involve the direct harvesting of wildlife. Both consumptive and nonconsumptive uses can have indirect impacts such as habitat loss or alteration. A great blue heron, for example, will leave its nest and young if startled by the presence of a photographer.

Wildlife-based recreation is important to many North Americans. Consumptive activities contribute millions of dollars to the economy through the sale of hunting and fishing equipment, firearms, ammunition and boats. hiking and canoeing and do not involve the direct harvesting of wildlife. Both consumptive and nonconsumptive uses can have indirect impacts such as habitat loss or alteration. A great blue heron, for example, will leave its nest and young if startled by the presence of a photographer.

Wildlife-based recreation is important to many North Americans. Consumptive activities contribute millions of dollars to the economy through the sale of hunting and fishing equipment, firearms, ammunition and boats. Nonconsumptive users may purchase items such as binoculars, photography equipment, canoes, bird food, off-road vehicles, gardening materials and backpacking gear. In addition to the money generated for local economies, many of these items are subject to federal excise tax that provides millions of dollars annually for conservation of wildlife. The **Federal Aid in Wildlife Restoration** and **Federal Aid in Sport Fish Restoration** programs, also know as the Pittman-Robertson and Dingell-Johnson Acts, are crucial funding sources.

Expenses related to hunting and fishing licenses and fees go to natural resource agencies to support operation of the state agency and the wildlife it manages. Entrance fees to publicly managed lands also contribute. Charging an access fee to hunt, fish, camp or trap on private land is common in many states. These funds may or may not be used for wildlife and habitat management. Nonprofit organizations, such as The Nature Conservancy and Ducks Unlimited, contribute millions of additional dollars towards wildlife management and protection of wildlife habitat.

Funds provided by consumptive users, not general tax dollars, historically have been the primary source of income for most state wildlife management programs and some federal programs. As the population has grown over the past 25 years, the total number of people engaged in direct consumptive uses of wildlife (e.g. hunting, fishing) has remained relatively constant. At the same time, nonconsumptive use has doubled as leisure time and increased mobility have allowed the pursuit of outdoor activities. These economic and demographic trends are creating additional pressures on wildlife and habitat, while the revenue generated from consumptive fees has remained the same. As a result, many state natural resource agencies are becoming concerned about their ability to meet the demands on wildlife resources.

In the United States, wildlife is owned by the people and managed by the states on behalf of the citizens. State wildlife agencies are responsible for managing wildlife on both public and private lands. Private land owners, such as ranchers and farmers, own their land but not the wildlife on their land. A hunter wishing to hunt on private land must have a hunting license issues by the state and also may pay an access fee to landowners to hunt on their property. Access to public land typically is free, although user fees may be charged and a hunting license is required.

Procedure:

1. Ask the students to define the meaning of the word "consume." From this informal definition, ask them to define what the phrase "consumptive use of wildlife" might mean and to give examples. Have the students also define and

give examples for "nonconsumptive uses of wildlife". Ask them to give examples of ways that nonconsumptive may affect wildlife. Explain that they will play a game that will help them further distinguish between these two terms. Have a discussion about the differences between public and private land; then, give the students local examples of each.

2. Divide the class into groups of 4-5 students. Provide the groups with the game board, materials (tokens and currency) and instructions.
3. Establish 2 banks with the excess money. One bank, the Wildlife Management Fund, represents the state fund where fees and fines are collected by the state natural resources agency. This fund, in turn, is the source of revenue to manage state wildlife area and parks. The other bank, the Public Bank, will handle revenues, fines and fees for the private business. Put $200 in the Wildlife Management Fund and about $3000 in the Public Bank. Identify student bankers for each.
4. Sort and shuffle the consumptive and nonconsumptive Activity Cards. Place them face down on the indicated spaces on the game board.
5. Each student should select a token and place it on "start."
6. Use pairs of dice, give one die to each group of players. Before rolling, each player must decide whether to purchase a hunting license, fishing license or park pass. These items are valid for 1 year (or one lap around the board). Require students to "pass" a hunter safety course before they can purchase a hunting license. To represent the course exam, ask each student applicant a question related to this activity, such as listing two consumptive or two nonconsumptive uses for wildlife. The money for these documents is put into the Wildlife Management Fund and is used for wildlife management or parks. When the players reach "Year end", they must STOP. Their licenses and parks passes have expired and must be renewed to remain valid. Players may not choose to renew a license.
    a. License Fees:
        i. Hunting =$100
        ii. Fishing= $30
        iii. Annual Parks Pass= $40
7. The first player rolls the die to indicate the number of spaces to move. EACH TIME A PLAYER PASSES A "PAYDAY", HE OR SHE COLLECTS $100 FROM THE PUBLIC BANK.
8. The player then declares an intention to act as a consumptive or nonconsumptive user at this location. The player takes the top Activity Card from the corresponding deck (consumptive or nonconsumptive), reads the top half of the card aloud and follows the instructions.
9. Next, the player reads aloud the "Management Factor" at the bottom of the card and follows directions. Some cards are a positive action and some are a negative action. Players must keep the positive cards and discard the negative ones.

10. The next player follows the same procedure and play continues.
11. The game cannot continue if the Wildlife Management fund runs out of money. If this possibility appears imminent, players must find ways to increase funding for wildlife management. They may decide to increase license fees, impose a tax or perhaps encourage each player to contribute to a special fund for wildlife.
12. A time limit or the number of completed circuits in the game board can determine the end of the game. The winner is the player with the greatest number of positive Activity Cards at the end of the game. In the case of a tie, the player with the most money is declared the winner. If the Wildlife Management Fund runs out during the game, everyone loses.
13. After the students have had a chance to play the game for a while, ask them to list consumptive and nonconsumptive uses associated with wildlife. Record the responses on the board or a flip chart. What expenses can they identify with each of these activities? Why were some areas of the board identified as public or private? What is the difference between private and public lands?
14. Ask the students to remember the fees and fines they had to pay. Were most fees (not equipment or travel expenditures) related to hunting and fishing activities or nonconsumptive uses? Why were they charged those fees? Who do they think collects them? For what purposes do they think the money will be used? Let the students know that those fees, not tax dollars, are the primary source of income to run most state wildlife management programs and some federal programs. In some cases, the fees are the only source of revenue.
15. Show students the figure on the next page. Ask students to discuss each of the following groups of questions:
    a. How have each of the following changed between 1970 & 1996; and between 1996 & 2006?
        i. The # of consumptive-use participants
        ii. The # of nonconsumptive-use participants
        iii. The total # of participants
    b. What specific impacts could the increased number of nonconsumptive users have on the environment and wildlife habitat?
    c. What specific impacts could an increased number of consumptive users have on the environment and wildlife habitat?
    d. Ask students to discuss finding sources for wildlife management. What new sources of funding would they recommend?
    e. Has the increaser in consumptive uses kept up with the increase in nonconsumptive uses? Which group pays the most in fees? How could these trends affect the revenue for natural resource agencies and their ability to maintain wildlife areas?
    f. How do students think the following affect wildlife and habitat: (a) the economy or (b) the increased use of wildlife lands for consumptive or

nonconsumptive purposes?

Number of Participants for Three Wildlife-Associated Activities

1970 versus 1996

Activity	1970	1996
Fishing	33,000,000	35,200,000
Hunting	14,000,000	14,000,000
Wildlife Watching	38,200,000	62,900,000
Total	**85,000,000**	**112,100,000**

Source: "1970 National Survey of Fishing and Hunting" and the "1996 National Survey of Fishing and Hunting and Wildlife-Associated Recreation," published jointly by the U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, Bureau of the Census.

16. After the discussion, have students play the game again, using the some of the following activity modifications:
    a. Fees and fines increase at the completion of a circuit because of increased costs associated with additional usage.
    b. Allow students to buy the private squares on which they land. Set a price beforehand (e.g. $100 a square). The owner-student now collects the fees and pays the fines. Allow students to form interest groups to purchase land. Have the tax bill be a percentage of the player's assets. Keep the taxes in a separate pile. When enough money has accumulated to purchase land, the students vote on a name and use of the land. Allow a student to sell land to the government (money comes from the tax pile) at half the original purchase price.
    c. Label the squares to reflect state or regional public lands and private lands.
    d. Allow students to vote on changes to the fee and fine amounts.

Extensions:

1. Use recreational maps to have students find local or state areas that allow certain activities. Contact county, state or federal sources for park and forest maps with listings of permitted uses.
2. Investigate land uses for consumptive activities in other countries. For example, land used for consumptive activities in some European countries is privately owned.
3. Identify additional revenues, such as the sale of duck stamps, that support public or private lands.

Evaluation:

1. Compare consumptive and nonconsumptive uses of wildlife.
2. Describe how fees, fines and federal aid are used to support wildlife areas.
3. Relate specific examples that demonstrate how increased human use means increased financial demands on wildlife areas.
4. Explain how increased human use caused by increased leisure time and the pursuit of outdoor activities has affected wildlife and habitat.
5. Explain ways nonconsumptive users can contribute to wildlife management.

Activity: Counting Foxes

Grade Level: 9-12

Setting: Indoors

Objective:
Students will estimate population sizes using a mark-recapture technique.

Materials for each pair:
- Blindfold
- Beaker filled with dried beans
- Marker & Data Sheet

Background:
To properly manage particular wildlife species, wildlife biologists need to know population sizes. If a population is too large, then measures may need to be taken to reduce its size. Conversely, if a population is too small, then more protection measures may need to be enacted.

Many times, it is impossible to count all individuals in a population, so biologists use techniques to estimate population size. One common technique is known as a mark-recapture study. In this technique, biologists capture individuals and mark them with ear tags, leg bands, pit tags or other devices. The marked individuals are then released and allowed to mix in with the general population before biologists capture a second sample of individuals. During the second sampling, biologists will count how many captured animals are marked and how many are not. This data can then be recorded and plugged into a formula to estimate population size.

The **Lincoln–Petersen method** (also known as the Lincoln index) can be used to estimate population size if only two visits are made to the study area. This method assumes that the study population is "closed." In other words, the two visits to the study area are close enough in time so that no individuals die, are born, move into the study area (immigrate) or move out of the study area (emigrate) between visits. The model also assumes that no marks fall off animals between visits to the field site by the researcher, and that the researcher correctly records all marks.
Given those conditions, estimated population size is:

$$N = \frac{MC}{R},$$

Where:

N = Estimate of total population size
M = Total number of animals captured and marked on the first visit
C = Total number of animals captured on the second visit

R = Number of animals captured on the first visit that were then recaptured on the second visit

Procedures:

1. Ask students how the U.S. government estimates population sizes. Write down responses on the board and then ask students to think about how biologists might determine the population size of wildlife species. Record responses. Why might it be important to know the population size of a particular species?
2. Tell students that today they are going to estimate red fox population numbers using a mark-recapture study. Explain the concepts behind mark-recapture studies and time permitting, give students some background information on red foxes.
3. Break students into groups of 2 and hand each pair a beaker filled with beans (aka. Red foxes) and a blindfold.
4. Before beginning the exercise, have the students guess how many beans are in their containers. Have the students record their guesses.
5. Blindfold one student in the group and have them grab a small handful of beans from the beaker. The other student should count the beans, mark them and record the number in the space provided.
6. Replace the marked beans back into the beaker. Cover the beaker and shake it up to mix the beans.
7. Have the blindfolded student grab another small handful of beans from the beaker. Count the number of marked beans versus unmarked beans and record the number in the space provided.
8. Once data has been collected, have the students calculate the population size using the mark-recapture equation. Once they have a result, have them record their population size on the board.
9. After students record their population estimates, have them count the total number of beans in their containers and record the actual population number on their sheet.

Evaluation:

1. How close was your initial population estimate compared to the actual population size? Why is it better for scientists to conduct a mark-recapture study rather than make a guess?
2. How close were your calculated mark-recapture population estimates compared to the actual population size?
3. Why was it important that you shook the beaker in between samplings? What natural occurrence did that symbolize?

Extensions:

1. Have students research different population estimate methods. Are some methods more effective for different types of animals? Why or why not?

Counting Foxes Student Worksheet

The **Lincoln–Petersen method** (also known as the Lincoln index) can be used to estimate population size if only two visits are made to the study area. This method assumes that the study population is "closed." In other words, the two visits to the study area are close enough in time so that no individuals die, are born, move into the study area (immigrate) or move out of the study area (emigrate) between visits. The model also assumes that no marks fall off animals between visits to the field site by the researcher, and that the researcher correctly records all marks.
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C = Total number of animals captured on the second visit
R = Number of animals captured on the first visit that were then recaptured on the second visit

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Counting Foxes Results:

Initial Population Size Estimate: _____
Number of "Red Foxes" captured and marked on first visit (M):_____
Number of "Red Foxes" captured on second visit (C): _____
Number of captured "Red Foxes" that were marked (R) : _____

Use Space Below to Calculate Population Size (N):

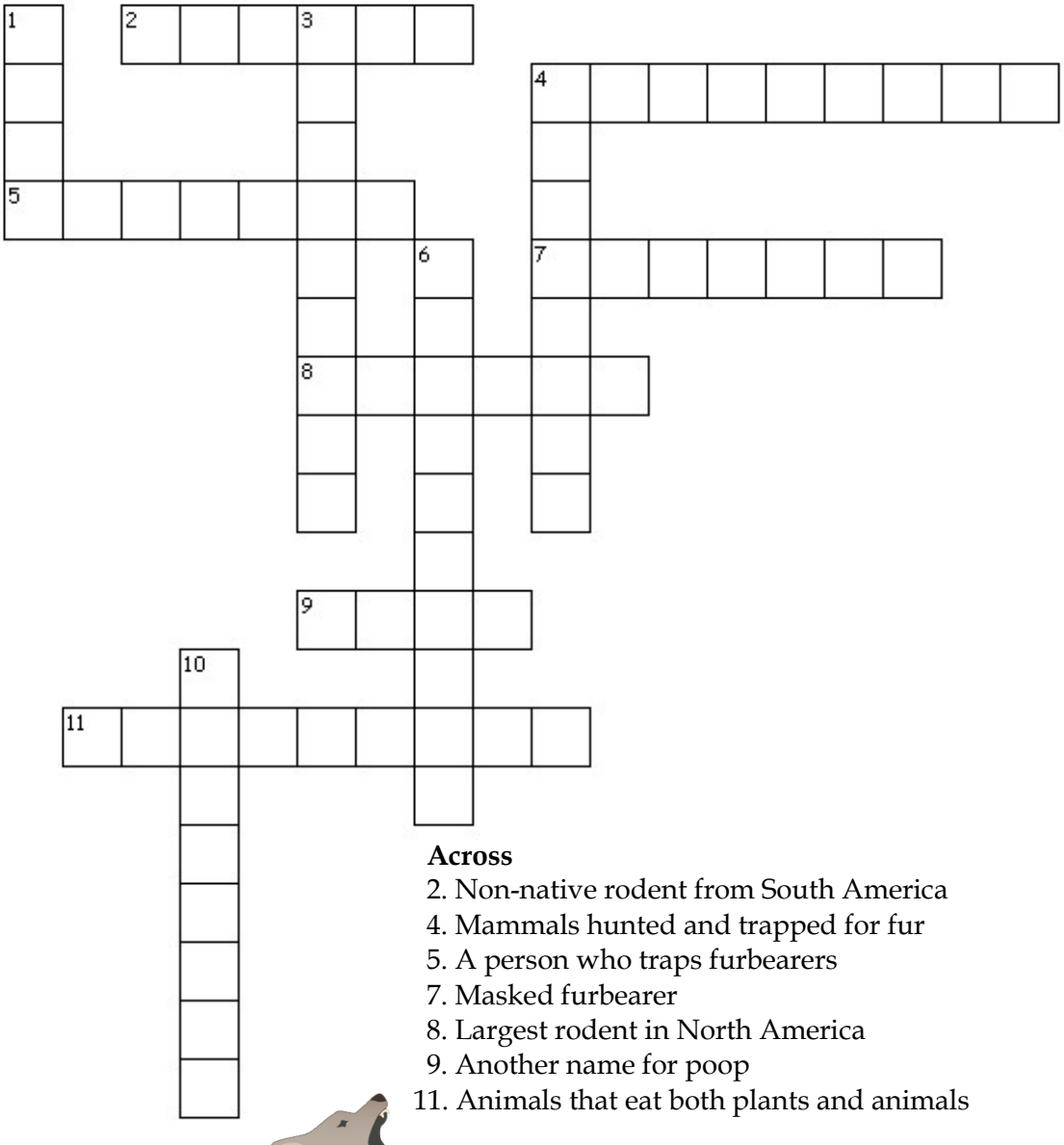
On a separate sheet of paper, answer the following questions:

1. How close was your initial population estimate compared to the actual population size? Why is it better for scientists to conduct a mark-recapture study rather than make a guess?
2. How close were your calculated mark-recapture population estimates compared to the actual population size?
3. Why was it important that you shook the beaker in between samplings? What natural occurrence did that symbolize?

Image by John White

Additional Activities

Furbearer Fun: Crossword Puzzle

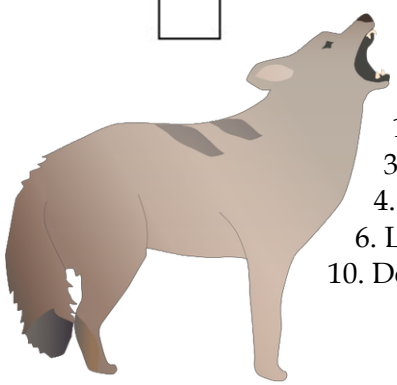


Across

2. Non-native rodent from South America
4. Mammals hunted and trapped for fur
5. A person who traps furbearers
7. Masked furbearer
8. Largest rodent in North America
9. Another name for poop
11. Animals that eat both plants and animals

Down

1. Another name for fur
3. Fur is a _____resource
4. Maryland has __ species of furbearers
6. Long, glossy hairs (two words)
10. Dense, soft fur on furbearer



Furbearer Fun: Crossword Puzzle Answers

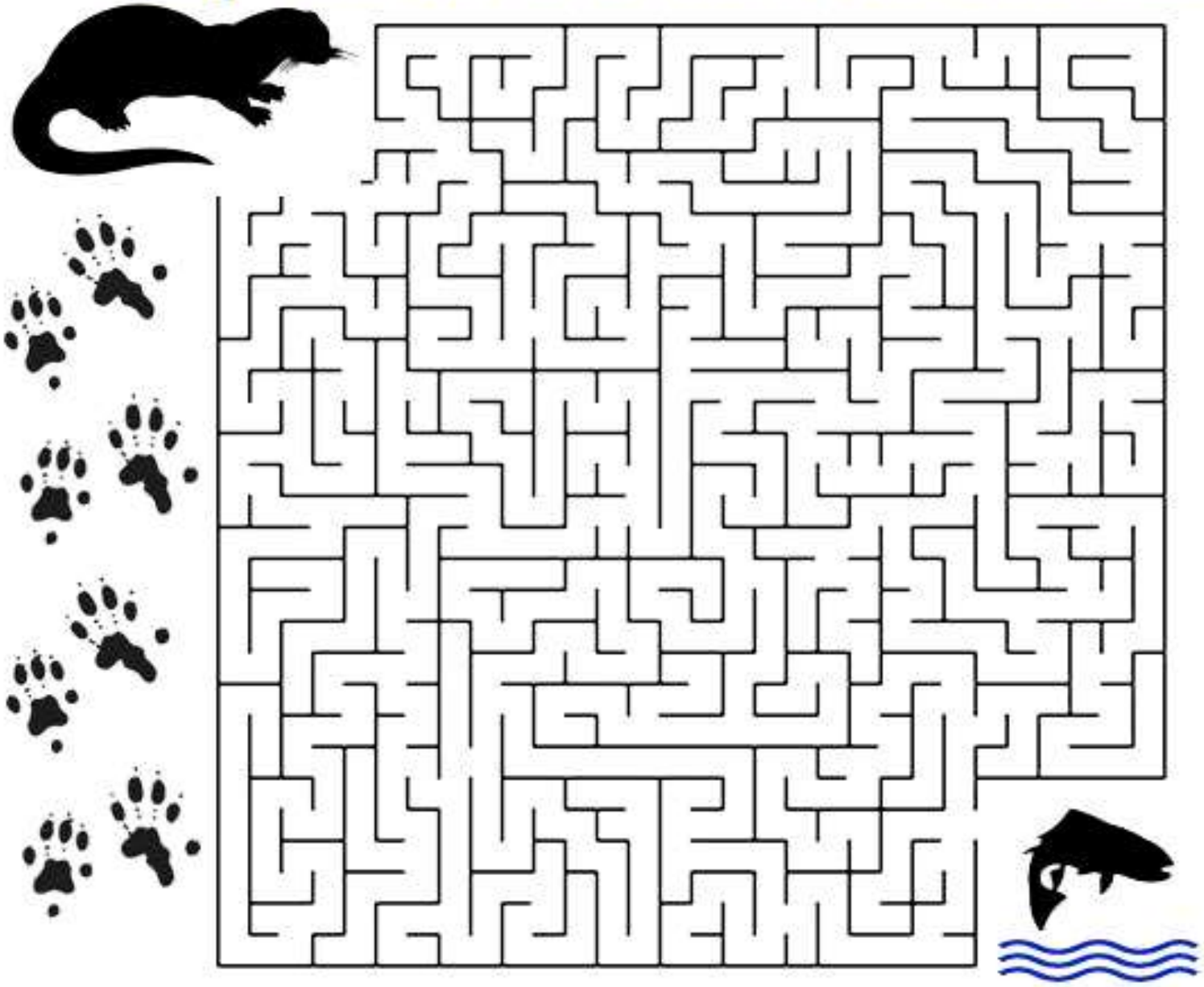
Across

2. Non-native rodent from South America: **Nutria**
4. Mammals hunted and trapped for fur: **Furbearers**
5. A person who traps furbearers: **Trapper**
7. Masked furbearer**: Raccoon**
8. Largest rodent in North America**: Beaver**
9. Another name for poop**: Scat**
11. Animals that eat both plants and animals: **Omnivores**

Down

1. Another name for fur: **Pelt**
3. Fur is a _____resource: **Renewable**
4. Maryland has __ species of furbearers: **Fourteen**
6. Long, glossy hairs**: Guard Hairs**
10. Dense, soft fur on furbearer: **Underfur**

Help the River Otter Find the Fish!

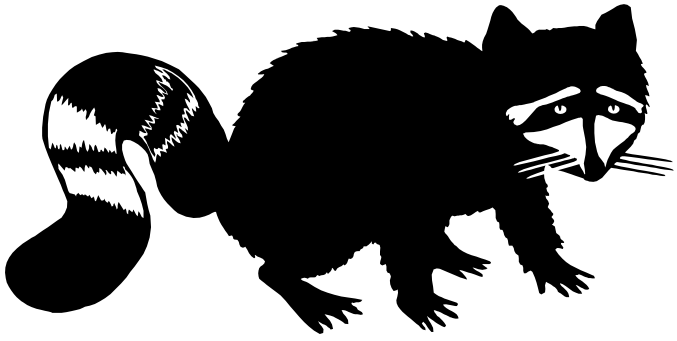


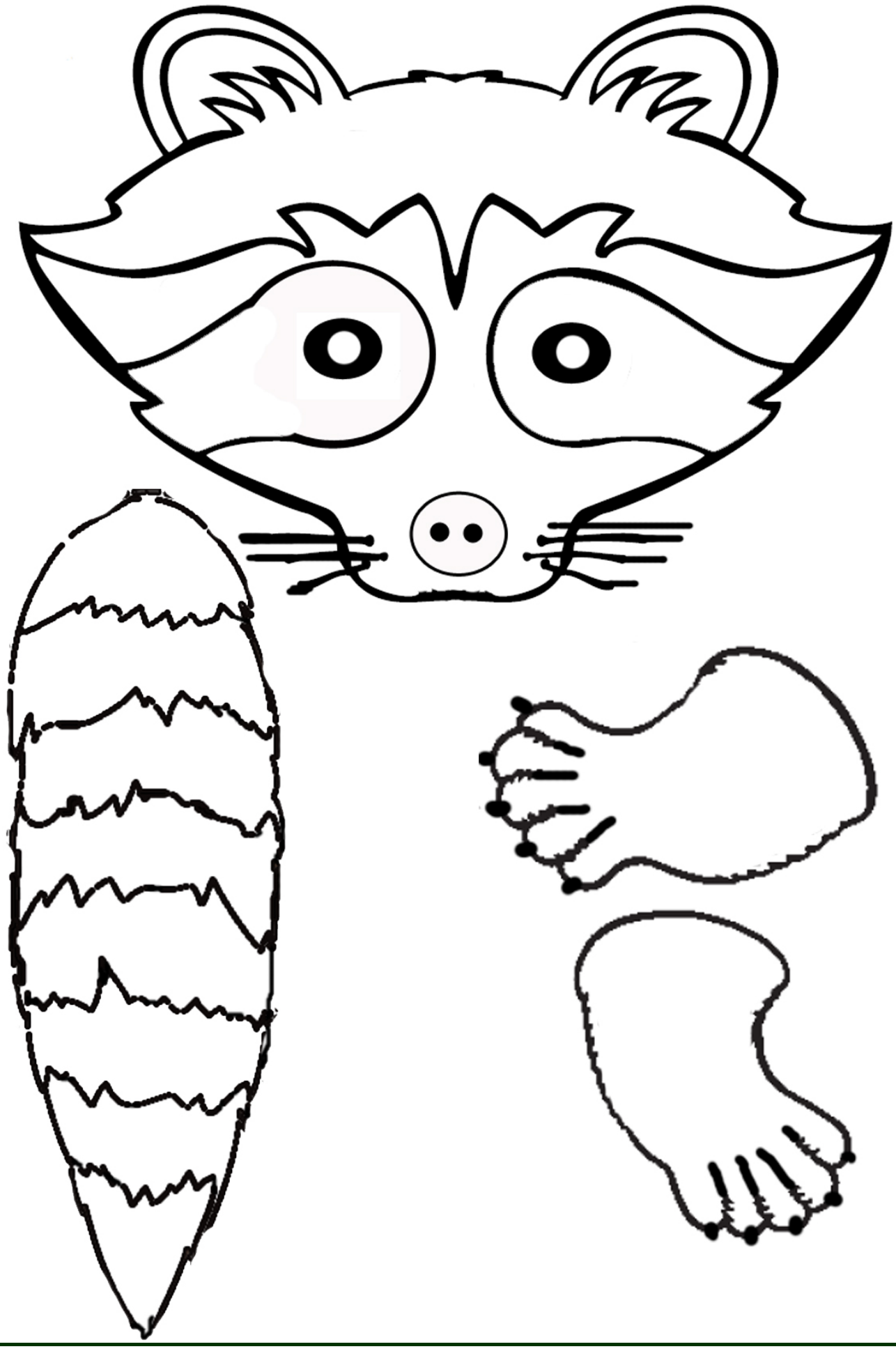
Make a Raccoon Puppet!

To make your very own Raccoon puppet, gather the materials listed below. Once you have everything, color your Raccoon. After that, cut out the parts to the Raccoon and attach them to the bag using glue or tape. Make sure you glue the head of the Raccoon on the bottom of the bag. Once you are finished, then have fun! Make up a story about your Raccoon and share it with your friends and classmates.

Materials Needed:

- Crayons, markers or colored pencils
- Glue or tape
- Paper bag
- Scissors
- Raccoon Print-out





There's No Place Like Home

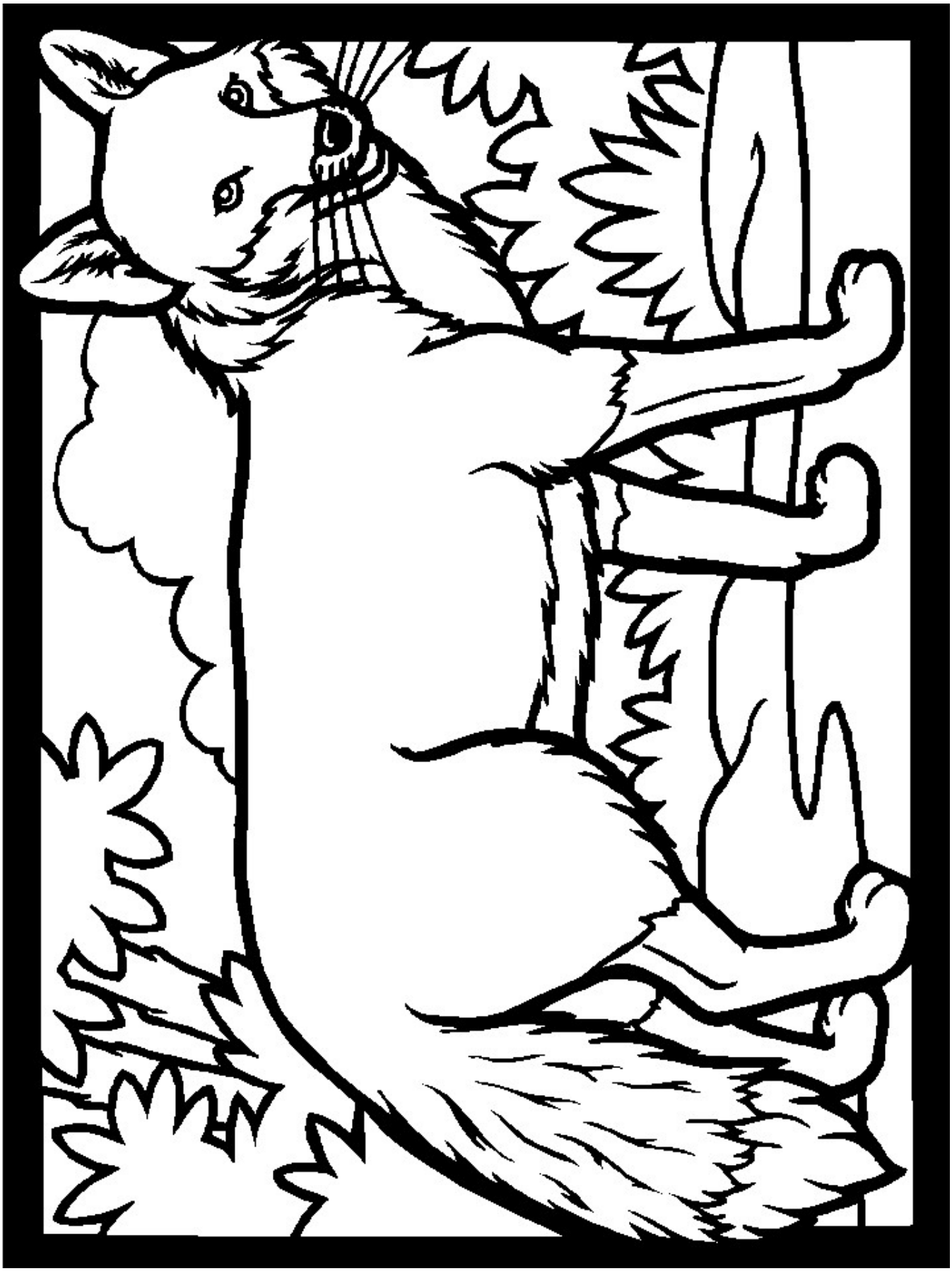
Read the story. Then circle the correct answer for each question below.

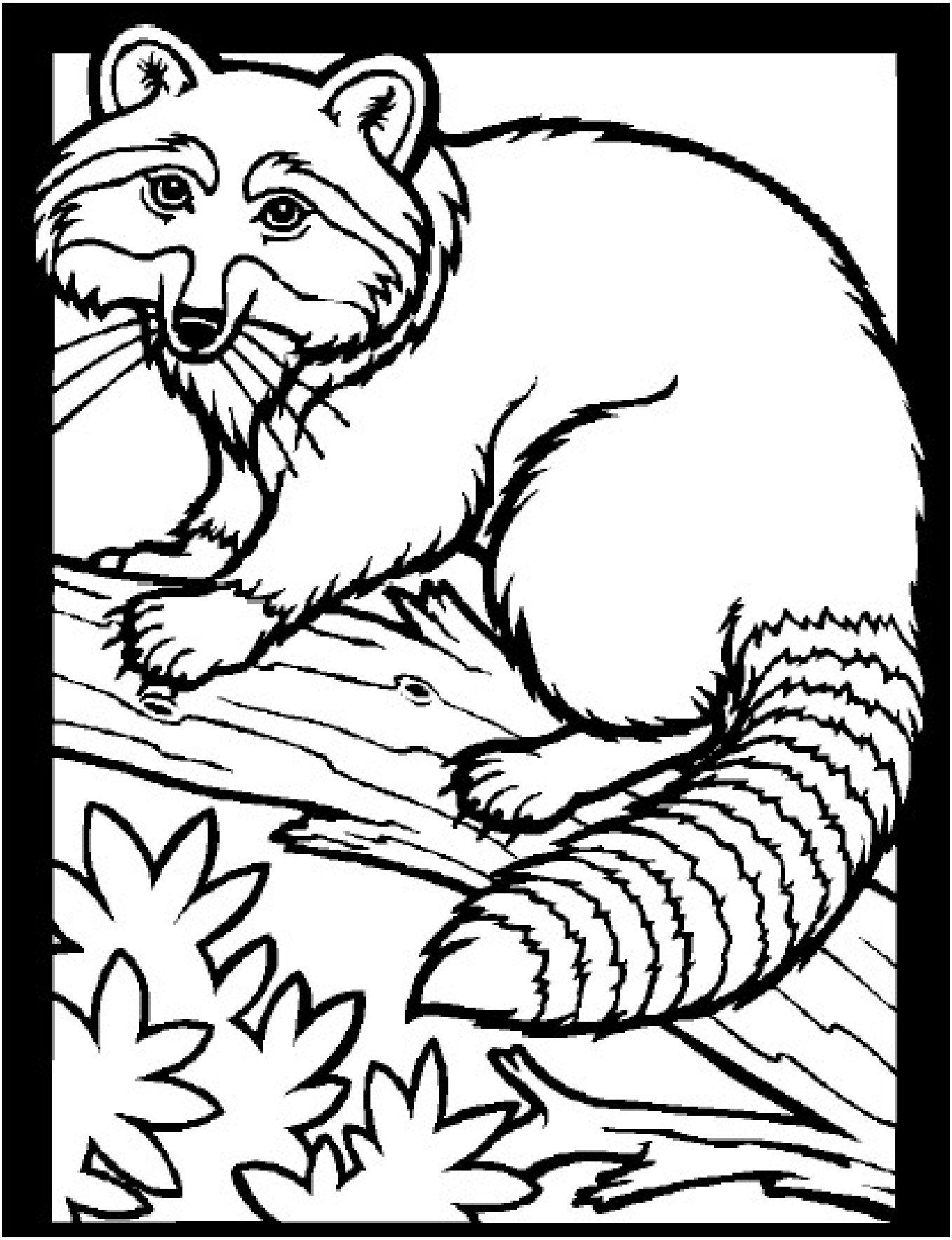
Slap! The beaver brings his flat tail down hard on the surface of the water.
The loud noise warns his family: Danger is near! The big rodent watches as an otter surfaces farther down the bank and disappears around the bend. Satisfied that the danger has passed, the beaver goes back to work. With his sharp teeth, he gnaws the trunk of a small tree. Taking a final chomp, he scampers away—just as the tree crashes to the ground.

The beaver has been busy all spring and summer. He and his family have built a dam upstream and one downstream in a slowly running creek. The pond they've created is a perfect place for their lodge—and perfect for many other wetland animals. Deer come to drink the clear, cool water. A loon lands gracefully on the water's surface. Fish swim below. A chorus of frogs croaks on the muddy banks. Bats swoop down to dine on swarms of buzzing mosquitoes.

Beavers are amazing architects. They've built not just a home for themselves but a habitat for a whole animal community. But their work isn't done. Winter is coming. They'll have to use some of the branches of the fallen tree to enlarge and repair their home. The rest will be stored underwater. That way, even when the pond is covered with ice, the family will have plenty to eat. They'll be comfortable in their cozy lodge. The large room above the water will keep them warm, dry, and safe. The only way into the lodge is through several underwater tunnels. Unwelcome visitors will have to brave the icy water to reach them. When the kits get hungry, one of the adults will swim out and grab twigs from their storage pile. The young family has worked hard to build their home. But it's been worth it. Together, they'll wait out the long, cold winter.

1. Beavers are (a) reptiles, (b) robots, (c) rodents.
2. The beaver in the story slapped his tail on the water to (a) wake his family, (b) warn his family, (c) wash mud off his tail.
3. Beavers cut trees with their (a) sharp nails, (b) sharp tails, (c) sharp teeth.
4. Entrances to the beavers' lodge are through (a) underwater tunnels, (b) underwater slides, (c) holes in the ice.
5. Young beavers are called (a) kits, (b) kids, (c) cats.
6. The beavers have created a pond by (a) building dams upstream and downstream, (b) digging with their tails, (c) hiring Ponds 'R Us.
7. Their work is similar to the work of (a) astronauts, (b) architects, (c) attorneys.
On another piece of paper, write a story about how another wetland animal feels about the new pond.





Raccoon Songs for Kids

I'm a Little Raccoon (to the tune of I'm a Little Teapot)
written by Leanne (http://www.dltk-teach.com)

I'm a little raccoon, prowling around,
(*use your hands like little paws and make a cautious prowling motion*.)
I hunt for food without a sound.
(*look left and then right and then make a shhhhhh motion*)
A mask on my face and a bushy tail,
(*point to your eyes and then swish one arm behind you like a tail*)
Let's see if you can spot my trail!
(*point at someone and then put hand on forehead (like a salute) and gaze at the floor like you're looking for pawprints*)

Ra-Ra-Raccoon
By: Songs for Teaching®, Using Music to Promote Learning
http://www.songsforteaching.com

I'm a ra ra ra ra ra ra raccoon.
I'm gonna sing you a tu tu tu tune
Under the sun or the mo moon,
I'm a ra ra ra ra ra ra raccoon

My eyes have circles;
My tail has rings
And what's so special is
I'm a ra ra raccoon that si sings!

I'm always looking for things to eat.
People chase me 'cause I'm not s-so ne neat!

Paper Plate Beaver Craft or Mask

Make your own beaver mask! Activity from http://www.dltk-kids.com

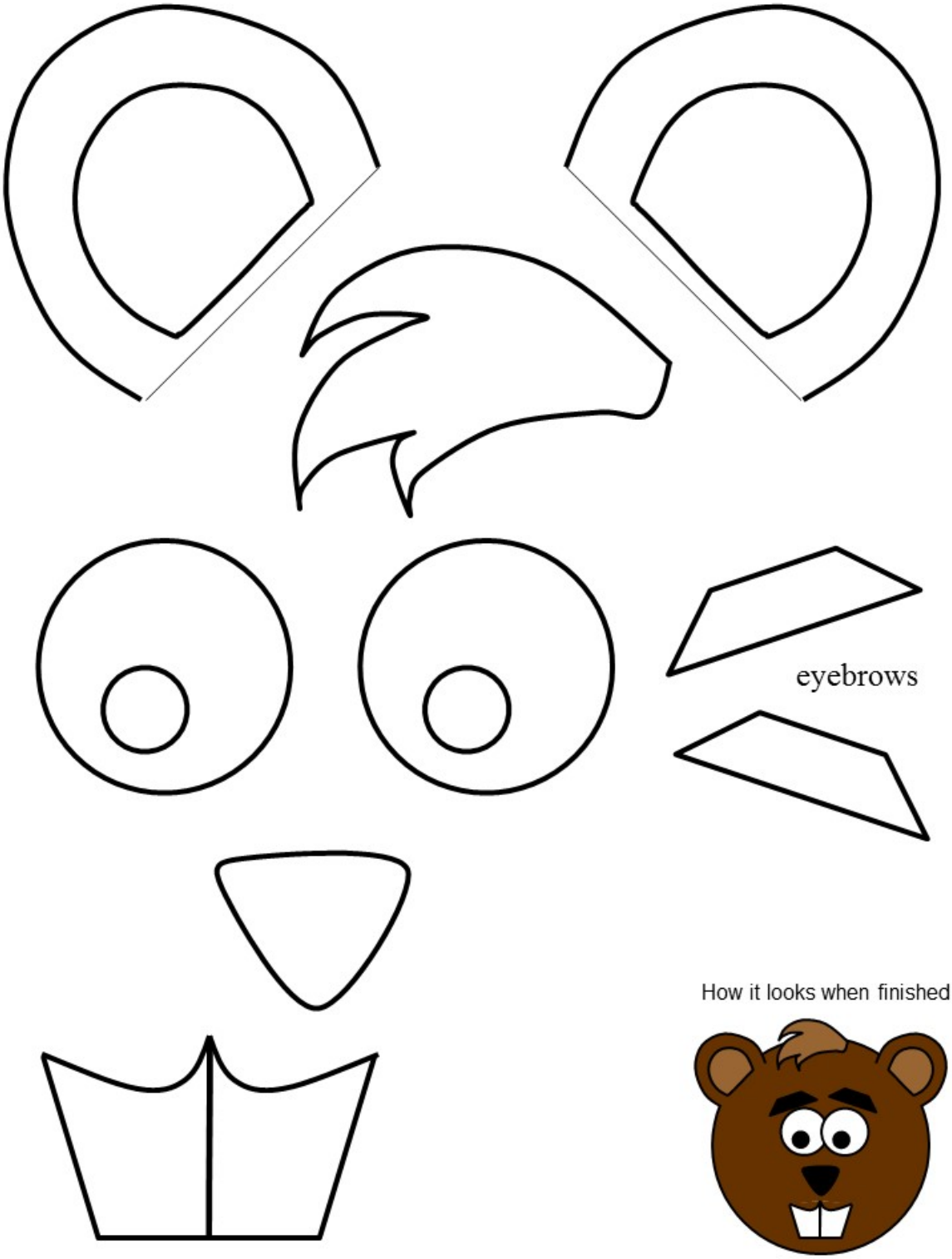
Materials:

- Paper plate
- Brown paint and paint brush
- Something to color with
- Scissors
- Glue
- Paper
- Printer
- Paint stick or tongue depressor
- Tape

Optional: You can substitute large wiggly eyes for the template eyes. You can also use a black marker to draw whiskers on the face.

Instructions:

1. Paint the bottom of the paper plate brown.
2. Print out template on next page.
3. Color (where appropriate) and cut out the template pieces. Most of the pieces are simple enough shapes for young children to cut out, but if needed, an adult can help with some of the harder pieces (the hair).
4. Glue the pieces to the plate to make a beaver face. Place the eyes on the face above the nose and under the hair (or cut out holes for eyes in a mask).
5. *Optional:* Use a black marker to draw whiskers on the beaver's face.
6. *Optional:* If making a mask, use masking tape or duct tape to attach a thin strip of wood, a tongue depressor or a paint stir stick


eyebrows
How it looks when finished

Environmental Literacy Alignments for Selected Furbearer Activities

Counting Foxes (Grades 9-12); pgs 101-103
No E-lit correlations

Creeping Coyotes (Grades 5-8); pgs 80-84
Grades 3-5

- 1.A.1; 3.C.1; 4.B.1; 4.C.1; 4.D.1; 4.D.2 – Explain ways that individuals and groups of organisms interact with each other and their environment.
- 1.A.1; 5.A.2; 6.B.1; 7.D.1; 8.B.1; 8.C.1; 8.D.1; 8.E.1 – Recognize and explain that decisions influencing the use of natural resources may have benefits, drawbacks, unexpected consequences, and tradeoffs.

Grades 6-8

- 1.B.1 – Identify and describe that ecosystems can be impacted by human activities.

Every Skull Tells a Story (Grades 3-5); pgs 67-68
Grades 3-5

- 1.A.1; 3.C.1; 4.B.1; 4.C.1; 4.D.1; 4.D.2 – Explain ways that individuals and groups of organisms interact with each other and their environment.

Nuisance Nutria (Grades 5-8); pgs 77-79
Grades 3-5

- 1.A.1; 3.C.1; 4.B.1; 4.C.1; 4.D.1; 4.D.2 – Explain ways that individuals and groups of organisms interact with each other and their environment.

Grades 6-8

- 1.B.1 – Identify and describe that ecosystems can be impacted by human activities.

The Otter Game (Grades 5-8); pgs 85-87
Grades 3-5

- 1.A.1; 3.C.1; 4.B.1; 4.C.1; 4.D.1; 4.D.2 – Explain ways that individuals and groups of organisms interact with each other and their environment.
- 1.A.1; 6.C.1 – Explain how the growth of communities and suburbs have had consequences on the environment.
- 1.A.1; 5.A.2; 6.B.1; 7.D.1; 8.B.1; 8.C.1; 8.D.1; 8.E.1 – Recognize and explain that decisions influencing the use of natural resources may have benefits, drawbacks, unexpected consequences, and tradeoffs.
- 3.A.1; 4.A.1 – Recognize food as the source of materials that all living things need to grow and survive.

Grades 6-8

- 1.B.1 – Identify and describe that ecosystems can be impacted by human activities.
- 3.A.1; 4.A.1 – Explain that the transfer of matter and energy links organisms to one another
- 5.B.1 – Recognize and explain the impact of a changing human population on the use of natural resources

Pay to Play (Grades 5-8); pgs 95-100

Grades 3-5

- 1.A.1; 6.C.1 – Explain how the growth of communities and suburbs have had consequences on the environment.
- 1.A.1; 5.A.2; 6.B.1; 7.D.1; 8.B.1; 8.C.1; 8.D.1; 8.E.1 – Recognize and explain that decisions influencing the use of natural resources may have benefits, drawbacks, unexpected consequences, and tradeoffs.
- 1.B.2; 1.B.3; 5.A.1; 6.B.1; 7.E.1 – Recognize and describe that consequences may occur when Earth's natural resources are used.

Grades 6-8

- 1.B.1 – Identify and describe that ecosystems can be impacted by human activities.
- 5.B.1 – Recognize and explain the impact of a changing human population on the use of natural resources
- 7.D.1 – Explain how regional population patterns, trends, and projections affect the environment and influence government policies.

Playing 'possum (Grades PK-2, 3-5); pgs 75-76

Grades PK-2

- 4.C.1- Modifying and adapting to the environment

Grades 3-5

- 1.A.1; 3.C.1; 4.B.1; 4.C.1; 4.D.1; 4.D.2 – Explain that individuals of the same kind differ in their characteristics, and sometimes the differences give individuals an advantage in surviving and reproducing.
- 3.A.1; 4.A.1 – Recognize food as the source of materials that all living things need to grow and survive.

Quick-Frozen Critters (Grades 5-8); pgs 49-51

Grades 3-5

- 1.A.1; 3.C.1; 4.B.1; 4.C.1; 4.D.1; 4.D.2 – Explain ways that individuals and groups of organisms interact with each other and their environment.
- 3.A.1; 4.A.1 – Recognize food as the source of materials that all living things need to grow and survive.

Grades 6-8

- 3.A.1; 4.A.1 – Explain that the transfer of matter and energy links organisms to one another…

Skull Detectives; pgs 69-74
No E-lit correlations

What You Wear Is What They Were (Grades 5-8); pgs 14-17
Grades 3-5

- 1.A.1; 5.B.1; 7.D.1; 8.A.1; 8.B.1; 8.C.1 - Recognize and explain how renewable and nonrenewable natural resources are used by humans to meet basic needs.
- 1.B.2; 1.B.3; 5.A.1; 6.B.1; 7.E.1 – Recognize and describe that consequences may occur when Earth's natural resources are used.

Grades 6-8

- 1.A.1 – Identify and describe problems associated with obtaining, using, and distributing natural resources.
- 8.A.1 – Understand and apply the basic concept of sustainability to natural and human communities.
- 8.D.1 – Recognize and explain the impact of a changing human population on the use of natural resources