SKULL INTERPRETATION
LESSON PLAN

SKULL INTERPRETATION

CLASS DESCRIPTION: An Animal Ecology Class

Students will learn about different features of the mammalian skull and how the different features can be interpreted to discern certain animal behaviors and adaptations. Students will also learn about the individual lifestyles of some North American mammals.

Total time: 1.5 hours
Audience: 4-20 students, 4th grade through adult
Activity level: easy
Travel: none
Total uphill travel: none

PURPOSE

To learn about different features of the mammalian skull and how the different features can be interpreted to discern certain animal behaviors and adaptations. Students will also learn about the individual lifestyles of some north American mammals.

CONCEPTS

1. All living and non-living components of an environment interact with one another to form an ecosystem.
2. A complex natural system is more stable than a simple one, and more able to absorb disturbances.
3. All living things acquire physical and behavioral adaptations to be successful in their environment.

OUTCOMES

Upon completion of the Skull Interpretation class students will be able to:
• Recognize and identify basic features of mammalian skulls.
• Know skull features used for different adaptations
• Understand predator and prey relationships.
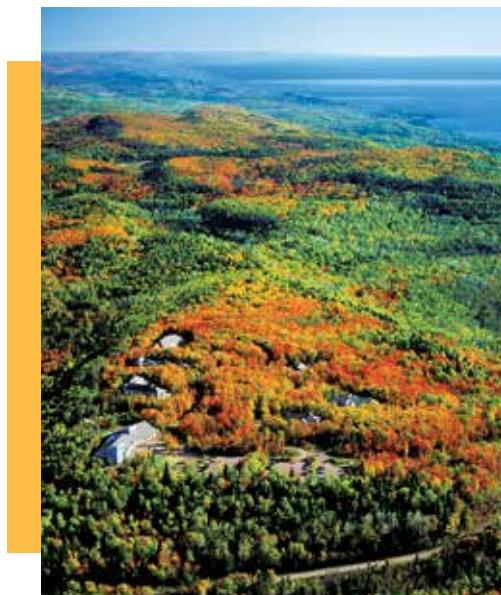
WOLF RIDGE
ENVIRONMENTAL LEARNING CENTER

Our mission is to develop a citizenry that has the knowledge, skills, motivation and commitment to act together for a quality environment.

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SKULL INTERPRETATION Revised May 2019

Equipment
- Which skull interpretation guides
- mammal skulls
- animal 20 question cards
- skull features chart
- skull observation data sheets
- North American Mammal books
- 20 blindfolds
- 10 scent jars pairs
- pencils
- skull answer sheet for instructor

Appendices
- Glossary
- References
- Sources
- Class Sheets

Set-up (15 min.)
- Classroom/class prep description
- Safety Management

I. Introduction (5 min.)
A. Grabber
B. Class Overview and Outcomes
C. Assess Learner Level

II. Meet the Mammals through 20 Questions (10 min.)

III. Blindfolded Skull Discovery (10 min.)

IV. Predator, Prey: Specific Features (30 min.)
A. Eyes
B. Sound Location
C. Smell ID

V. Skull Interpretation (30 min.)

VI. Conclusion (5 min.)

Clean-up (15 min.)

Set-up (10 min.)
Classroom/class prep description

Set up tables and chairs so each student has a workstation and bring the "skulls" kit and black tool cart with the skulls into the classroom from the kit room. After the first activity, students will be working in groups of 2-3 students throughout the evening.
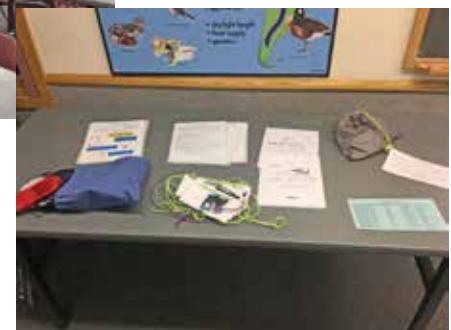
Safety Management

Adhere to and be familiar with all general safety practices designated by Wolf Ridge. Be aware of any student's special needs (medical, etc.) and adjust the activities as needed to maintain safety.

• First aid kit is located in the kitroom.

I. Introduction (5 min.)
A. Grabber

The readied equipment/skulls should interest the students and serve as the grabber.

B. Overview of the Class and Outcomes

Students will learn about different features of the mammalian skull and how the different features can be interpreted to discern certain animal behaviors and adaptations. Students will also learn about the individual lifestyles of some North American mammals.

C. Learner Level

Assessment Concept 1 - All living and non-living components of an environment interact with one another to form an ecosystem.

Ask the students if they have found bones before in the woods and if they think they could learn many things from bones. Other beginning questions could be, "have you studied skulls of organisms before?"

II. Meet the Mammals through 20 questions (10 min.)

Mammals are warm-blooded vertebrates (animals with backbones) that give birth to live young and nourish their young with milk. Mammals all have hair or fur protecting their skin, even dolphins and whales have small amounts of hair. Mammals have well developed brains and senses compared to other vertebrates. Mammals occupy every continent, they range in sizes from the tiniest of shrews to a multi-ton great blue whale. Within the varieties of mammals there are prey and predator species, and some animals that are both.

The features of an animal's skull can be used to understand the adaptations and behaviors of that animal. An animal's teeth, cranial cavity (brain), eye orbitals (vision), auditory bullae (hearing) and nasal passages (scent) are all observable in the mammal skull. The shape, size, and position of these different structures indicate the physical capabilities of an animal. The skull surface and overall shape are related to the soft tissues, like muscles, that an animal used to eat and capture prey. For example, larger ridges along the middle of a mammal skull create more room for lower jaw muscles to attach to the skull which creates a stronger bite.

Any one skull feature does not provide enough information to completely understand an animal. And although we can learn an immense amount from these bones, examining the skull in its entirety does not tell the complete story of an animal. The teeth of a wolf indicate a carnivorous diet, but wolves observed in the wild will consume fruits and plants.

Assessment Concept 3 - *All living things acquire physical and behavioral adaptations to be successful in their environment.*

20 Questions Activity - Student's using peers to identify correct animal using yes and no questions.

Activity: WITHOUT LOOKING AT THE CARD, each participant will receive an animal ID card to hang around their neck. Place the card on their back so the student doesn't see it. Everyone with a card will try to determine what their animal is by asking other people yes or no questions about their animal. A card can be viewed by anyone except the person wearing the card. Features and facts should be visible to other students.

Examples of yes and no questions? - Do I have antlers?, Is my fur brown?, Am I bigger than a dog?

Once someone has guessed their animal, they should continue to help others figure out their animals. Have students reflect on if they have seen these organisms and what they know or wonder about these organisms. This activity incites excitement to explore skulls of these animals.

Mystery Animal Card Example:
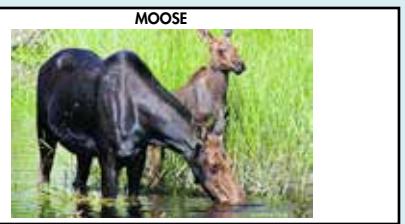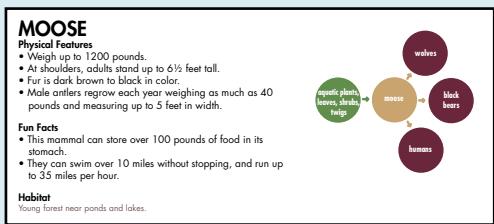
MOOSE
Physical Features
• Weigh up to 1200 pounds.
• At shoulders, adults stand up to 6½ feet tall.
• Fur is dark brown to black in color.
• Male antlers regrow each year weighing as much as 40 pounds and measuring up to 5 feet in width.

Fun Facts
• This mammal can store over 100 pounds of food in its stomach.
• They can swim over 10 miles without stopping, and run up to 35 miles per hour.

Habitat
Young forest near ponds and lakes.

III. Blindfolded Skull Discovery (10 min.)

Divide the students into groups of 2 or 3. Have the students put blindfolds on. Hand each group of students 1 skull from the cart. Give students time to explore these skulls with a blindfold and support them in noticing features of the skull and asking questions about their organism. Some guiding questions are: "How large is this skull?" "How many holes do you notice?" "What texture is the skull?" Once students have spent time becoming curious about their skull, allow them to take off the blindfolds and explore the skulls with sight.

IV. Predator, Prey: Specific Features (30 min.)

In the following activities, students will participate in an activity to illustrate a specific sense, then they will observe their skulls and pay attention to the features specific to that sense to learn about that animal.

Predation is an absolutely essential part of the delicate balance of the environment. It is just as important to the prey species as it is to the predators, although this is often misunderstood. Hunters go for the easiest meal they can find, so the weed out the elderly, sick, or very young of the species. This makes the remaining population stronger and healthier. Without predators to maintain a proper balance in prey species, their populations would escalate to unnatural levels, and many animals would die of starvation or disease.

When something disrupts the food chain at the bottom, it is magnified at each succeeding level. When it reaches the top, the disturbance appears as a major environmental disruption. This makes predators at the top of a food chain especially vulnerable when the chain becomes unbalanced.

Moose & Wolves

An adult moose weighs up to 1,200 lbs and stands over 6 feet tall at the shoulders, they can swim over ten miles without stopping and run up to 35 miles per hour. Moose have an excellent sense of smell and good hearing. A moose can kick with enough force to kill an adult wolf in a single blow. All of these adaptations make killing a healthy adult moose a formidable and dangerous challenge for predators. Wolves have to be strategic hunters, preying on weaker moose like the young or sickly and old. Part of their strategy is to hunt as a pack, spreading out around their prey and attacking from all sides. Even hunting as a pack, wolves are only successful 10-20% of the time.

Assessment Concept 2 - A complex natural system is more stable than a simple one, and more able to absorb disturbances.

A. Eyes
Predator/Prey Eye Activity
Supplies: blindfolds, open area (hallway or outside), chair.

This activity will be played in small groups of 3-4 students either outside or in the hallway. Two students will work together to be the moose, and the other group members will be wolves. Moose have monocular vision; their eyes are positioned on either side of their heads so they are able to see approaching predators. Each of the moose students will have one eye covered by a blindfold, and they will stand back to back. The moose students will do their best to protect their baby moose, a classroom chair, from being snatched by the wolves. The wolves must grab the object without being tagged by the moose, and the wolves cannot touch the adult moose. Wolves have binocular vision like humans, they are able to see depth and distance with both eyes simultaneously. Wolves should be stealthy when trying to capture the baby moose, and they should work together to get past the adult moose.

Skull observations: Where are this organism's eyes positioned? What type of sight do they rely on?

B. Sound Location

Prey and predators are constantly receiving sensory information and processing that information. For many prey species, sound is an important sense for avoiding predators. Sounds can also be used to find mates and family members, or to communicate territory boundaries.

Predator/Prey Sound Activity
Supplies: blindfolds, open space outdoors (or indoors if necessary).

In small groups, one student at a time should be blindfolded in the center of the space, and the remaining students should take turns making sounds one or two students at a time. The blindfolded student should try to locate the sounds being made with their ears only. To improve hearing, students can cup their hands behind their ears, and turn the heads to try and better locate where the different sounds are coming from.

Skull observations: Where are the ear openings? How much does this organism rely on hearing?

C. Smell ID

Scent is one of the most basic and ancient senses. Mammals especially have a very well developed sense of smell which is used to find food, find mates, mark territory and avoid predators. Humans rely less on smell for survival than other mammals so our sensitivity to odors is not as strong. Humans can smell many different chemicals, but our noses are not as sensitive as some animals. For example, some canines have noses that are 60 times more sensitive than a human's nose. Some animals hunt using smell, and many animals identify their kin using smell. Some animals, like beavers and wolves will mark their territories by leaving their specific scent on trees or lodges.

Smell ID Activity
Supplies: scent jars, open space inside or outside.

Each person should receive one scent jar, and they should smell jars of others until they find the person with their matching scent. The bottoms of all the jars have unique labels, the same scents have the same labels. Students don't need to identify the scents, just match them.

Skull observations: Can you identify the nasal passage? What can this tell you about the animal?

Assessment Concept 3 - *All living things acquire physical and behavioral adaptations to be successful in their environment.*

V. Skull Interpretation (30 min.)

Participants should be split into groups of 2-4 for the skull interpretation. Each group should find space to work at a table to ensure the skulls have a stable position for examination. Using the Skull Interpretation Guide Sheet, the 20 question cards, and the field guides in the kit, groups should determine which animal's skull they are examining. Have students use the Skull Observation Data Sheet to take notes.

Once a group has their Skull Observation Data Sheet complete except for the last question, give them a Skull Features Chart and to find the common and scientific name of their animal skull.

The activity facilitator can then match the letter printed on the skull to the group's answer. Once a group has completed one identification, they may choose another skull to examine.

SKULL ANSWER SHEET

LETTER	MAMMAL	SCIENTIFIC NAME
A	Moose	*Alces alces*
B	Lynx	*Felis canadensis*
C	White Tailed Deer	*Ococoileus virginianus*
D	Grey Wolf	*Canis lupus*
E	Red Fox	*Vulpes vulpes*
F	River Otter	*Lontra canadensis*
G	Mink	*Mustela vison*
H	Coyote	*Canis latrans*
I	Raccoon	*Procyon lotor*
J	Muskrat	*Ondatra zibethicus*
K	River Otter	*Lontra canadensis*
L	N. American Porcupine	*Erethizon dorsatum*
M	Muskrat	*Ondatra zibethicus*
N	Pine Marten	*Martes americana*
O	Bobcat	*Lynx rufus*
P	Snowshoe Hare	*Lepus americanus*
Q	North American Porcupine	*Erethizon dorsatum*
R	Beaver	*Castor canadensis*
S	Striped Skunk	*Mephitis mephitis*
T	Black Bear	*Ursus americanus*
U	Eastern Chipmunk	*Tamisa striatus*

VI. Conclusion (5 min.)

Review

Have students reflect on/share features they noticed about the specific skulls they explored and describe aspects of that organism based on the evidence they learned from features of their skull. Encourage students to share interesting facts they learned about the organisms they explored from the skull and the information card. Allow them to share questions they have about those organisms sparked by studying the skulls.

Clean up
Gather up all information sheets. Have the students erase the Skull Observation Data Sheets. Collect pencils and erasers and return to kit. Return skulls to cart. Stack chairs along wall in piles of five. Take down tables and lean against wall. Erase boards.Return kit to kit room.

Appendices
Glossary
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 pre- molars; 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.

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.

References
• Sullivan, L. (1999). Wildlife Skull Activities. University of Arizona.

Sources
• skulls - https://www.skullsunlimited.com/

WHICH SKULL INTERPRETATION GUIDE?

Examine your skull using this guide to answer the questions on the "Skull Observation Data Sheet."

EYE PLACEMENT

Look at the eye socket placement and determine if your animal had binocular or monocular vision.
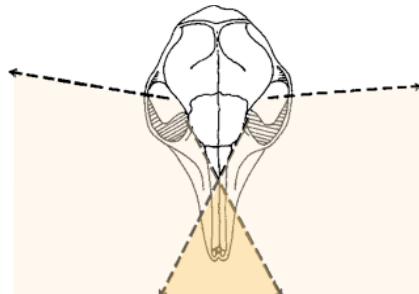
Binocular vision

With binocular vision the eye sockets are forward-facing. Each eye has a similar field of view with some overlap. This allows the animal to detect depth or distance to objects. This vision is called 3D.
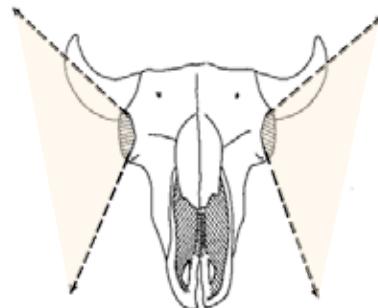
Monocular vision

With monocular vision the eye sockets are side-facing. Each eye has a separate field of view, this makes it difficult to detect the depth or distance to objects. This vision is called 2D. These animals have excellent peripheral vison.

TEETH TYPE

Examine the shape of the different type of teeth and deterimine if your animal was a carnivore, herbivore, or omnivore.

| tooth type	carnivore	herbivore	ominivore
incisors	• narrow and small • good for cutting and piercing	• may only be present on the bottom jaw • sharp edges for cutting vegetation • may be very large in some herbivores	• present on both jaws • good for cutting food
canines	• large • used for gripping and tearning flesh	• none	• could be large or small • used for eating plants or animals
premolars	• similar to canines • used for gripping and tearing flesh	• none	• sharp edges used for gripping and tearing food
molars	• serrated for cutting	• flat for grinding	• generally flat for grinding • some sharp edges may be present for tearing and slicing

FRONT AND BACK JAW STRENGTH

flat ⌣   **round** ⌢   **peaked with sagittal crest**

The shape of the cranium indicates how the temporalis muscles are attached to the skull.
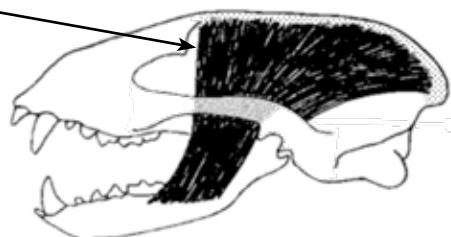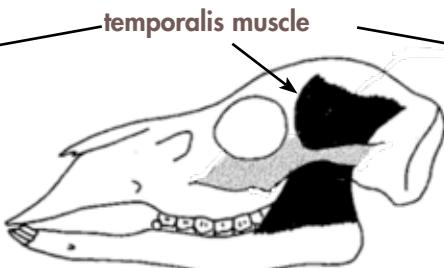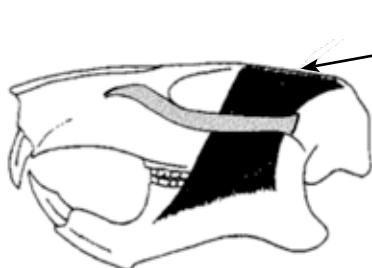
temporalis muscle

No sagittal crest
• less temporalis muscle attachment
MEANS
less front jaw force

Large sagittal crest
• large temporalis muscles
MEANS
greater front jaw force
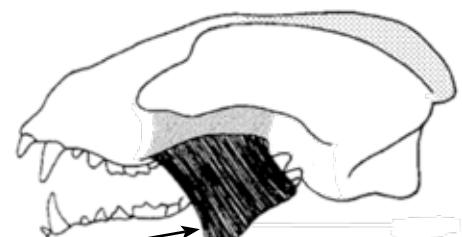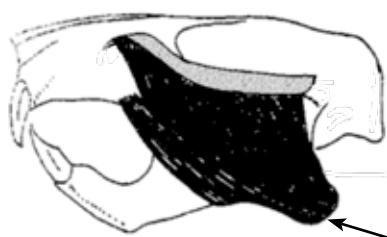
masseter muscle

Longer zygomatic bone
• with more space for masseter muscle attachment
MEANS
strong back jaw for grinding and crushing

Shorter zygomatic bone
• less space for masseter muscles attachment
MEANS
less back jaw strength for grinding and crushing
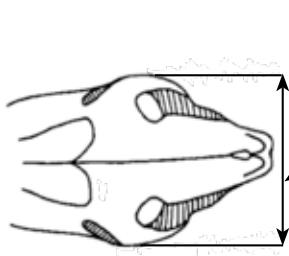
zygomatic breadth
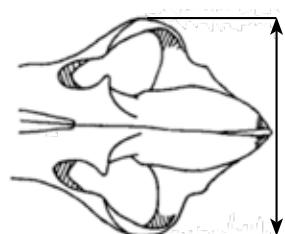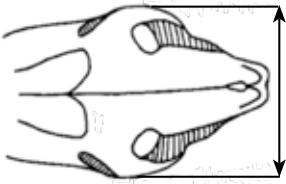
Narrow zygomatic width
• less room therefore smaller temporalis muscles
MEANS
less front jaw strength

Wide zygomatic width
• more room for well-developed temporalis muscles
MEANS
strong front jaw for ripping and biting

SKULL FEATURES CHART

Using your completed "Skull Observation Data Sheet" and the chart below determine what animal skull you have.

Diet	Vision	Front Jaw Strength	Back Jaw Strength	Scientific Name	Common Name
herbivore	monocular	fair	great	*Alces alces*	Moose
carnivore	binocular	great	fair	*Felis canadensis*	Lynx
herbivore	monocular	fair	great	*Ococoileus virginianus*	White-tailed Deer
carnivore	binocular	great	good	*Canis lupus*	Grey Wolf
carnivore	binocular	great	good	*Vulpes vulpes*	Red Fox
carnivore	binocular	great	good	*Lontra canadensis*	River Otter
carnivore	binocular	great	good	*Mustela vison*	Mink
carnivore	binocular	great	good	*Canis latrans*	Coyote
omnivore	binocular	great	good	*Procyon lotor*	Raccoon
herbivore	monocular	great	good	*Ondatra zibethicus*	Muskrat
omnivore	binocular	great	good	*Lontra canadensis*	River Otter
herbivore	monocular	great	good	*Erethizon dorsatum*	N. American Porcupine
carnivore	binocular	great	fair	*Martes americana*	Pine Marten
carnivore	binocular	great	fair	*Lynx rufus*	Bobcat
herbivore	monocular	great	good	*Lepus americanus*	Snowshoe Hare
herbivore	monocular	great	good	*Castor canadensis*	Beaver
omnivore	binocular	great	good	*Mephitis mephitis*	Striped Skunk
omnivore	binocular	great	good	*Ursus americanus*	Black Bear
omnivore	monocular	great	good	*Tamisa striatus*	Eastern Chipmunk

SKULL OBSERVATION DATA SHEET

Blindfolded discovery: What observations did we make about our skull through blindfolded discovery?

_____

_____

_____

Sound: Where are the ear openings? _____

Smell: Where is the nasal passage? _____

Eyes: Where are the eye sockets located? _____

    This mammal has (circle one)   monocular   binocular   vision.

Teeth: What do the teeth tell you about the mammals diet? (circle one) herbivore   omnivore   carnivore

Front jaw strength: (circle one)   fair   good   great

Back jaw strength: (circle one)   fair   good   great

Using the information you collected go the "Skull Features Chart" and determine what kind of animal your skull is from.

_____