

MIDDLE CREEK WILDLIFE MANAGEMENT AREA



Self-Directed Curriculum

Skull King

adapted from the
International Wildlife Museum
curriculum



Self-Directed Curriculum Kits

- **Connect With Wildlife**

Students compare and identify twelve different Pennsylvania mammals using their pelts and wildlife background information.

- **Decoy Detective**

Students use the decoys to learn about waterfowl identification and divide birds into a diver or puddle duck classification.

- **Feet Are Neat**

Students explain the role of bird feet in bird survival and compare and contrast bird feet adaptations.

- **Let's Wing It**

Students compare and identify the different types of flight feathers that make up a bird's wing.

- **Scatology**

Students create fake animal scat and learn to identify an animal by its droppings.

- **Skull King**

Students infer from a skull what classification and niche the animal inhabits.

- **The Nose Knows**

Students identify different food smells and will compare the ability to distinguish different smells to animals using their sense of smell to find mates, offspring and food.

- **Wildlife Tracks**

Students use a variety of methods to observe, identify, collect and document tracks of different common wildlife species in Pennsylvania.

SKULL KING - Teacher's Page

from *International Wildlife Museum* curriculum

Objective:

Students will infer from a skull what classification and niche the animal inhabits.

Materials Needed:

- Collection of skulls and answer key.

Background:

The physical characteristics of an animal's skull are clues to how the animal adapted to its environment and what niche it inhabits in its habitat. Teeth, eye position, size and shape can indicate whether the animal is a carnivore, herbivore or omnivore. These characteristics can also tell whether the animal is a predator or prey and if it is nocturnal (night hunter), diurnal (day hunter), or crepuscular (dawn or dusk). Physical characteristics are as follows:

TEETH

Carnivore: Sharp, pointed teeth suitable for tearing flesh. Long, thin canines on upper and lower jaws. Small incisors. Jaw that moves up and down.

Herbivore: Flat, smooth surface on molars for chewing. Jaw moves sideways. May have no incisors or have them on one or both jaws. Canines lacking.

Omnivore: Combination of flat, smooth teeth for chewing vegetation, large incisors for biting, and pointed canines on upper and lower jaws.

EYE SOCKETS

Predator: Eyes high on skull, facing forward, focusing on prey.

Prey: Eyes lower and on sides to look in all directions.

Size: Eyes small for diurnal animals, large for nocturnal and crepuscular animals.

NASAL CAVITY

The larger the nasal cavity, the more important the sense of smell.

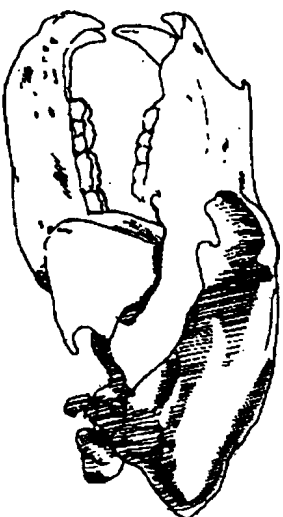
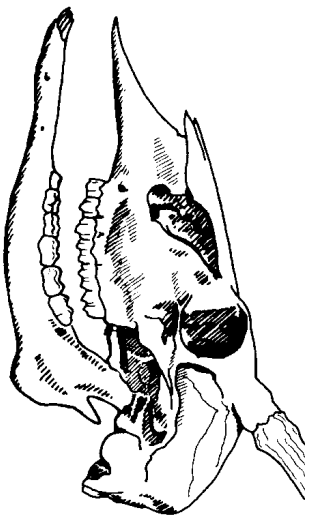
EAR POCKETS

The larger the ear pockets, the better the sense of hearing and the better balance the animal has.

Activities:

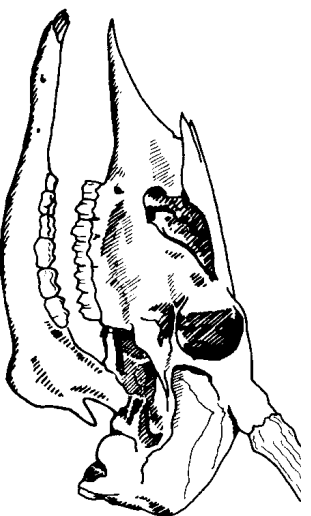
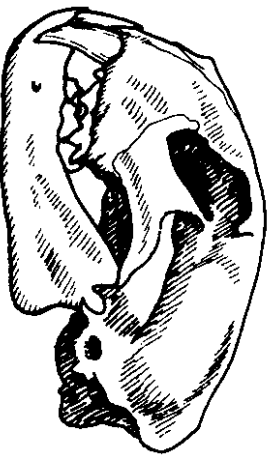
1. Tell students they are going to gather evidence regarding an unknown animal. They are not allowed to guess what the animal is until they have all the evidence.
2. Provide a copy of the attached chart.
3. Show a skull and have students discuss and complete their chart regarding the following information: location and size of eyes, description of teeth and direction of jaw movement. By looking at the size and shape of the skull, help students visualize the height and length of the animal. Using their gathered "evidence", students should try to determine the animal's diet and whether they are a predator or prey. With the information on their chart, have students infer the family and name of each skull.

Skull Number	Eyes	Teeth	Jaw	Diet (Meat, Herbs, both)	Size and Shape	Niche (Predator /Prey)	Family	Name



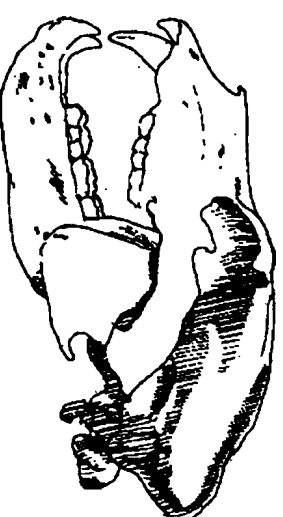
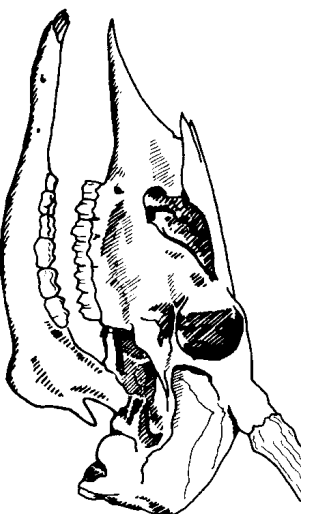
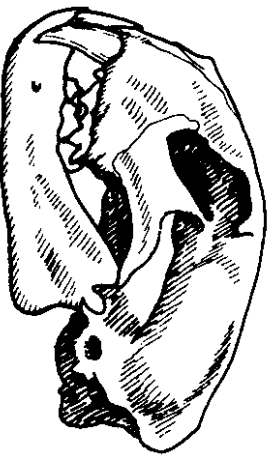
EXAMPLE

Skull Number	Eyes	Teeth	Jaw	Diet (Meat, Herbs, both)	Size and Shape	Niche (Predator /Prey)	Family	Name
Skull # 1	High on skull & face forward	Sharp Pointed	Moves up & down	Meat	Round Compact	Predator	Cat Feline	Bobcat



ANSWER KEY

Skull Number	Eyes	Teeth	Jaw	Diet (Meat, Herbs, both)	Size and Shape	Niche (Predator /Prey)	Family	Name
Skull # 1	High on skull & face forward	Sharp Pointed	Moves up & down	Meat	Round Compact	Predator	Cat Feline	Bobcat
Skull # 2	High on skull & face forward	Sharp Pointed Last molars slightly flattened	Moves up & down	Meat & Plants	Elongated with long, narrow nostrils	Predator	Dog Canine	Coyote
Skull # 3	High on sides of skull	Large incisors; space between incisors & molars	Moves up & down & side to side	Plants	Flat & broad	Prey	Rodent	Wood-chuck



Skull-king

Objectives:

The students will infer from a skull what classification and niche the animal inhabits.

Background:

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Physical characteristics are as follows:

TEETH

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Omnivore: Combination of flat, smooth teeth for chewing vegetation, large incisors for biting, and pointed canines on upper and lower jaws.

EYE SOCKETS

Predator: Eyes high on skull, facing forward, focusing on prey.

Prey: Eyes lower and on sides of skull in order to look in all directions.

Size: Eyes small for diurnal animals, large for nocturnal or crepuscular animals.

NASAL CAVITY

The larger the nasal cavity, the more important the sense of smell.

Grade level: 2-8.

Materials: A variety of skulls.

Time required: 40 minutes.

Structures: Teacher-led discussion.

Resources: Arizona Game & Fish Skull

Kit or Arizona Sonora Desert Museum

Predator-Prey Kit.

Source: Adapted from Skull Lab

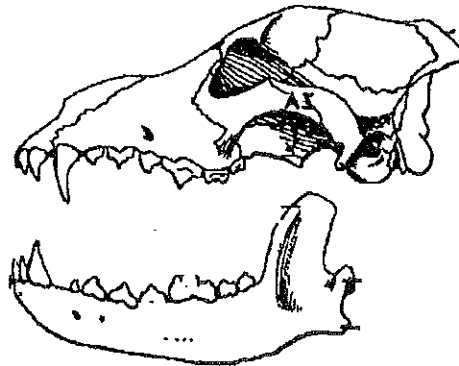
(ASDM)

EAR POCKETS

The larger the ear pockets, the better the sense of hearing and the better balance the animal has.

Procedure:

1. Tell students they are going to gather evidence regarding an unknown animal. They are not allowed to guess what the animal is until they have all the evidence.
2. Create a chart on the board or provide students with a blank chart with the following headings: skull number, eyes, teeth, jaw, diet (meat, herbs, both), size and shape, niche (predator/prey), family, name.
3. Show a skull. Ask which way the animal appears to be looking. A pencil in the eye socket will help tell this. Have students determine relative size. Record this information on chart.
4. Work the jaw and show the teeth. Ask students to describe the kinds of teeth and how the jaw works. Record this information.
5. Hold the skull above the table with one hand and use the other to help the students visualize the height and length of the animal. Suggest words to describe the size and shape.



Discussion:

1. "From the information on the chart, what food would this animal eat? If it is equipped to eat meat, what else do you know?" (It is a carnivore and its niche is predator.) Do this for each skull.
2. "If a skull has large eye sockets and large ear pockets, flat gnawing teeth, and small size brain capacity, what else can be inferred?" (It is a herbivore, has good hearing for listening for predators, and is probably nocturnal.) Do this for all the skulls.
3. Have students infer family and name of each skull.

Closure:

1. Have the students state what important characteristics of the skull were needed in order to identify the skull. (Kinds of teeth, size and direction of eye sockets, jaw movement, size and shape of skull, etc.)
2. Explain that these characteristics are the basis for the science of taxonomy.

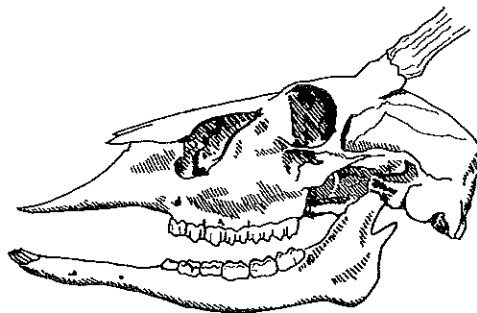
Extensions:

1. Design an animal. Decide on the size and direction of the eyes (nocturnal or diurnal) nose, ears, fur color, legs, feet, etc. Draw or create a model of the animal. Present the animal's characteristics to a partner or the class.
2. Write a description of an animal. Be sure to include all the important information learned in this activity. Give to another student to infer what the animal is. Be sure to use references in order to have correct information.

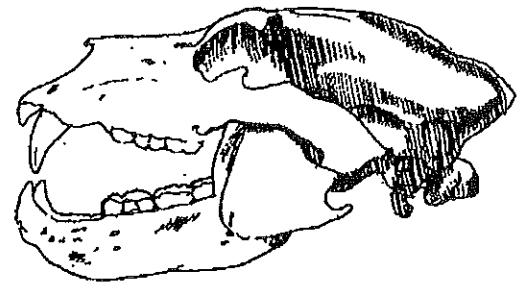
TYPES OF SKULLS



Mountain Lion
Carnivore

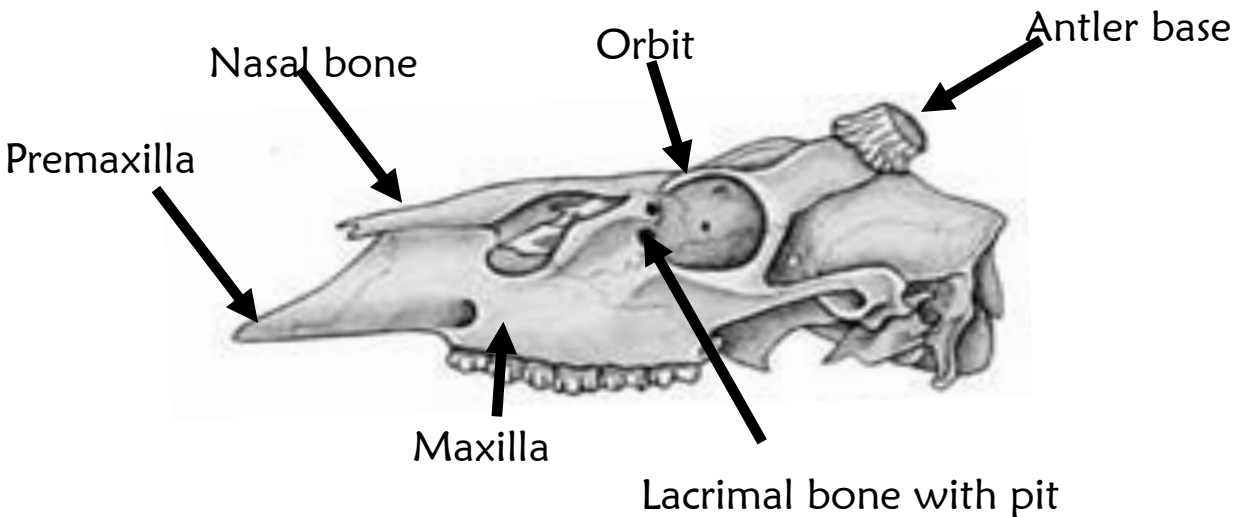
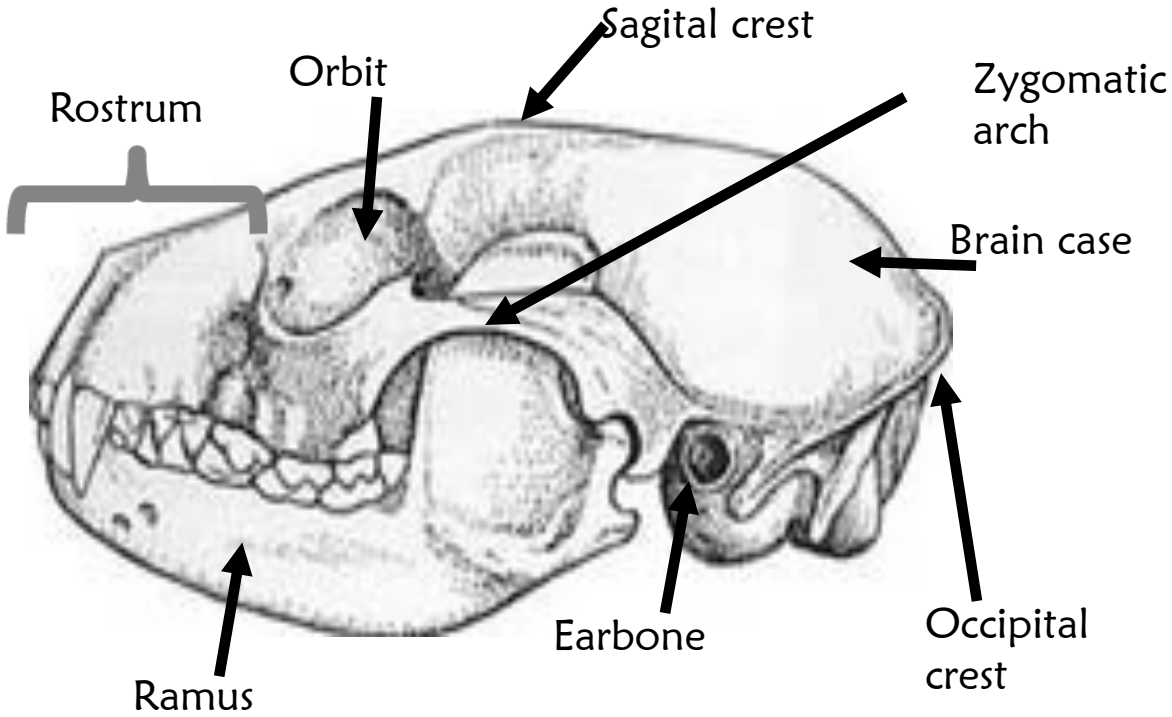


Elk
Herbivore



Bear
Omnivore

Parts of the Skull



Braincase— contains the brain, part of skull located behind the orbits

Earbone- found on lower surface of the skull which contains the middle ear.

Infraorbital foramen O a large hole in the side of the maxilla usually below or in front of the orbit

Lacrimal bone—forms the front edge of the orbit (large in hoofed animals, small in most other species)

Length of skull— measure from front of incisors or premaxilla to the most posterior or rear part of the skull

Maxilla—bone forming major portion of the upper jaw on each side.

Nasal bones—form the upper surface of the rostrum or muzzle above the nasal opening.

Occipital bone—large, broad bone forming the back of the skull.

Occipital ridge— ridge on top of braincase—running across width.

Orbit—eye socket

Plate— roof of mouth

Postorbital process—marks the back, upper edge of the orbit, as well as on the upper surface of the zygomatic arch (if present)

Premaxilla—very front of the skull— front tip of the upper jaw.

Rostrum— muzzle, part of the skull in front of the orbits.

Sagittal crest—length-wide ridge on the top of the braincase.

Zygomatic arch—curved bones forming arch along side of skull—cheekbones

Skull Size:

Large skull— over 150 mm (6" long)

Medium skull 75-150 mm (3-6 inches long)

Small skull— 25-75 mm (1-3 inches long)

Tiny skull— less than 25 mm (1 inch long)

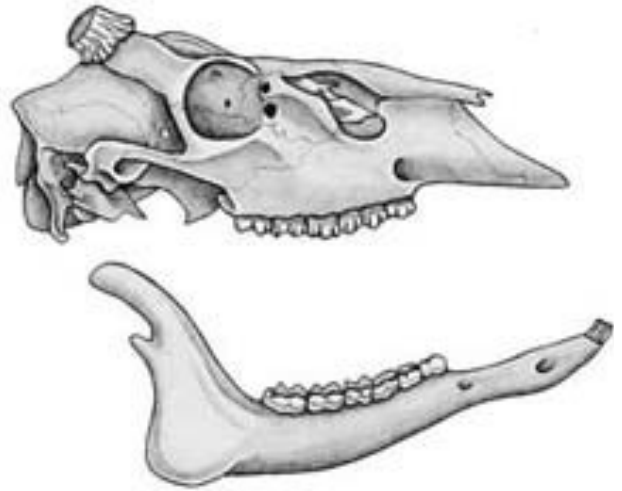
White-tailed deer (herbivore)

Order: Artiodactyla

Family: Cervidae

Odocoileus virginianus

Herbivore, note incisors in front of lower jaw and grinding premolars and molars in rear. The outer tooth that looks like an incisor is actually a small canine.



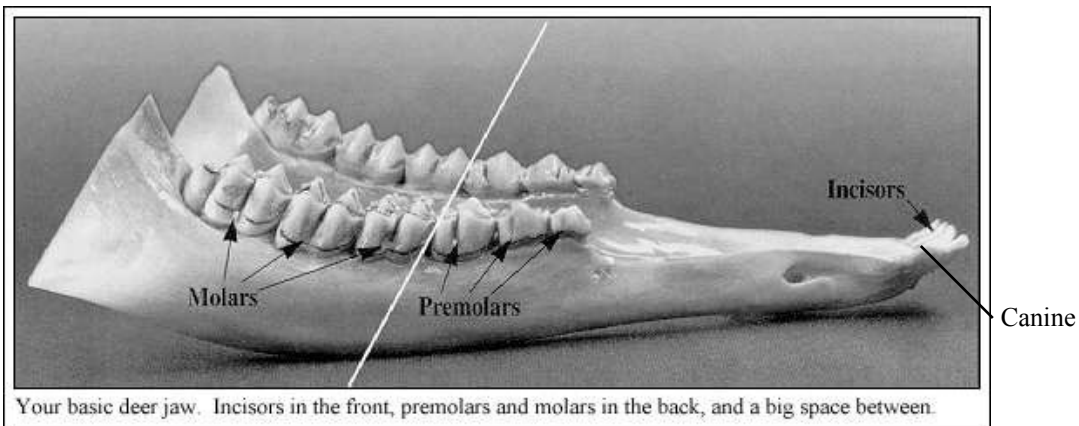
Prey species skull configuration, note eye socket on side of skull.

Tooth Formula

I C P M

0 - 0 - 3 - 3 per side Total = 32 teeth

3 - 1 - 3 - 3



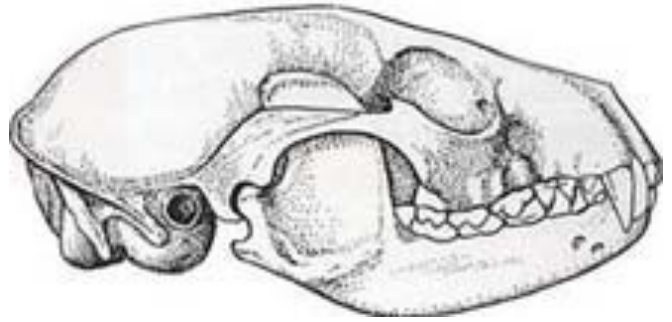
Your basic deer jaw. Incisors in the front, premolars and molars in the back, and a big space between.

Northern raccoon (Omnivore)

Order: Carnivora

Family: Procyonidae

Procyon lotor



Although in the Order Carnivora, the raccoon is an omnivore.

Eye placement reflects the predator role (at times) of a raccoon.

Teeth show signs of both carnivore and herbivore with the large canines of the carnivore and molars that can both grind like an herbivore and cut similar to a carnivore.

Tooth Formula

I C P M

3 - 1 - 4 - 2 per side Total = 40 teeth

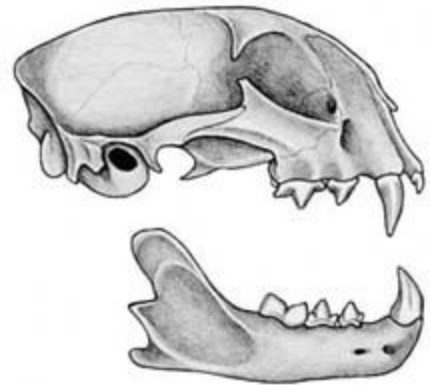
3 - 1 - 4 - 2

Bobcat (carnivore)

Order: Carnivora

Family: Felidae

Lynx rufus some books list bobcat as *Felis rufus*



Carnivore, note the sharp canine teeth and the small number of sharp molars and premolars called carnassials.

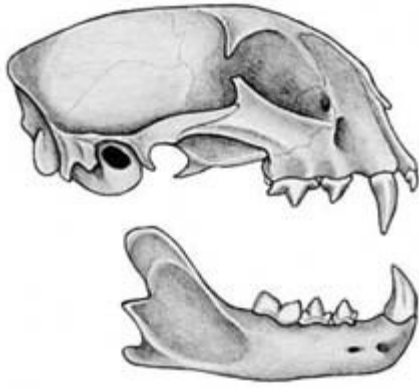
Predator, note the eye socket placement towards front, as well as the teeth typical of a carnivore.

Tooth Formula

I C P M

3 - 1 - 2 - 1 per side Total = 28 teeth

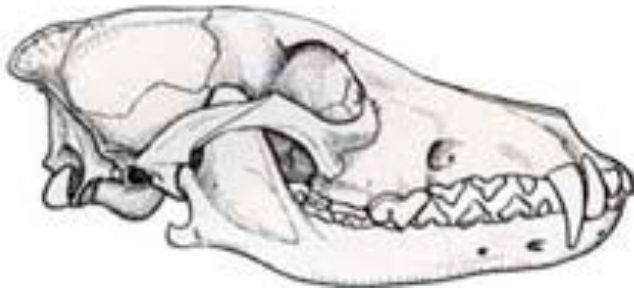
3 - 1 - 2 - 1



Bobcat

Note: round skull , open orbit, large canines, short rostrum

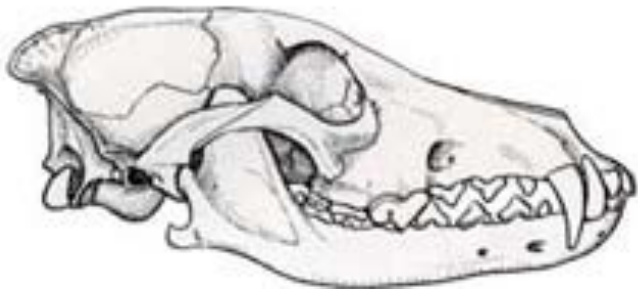
Notes



Coyote

Note: elongated skull, large canines, front-facing orbit, open orbit, long narrow nasals (look at top of skull), low /flat sagital crest,

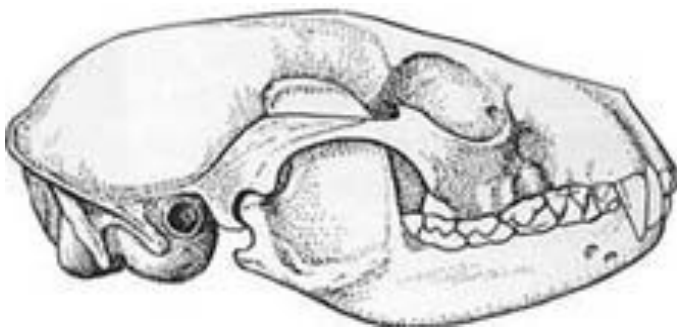
Notes



Red Fox

Note: Medium sized skull, large canines, o toothless space, postorbital process at or near skull midpoint, longer rostrum, low ridges from postorbitat processes, form a “V” shape

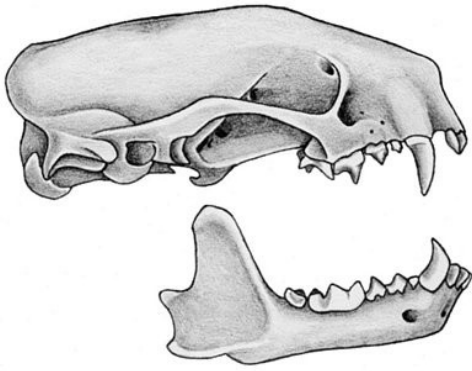
Notes



Raccoon

Note: medium-sized skull, large brain case that narrows towards back, front-facing orbit, open orbit, large canines, 3 incisors on each side, no space between canines

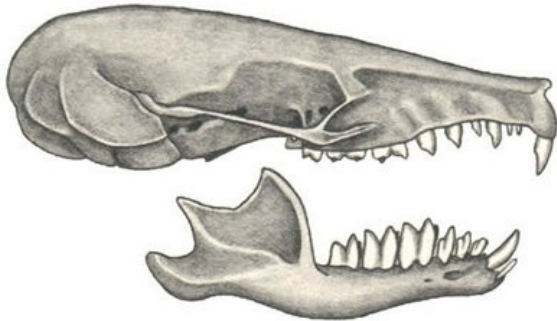
Notes



Striped Skunk

Small skull, short palate, 4 cheek teeth, large canines, closed orbit

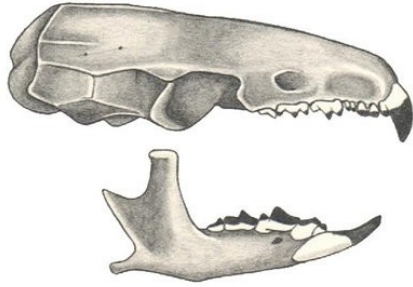
Notes



Eastern Mole

Notes: Tiny skull, no wide gap, all teeth have sharp points, Teeth all white, low flat skull, thin orbit, no distinct zygomatic arch

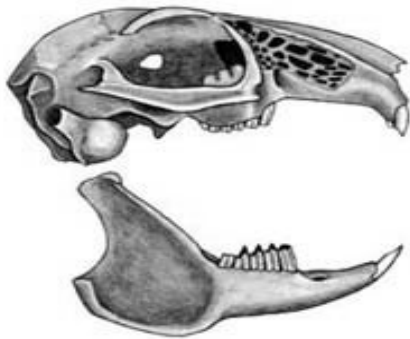
Notes



Short-tailed Shrew

Note: Tiny skull, low flat skull and sagittal crest, all teeth have sharp points, no zygomatic arch, teeth tipped with reddish-brown pigments.

Notes



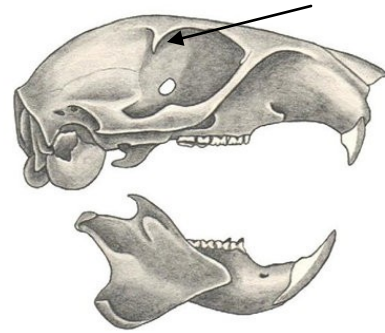
Rabbit

Note: Small skull, open orbit, large incisors, space between incisors and premolars and molars; 2 pairs of upper incisors, -small incisor behind large incisor; rostrum is an open latticework on upper rostrum

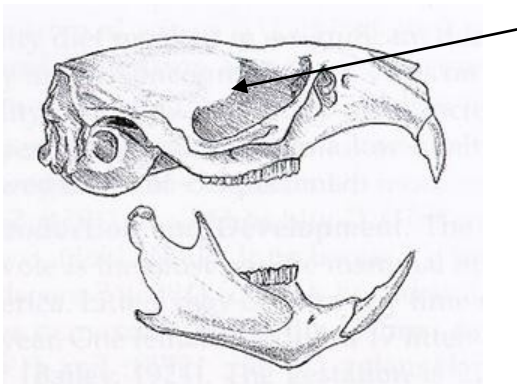
Notes:

Gray squirrel

Notes: Small skull, large incisors, gap between incisors and premolars/molars, only 1 large incisor on each side; rostrum solid, sharp postorbital processes



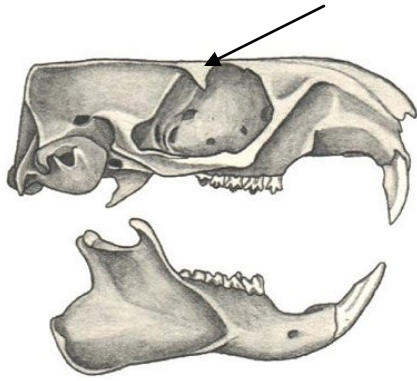
Notes



Meadow vole

Note: Small to tiny skull, large incisors, wide toothless space between incisors and premolars/molars, postorbital process basically just a bump.

Notes



Woodchuck

Note: flat –broad skull, large incisors, space between incisors and premolars/molars, angled superorbital processes

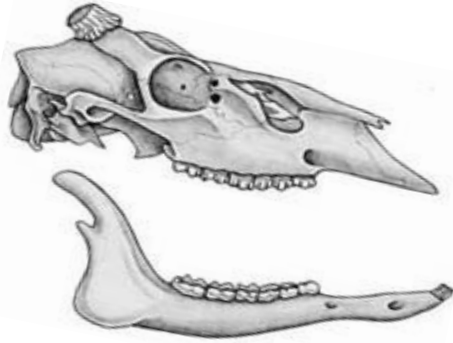
Notes



Opossum

Note: Sharp, blade-like sagittal crest, 5 incisors on each side, canines large but no toothless space in front of cheek teeth, medium sized-skull, 50 teeth | adults

Notes



White-tailed deer

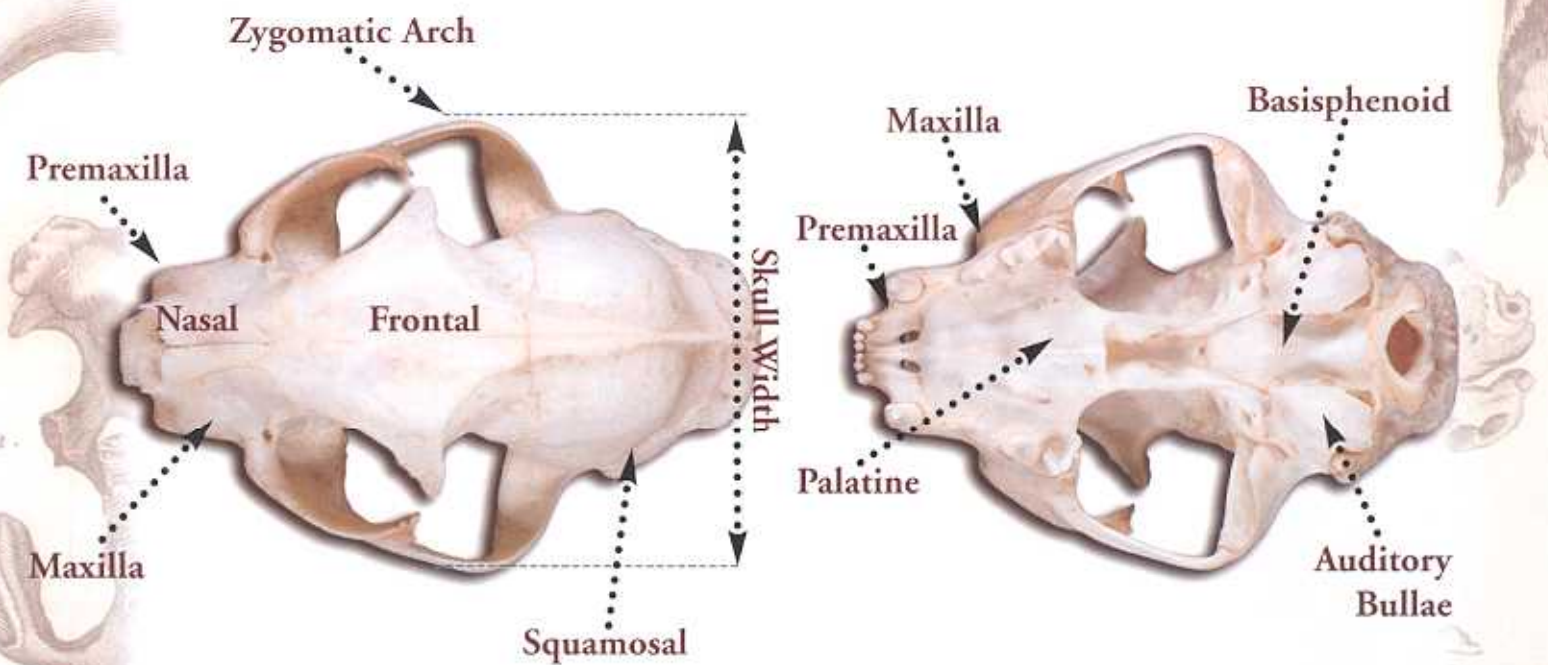
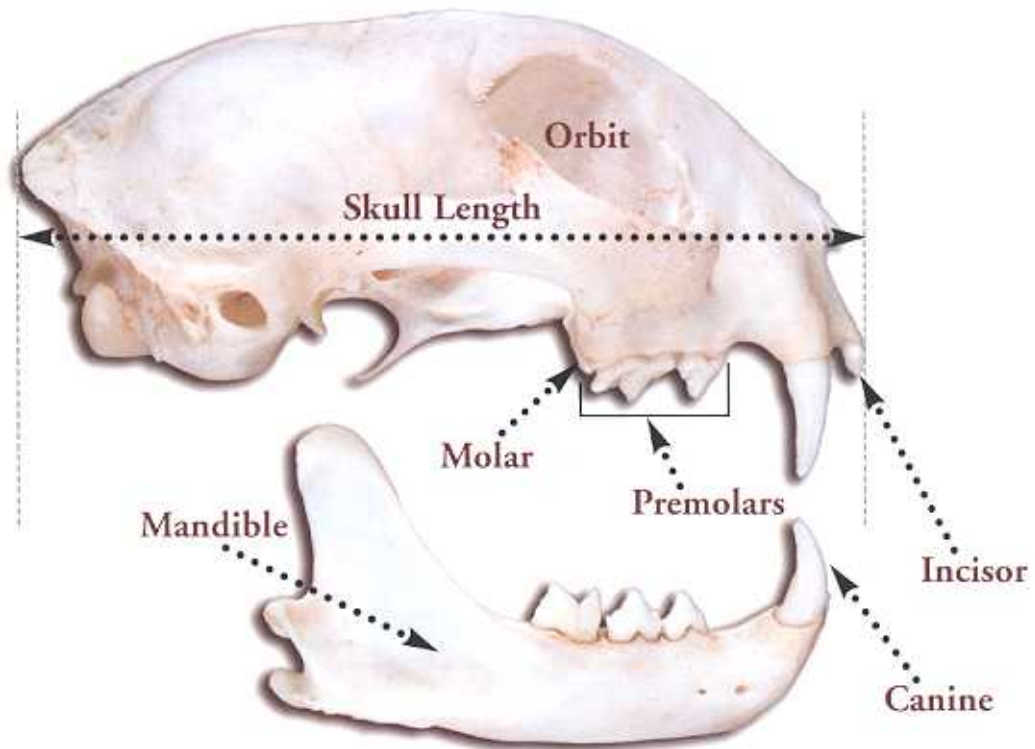
Note: elongated skull, no incisors on top jawbone, large space between incisors and premolars and molars, closed orbit, lacrimal bone has pit, lacrimal bone separated by a wide space exposing bones underneath.

Notes

Many skull illustrations from:
<http://www.mnh.si.edu/>

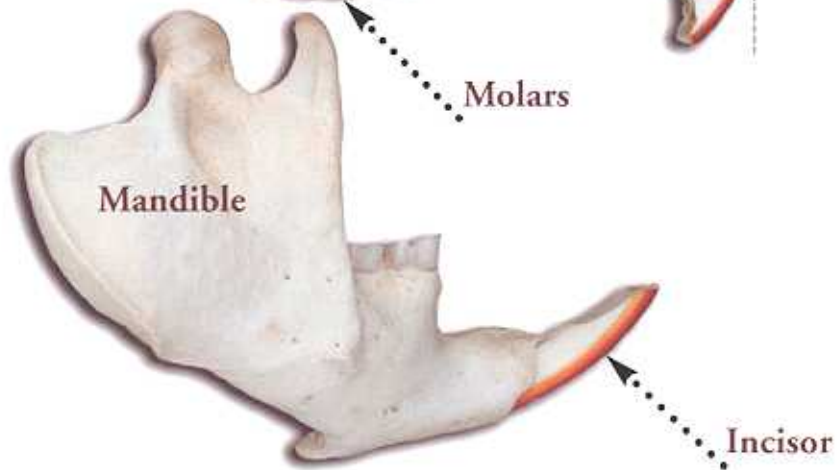
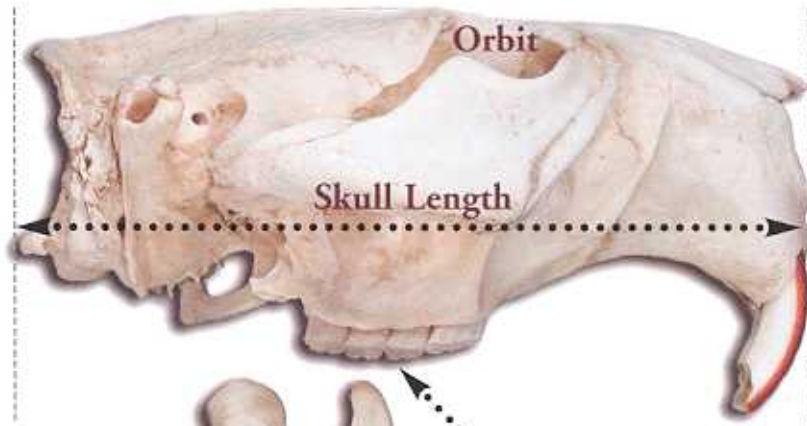
Education

Bobcat Skull - Carnivore



Education

Beaver Skull - Herbivore



Zygomatic Arch

Premaxilla

Nasal

Frontal

Maxilla

Skull Width

Squamosal

Basisphenoid

Maxilla

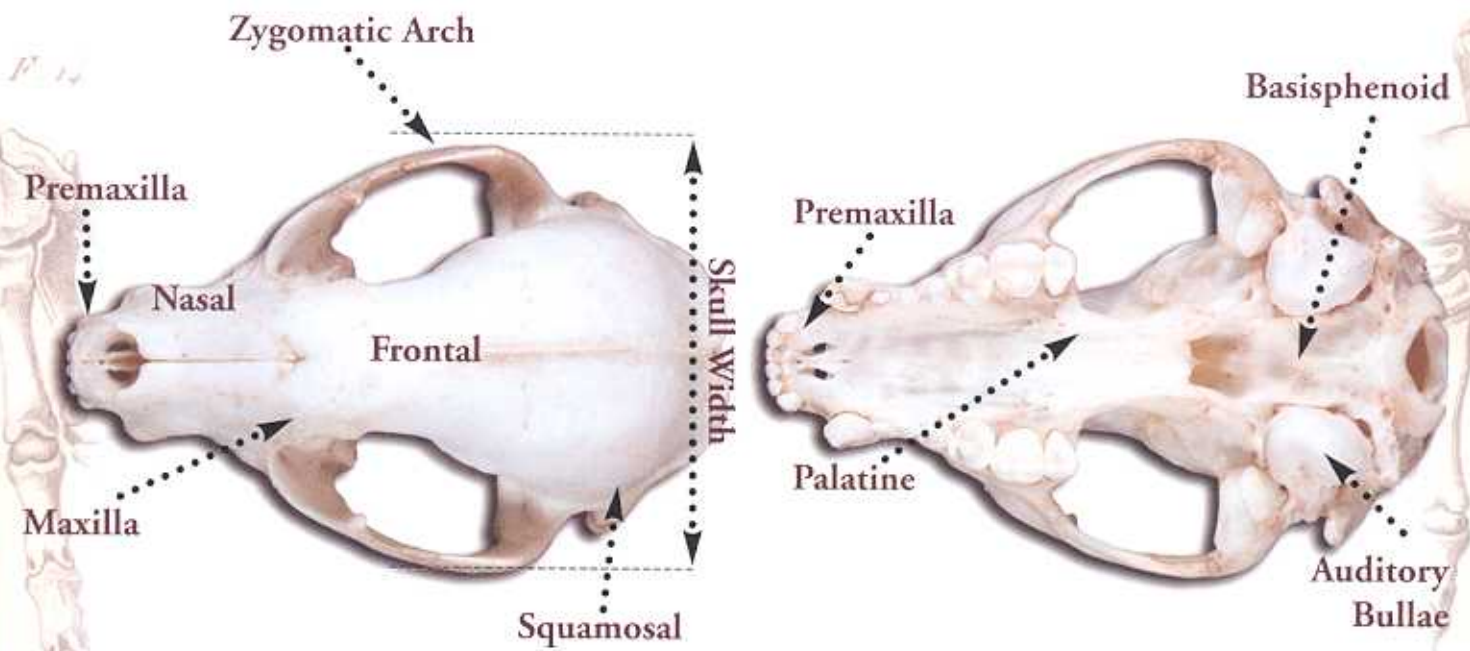
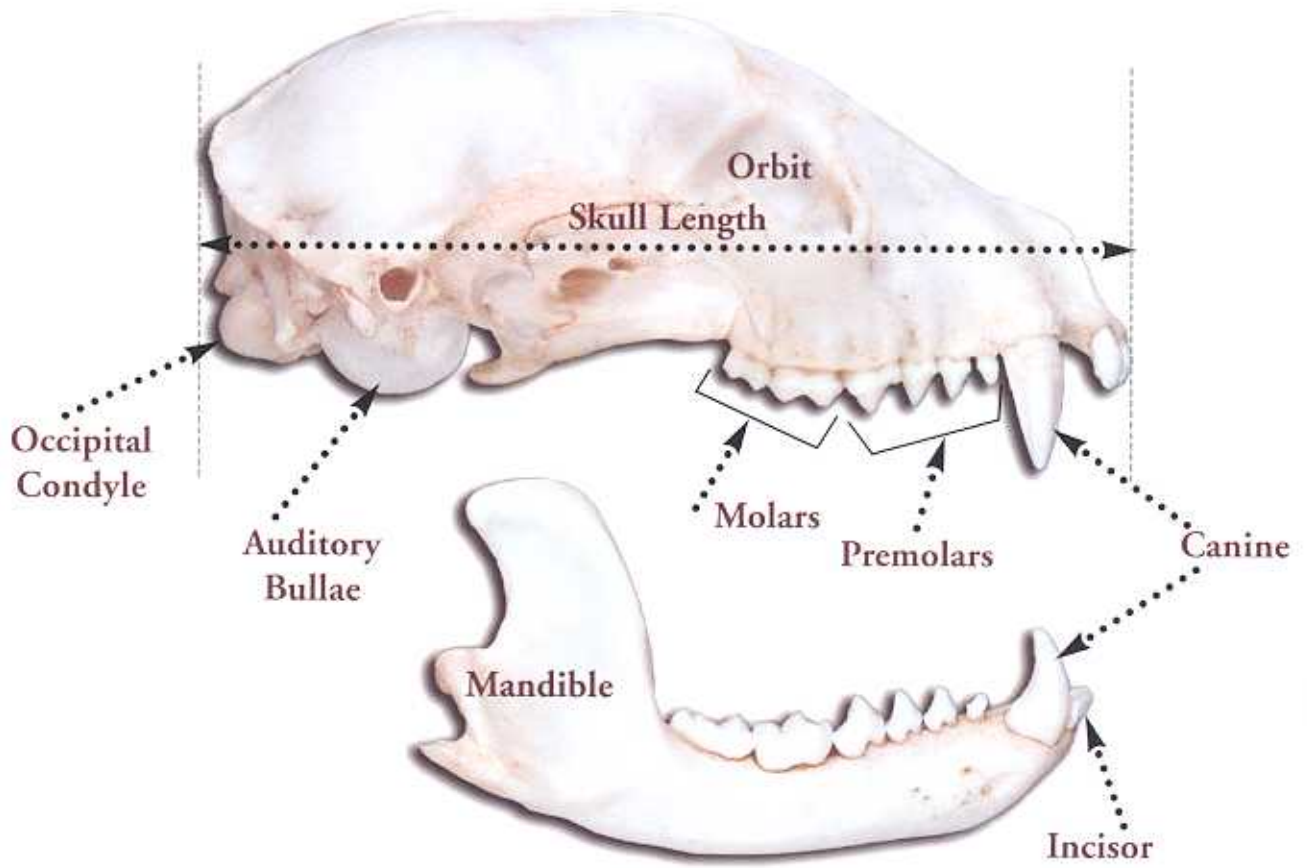
Premaxilla

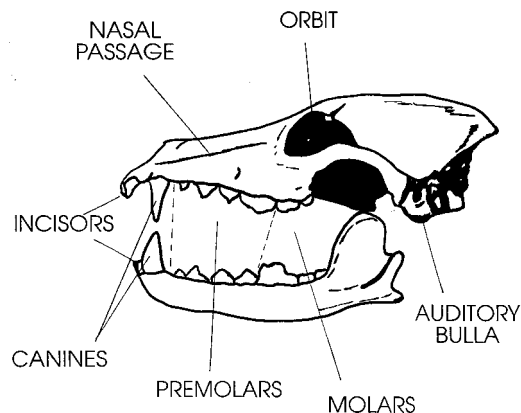
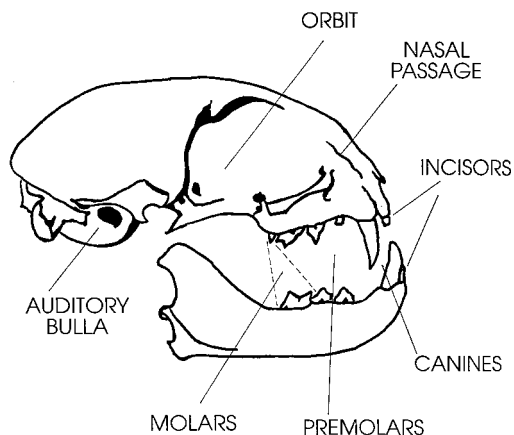
Palatine

Auditory Bullae

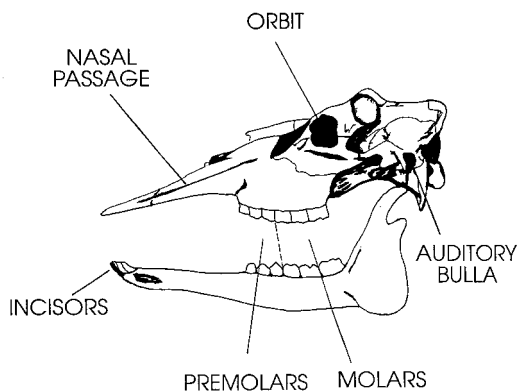
Education

Raccoon Skull - Omnivore





Wildlife Skull Activities



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School of Renewable Natural Resources

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This information has been reviewed by university faculty.

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Animal skulls can tell us many things about creatures and how they once survived in their natural environment. A few relatively simple observations of an animal's skull can tell us what the animal ate, whether the animal was predator or prey, and which senses were most important to the animal's survival.

Some of the characteristics of skulls that we use to tell us about how the animals lived are explained below. The skull diagrams on pages 5 through 7 in this publication will be very useful references while reading this information.

Note: Words in the Vocabulary List (page 17) are italicized in the body of this publication.

Teeth

The teeth in an animal skull can tell us whether the animal was a *carnivore* (meat eater), *herbivore* (plant eater) or an *omnivore* (meat and plant eater). These classifications and some of the corresponding characteristics of teeth are:

CARNIVORE: (meat eater, e.g. mountain lion, bobcat)

Carnivores have comparatively small, less developed *incisors*. *Incisors* play a minor role for carnivores such as grooming. The *canine teeth* are large, long and pointed for piercing and holding prey. Cheek teeth (*pre-molars* and *molars*) are sharp and pointed for cutting and tearing flesh. Some of the upper cheek teeth overlap lower teeth, providing a scissor-like shearing action to cut meat. These teeth are referred to as *carnassial teeth*. With overlapping cheek teeth and long *canines*, *carnivores* do not have the ability to move the lower jaw from side to side in a chewing motion.

Carnivores are predators (they kill and eat other animals) and tend to bite, tear and gulp food without any chewing action. The meat eater's teeth tend to be clean and white because they are not stained by plant material.

HERBIVORE: (plant eater, e.g. mule deer, elk)

Herbivores have large, well developed *incisors* for cutting plant material. Their *canines* resemble *incisors* in form and function. Most ruminant (cud chewing) *herbivores* (deer, sheep, cattle, etc.) do not have upper *incisors* or *canines*. Instead, they have a hard upper *palate* that serves as a "cutting board" for the lower *incisors* to cut through plant stems. This arrangement permits the rapid ingestion of large amounts of plant material. Ruminant animals often seek cover after eating to regurgitate and chew their cud while watching for predators.

Herbivore cheek teeth are large and wide with high, sharp crowns for grinding and chewing plant material. Instead of overlapping, the cheek teeth make surface contact to provide a grinding action. Unlike predators,

herbivores have side-to-side movement of the lower jaw and are able to chew food. This chewing, grinding action causes their teeth to wear with age. *Herbivore* teeth are often stained from substances in plants.

NOTE: American elk are the only members of the North American deer family that have upper *canine teeth*. These teeth, found in both males and females are often referred to as "ivory teeth" or "tusk teeth." They are not ivory and they do not presently serve any function. These stubby, rounded upper *canines* are carry-overs from the pre-historic ancestors of the American elk. Elk ancestors had tusks which protruded outward from the upper jaw over the lower jaw and served a defensive purpose. For an excellent treatise on the North American elk, that contains a complete description of the evolution of elk "ivory teeth" including the historical use of these teeth as ornaments and trade items by Native Americans see: *Elk of North America*, Jack T Ward and Dale E. Towell, eds., Stackpole Books, 1982.

OMNIVORE: (plant and meat eater, e.g. bear, coyote)

As might be expected, *omnivores* have a combination of *carnivore* and *herbivore* teeth characteristics. *Omnivores* have fairly large and well developed *incisors* for cutting plant material. The *canine teeth* are long and pointed for killing and holding prey. Cheek teeth are a combination of sharp, scissor-like *carnassial teeth* for shearing meat, and teeth with more rounded *cusps* for grinding and crushing plant material. There is surface contact between some upper and lower *molars*. *Omnivores* (except some primates) do not have side to side lower jaw movement. Rather than a chewing action, their cheek teeth perform both shearing and crushing actions.

Many *omnivores* are either predominately meat eaters or predominately plant eaters. The cheek teeth of these animals can usually tell us their predominant feeding strategy. The cheek teeth are the principle indicators. For example, the coyote is an *omnivore* that is predominately a meat eater and has cheek teeth very similar to a *carnivore*. However, the coyotes' most *posterior molars* have rounded *cusps* for grinding and crushing plant material. On the other hand, the black bear is an *omnivore* that is predominately a plant eater and has cheek teeth more closely resembling those of an *herbivore*.

Eyes

The size of the *orbits* (eye sockets) in relation to the overall size of the skull, is generally proportional to the sharpness of the animal's eyesight. The larger the *orbits*, the better the eyesight of the animal. As an example, mountain lions (and most cats) have very large *orbits* and hence, very acute vision. The large eyes of cats, and many other *nocturnal* animals, play a role in their keen night vision. The javelina (collared peccary) has small *orbits*

and hence, comparatively poor eyesight. The javelina must rely more on its keen sense of smell, rather than eyesight, to locate food and predators.

Nasal Passage

The relative size of the *nasal passage* on a skull is an indication of the animal's sense of smell. The thin bony structures inside the *nasal passage* (nasal turbinates) provide the framework for membranes which sense odor. The greater the size of these structures the greater the sense of smell. The short *nasal passages* of cat skulls tell us that cats do not have a very good sense of smell compared to many other animals and rely more on other senses to locate prey. Conversely, the long *nasal passage* of a coyote indicates that coyotes have a very keen sense of smell and that this sense is important to the coyote's survival.

Auditory Bullae

The *auditory bullae* ("bully") are the bony portions of a skull that encase structures of the inner and middle ear. In general, the larger, more inflated, this structure the greater the sense of hearing. Cats have comparatively large, inflated *auditory bullae* and very acute hearing. Although their hearing is much better than a human's, deer and elk have a relatively poor sense of hearing as compared to that of a cat.

Predator and Prey

Predators are animals that eat other animals and prey are animals that are eaten by other animals. Predators can also become prey. When a cat eats a mouse, the cat is predator. When a cat is eaten by a coyote, the cat is prey. Predators are always *carnivores* or *omnivores*, whereas prey may be *carnivores*, *herbivores* or *omnivores*. When we consider humans as predators, all animals may become prey.

When examining skulls to determine predators, we of course look for the teeth characteristics of a *carnivore* or an *omnivore*. If the teeth characteristics of a skull are strictly those of a *herbivore*, we consider the animal to be a prey species.

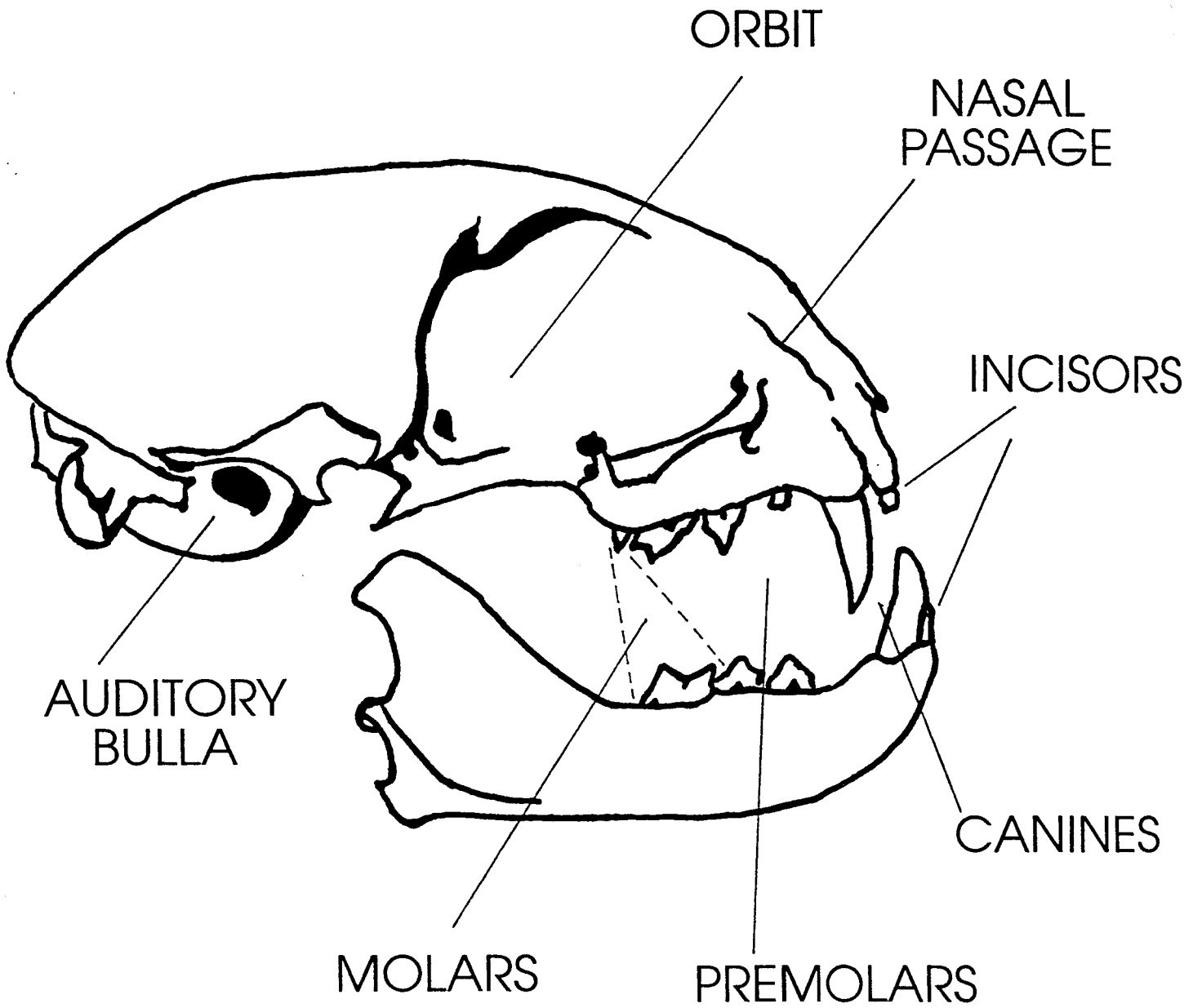
There is another skull characteristic that is very useful in determining predator/prey classification. This is the location of the *orbits* (eye sockets.) Most all predators have the eyes located in a forward position on the skull. Forward eye placement provides the animal with a greater degree of *binocular vision*. *Binocular vision* means that both eyes focus on an object providing the animal with a greater ability to judge distance (depth perception). *Binocular vision* is an advantage when attacking prey and an important element of the predator's survival.

Herbivores are strictly prey and most have *orbits* located on the side of the skull. This placement limits *binocular vision*, but enhances the animal's field of view or peripheral vision. These *herbivores* have *monocular vision* which means that they can see an object with only one eye. With *monocular vision*, each eye has a field of view of almost 180 degrees. Therefore, by using both eyes, these animals almost have a 360 degree field of view. This field of vision provides the animal with a greater ability to locate predators and is an important element of their survival. In some *herbivores* there is some overlap in the field of view and these animals may have partial *binocular vision*.

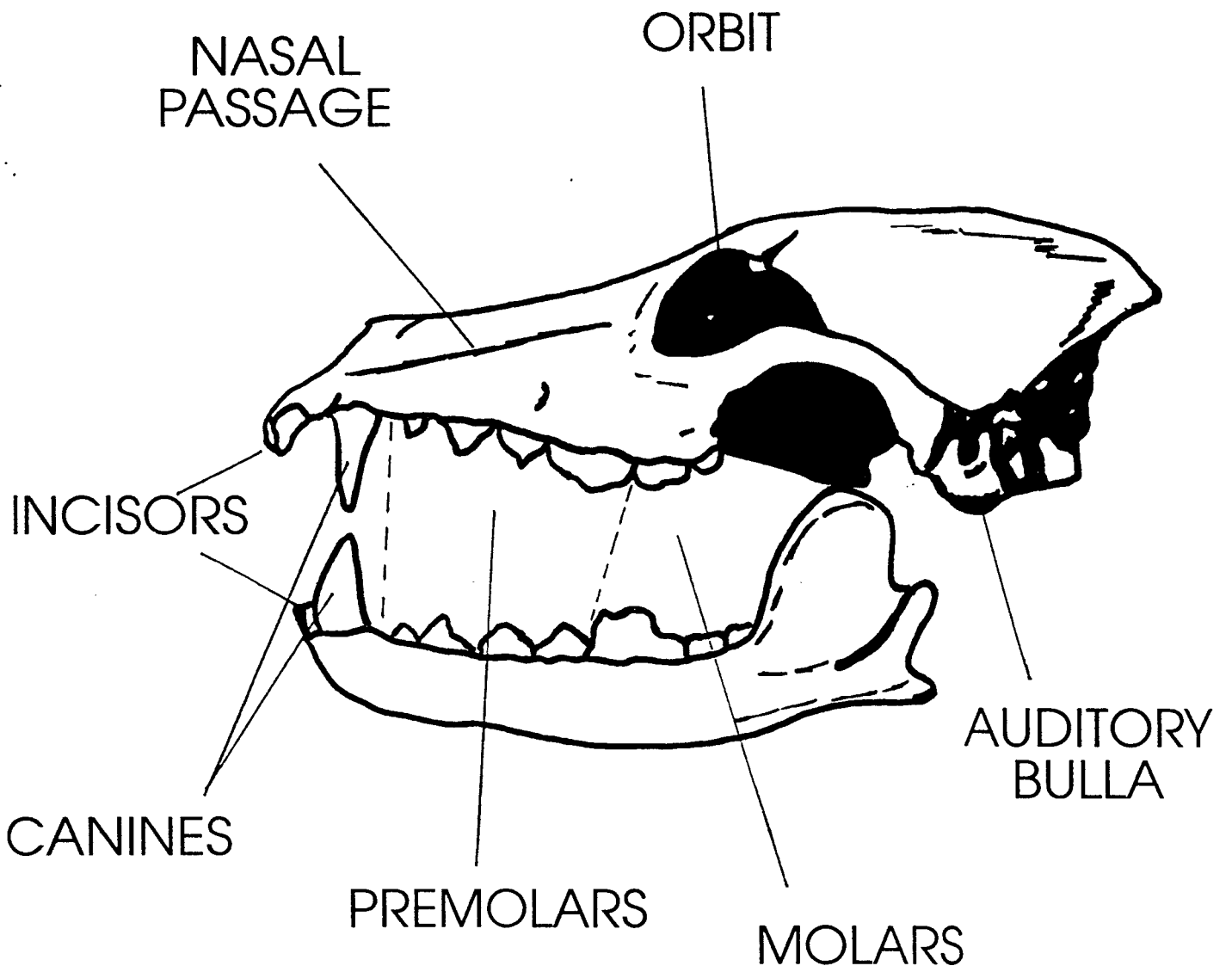
Characteristics for Survival

All of the characteristics discussed here are elements of survival. The particular combination of characteristics that an animal has determines how that animal survives. Ruminant *herbivores*, such as deer and elk, are able to ingest large amounts of food and retreat to cover to regurgitate and chew this food (chew their "cud") while hiding from predators. These *herbivores* are equipped to detect predators with keen senses of hearing and smell along with *monocular vision* which provides for a wide field of vision. When predators attack, the *herbivores* best defense is their fleetness of foot. *Carnivores* that would predate upon these *herbivores* are equipped with large *canine teeth* to capture and kill prey. These predators have *orbits* forward on their skulls and thus *binocular vision* which permits depth perception when attacking prey. *Omnivores*, with the ability to eat both meat and plants, have a wider choice of food sources than strict *carnivores* or *herbivores*.

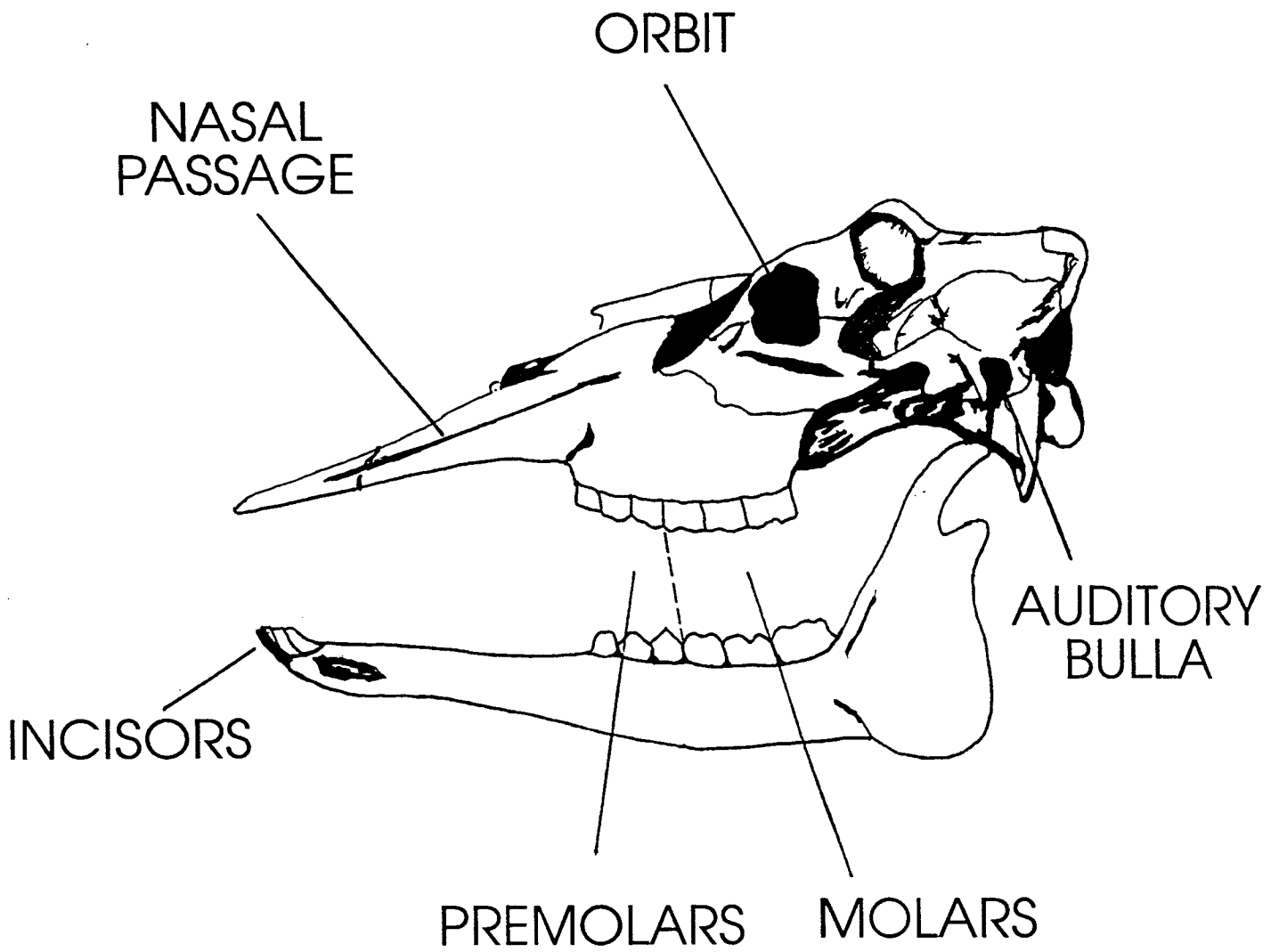
An example of one of the most successful animal survivors is the coyote. Coyotes are currently found in all the contiguous United States, throughout Canada, north to near the Arctic Circle and south to the Panama Canal. Within this extensive range of climates, this animal is found in remote wilderness and in large urban areas. The characteristics that play a role in this survivability include the combination of being an *omnivore* that can eat almost anything with excellent senses of sight, hearing and smell.



CAT



COYOTE



DEER

Wildlife Skull Activities

GOAL: To teach students some of the differences and similarities among animals and how an animal's skull can reveal certain characteristics about how that animal survived in its natural *habitat*. Later in the lesson plan, the students will have the opportunity to put this new knowledge into practice with a “hands-on” activity.

Instructions for Teacher/Leader

1. These activities are written to make extensive use of questioning as a teaching method.
2. Students, especially younger ones, could be disturbed by skulls — go slowly, gently. After the initial introduction, most students are eager to handle skulls and to learn about them.
3. Caution and closely supervise students when they are handling the skulls. Skulls are breakable and difficult to repair or replace. The children should be encouraged to touch the skulls and the features pointed out in this lesson, but the teacher/leader should retain control by holding the skull until the hands-on activity near the end of the lesson plan. If the students are seated in a circle on the floor, they can pass the skulls around the circle and there is less chance of the skulls being dropped.
4. The skulls used to describe activities 1 through 3 in this publication are: a mountain lion to represent a *carnivore*; a mule deer doe to represent an *herbivore*; and a black bear to represent an *omnivore*. The discussions and answers to questions presented here may need to be altered somewhat when different species are used.

Materials Required

- Skulls — A minimum of 1 *carnivore*, 1 *herbivore* and 1 *omnivore*.
- A large photo or poster of the live animal for each skull.
- Individual placards containing the words:
CARNIVORE PREDATOR
HERBIVORE PREY
OMNIVORE PREDATOR AND PREY
- One photocopy of the Mystery Skulls Worksheet for each student.

Objective 1

Students will learn some of the skull characteristics of several animals. They will learn how an animal's teeth can tell us what the animal eats, and they will learn the definitions of the words *carnivore*, *herbivore* and *omnivore*.

Activity 1a. What did this animal eat?

Invite guesses and discussion to the questions posed. Show the skulls separately, ask each question about each skull and point out the feature described in the answer. Do not identify the animal until later, in Activity 2.

Before posing questions, tell the students we will identify the animals later.

Skull 1. (*Carnivore* — mountain lion)

What did this animal eat?

Answer — This animal was a meat eater. We can tell what this animal ate by looking at the teeth.

Why are the *canine teeth* so long and pointed?

Answer — The canine teeth are used for piercing and holding other animals.

Why are the *incisors* (smaller teeth in front between the large *canines*) relatively small and short?

Answer — *Incisors* play a minor role for this animal — such as grooming.

Why are the cheek teeth (*pre-molars* and *molars*) sharp? Why do the upper and lower cheek teeth overlap?

Answer — The *molars* are used for cutting and shearing meat in a scissor-like action.

Could this animal *chew*?

Answer — The long *canine teeth* and the type of attachment of the lower jaw prevent this animal from having side-to-side movement of the lower jaw. This animal bit, sheared and gulped its food without any real “chewing” action.

Skull 1. This animal is a **CARNIVORE**. (show placard with word). *Carnivores* eat meat. They kill and eat other animals.

Skull 2. (*Herbivore* — deer)

What did this animal eat?

Answer — This animal ate plants. We can also tell what this animal ate by looking at the teeth.

Compared to the *carnivore*, are these *incisors* relatively larger or smaller?

Answer — The *incisors* are relatively large and well developed.

What are these *incisors* used for?

Answer — They are used as blades for cutting plant parts and stripping away leaves.

Do these *canines* look like the *canines* in the *carnivore*?

Answer — No. The *canine teeth* in this animal resemble

and function as *incisors* because as a plant eater, this animal had no use for long, pointed *canine teeth*.

Do the cheek teeth (*molars* and *pre-molars*) look like the *carnivore*'s?

Answer — No, they are large with high crowns and wide across the top for grinding and crushing plant materials.

Do the upper and lower cheek teeth overlap?

Answer — No. The upper and lower *molars* fit together to provide grinding and crushing surfaces.

Could this animal chew?

Answer — Yes. This animal had the ability to move its lower jaws in a side-to-side, chewing motion

Notice there are there no upper *incisors* or *canines*. Why not?

Answer — Most ruminant (cud chewing) animals (deer, sheep, cattle, etc.) Do not have upper *incisors* or *canines*. Where the upper *incisors* and *canines* would be, these animals have a hard *palate* that serves as a “cutting board” for the lower *incisors* to cut grass and other plant materials and to strip leaves off branches.

(Note: See note on page 2 which describes upper *canine teeth* in American elk.)

Skull 2. This animal is a **HERBIVORE**. (show placard with word). *Herbivores* eat plants.

Skull 3. (*Omnivore* — black bear)

What did this animal eat?

Answer — This animal ate both meat and plants. We see in this skull, teeth features of both *carnivores* and *herbivores*.

Why are the *canine teeth* long and pointed?

Ans. The long, well developed *canines* are used for capturing and killing other animals.

How do the *incisors* compare to *carnivores* and *herbivores*?

Answer — The *incisors* are relatively large for cutting plants and stripping leaves.

How do the cheek teeth compare to *carnivores* and *herbivores*?

Answer — This animal has both high crowned cheek teeth with sharp edges for shearing meat, and cheek teeth with wider crowns to crush bone and plant parts.

Look closely at the back *molars*. They look very similar to ours. Humans eat both meat and plants.

Why don't we have long *canines*?

Answer — We do not kill and capture animals with our teeth.

Skull 3. This animal is an **OMNIVORE**. (show placard with word). *Omnivores* eat both plants and animals.

Activity 1b. What animal is this?

Skull 1. (*Carnivore* — mountain lion)

Look at the teeth. What did this animal eat?

Review the teeth characteristics of a meat eater:

Incisors — small

Canines — large, pointed

Cheek teeth — sharp with high crowns — some overlap like scissors

Answer — This animal ate meat.

Is this animal a *carnivore*, *herbivore* or *omnivore*?

Answer — A *carnivore*.

What animal is this?

Invite guesses. Give hints such as, “this animal hunts mostly at night”, or “notice the very large *orbits* and short *nasal passage*”.

Answer — This is a **mountain lion**. (show photo/poster).

Mountain lions live in rugged mountains, forests and swamps and are found in most of the western U.S., western Canada, northern Mexico and southern Florida. Mountain lions are chiefly *nocturnal* (active at night) and feed on deer, rabbits, mice and occasionally on domestic animals.

In Arizona — Live in desert or forest mountain ranges with rough canyons and rocky slopes. Found statewide, wherever deer are found. Occasionally crosses through non-deer *habitat*.

Skull 2. (*Herbivore* — deer)

Look at the teeth. What did this animal eat?

Review teeth characteristics of a plant eater:

Incisors - large

Canines - small, resemble *incisors*

Cheek teeth - wide crowns with surface contact between upper and lower teeth.

Ans. This animal ate plants.

Is this animal a *carnivore*, *herbivore* or *omnivore*?

Ans. A *herbivore*.

What animal is this?

Invite guesses. Give hints such as, “notice the absence of upper *incisors* and *canines*”, or “this animal can run very fast to avoid danger.”

Answer — This is a **mule deer**.

Is this a male or female mule deer?

Answer — This is a female mule deer (called a doe — show photo/poster). Male mule deer (called bucks) have antlers. Females do not.

Mule deer live in desert shrubs, semi-open forests, mountain meadows, foothills, plains and valleys. They are found in scattered areas of the western United States and Canada. The males have antlers which are shed each year. Deer are *crepuscular* (most active in early morning and late evening). They feed on browse plants, grasses, herbs, twigs and bark.

In Arizona — Found throughout the state except for the southwestern corner.

Skull 3. (*Omnivore* — black bear)

Look at the teeth. What did this animal eat?

Review teeth characteristics of an *omnivore*:

Incisors — relatively **large**

Canines — large, pointed

Cheek teeth — provide for both shearing and crushing

Answer — This animal ate both meat and plants.

Is this animal a *carnivore*, *herbivore* or *omnivore*?

Answer — An *omnivore*.

What animal is this?

Invite guesses. Give hints such as, “notice the long nose and relatively small orbits.

Answer — This is a **black bear**. (show photo/poster).

Black bears live in the mountainous areas of the western United States and in forested areas of the eastern United States. Black bears are also found in most of Canada. Bears feed on berries, nuts, roots, insects, eggs, honey, *carrion*, garbage, small animals and occasionally domestic animals. They are primarily *nocturnal* (most active at night.) Their color varies from black to cinnamon.

In Arizona — Found in mountain ranges of the north, east and southeastern parts of the state, usually above 5000 feet elevation.

Objective 2.

Students will now learn the definitions of the words PREDATOR and PREY and the skull characteristics that correspond with these classifications.

Activity 2. What do the words “predator” and “prey” mean?

Ask students to define the words predator and prey. Ask if an animal can be classified as both predator and prey.

After the students provide definitions, be sure each word is correctly defined. Give examples of each classification and show placard with the words “predator”, “prey”, and “predator and prey.” Place placards on table with the appropriate skull placed behind each placard.

- Predator = an animal that kills other animals for food. Some predators also eat *carrion*. Predators are *carnivores* or *omnivores*.
- Prey = animals that are eaten by other animals. Prey animals may be *carnivores*, *herbivores* or *omnivores*.
Example: A mountain lion kills a deer. The lion is the predator and the deer is the prey
- Predator and Prey = an animal that eats other animals but may also be eaten by other animals.
Example: An animal can be both predator and prey. A cat kills a mouse — the cat is predator. A coyote kills the cat — the cat is prey.

Objective 3.

Students will learn some of the skull characteristics of predator and prey animals.

Activity 3. Was this animal a predator? Prey? Both?

Using the skulls from ACTIVITY 1, describe and point out the characteristics indicated below.

Skull 1. — Mountain Lion

This animal, the mountain lion, is a *carnivore* and a **predator**.

Point out and review the skull characteristics that tell us this was a predator.

- **From looking at these teeth, how do we know this is a predator?**

Answers: Large *canines* in upper and lower jaw for piercing and holding prey.

Cheek teeth (*pre-molars* and *molars*) sharp and pointed for tearing flesh. Upper and lower cheek teeth overlap for shearing action to cut meat.

Long *canines* prevent side-to-side, chewing movement of lower jaw. Predators tend to bite, tear and gulp food without chewing action.

Teeth clean and white, not stained by plant materials.

- **From looking at the orbits in this skull, how do we know this is a predator?**

Answer: Orbits are forward for *binocular vision*. Forward eye placement is common in predators and helps them to judge distance (depth perception) when attacking prey. *Orbits* very large; providing for excellent eyesight. *Nocturnal* with good night vision.

- **What do the *auditory bullae* tell us about this animal's sense of hearing?**

Answer: *Auditory bullae* are inflated and large in relation to skull size. Cats have a very acute sense of hearing.

- **What does the *nasal passage* tell us about this animal's sense of smell?**

Answer: *Nasal passage* is relatively short. Sense of smell not as good as some other animals. Relies more on eyesight and hearing and less on sense of smell to locate prey.

Skull 2. — Mule deer

Deer are *herbivores* and **prey** animals.

Point out and review the skull characteristics that tell us this was a *herbivore*.

- **From looking at these teeth, how do we know this is a prey animal?**

Answers: Large, well developed *incisors* for cutting plant material.

Canines resemble *incisors* in form and function.

Cheek teeth high crowned with grinding surfaces and often stained from plants.

Has side-to-side movement of lower jaw for chewing action.

- **From looking at the orbits in this skull, how do we know this is a prey?**

Answer: The placement of the orbits at side of head for wide field of vision to help this animal watch for predators. They can almost see behind them. This is common in *herbivore*, prey species.

Comparatively large *orbits*, but not as large relative to cats. Good vision.

- **What do the *auditory bullae* tell us about this animal's sense of hearing?**

Answer: Comparatively small, indicating a relatively moderate sense of hearing and more reliance on smell and sight to locate predators.

- **What does the *nasal passage* tell us about this animal's sense of smell?**

Answer: Very long in relation to skull size. Deer have an excellent sense of smell.

Objective 4.

Students will apply their knowledge of the primary characteristics of an animal skull that were used to determine if the animal was a *carnivore*, *herbivore* or *omnivore* and if the animal was a predator, prey or both.

Activity 4. Mystery Skulls

Additional skulls, that have not been previously examined in this lesson are numbered and placed at several different locations in the room.

Distribute worksheets (For original worksheet for photocopy see page 14.) Divide students into approximately equal groups with one group at each skull location. Ask students to examine the skull at their location and rotate to the next skull location. Students are to individually record their observations on the worksheets by skull number.

When worksheets are completed, ask for volunteers or call on individuals to tell the group/class what they have entered in a particular blank on the worksheet. Proceed through the answers for each animal represented. Show photos/posters of each animal as it is identified.

If no student is able to identify the species, tell the group what the animal is and, if desired, discuss where this animal is found, how the characteristics observed relate to the animal's survival and *habitat* and other facts we may know about the animal.

Teacher/leader may collect worksheets to evaluate the knowledge gained by the group.

Suggestions for further learning activities

1. Continue a discussion of how these characteristics help each animal survive. How do these characteristics fit with what we know about each animal? Other characteristics such as length of legs, claws and coloration may be discussed from the photographs.
2. Have students draw (or describe) a fictitious animal which has all of the “best” characteristics for survival. When finished, have them “show-and-tell” to the class. Give their animal a fictitious name. Students may work in small groups to encourage interplay of creative ideas.
3. Ask students to read about their favorite animal and report back to the class.
4. Ask students to bring a photographs and drawings of animals clipped from magazines or news newspapers and discuss the characteristics covered here for each of the animals.
5. Include vocabulary list in spelling and language arts program.
6. Include the geographic range of each animal in a geography program. Maps showing each species distribution can be found in the “Peterson Guide” and other references listed in the teacher/leader materials.

Vocabulary list

anterior — situated located before or toward the front.

auditory bullae (singular - bulla) — bony capsules which encase parts of the inner ear.

binocular vision — the ability of an animal to focus on an object with both eyes.

canine teeth — located between the incisors and premolars; usually large, conical and pointed when found in meat-eating animals; used to kill and hold prey;

carnivore — an animal that eats meat nearly exclusively.

carnassial teeth — “scissor like”, cheek teeth in carnivorous animals used for shearing meat - very noticeable in both the cat and dog families.

carrion — the remains of dead animals.

crepuscular — most active in early morning and evening.

cusps — a point on the grinding surface of a tooth.

deciduous teeth — teeth that have an earlier form which is shed and replace by permanent teeth.

diurnal — most active during daylight.

habitat — an arrangement of food, water, cover and space that constitutes a natural environment for a particular species of animal.

herbivore — an animal that eats plants nearly exclusively.

incisors — teeth at the front of the jaw used for nipping or chiseling .

mandible — the entire lower jaw.

maxilla (maxillary) — the bone in the upper jaw that bears the canine, premolar and molar teeth.

molars — the non-deciduous, *posterior* teeth in the upper and lower jaws.

Monocular vision — the ability of an animal to individually focus on an object with one eye.

nasal passage — the anterior most pair of middle top bones encasing “flaky” thin bony structures (nasal turbinates) which provide the framework for the membranes in the nose that sense odor.

nocturnal — most active during darkness.

omnivore — an animal that eats both meat and plants.

orbit — the bony socket that contains the eyeball.

palate — the bony roof of the mouth.

posterior — situated behind or toward the rear.

pre-molars — deciduous teeth posterior to the canines and anterior to the molars..

Sources of animal skulls

Getting a supply of sufficient skulls for this lesson can be difficult. All skulls are all somewhat fragile and, some are very fragile. If this lesson is to be conducted a number of times, by several different people in a variety of situations, it is advisable to have a backup supply of skulls.

Some possible sources of cleaned skulls are:

- State or federal fish and wildlife agencies
- The Arizona Game and Fish Department, Regional Offices have “Bone Boxes” available for loan to educators. These boxes contain skulls, hide and fur samples, animal tracks, and lesson plan activities.
- College and university biology, zoology and wildlife departments
- Taxidermists
- Commercial suppliers

There are several, relatively simple, methods to clean and preserve skulls from intact animal heads. See The University of Arizona, Cooperative Extension publication AZ1144: *Cleaning and Preserving Animal Skulls*.

Some sources of animal heads are: ¹

- State or federal fish and wildlife agencies.
- College and university biology, zoology and wildlife departments
- Local hunters
- Shooting, hunting and related groups
- Farmers and ranchers
- Meat packing plants
- Carrion
- Road kills

¹ Note: There are state and federal regulations for the possession of certain wildlife species or parts of these species. Always check with your state game and fish agency before taking or possessing any carrion or road killed wildlife.

Skull talk references

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Mystery Skull Worksheet

NAME _____ GROUP/CLASS _____

Skull no.	Side to Side Movement of Lower Jaw? (Y/N)	Teeth (Carnivore, Herbivore, Omnivore)	Hearing (Auditory Bullae) Relative Size (Large/Small)	Smell Nasal Passage Relative Size (Large/Small)	Eyesight Orbits Relative Size (Large/Small)	Eye Placement (Forward/ Side)	Predator, Prey or both	Kind of animal
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								



AZ1145