



Arizona Game and Fish Department  
Education Branch

***Teacher's Guide to  
the  
Bone  
Box***



## BONE BOX CONTENTS AND KEY

### Skulls – 11 Total

Grey Fox	(#1)
Ringtail	(#2)
Bobcat	(#3)
Mountain Lion	(#4)
Coyote	(#5)
Javelina	(#6)
Black Bear	(#7)
Beaver	(#8)
Deer	(#9)
Jackrabbit	(#10)
Raccoon	(#11)

### Animal Tracks – 10 Total

Grey Fox	(#1)
Bobcat	(#3)
Mountain Lion	(#4)
Coyote	(#5)
Javelina	(#6)
Black Bear	(#7)
Beaver	(#8)
Deer	(#9)
Jackrabbit	(#10)
Raccoon	(#11)
·Front Foot	·Hind Foot

### Hides – 10 Total

Grey Fox	(#1)
Ringtail	(#2)
Bobcat	(#3)
Mountain Lion	(#4)
Coyote	(#5)
Javelina	(#6)
Black Bear	(#7)
Beaver	(#8)
Deer	(#9)
Raccoon	(#11)

### Animal Pictures – 12 Total

Grey Fox
Ringtail
Bobcat
Mountain Lion
Coyote
Javelina
Black Bear
Beaver
Deer
White-tailed Deer
Jackrabbit
Raccoon

- \*Animal Sounds Audio Tape
- \*Animal Sounds Video Tape
- \*Bone Box Guide
- \*Antler
- \*Mammal Booklets



THE STATE OF ARIZONA  
**GAME AND FISH DEPARTMENT**

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Dear Teacher,

Enclosed you will find a set of skulls, hides, antlers, rubber animal tracks, animal guides, and a Teacher's Guide for your classroom use. Please follow the guidelines stated below:

You have permission to copy any of the written materials for your classroom use only. If another teacher wishes a copy of the materials, please have them write or call us at Arizona Game and Fish Department, Education Branch, 602-789-3220.

- The "mammal" booklets are yours to give to students or to keep as a classroom set.
- We want the hides and skulls to be touched by students, but we also know that accidents will happen. Because of the time involved in preparing each skull, please save all pieces if they should be broken. Also, please do not forget to notify us that skulls need repair when returning the box.
- Tracks are expensive. Please be sure to return all of the tracks you received.

We are in the process of revising the bone box. If you have produced any activities or activity sheets that you feel would make a good addition to the bone box, please let us know. Credit will be given for materials included in the bone box.

We hope that your students enjoy the bone box materials and activities.

Sincerely,

Sandy Reith  
Education Specialist

# Background Information



# Key to Skulls

1. Canines absent ..... 2  
 Canines present ..... 4
  
2. Upper incisors absent: orbits fully enclosed by bone ..... Deer  
 Upper incisors present ..... 3
  
3. Large orange incisors: 8 molars on either the upper or lower jaw ..... Beaver  
 Incisors white: second set of peg-like incisors behind the top front pair;  
 Fenestration (lots of openings) on maxilla ..... Rabbit
  
4. Cheek teeth flat with rounded cusps (similar to human teeth) ..... Javelina  
 Cheek teeth a mixture of both sharp and flat teeth ..... 5
  
5. Short nasal bones: 3 lower cheek teeth on each side of jaw:  
 Cheek teeth narrow with pointed centers ..... 6  
 More than 3 lower cheek teeth on each side of the jaw ..... 7
  
6. 4 upper cheek teeth per side of jaw (first and last cheek teeth are  
 smaller than the others) ..... Mountain Lion  
 3 upper cheek teeth per side of jaw (last greatly reduced) ..... Bobcat
  
7. No or poorly developed postorbital process ..... 8  
 Postorbital process developed ..... 9
  
8. 3 to 5 cheek teeth on side of upper jaw; no nasal sutures visible ..... Skunk  
 6 cheek teeth on each side of upper jaw; nasal sutures visible ..... Raccoon
  
9. Molars with rounded cusps; some premolars absent (large gap  
 Between premolar and canine) ..... Black Bear  
 Cheek teeth sharp and evenly distributed ..... 10
  
10. U-shaped ridge on top of skull ..... Grey Fox  
 Single ridge on top of skull; upper incisors lobed in front ..... Coyote

# Skulls

Animal **skulls** can often indicate many things about the habitat, behavior, and physical attributes of an animal. Many of these characteristics must be assumed by comparing unknown animal skulls with known specimens, such as domestic animal skulls, or even the skull of a human. The development of various parts of the skull, including the overall size and shape, can indicate many things about the animal: what it eats, the size of the animal, whether the animal was originally a forest or plains animal, lived in water, or if the animal lived above or below ground. An animal's skull can also indicate what kind of eyesight or sense of smell it may have had. Was the animal active at night (**nocturnal**), active during the day (**diurnal**), or was it active in the early morning and evening (**crepuscular**)? The teeth in a skull can indicate whether the animal was a plant eater (**herbivore**), meat eater (**carnivore**), or if the animal ate both plants and animals (**omnivore**).

## NOSE

The size of the nose is indicative of the animal's ability to smell. Long nasal bones indicate an animal has a good sense of smell. Herbivores usually (but not always) have good "smellers" to enable them to detect the presence of a predator and to locate food on a dark night.

Animals with short noses generally have a poor sense of smell but will have good hearing, eyesight, or both to enable them to detect predators and find food. Rabbits have a relatively poor sense of smell, but well developed eyesight and hearing. Coyotes are well adapted with good eyesight, keen sense of smell, and keen hearing.

## TEETH

Most mammals have **heterodont** (hetero = different, -dont = teeth) teeth consisting of incisors, canines, premolars, and molars. The shape of teeth is one of the most important characteristics used to determine the general types of food a mammal (or marsupial) can eat efficiently (in birds, bill shape is used to determine the general types of food a bird eats). Check the cheek teeth first. **Cheek teeth** are the premolars and molars. Teeth used by herbivores for grinding vegetation tend to be discolored (remember grass stains on your knees?) and flattened either horizontally or at an angle. The flattened surface is used to crush and grind vegetation. The teeth that are flattened at an angle tend to have "sharp" top and bottom edges. These "sharp" edges are due to the sliding-grinding action of the upper and lower jaws against one another and should not be confused for "sharp" carnivorous teeth.

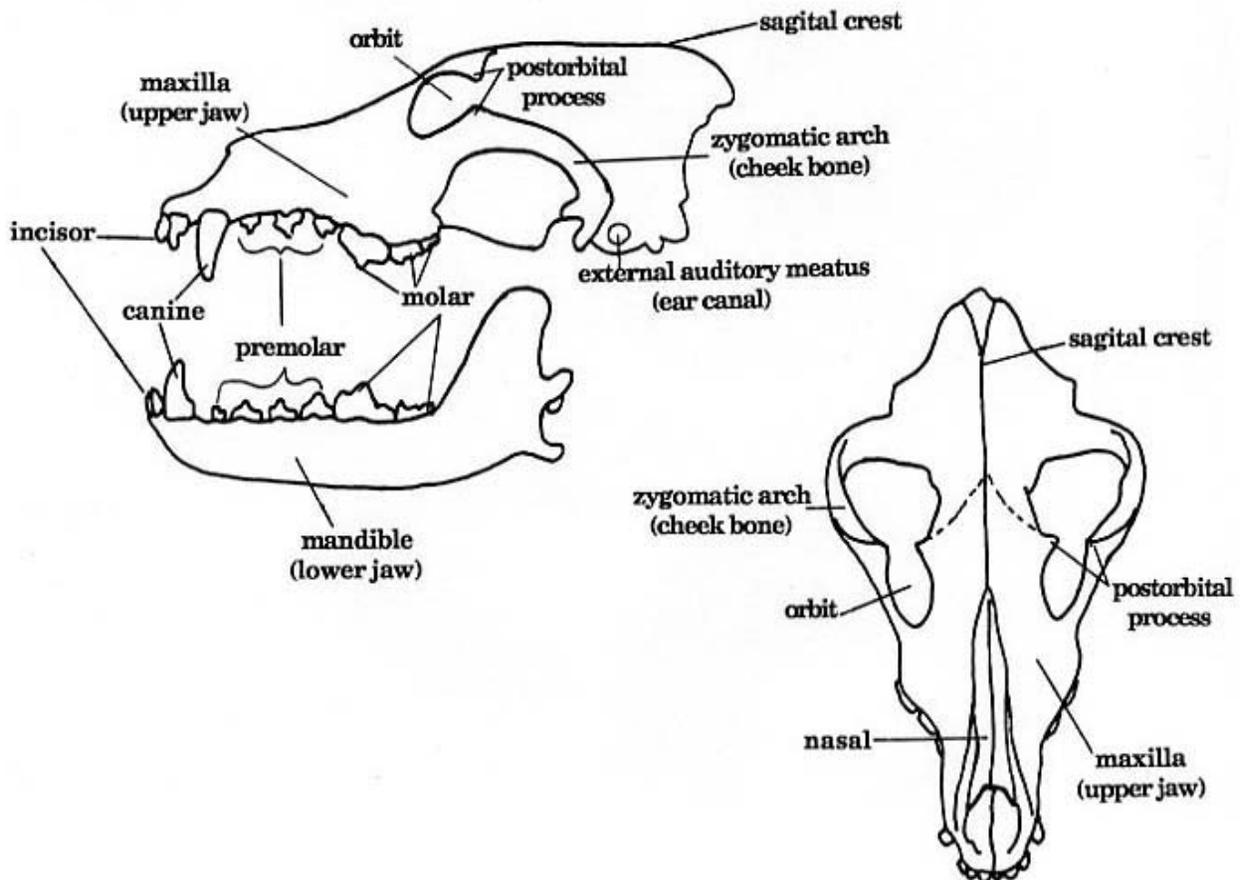
Cheek teeth of carnivores tend to be narrow and shaped into sharp cutting edges. The cheek teeth of the lower jaw slide (like scissors) against their counterparts in the upper jaw. These teeth are used for ripping and tearing flesh (or insects in smaller carnivores). No grinding takes place due to the absence of sideways movement between the upper and lower jaws. Carnivores also tend to have fewer cheek teeth than herbivores, possibly because a large surface area for grinding food is not required.

Omnivores have a combination of both flat grinding teeth for vegetation and sharp cutting teeth for flesh. Omnivores that tend to eat more meat will have more sharp than flat teeth and those that tend to eat more vegetation will have more flat than sharp teeth.

## ORBIT OR EYE SOCKET

Eye location and the size of the **orbit** can be used to indicate whether the animal was a predator or prey, and if nocturnal, diurnal or crepuscular in activity. The eyes of most prey species are large and located towards the sides to back of the skull like the turkey, deer, and rabbit. This allows for the detection of predators at a great distance and in many directions without turning the head: in the beaver, the eyes are located towards the top of the head for the detection of predators while swimming! Eyes of most predators are “forward looking” as in the mountain lion, hawks, owls and humans. Forward facing eyes enable predators to judge distance – a critical adaptation for predators hunting moving prey! The size of the orbit will indicate the size of the eye and thus the quality of eyesight and behavior of the animal. Animals such as bears and javelina have relatively small eyes for the size of their skull, thus poor eyesight. Small eyes also can indicate diurnal activity. Animals such as bobcats and coyotes have large orbits, thus good eyesight and either nocturnal or crepuscular activity.

It is sometimes difficult for students (and adults) to distinguish the orbit from the space defined by the zygomatic arch. In many cases, these two spaces are continuous. The space formed by the zygomatic arch allows for the large lower jaw muscles attachment sites, and forms the surface upon which the lower jaw hinges. The arch also protects the eye. To differentiate the two spaces, look for the postorbital (post = after) process on both the frontal bone and zygomatic arch. These processes define the posterior borders of the orbit. On some skulls, the postorbital process of the zygomatic arch is poorly defined or absent. And in the weasel family, all 4 processes are greatly reduced or absent. In these cases, the orbit can be considered to be the front half and the zygomatic arch space the back half.



# Skulls at a Glance

This is a quick reference to some of the characteristics of the skulls included in the bone box.

<u>Animal</u>	<u>Nose</u>	<u>Teeth</u>	<u>Orbit</u>
Beaver	short	flat	large, toward top of skull
Bear	long	flat, few sharp	small, toward front
Bobcat	short	sharp	large, toward front
Coyote	long	flat and sharp	large, toward front
Deer	long	flat	large, to side of skull
Grey Fox	long	flat and sharp	large, toward front
Javelina	long	flat	small, to side of skull
Mountain Lion	short	sharp	large, toward front
Rabbit	long	flat	large, to side of skull
Raccoon	short	flat and sharp	large, toward front
Ringtail	short	flat and sharp	large, toward front

# Horns and Antlers

Both horns and antlers are bony growths of the frontal bone of the order *Artiodactyla* (even-toed hoofed mammals). Antlers are confined to the family *Cervidae* (deer-like mammals) while horns are generally found in the family *Bovidae* (cattle, sheep, goats and antelope).

## Antlers

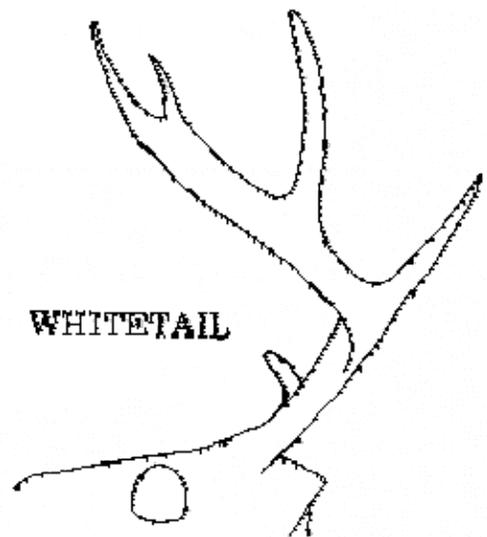
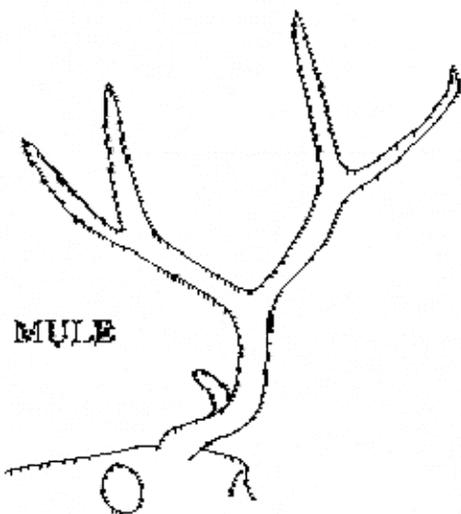
Antlers are branched bony rods which grow yearly from an outgrowth of the frontal bone called the pedicel. In deer, the pedicel begins to develop around the 3rd to 5th month of age, and is present throughout the life of the male. Antlers are cast annually and found only on males (the exception being reindeer, where both males and females possess antlers). Size and shape of antlers depends on diet, age, heredity and species.

**Growth:** Antler growth begins in response to increasing daylight of March and April, with growth completed by the end of August. Bone salts (calcium salts) are deposited on the pedicel by a highly vascularized network just beneath the skin. As the antlers grow, so does the skin covering the pedicel. This thin skin is called **velvet** because it looks and feels like velvet cloth. The velvet also nourishes the growing antler tissues. Once antler growth ceases (in response to increasing levels of the hormone testosterone) the velvet is shed. Calcium is deposited into the connective tissue of the antlers which closes off the flow of blood, nutrients and oxygen to the antlers. The lack of blood causes the velvet to die, dry, and shed and the antler to harden. Drying velvet is removed by the male rubbing his antlers against stumps, trees, shrubs, and grasses. By the time the velvet is completely shed (1 to 5 days), testosterone has increased to a level where the testes (male reproductive organs) are fully developed and the male is capable of impregnating a female.

Antler growth is one of the fastest forms of tissue growth, taking approximately 6 months to fully develop (a bull elk can grow 15 to 30 pounds of antlers in 6 months!). This fast growth puts a large strain on the male's nutritional resources. Some calcium is ingested from vegetation and also drained from the skeleton, especially the ribs. Size and shape of antlers depends upon 3 main factors: diet, age, and heredity. A diet containing a high percentage of protein, the proper percentage of fats and carbohydrates, and adequate minerals (especially calcium and potassium) will produce large antlers. The largest antlers tend to be seen on males in their early to mid years, with antler size decreasing after prime; prime being anywhere from 4 to 12 years old, depending on the species. The early years (birth-2.5 years) demand on food is primarily for sustenance and body growth. Whatever extra nutrients are available go into antler growth. Correspondingly, the first antlers of yearlings are generally small unbranched spikes. Once a male has obtained maximum adult size, "extra" nutrition can be used for antler growth and development

**Casting:** As long as testosterone levels stay above a critical level, antlers are naturally retained. By January and February testosterone levels have fallen and the antlers are cast (dropped). Antlers can be cast one at a time within a few days or both on the same day. There are also instances, called "double-set" antlers, where an antler may not cast (for whatever reason) and the new one begins to grow along side of the old. The old antler cannot be cast at this stage because as the new grows, it engulf the base of the old antler. Both the old and new are then cast the following January/February. "Double-set" antlers do not occur often and rarely do "tripe-set" antlers occur.

**Identification:** White-tailed deer (*Odocoileus virginianus*), mule deer (*O. hemionus*) and elk (*Cervus canadensis*) antlers are readily differentiated from each other. White-tailed antlers possess a single main beam, sweeping upward and back, then curving forward. The tines (points) originate from the dorsal (back) surface of the main beam. Mule deer antlers also sweep upward, back, and then curve forward, but the main beam is dichotomous (forks into 2 equivalent beams). These beams may fork also. Additional forking of the forks may occur. Both mule and white-tailed deer generally have one brow tine (eye guard). Elk antlers are larger and do not curve forward. Elk antlers have a main beam similar to white-tailed antlers, but the tines emerge from the anterior (front) surface of the beam. Elk possess a brow tine, and one additional eye guard called the **bez tine**. Both eye guards extend out and above the muzzle.

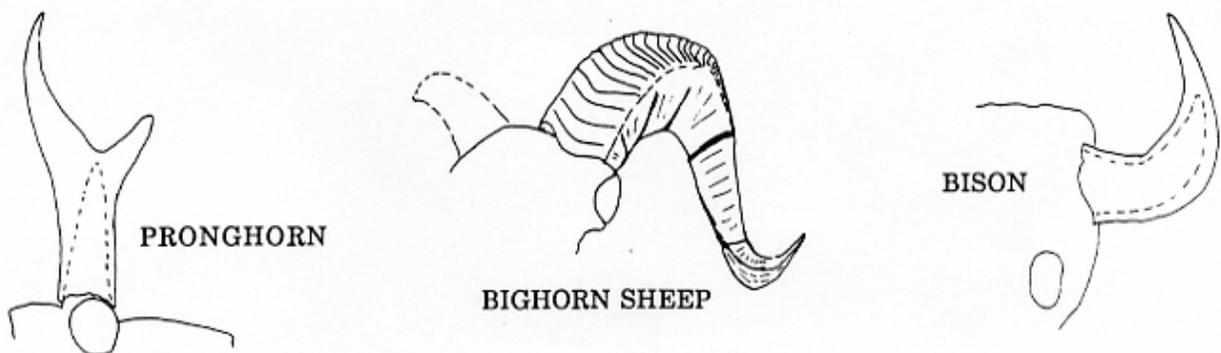


## Horns

True horns consist of a bony core with a sheath covering. The inner core of bone is an outgrowth of the frontal bone. The sheath is keratinized epidermal tissue, similar to human hair and nails, mammal hooves, reptile and bird scales and bird feathers. Both the inner core and sheath are permanent structures which grow throughout the life of the individual. If the sheath is damaged or lost, it is generally not replaced. The exception is the pronghorn antelope whose sheath (composed of compressed and fused hair) is shed and replaced annually. Like hair or nails, the sheath is not a living sensitive tissue. The bony core is supplied with blood vessels but not nerves, but there are no blood vessels or nerves supplying the sheath with oxygen or nutrients. Thus the sheath is a dead tissue, insensitive to pain and will not bleed if cut or damaged.

Horns are a slow growing structure and can show growth rings similar to tree rings. The growth rings can be used by biologists to age some animals. In a few animals with horns, these periods of growth are readily seen and counted. One year of growth is seen as a series of wide concentric rings (rapid growth) followed by thinner rings (slow growth). The alternating wide and thin bands are then counted to get a rough estimate of the age of the animal. Availability of food and overall habitat quality can also be indirectly judged by the width of growth rings. Good years tend to be seen as wider bands than lean years. Females cannot be aged by horn growth because their horns do not grow as much as a male's horns. Actually, the best technique for aging horned animals is by using tooth eruption pattern, tooth wear, and number of rings inside the tooth.

Identification: There are four horned mammals found in Arizona: desert bighorn and Rocky Mountain sheep (*Ovis canadensis*, different subspecies), bison (*Bison bison*), and pronghorn antelope (*Antilocapra americana*). The horns of all four can be easily identified from one another. Bighorn sheep horns emerge from the frontal bone just above the eyes. Male horns are robust, curl back over the head, then curl back towards the front. In males over 6 years old, the horns can curl into a 3/4 to full circle. In females, the horns are smaller, lighter and come to a point. Female's horns do not tend to curl backwards. Bison horns emerge from the frontal bone above and in front of the ears. The horns project horizontally, then curve upward. The horns generally come to a point. Finally, pronghorn antelope horns are the only ones in Arizona to have a forked sheath, even though the bony core is not forked. The horns emerge from the frontal bone directly above the eye, projecting vertically. The first fork projects forward and is short and broad. The second fork is higher than the first, more slender and curves backwards. Look close at the sheath and you can see and feel the individual hairs that make up the sheath.



# Animal Tracks

Many times we never see the animal, but we know it was there because it left some sign of its presence. The sign is usually a footprint or track in the snow, mud, dust or sand. There is a story behind every track it just takes time to interpret the story.

Most of the time only part of a track is present: claw mark, incomplete toes, incomplete heel pad, no heel pad, etc. The professional biologist, unless he or she actually had seen the tracks being made, only gives his or her best guess as to the identity of the track maker (even after looking at a series of tracks). Never make a positive ID of an animal by one track.

Interpreting tracks is not an easy task, and takes some detective work. There are a few broad principles to use (number of toes, overall shape of foot, claw marks, etc.), but none of these principles are hard and fast for their will always be a track that breaks every rule. The substrate in which the track is made can also alter your interpretation. Tracks made in mud or snow tend to be larger than actual size, dust tracks tend to be incomplete, and wind swept sand tracks are obscured or altered. But the substrate can also help identify the track-maker. Those tracks found in desert sand exclude many animals that are not found far from water. Tracks in snow generally exclude desert dwellers (the exception being the rare snow fall in the Sonoran Desert).

When interpreting the story behind tracks, look forward and back from your initial starting point. Much can be revealed. For instance, you may discover a day bed of a jackrabbit, or even clipped vegetation. Looking further ahead, the distance between tracks may suddenly lengthen and then be joined by a different set of tracks (possibly a coyote). Still further you may find that the coyote ate the jackrabbit or the jackrabbit escaped under a brush. Following tracks for some distance may also help you identify, with some degree of certainty, the true identity of the track maker - you may come across "the perfect" track, making identification more positive.

The following is a list of animal tracks and some track features that may help identify the track-maker. In general, only one or a few have these features will be seen in any given single track. The examples are of "perfect" tracks made with the rubber tracks in the kit. It will take much practice and time to make tracks like the examples. Inked tracks will even show the creases and wrinkles in the toe and heel pads. Let students experiment with making tracks. Remember, most tracks in nature are not perfect, so students should not try for the perfect track each and every time.

So, take your time when interpreting tracks. A whole new mammal world may be seen if you just step off the "beaten path".

**BEAR:**

- toes:** - 5 toes on front and hind feet
  - inner small toe occasionally will not imprint, specially in dust or shallow mud
- pads:** - plantigrade (walks on the sole of the foot, thus toe and heel pads are connected)
  - heel of front foot occasionally will not imprint
- claws:** - usually imprints

- other:**- when walking, the hind foot is a little forward of the front foot of the same side
  - young usually place hind foot in track of front foot, making the track appear larger
  - hind foot larger than front foot



**BEAVER:**

- toes:** - 5 toes on front and hind feet
  - webbing, if present, only seen between toes on hind feet
  - rarely do all 5 front toes register

**pads:** - toe and heel pads generally connected

**claws:** - do not have long claws (have nails), thus claw marks do not imprint

**other:** - tail drag usually obscures tracks



**CANINE:**

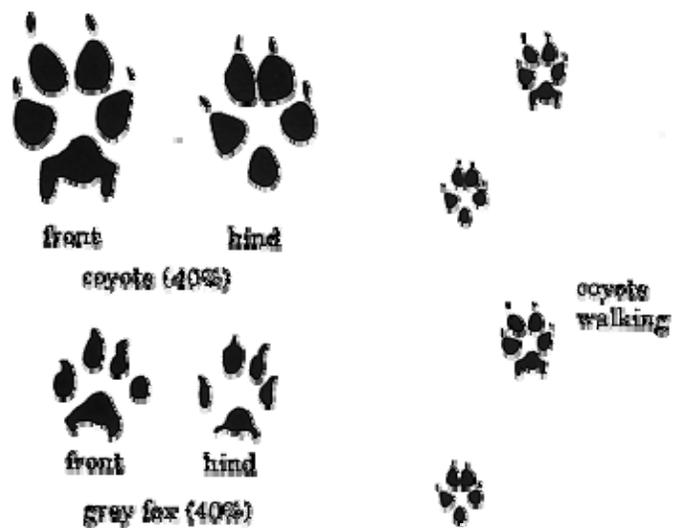
- toes:** - 4 toes on front and hind feet
  - front toes tend to be spread

**pads:** - toes on front and hind feet

- hind heel pad does not always imprint completely, giving a roundish or oval depression without lobes

**claws:** - generally imprints, but not always

- other:** - front foot larger than hind foot
  - **Coyote:** heel pad of hind foot looks compressed horizontally
  - **Grey fox:** heel pad lobes hook-shaped on both front and hind foot



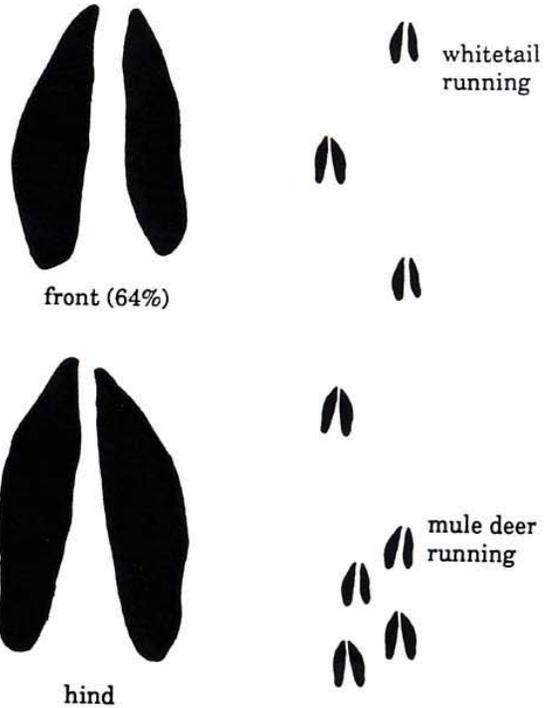
**DEER:**

- toes:** - 2 hooves, not toes (actually hooves are toe nails)  
 - hooves frequently separated from each other  
 - dewclaws only imprint when running, walking in deep snow or walking in soft mud

**pads:** - none

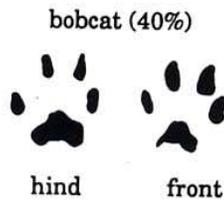
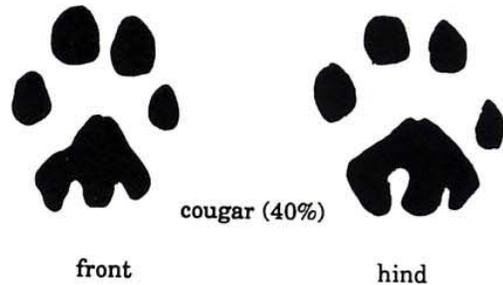
**claws:** - none

- other:** - upside down heart shaped prints  
 - difficult to tell one hoofes animal track from another. Use habitat clues to help identify track. Mule and white-tailed deer con, on occasion, be differentiated when running: mule deer run with all 4 feet coming down in the same general area, while white-tailed deer's hind feet swing far ahead of front tracks



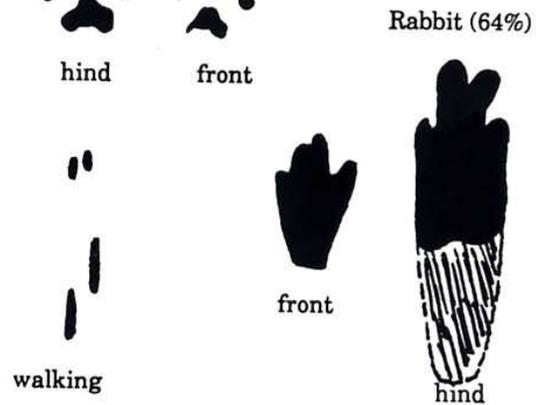
**FELIS (Cats):**

- toes:** - 4 toes on front and hind feet
- pads:** - toe and heel pad separated  
 - anterior (front) border of heel pad has 2 lobes (in canines it is single)
- claws:** - occasionally imprints
- other:** - Antelope Jackrabbit and Black-tailed Jack-rabbit tracks can not be differentiated, except by possibly using habitat clues



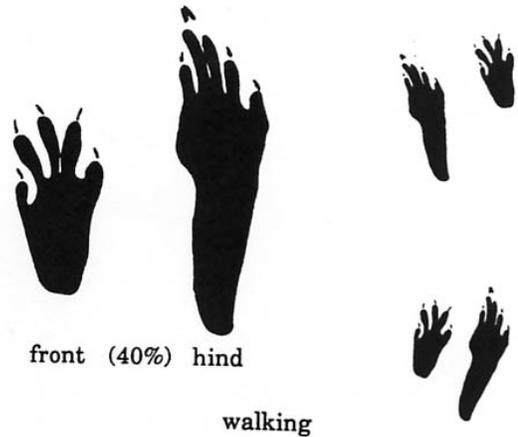
**RABBITS and HARES:**

- toes:** - 4 toes on front and hind feet
- pads:** - sometimes see an elongated hind foot track where heel touches ground
- claws:** - occasional imprints
- other:** - hind foot comes ahead of front foot in normal gaits  
 - only difference between Jacks and cottontail is size  
 - Antelope Jackrabbit and Black-tailed Jackrabbit tracks cannot be differentiated, except by possibly using habitat clues.



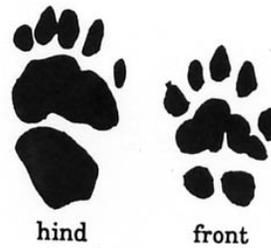
**RACCOON:**

- toes:** - 5 toes on the front and hind feet  
- front toes tend to be spread
- pads:** - elongated toe pads connect to heel pad in good substrates (plantigrade)
- claws:** - generally imprints
- other:** paired tracks: left hind foot placed beside right front foot (and right hind next to left front)



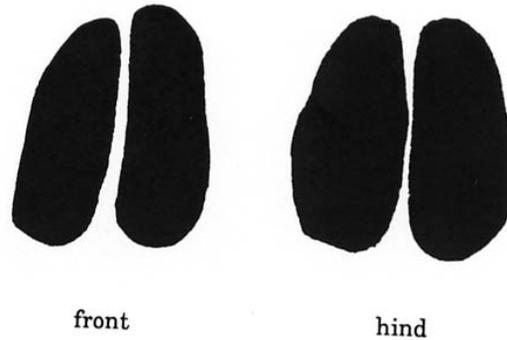
**RINGTAIL:**

- toes:** - 5 toes on the front and back feet
- pads:** - toe and heel pad separate
- claws:** - semi-retractable
- other:** - front foot generally slightly ahead of hind foot



**JAVELINA:**

- toes:** - 2 hooves, not toes  
- hooves appear more rounded than deer, sheep or pronghorn tracks  
- dewclaws rarely imprint
- pads:** - none
- claws:** - none
- other:** - tracks are much smaller than those of deer, sheep or pronghorn  
- one dewclaw on hind feet, 2 dewclaws on front feet



# Activities



# Skulls Talk

## Goal:

To teach students to become aware of the many differences and similarities between animals, and how an animal's skull can reveal many characteristics about an animal's habitat, behavior, size, and the adaptations they have for survival.

## Objectives:

1. Students will learn through inductive and deductive reasoning how to determine many characteristics about animals.
2. Students will learn about many anatomical features that are comparable to the human skull.
3. Students will perceive how each animal has adapted for survival in the environment (what they eat, what eats them) and how humans are adapted for survival.
4. Students will learn that humans are, after all, just another animal.

## Materials:

Three skulls (the larger the better):

1. herbivore such as a deer, cow, elk, horse, mouse, vole, etc.
2. carnivore such as a mountain lion, bobcat, house cat, etc.
3. omnivore such as a bear, coyote, dog, raccoon, human, etc.

Note: Bird, reptile, or amphibian skulls can be used, but various features are not as well differentiated as with mammal skulls.

Drawings can also be used but are not as effective.

## Procedure:

By using the inquiry method of teaching, students will proceed to answer questions about skulls; the most obvious one first, then those that require more thought. Only three skulls are needed for the presentation, but more skulls could represent individual variations and combinations of characteristics.

Review basic anatomy of a skull, so students are familiar with the terms and locations of various parts.

Ask students not to try to identify the species represented by the skull, but to simply answer questions as they are asked. As each skull is shown, ask students the following questions:

1. Judging by the size of the skull, how tall do you think this animal was?
2. Did this animal have good or poor eyesight, judging from the size of the orbits?
3. Judging from the length of the nose, did this animal have a good or poor sense of smell?

4. Did this animal originally live in dense forests (where small eyes and thus poor eyesight is not a disadvantage)?
5. Did this animal originate on the plains, grasslands, or mountains where visibility was good (keen eyesight being an advantage)?
6. Look at the teeth - are they flat? sharp? some of both?
7. How do all of the above characteristics enable each of these animals survive (review each characteristic for each skull and discuss sense of smell, sight, hearing, etc.)?
8. How does good eyesight (hearing or smell) enable herbivores to survive? carnivores? omnivores?

**Discussion:**

Knowing the characteristics of each skull, what animal do students think each skull represents?

Ask students to discuss the merits of the many adaptations of each animal represented by the skulls. For example, the coyote has good eyesight and sense of smell while a bobcat has good eyesight but a poor sense of smell. How do these features effect survival?

**Extended Activities:**

Place a different set of skulls on a table. Students write down the characteristics seen on each skull. From clues, students guess the identity of each skull.

A library assignment to find out more on each animal.

Have students draw a fictitious animal which has all of the "best" features for survival. When finished, have the students show-and-tell their animals explaining the adaptations for survival.

# **Project WILD Activities**

If you are a Project WILD teacher, then try using these materials with the following activities:

**Color Crazy**

**What's for Dinner**

**Tracks**

**Make a Coat**

**The Thicket Game**

**Seeing is Believing**

**Visual Vocabulary**

**First Impressions**

Project WILD is a set of K-12 supplemental, multidisciplinary activities that teach about wildlife and the environment. Project WILD workshops are free of charge. Participants receive an Activity Guide that includes over 80 Project WILD activities as well as a resource packet and other materials.

If you are not a Project WILD teacher and would like to be, contact the Arizona Game and Fish Department (602-942-3000 or 1/800-824-2456) to find the nearest Project WILD workshop near you.

# TRACKS!

## OBJECTIVES

Students will be able to identify common animal tracks.

## METHOD

Students make plaster casts of animal tracks.

## BACKGROUND

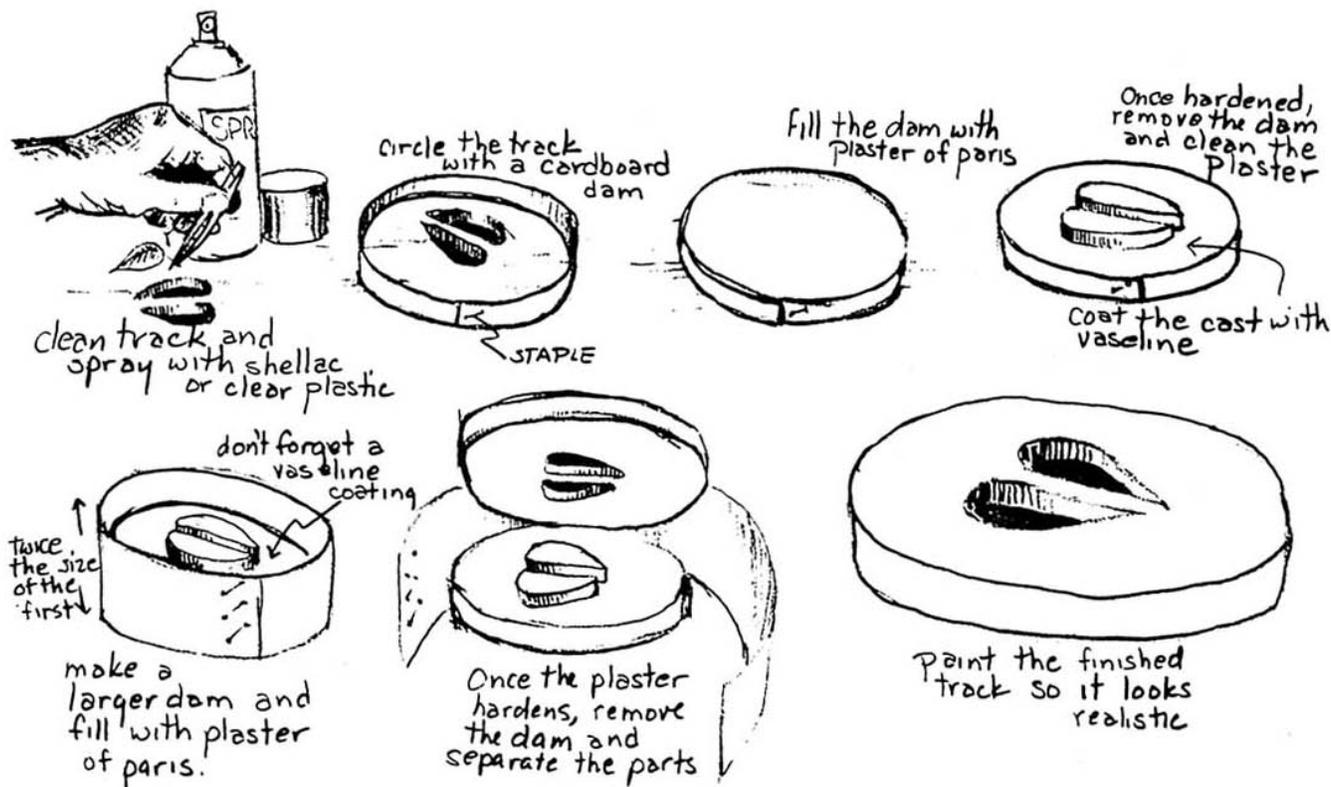
Looking for evidence of wildlife is one method of determining what types of animals are around. Signs such as burrows, nests, droppings or food litter can be identified—but some of the easiest signs to interpret are animal tracks.

Animal tracks can be the basis for several types of investigations. Identifying the tracks that you and your students find will help fill in a species list of those animals found in your area. Wildlife population estimates can be made from observing the number of

tracks found during a specified length of time. Habitat requirements of individuals can be determined by finding their tracks in certain areas and not finding them in others.

Track hunting is really very easy. Just find a spot of level ground with fairly soft, fine, textured soil. Smooth it over and come back later to see what has been there! Obvious places for your smooth spot would be near water or on well worn trails. Larger animals will use the more open areas, while a small spot the size of your hand cleared under some bushes may reward you with many different little tracks of mice, shrews and reptiles.

Tracks can be preserved and collected by making plaster casts of them. This simple procedure will allow you to "collect" track and add them to other evidence like bones, nests or scats that you already may have collected.



Once these tracks have been observed or preserved, information about the animal that made them can be discovered. For example, all mammals have basically the same foot structure. They just use the parts in different ways. If we look at an animal's foot in relation to the human hand, we find that some animals walk on their hands—like raccoons and bears. Others walk or run on their toes, like cats and coyotes, while some walk on their "toenails" or hooves like deer and elk.

By looking at a track, we can make some determinations about how that animal lives. We can notice what part of the foot it walks on, whether claws are present and how many steps are taken in a measured distance.

The major purpose of this activity is for students to become sufficiently familiar with evidence of wildlife to be able to identify a few animal tracks common to their area.

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### *MATERIALS*

plaster of Paris; containers for mixing; spray shellac or plastic; vaseline; cardboard; knives; sandpaper; black ink or paint

OPTIONAL: loops of wire

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### *PROCEDURE*

1. Take your class on a field trip to a nearby lake, stream, or wildlife refuge area—somewhere where there will be lots of tracks!
2. Divide into small groups to find tracks. You may want to divide the students into groups according to areas in which they will look for tracks; e.g., one group under bushes, one group at a meadow's edge, one group near a pond's edge. Prepare the students in advance to assist them in looking carefully and responsibly.
3. Once a track is found, clean it of loose particles of soil, twigs, leaves and other litter.
4. Spray the track with shellac or plastic from a pressurized can if available.

5. Form a two-inch wide strip of cardboard or tin into a ring surrounding the track. Press firmly into the ground to give support, but allow at least one inch to form the edge of the mold for the plaster. Square forms can be made by cutting milk cartons horizontally—one of the easiest ways to make the forms! Simple round forms can be made by cutting both the top and bottom from a tuna or catfood type of can or a plastic margarine tub. Stapled strips of cardboard in the shape of a circle can also be used.

6. Mix about two cups of plaster of Paris in a tin can or plastic bowl, adding water slowly until it is about as thick as heavy cream. Pour carefully into the mold until the plaster is about to the top. Allow plaster to harden at least 15 minutes before lifting it out of the track. If the soil is damp, hardening may take longer.

7. When the cast is hardened, lift the cast out, remove the ring and clean the cast by scraping it with a knife blade and washing.

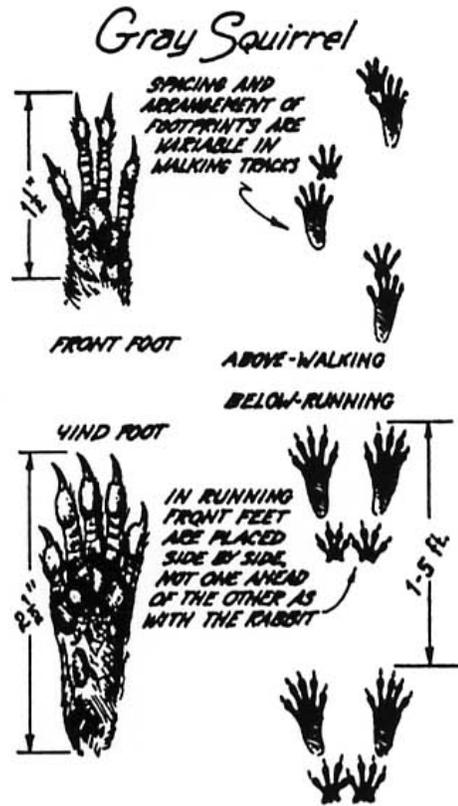
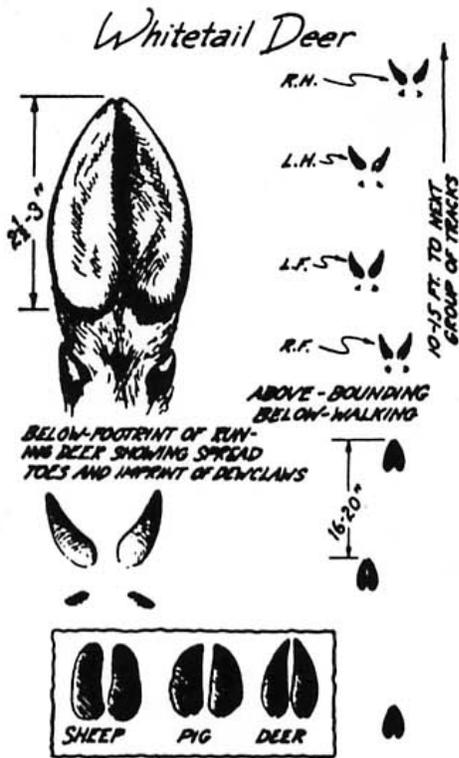
8. Back in class, apply a thin coating of vaseline to the track and surface of the cast. Place it on a flat surface and surround the casting with a two-inch strip of cardboard or tin as before.

9. Mix plaster of Paris and pour it into the mold, making certain that the top surface of the casting is smooth and level with the mold. If you plan to use the casting as a wall plaque, place a loop of wire in back of the casting while the plaster is still soft. Allow two hours for plaster to harden.

10. Carefully remove the mold when the plaster is dry. Separate the two layers and wipe the excess vaseline from the face of the cast and track. Scrape any rough places with a knife blade, or use fine sandpaper to smooth the surface. Wash the completed cast in running water.

11. When the cast is thoroughly dry, paint the inside of the track with India ink or black poster paint. Label each cast with the name of the track and the student's name. A coat of clear shellac or clear plastic may be applied to protect and preserve the casting.

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J. J. Shomon

Reprinted from December 1953 Virginia Wildlife Magazine

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## EXTENSIONS

1. In a sandy area, move in different ways. For example, you can walk, run and jump. Compare the differences between sets of tracks made by the same person. Evaluate how speed, directional changes and other variations in travel alter the tracks.
2. You may be able to obtain various animal feet or rubber replicas of feet from your local wildlife agency, nature center or scientific supply company. The feet or replicas can then be used to make tracks and plaster casts. Once you have made tracks with real or rubber feet, make up a wildlife story and express it by making the appropriate tracks. As a variation, make up a "track story" and have others guess what happened.

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## AQUATIC EXTENSION

Display all the tracks according to the habitats in which you found them. How many of the tracks, if any, were found near water? If any were found near water, identify the kind of aquatic environments in which the tracks were found—for example, pond, stream, lake, marsh, beach.

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## EVALUATION

1. Draw and label tracks of animals common to your area.
2. How would knowing about animal tracks and tracking help the following people? Consider: a biologist studying lions; a wildlife photographer interested in elk; a shepherd with a flock of sheep. What kinds of things would they need to know about animal tracks to do their jobs?

<p><b>Age:</b> Grades 4-7 <b>Subjects:</b> Science, Art <b>Skills:</b> analysis, application, comparing similarities and differences, psychomotor development, synthesis <b>Duration:</b> two 45-minute periods or longer <b>Group Size:</b> small groups of two to five <b>Setting:</b> outdoors <b>Conceptual Framework Reference:</b> I.B., I.B.1., I.B.3., I.B.4. <b>Key Vocabulary:</b> tracks, evidence <b>Appendices:</b> Outdoors, Field Ethics</p>
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# COLOR CRAZY

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## OBJECTIVE

Students will be able to generalize that wildlife occurs in a wide variety of colors.

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## METHOD

Students create representations of colorful wild animals.

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## BACKGROUND

Nature is rich with color. Animal coloring has a wide variety of survival implications. For example, wildlife benefits from color for protection and as a way to attract mates. The colors that we see are not the same colors that all animals see. An animal's bright colors may not be visible to its primary predators.

Camouflage, or the ability to blend with surroundings, can determine whether a prey species, like a rabbit, remains hidden from a predator or is easily identified, killed and eaten. Many predators, such as leopards and trout, have camouflaged bodies so that their prey will not see them. Some animals go through seasonal color changes to remain camouflaged. For example, ptarmigans are ground-dwelling tundra birds. In winter, they are white and blend with the color of snow. In summer, they turn mottled brown and resemble their environment.

Many animals are brightly colored. The eastern newt in its land-dwelling juvenile, or eft stage, is a bright red salamander. That color warns predators because the newt's skin contains a toxin. A predator that eats a newt and finds it distasteful learns to avoid newts in the future. Unusual animal coloring can serve as a warning to predators much like a flashing yellow highway light advises motorists of a road hazard to avoid.

Bright colors or other markings may also serve as a defense. Some animals use color to appear to be something that they are not. Polyphemus moths have giant eye spots that create the impression that the animal is larger than it really is. Some caterpillars have spots that make them look like they have two heads.

It is often theorized that color plays a role in animal mating. The brightly colored male scarlet tanager and peacock are two birds that are often given as examples of bright coloration used to attract mates. Female *Anolis* lizards have been shown to be more likely to approach red throated males than males with green painted throats.

We can see that wildlife occurs in a wide variety of colors. We do not know all the reasons and ways that color affects the lives of animals. No matter what the reasons, nature's colors can be interesting and inspirational. For wildlife, this variety is linked to survival.

The major purpose of this activity is for students to recognize that wildlife exists in a variety of colors.

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## MATERIALS

pictures of brightly colored animals such as coral reef fish, tropical birds and insects; crayons; paint; chalk; construction paper; scissors; glue

OPTIONAL: other brightly colored art construction material, like artificial feathers, tissue paper, acorn shells, uncooked noodles

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## PROCEDURE

1. Lead a discussion by asking students to name and describe real, brightly colored animals. Show students photographs of a variety of brightly colored animals. Discuss how the animals' colors and markings might help them survive.
2. This is a "Make A Colorful Wild Animal" project! Get out brightly colored crayons, paint, chalk, construction paper, scissors, and glue. Other brightly colored materials would also be helpful. With these materials, ask the students to draw, paint, or construct a colorful creature—one that could be a real, wild animal. They can make birds, reptiles, amphibians, insects, fish, mammals—whatever real, wild animal they would like. Have the students describe how the coloring on the animal they created would help it to survive.
3. Make a "Colorful Wildlife Gallery." Display the animal creations in the classroom.
4. Develop a vocabulary list based on the children's descriptions of the animals.

5. **OPTIONAL:** Bring in wildlife reference books. Let the students look to see if they can find real animals like those they created.

6. Ask the students what they have learned about wild animals. Encourage the generalization that wild animals occur in a wide variety of colors and that animals' colors and markings help them survive.

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### EXTENSIONS

1. Make a "Museum of Color." Match the students' invented animals with pictures of real animals. Find the primary colors of red, yellow and blue. Look for "rainbow" animals that have three or more distinct colors on their bodies.

2. Make a "Colors from Nature" exhibit, and include colors from plants, rocks and soil—as well as wildlife.

3. Put the pictures of animals with pictures of their natural surroundings. Look for animals that blend and those that stand out brightly.

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### AQUATIC EXTENSIONS

1. Make a colorful, wild, aquatic animal!

2. A coral reef is one of the most colorful places in the world. Find pictures of reef fish or other reef animals. A look at tropical fish tanks in a pet store or aquarium would also show the diversity of colors found in coral reef animals. Pick a picture of a colorful animal that lives in a coral reef. Think of at least one way this bright color might help the animal survive in

its environment. Using bright-colored crayons or other art materials, create a colorful reef animal and draw a picture of it in its habitat.

3. Research light extinction in water. Find out, for example, why bright red fish are camouflaged. Then design a fish based on the depth of its aquatic habitat. View the fish through appropriately colored cellophane or plastic to simulate the effect of its camouflage.

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### EVALUATION

1. Name a wild animal that has red for a color. Name two wild animals that have brown for a color. Name one that has yellow, one that has blue, and two that have green for a color.

2. Create a model or picture of a colorful butterfly or moth and place it in the classroom. Explain how the colors you gave it will help it survive. Explain where in the classroom its chances for survival would probably be best.

**Age:** Grades K-6

**Subjects:** Science, Language Arts, Art

**Skills:** description, drawing, generalization, invention, media construction, observation, reading, writing

**Duration:** 45 minutes

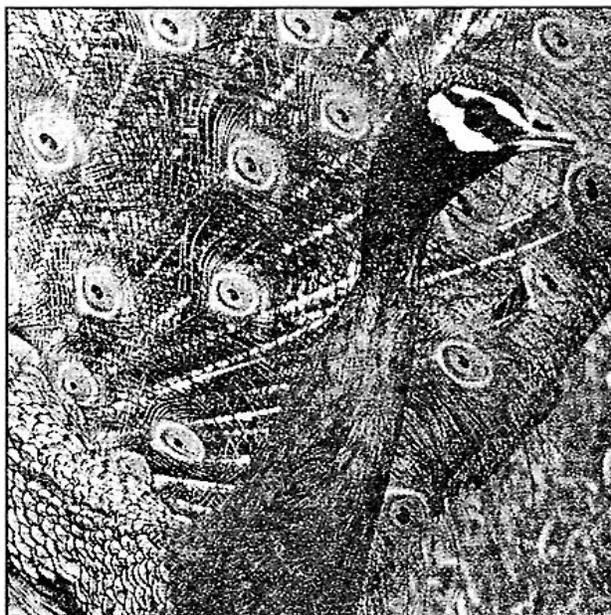
**Group Size:** any

**Setting:** indoors

**Conceptual Framework Reference:** I.B.4.

**Key Vocabulary:** color, wildlife

**Appendices:** Local Resources



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# MAKE A COAT!

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## OBJECTIVES

Students will be able to: 1) identify that some historical and present-day sources of clothing are plants and animals; 2) collect and analyze data to infer the sources of most materials used in clothing today; and 3) distinguish between some examples of renewable and nonrenewable natural resources. (All three objectives are appropriate for upper elementary grades; kindergarteners and 1st grade students may only accomplish the first objective.)

## METHOD

Students make replicas of coats using different materials and representing varying historical periods.

## BACKGROUND

NOTE: "What You Wear Is What They Were" is a similar activity for older students.

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 about 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, woolly mammoths and wolves were among the animals hunted for meat and clothing.

American Indian 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 materials. We can divide the sources of these materials into two categories: **renewable and nonrenewable natural resources**. Definitions of renewable and nonrenewable natural 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. It is, 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 animal. Other domesticated animals, like cattle, provide clothing products, such as 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, such as 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 simply for students to be able to identify principal sources of clothing. An additional major purpose for elementary age students in the upper grades is for them to be able to distinguish, in scientific terms, between clothing produced from renewable and nonrenewable natural resources.

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### MATERIALS

butcher paper or large shopping bags; scissors; paint; crayons; yarn; wool scraps; heavy thread and needle

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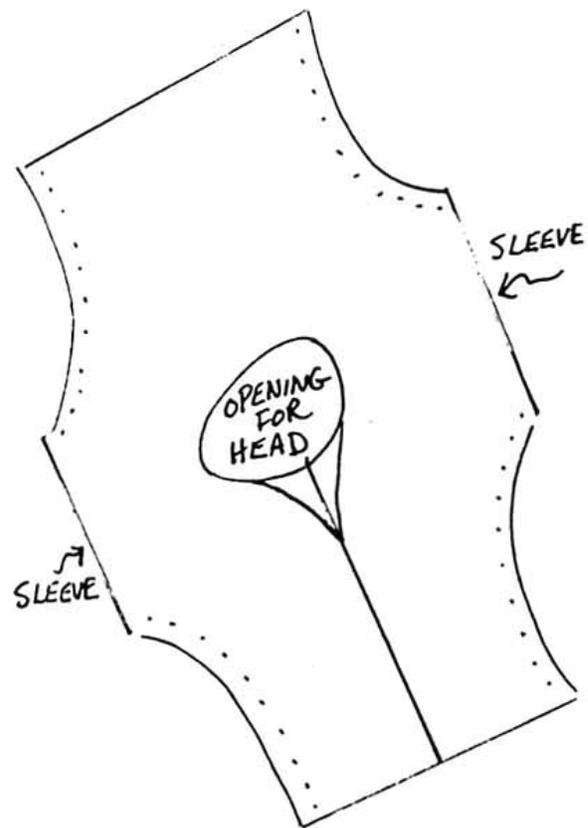
### PROCEDURE

1. Tell your students they are going to be making coats for themselves, but first, explore what coats are made of and why we need them. Have students answer this question: "On cold days, we wear coats. Where do we get them?" Most students will say, "At a store." Some will say that someone at home made it for them, or it was a gift. If made at home, it will usually be from purchased materials. Children from families who hunt or raise sheep for wool may have coats made from animal materials. "How would you keep

warm in a cold climate if you couldn't buy a coat at a store—or if someone in your family or neighborhoods couldn't buy the materials to make a coat? NOTE: If your students are from families who make their own clothes directly from plant and animal materials, change the question to: "...If we couldn't make our clothes, . . .?"

2. Divide the students into groups of three or four. Assign, or have them choose, different historical periods and places in which to live.

3. Have each group make a coat. Cut a pattern out of butcher paper. Color and paint it to resemble a fur coat, a down parka, or some other kind of coat typical to their historical period. Use a simple pattern for all the coats. For example:



OR, use a shopping bag. Cut neck and sleeve holes. If time and materials permit, each student could make a coat. Students can sew the seams with carpet or quilting thread and a crewel embroidery needle.

4. Have a fashion show, or display the coats in the classroom. Ask the students to identify their coats, indicating the time period and place represented, and the materials used. Older students should be able to distinguish whether the materials are from renewable or nonrenewable natural resources.

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*EXTENSIONS AND VARIATIONS  
FOR OLDER STUDENTS*

1. Divide the renewable resources into plants and animals. Then divide the animal-derived resources into those that require the killing of animals versus those that do not. Talk about under what conditions, if any, **it seems appropriate** to kill animals to get products for human use, like clothing. Talk about under what conditions, if any, **it does not seem appropriate** to kill animals to get products for human use, like clothing.
2. Talk about your reasons for designing your coats as you did, and out of the particular materials you chose. For warmth? Because of the availability of the materials? For convenience? For practicality? Because of the expense of the materials? For fashion? Because you like the looks or feel? For moral or ethical reasons? Because it seemed a wise choice, etc.?
3. Discuss the costs to wildlife of each of the following materials used for clothing: cotton, orlon, vinyl, wool, fur, silk, leather, nylon, rubber, polyester, paper, plastic, acrylic. Under what conditions? Costs to individual animals? Costs to populations of animals? Costs to habitats? Costs to ecosystems? Other costs?
4. Establish your own personal standards for choices in clothing. Identify the basis for your criteria.
5. Determine what natural resources were used to make the clothing that you are wearing. Consider the environmental consequences of each step in the production and transportation of your clothing. What impacts do different coat materials make on wildlife and the environment?

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*EVALUATION*

*Grades K-3* Where did the American Indians and early pioneers get the materials to make their clothing? Draw pictures to show how they made clothing.

*Grades 2-6* Identify which of these materials are from renewable resources and which are from nonrenewable resources: plastic, wool, silk, polyester, paper, linen, cotton, leather, acrylic, rubber, fur, nylon?

*Grades 4-6* List four renewable and four nonrenewable materials that are used to make clothing today. Describe three ways we make clothing differently today than during pioneer days. What do you think are likely some of the reasons American Indians have used furs in the past and some Alaskan Indians do today? What do you think are some of the reasons that most other people do not use furs in their clothing today?

<p><b>Age:</b> Grades K-6 (Grades 2-4 recommended) <b>Subjects:</b> Social Studies (History, Geography, Anthropology), Science, Art, Language Arts, Home Economics, Math (if measuring is involved) <b>Skills:</b> analysis, classification, description, discussion, evaluation, invention, media construction, observation, psychomotor skills (cutting, sewing), synthesis <b>Duration:</b> 45 minutes; 60 minutes possible (two 30-minute periods) for older students <b>Group Size:</b> small groups; up to total of 20-30 students <b>Setting:</b> indoors <b>Conceptual Framework Reference:</b> II.A., II.B., II.C., II.D., II.D.2., II.D.4., II.E., II.F., IV.B., IV.B.1., IV.B.2., IV.D., V.A.1., V.A.2., V.A.3., V.A.5., V.B.1., VI.B., VI.B.1., VI.B.2., VI.C., VI.C.2., VI.C.12., VI.C.16., VI.D., VI.D.2., VI.D.3., VII.A., VII.A.1., VII.A.4., VII.B., VII.B.2., VII.B.3., VII.B.4., VII.B.5., VII.B.7. <b>Key Vocabulary:</b> clothing, renewable resource, nonrenewable resource <b>Appendices:</b> None</p>
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# Work Sheets



# Mammals of Arizona

**Directions:** Find and then circle the names of Arizona animals in the puzzle below. Words can go across or down.

Beaver  
Black Bear  
Bobcat  
Coyote

Deer  
Grey Fox  
Javelina  
Mountain Lion

Rabbit  
Raccoon  
Ringtail  
Skunk

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

# Skulls

**Directions:** Find and circle the following words that deal with skulls. Words can be found forward, backward, and diagonally.

ANTLER  
CANINE  
CARNASSIAL  
CARNIVORE  
CREPUSCULAR

DIURNAL  
HERBIVORE  
HETERODONT  
HORN  
INCISOR

MOLAR  
NOCTURNAL  
OMNIVORE  
ORBIT  
PEDICEL

PREDATOR  
PREMOLAR  
PREY  
SKULL  
ZYGOMATIC

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

# Tooth Type and Function

**Directions:** Find and circle the following words that deal with mammal teeth. Words can be found forward, backward, and diagonally.

CANINE  
CARNIVORE  
CHEEK TEETH  
HERBIVORE

HETERODONT  
INCISOR  
MOLAR

OMNIVORE  
PREMOLAR  
SKULL

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

# Horns and Antlers

**Directions:** Find and circle the following words that deal with horns and antlers. Words can be found forward, backward, and diagonally.

ANTLER  
BEZ (tine)  
BISON  
BROW (tine)  
CALCIUM

CAST  
CORE  
DICHOTOMOUS  
ELK  
HORN

MULE (deer)  
PEDICEL  
PRONGHORN  
SHEATH

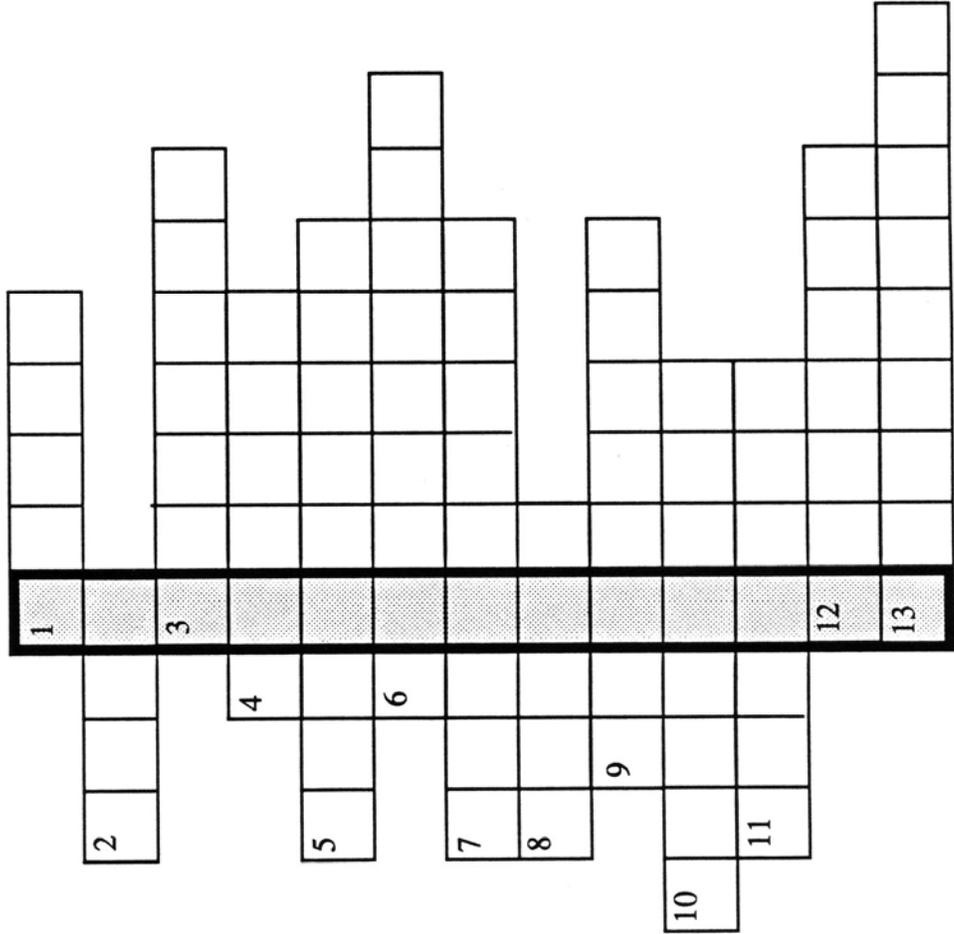
SHEEP  
TINE  
WHITETAILED (deer)  
VELVET

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

# The Skull

**Directions:** Complete the clues and write your answers in the space provided on the puzzle. Answers are placed in the horizontal position. The shaded boxes give the answer to the following:

**This skull projection forms the cheek bones and protects the eye.**



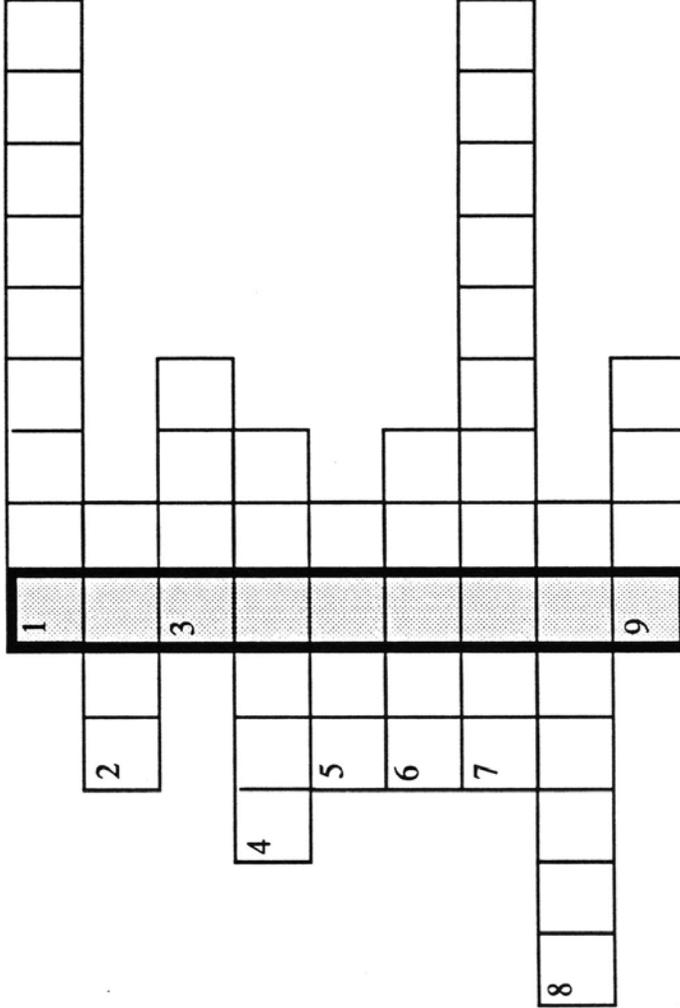
## CLUES

1. A black and white striped animal of the African grasslands.
2. An animal that is eaten by another animal.
3. A small canine that can climb trees.
4. The teeth that are found furthest back in the mouth.
5. The teeth found just in front of those described in #4.
6. A meat eater.
7. Night active.
8. Another name for the eye socket.
9. The very front teeth.
10. An animal that hunts and eats other animals.
11. Day active.
12. The elongated and sharp teeth found in many carnivores.
13. A plant eater.

# Antlers and Horns

**Directions:** Complete the clues and write your answers in the space provided on the puzzle. Answers are placed horizontally. The shaded boxes give the answer to the following question:

**What is an important mineral for antler growth?**



## CLUES

1. The \_\_\_\_\_ is the only mammal in Arizona with a forked horn.
2. The \_\_\_\_\_ tine is another name for the eyeguard found on the antlers of white-tailed and mule deer.
3. Points on an antler are also called \_\_\_\_\_.
4. The \_\_\_\_\_ covers the bony core and is made up of tissue similar to human nails.
5. Another name for shed.
6. The largest horned Arizona mammal.
7. The smallest antlered mammal in AZ.
8. Another mineral that is required for proper antler growth. (You get this mineral by drinking milk and eating dairy products.)
9. The \_\_\_\_\_ deer has antlers that are dichotomous (forks into 2 beams of equal size).



# TRACK DECODING

**Directions:** Time to test your detective skills. Each track below represents a letter of the alphabet. Can you complete the following sentence?



B

D

F

H

I

M

N

O

R

S



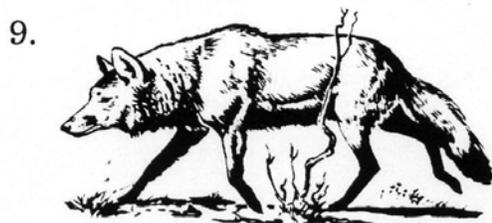
The largest mammal in Arizona is the \_\_\_\_\_

\_\_\_\_\_

# ARIZONA'S MAMMALS

**Directions:** Identify each animal picture. Write the name of each animal in the spaces provided on the crossword puzzle.

## ACROSS



## DOWN





# Horn & Antler Crossword Clues

## ACROSS

1. To shed an antler.
2. The name of the 2nd eye guard found on elk antlers; \_\_\_\_\_ tine.
4. The thin, soft, skin covering antlers as they grow.
6. This animal's antlers consist of tines projecting from one main beam.
9. The heaviest horns belong to the bighorn \_\_\_\_\_.
11. Found only on male deer.
12. Covers the bony core of horns.
14. This animal's antlers are forked into 2 equal sized beams; \_\_\_\_\_ deer.
15. The largest horned mammal in Arizona.
16. The largest antlered mammal in Arizona.

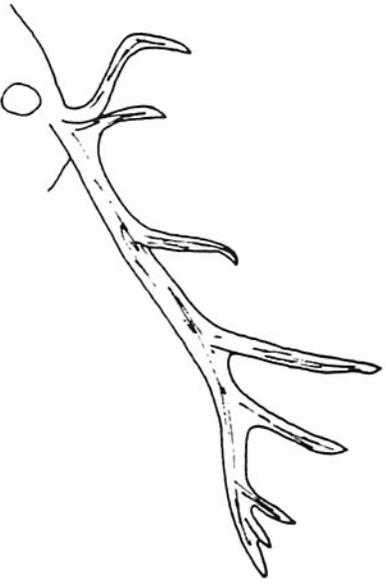
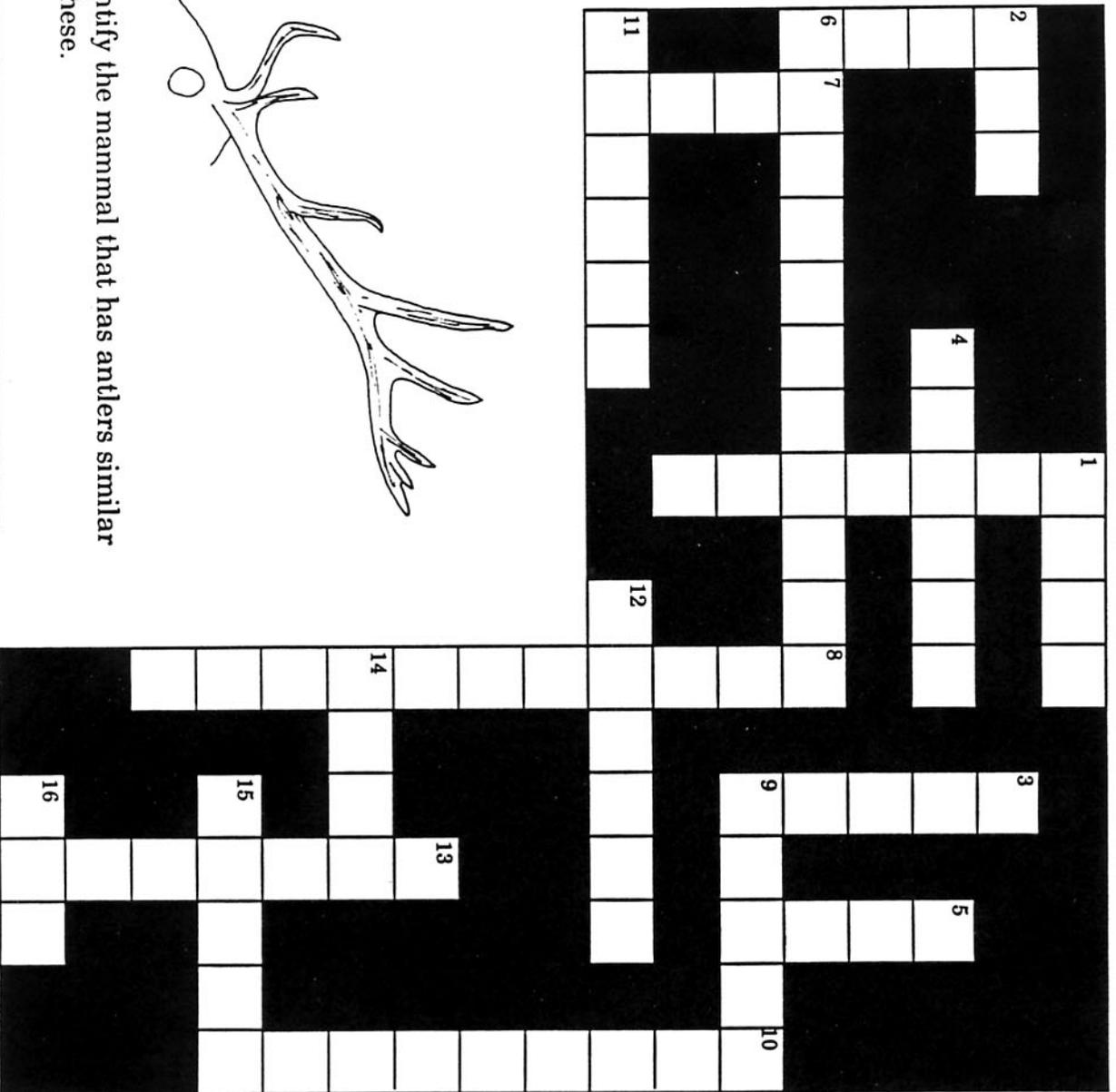
## DOWN

1. An essential mineral for horn and antler growth.
2. The eye guard on white-tailed deer, mule deer, and elk.
3. Points.
5. Found under the sheath in horns is the bony .
7. Permanent structures on the heads of pronghorn or bison.
- 8 Forking into 2 equal beams.
10. This animal's sheath is shed every year.
13. The part of the frontal bone from which antlers develop.

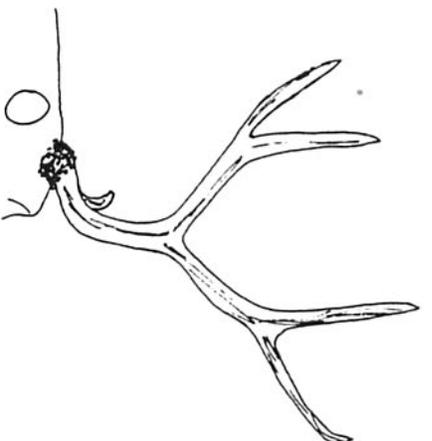
## WORDS THAT CAN BE USED

antler	cast	horn	sheath
bez	core	moose	shed
bighorn	cotton	mule	sheep
bison	cow	pedicel	tines
brow	dichotomous	points	velvet
calcium	elk	potassium	whitetailed
caribou	eye guard	pronghorn	

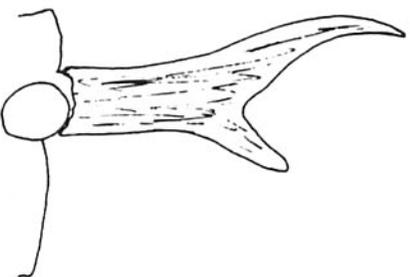
# Horns and Antlers



Identify the mammal that has antlers similar to these.



Identify the mammal that has antlers similar to these.



Identify the mammal that has horns similar to these.

# Answers

## Mammals of Arizona

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

## Tooth Type and Function

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

## Horns and Antlers

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

## Skulls

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

# Answers

## TRACK DECODING

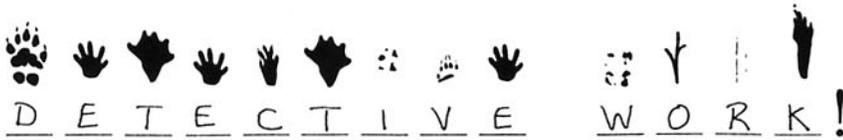
The largest mammal in Arizona is the



B I S O N

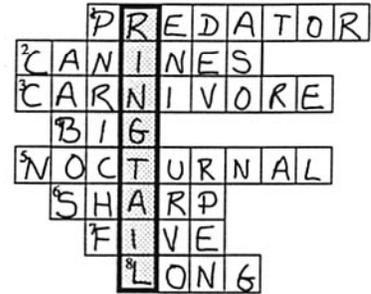


T R A C K I N G I S

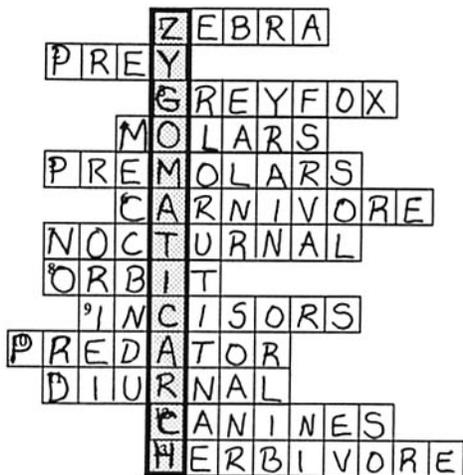


D E T E C T I V E W O R K !

## The Arizona State Mammal



## The Skull

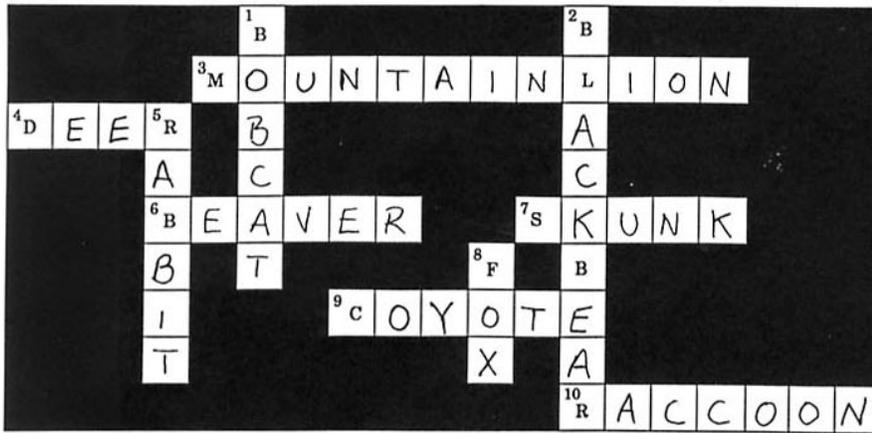


## Antlers and Horns

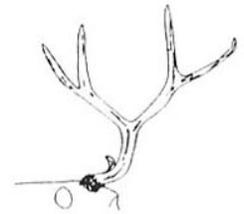
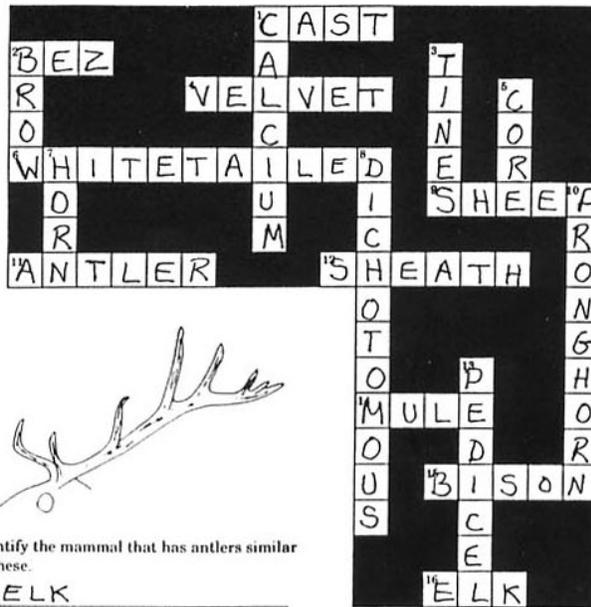


# Answers

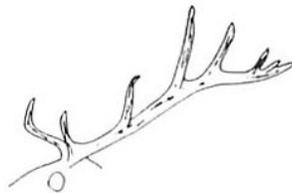
## Arizona's Mammals



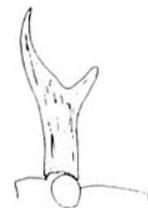
## Horns and Antlers



Identify the mammal that has antlers similar to these.  
MULE DEER



Identify the mammal that has antlers similar to these.  
ELK



Identify the mammal that has horns similar to these.  
PRONGHORN

# Natural History



## Natural History Note

### Beaver

### Castor Canadensis

**Identification:** The largest native rodent in North America, weighting from 30-80lbs., it is distinguished from all other rodents by its naked, broad, flat, and paddle-like tail. Huge chisel-like incisors are orange colored on the front surface only. The hind feet are webbed with a doubled second claw acting as a grooming claw. The brown fur is rich, soft and dense and valuable to the fur trade.

**Habitat:** Beaver live today along continuously flowing rivers and streams in western, central and northern Arizona. Beaver were formerly found in much greater numbers in Arizona, but dams and the lowering of the water table has greatly reduced their numbers.

**Niche:** Beaver are strict herbivores, eating the cambial layer of trees such as cottonwood, aspen, willow, tamarix and mesquite. They will also eat cattail, roots of pond lilies, and tuberous plants. Beaver will store branches and small logs underwater for winter use. Predators include any medium to large animal that finds a beaver on land. River otters have been known to kill and eat young beaver.

**Life History:** Beavers will build one of two types of dens: the bank den, (the more common one in Arizona) and the lodge. The bank den is located along the side of a stream, with the entrance below the water line. The burrow proceeds upward from the entrance to an enlarged cavity, large enough for one to several beavers. The cavity is always dry because it is located above the high water line. The lodge den is located in the beaver pond or as part of the beaver dam. The entrance(s) are also located underwater with the nesting cavity above the high water line.

Young are born in April through July after a gestation period of about 128 days. The average litter size is 2-4 kits with a maximum of 8. The family group or colony consists of the parents, yearlings and kits. Two year olds are forced to leave by the parents. Colonies defend their territory from all other colonies, and all help to repair their dam.

**Comments:** Beaver can use their tails as a communication device. When disturbed, they will dive to the bottom of the pond, but first slap the surface of the water with their tail to warn other beavers of danger. Their tail is also used to help direct swimming (like a rudder) and to pack mud and sticks in building dams.



## Natural History Note

### **Black Bear**

### **Castor Canadensis**

**Identification:** These bears are black by name, but they can vary in color from blonde to cinnamon, brown, and true black. In Arizona most of our black bears are actually brown in color. A small white patch is often seen on the chest.

**Habitat:** Black bears in Arizona are found in a variety of vegetation types around the state. In Southeastern Arizona, bears are found in the pine-oak woodland habitats in many of the isolated mountain ranges. Central Arizona bears can be found in the chaparral, pinyon-juniper, and diverse mixed conifer areas south of the Mogollon Rim. Central and Southern Arizona bears will also use areas of the Sonoran desert that provide ripe prickly pear fruits in late summer. Bears that use the desert are unique to Arizona. In Northern Arizona, black bears are found in the mixed conifers of the Mogollon Rim and in the spruce-fir forest of the White Mountains.



**Niche:** Bears are omnivores and opportunists. They will make use of a variety of available food sources. About 75% of a bear's diet in Arizona is made up of plant material. Generally this consists of: green grass in the spring and early summer, a variety of berries and fruits in the summer (manzanita berries in Central Arizona, broomrape in Southeastern and Northern Arizona, as well as juniper berries and other types) and acorns in the fall. Acorns are especially important to bears since the fall is a critical food time before winter hibernation. Areas of the state that provide several species of acorns usually are especially good bear habitat since acorn production may vary greatly from year to year and species to species.

The remaining 25% of a bear's diet consists of animal matter, much of it in the form of insects. Bears are also capable and efficient predators if they choose to be and prey on javelina, deer, elk calves, domestic calves, or sheep.

**Life History:** Cubs are born in the den in late January or early February. They weigh only about 8 ounces at birth (the same as 2 sticks of butter). Litters range in size from 1-5 but average two in Arizona. Upon emergence from the den in May the cubs average about 6 pounds. They will nurse from their mother through June, but will also forage for other foods. Cubs remain with their mother for about 16 months before becoming independent.

**Natural History Note**  
**Bobcat**  
**Felis rufous**

**Identification:** Bobcats are a medium sized (20-30 lbs.) cat, with large feet and a “bobbed” tail. Coat color varies greatly and depends on location: desert bobcats tend to be pale colored with less distinct markings than those found in forests and wetter regions. Coat color can range from reddish brown to golden and red gray with variable and/or stripes. Prominent white spots are located on back of the ears. Short tail is black on top and white underneath.

**Habitat:** Varied: found throughout Arizona in all life zones.

**Niche:** A nocturnal predator of reptiles, birds, and small mammals. Kittens fall prey to coyotes and mountain lions. Adults may be killed by mountain lions.

**Life History:** Female dens in rock crevices, hollow logs or holes in hillsides. One to three young (average 2) are born in the early spring, but kittens can be born any month of the year. Gestation is 50-60 days, and the kittens’ eyes open 10-11 days after birth. Kittens will stay with female for 6 to 9 months, learning to hunt. The white spots on the back of the ears may serve as a visual cue to kittens as they follow their mother in the dark. These spots may also function in aggressive encounters, serving as eye mimics, giving the impression of a wider and thus larger head.



# Natural History Note

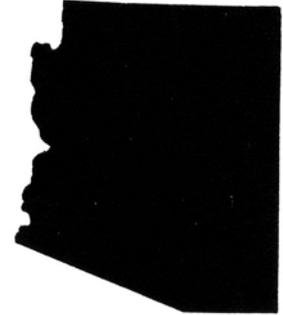
## Coyote

### Canis latrans

**Identification:** The coyote looks like a medium sized (20-30 lbs.) dog. It is gray to red gray with rusty colored legs, feet and ears with a whitish belly and throat. When running, the tail is held down between hind legs.

**Habitat:** Varied, found throughout the state in all types of habitat from mountain forest to lowland desert.

**Niche:** Chiefly nocturnal, the coyote can be active all times of the day. The coyote is a true scavenger, eating most anything. It mainly feeds on rodents and rabbits, but will eat fawns, birds, small reptiles, insects, cactus fruit, mesquite beans, garbage, carrion, etc. Coyotes may be preyed upon by wolves and mountain lions. Seeds found in scat (droppings) are viable and will germinate, thus the coyote may be important in seed dispersal.



**Life History:** The coyote normally dens underground but will use other shelter, as long as it is not too far from water. Adults breed once a year with 2 to 10 young (average 4) born in the spring from April to May. Gestation is 60-63 days. Pups eyes open in 9-14 days. Both the female and male care for and feed the young. The young are nursed for 12-15 days, and then fed supplemental food brought by parents. Young are independent of parents by 6 months of age. The young of the year may leave prior to the next breeding season or remain to form a family group and help raise the next litter.

**Comments:** The name coyote comes from the Aztec word Coyotl, and coyotes are depicted in Pre-Columbian art dating back to 1250 AD. In Navajo tradition, the coyote was considered a deity. Present day Tohono O'odham view the coyote as a messenger of the spirit world, a spiritual brother, and as a clown.

## Natural History Note

### Deer

Odocoileus virginianus

Whitetail

Odocoileus hemionus

Mule

**Identification:** **Whitetail:** A small deer rarely exceeding 110lb. Distinguished from mule deer by its all white tail tip. In males, antlers consist of a main beam with tines projecting from the dorsal surface.

**Mule:** A medium-sized deer (doe 100-500 lbs., buck 125-300 lbs.) with large ears. The tail has a black tip. In males, antlers branch equally with each fork, with no main beam.

**Habitat:** Whitetail deer range in the higher elevations and moister regions of Arizona. Mule deer can be found throughout the state (except the extreme SW corner) from the high mountain ranges to the low desert.

**Niche:** Both are browsers of woody vegetation, but will utilize grasses if preferred vegetation is absent. Most active during mornings and evenings. Natural predators of adults include mountain lions and wolves, while fawns are eaten by bobcat, coyote, mountain lion, black bear and wolves.

**Life History:** Twins are common to both deer, being born in early summer after a 6.5 to 7 month gestation. Weaning of fawns occurs around 4 months of age. Fawns are born spotted, lose these spots around 3 months and can walk within hours of birth.

During the breeding season of fall and winter, the necks of males become enlarged due to increased levels of the male hormone testosterone. Antlers are shed shortly after the breeding season. Whitetail generally begin breeding one month after mule deer, thus giving birth one month later



**Natural History Note**  
**Grey Fox**  
**Urocyon cinereoargenteus**

**Identification:** One of the smaller canids, weighing from 7-13 lbs., the gray fox is gray above, and lighter gray below with rusty-yellowish sides of neck, back of ears, sides of body, legs and feet. Its tail is long and bushy with a median black stripe down the full length.

**Habitat:** The gray fox can be found in open desert, scrub, chaparral, and oak, pinyon-pine, and ponderosa pine-doug fir forests.

**Niche:** A nocturnal omnivore feeding chiefly on rodents but will also eat cottontails, insects, fruits, birds, eggs, lizards, snakes, grasses, and occasionally carrion.

**Life History:** Grey fox utilize hollow trees, mine shafts, rock piles, cliff crevices and abandoned badger holes for dens, but will not dig its own burrow. Breeding occurs in February to March with the young (3-7) born in April to May after a gestation period of about 51 days. Pups are born blind with dark brown fur.

**Comments:** Grey fox are the only fox that can readily and easily climb trees. They will climb trees to hunt for food (fruits, birds, eggs, lizards) or to just bask in the sun.



## Natural History Note

### Javelina Tayassu tajacu

**Identification:** Javelina, also called collared peccary, are medium-sized animals, weighing between 40 to 50 pounds. Many people mistake the javelina for a pig, because they are pig-like in body form, but the two are not related. The body is grayish with a white to yellow stripe extending from the mane, over the shoulders, to the throat. There is a scent gland on their back towards their tail.

**Habitat:** Javelina are found generally south of the Mogollon Rim in desert scrub, rarely going above oak forests.

**Niche:** This animal is an herbivore, eating cacti fruit and stems (especially prickly pear), grasses, agave, seeds, beans, and tubers. They may occasionally eat insects and grubs when digging up plant tubers, but they do not actively hunt for these items. Young are preyed upon by coyote, bobcats, and possibly gray foxes, while adults are prey for mountain lions and gray wolves.



**Life History:** Young (1-3, average 2) are born throughout the year after a gestation period of 144 days. The young will nurse for 1 to 1.5 months. Javelina are generally found in herds of 8 to 20 individuals, depending on food availability and the time of year. The dorsal scent gland is used to help the herd establish a group scent in which to identify herd members. Two individuals will stand nose to tail and rub along each other's scent gland.

**Comments:** The kidney of the javelina is an extremely efficient organ in reducing water loss (concentrates urine) and excretion of oxalic acid found in cacti

## Natural History Note

### Mountain Lion

### Felis concolor

**Identification:** The largest of the small cats (80-175 lbs.) is the mountain lion. Mountain lions are a uniform tan or reddish gray with a black tip to its long tail, black spots on back of ears and sides of muzzle. Young are spotted with dark rings on their tails until 5 months old.

**Habitat:** Prefer rugged mountains, forests and area that have a good deer population.

**Niche:** A nocturnal carnivore feeds on deer (mule and white-tailed), cattle, domestic sheep, horses, javelina, pronghorn, porcupine, rabbits, and even beaver. Deer are the most important food item, making up 50-75% of their diet. On average, a mature male or female without kittens will make a kill approximately every 10-½ days. Females with young make kills every 6-¾ days on average. The number of days between kills depends on the size of the prey, number killed, “keeping” ability of the carrion, and the amount of time a mountain lion spends eating on the kill.



**Life History:** Adults are solitary, except to mate or when a female has young. Kittens (1-6, average 2) are born all months of the year and will stay with the female until about 18 months old. The gestation period is 88-97 days, with the kittens opening their eyes in about 10 days. Young lions between 18 months and 3-5 years can travel long distances (longest recorded distance traveled was 350 miles from place of birth) looking for unoccupied territory of their own.

Home ranges are about 150 square miles for males and 50 square miles for females. The territory of a male overlaps many females, but they only come together for breeding. Large males kill kittens in their territory if he happens to come across them unprotected by the female.

The present resident population in Arizona is estimated to be around 2,000 animals. Kittens and transient young lions can elevate this number to 4,000. In most cases, transient lions will occupy the home range of a resident lion that has died or been killed.

## Natural History Note

### Rabbits and Hares

Sylvilagus auduboni

Sylvilagus nuttalli

Sylvilagus floridanus

Lepus californicus

Lepus alleni

**Desert Cottontail**

**Nuttall's Cottontail**

**Eastern Cottontail**

**Black-tailed Jackrabbit**

**Antelope Jackrabbit**

**Identification:** The main physical difference between rabbits and hares are body size, ear length, and hind foot length. Jackrabbits are bigger than cottontails. Jackrabbits are also born furred and precocial, while cottontails are hairless and altricial at birth. Both rabbits and hares have tails that are all white on the underside. Further distinctions are given below.

**Desert cottontail:** The smallest (1-2 lbs) and most abundant rabbit found in Arizona. Its ears are between 2.25 and 2.75 inches long. The top of its tail has a wide edging of white, while the body is a pale gray washed with yellow.

**Nuttall's cottontail:** This cottontail has the shortest ears (2-2.25 inches), with a grayish to brownish body. The top of the tail has a narrow edging of white and a broad rufous area on the top.

**Eastern cottontail:** The ears are between 2.25 and 2.66 inches long with the nape of the neck rufous. The top of the tail has a narrow edging of white and a broad rufous area on the top. The body is gray to brown with whitish feet.

**Blacktailed Jackrabbit:** The ears are between 4.4 to 5 inches long with black tips. There is a narrow black streak of the top of the tail. The belly is white and the sides of body brownish.

**Antelope Jackrabbit:** The long ears are 5.5 to 6 inches long with white tips. There is a narrow black streak on the top of the tail like blacktailed jackrabbits. The sides of the body are light gray to white. They are also the largest jackrabbit in Arizona, weighing around 8 pounds.

Desert



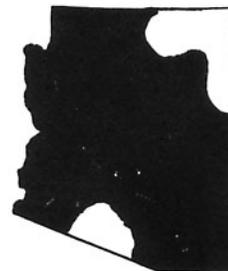
Nuttall's



Eastern



Blacktailed



Antelope



**Habitat:**

**Desert** – Elevations below the coniferous forests in the deserts and semiarid grasslands. Generally not found in forests.

**Nuttall's** – High elevation grass and rocky areas near or among spruce and fir or in the sagebrush flats near ponderosa pine and spruce-fir forests.

**Eastern** – Mountains and adjacent slopes where scrub oaks and oak/mesquite grasslands are found.

**Blacktailed** – Open to semi open areas below pine forests.

**Antelope** – Deserts and semiarid grasslands of south central Arizona.

**Niche:**

All cottontails and jackrabbits are herbivores eating grasses, shrubs, forbs, seeds, flowers, and occasionally woody vegetation. They are an important prey species for many mammals and birds of prey. They are most active in the early mornings and late afternoons, resting in shallow depressions during the day.

**Life History:**

**Cottontails** – Cottontails usually have a gestation period of around 28 days, giving birth multiple times a year (January through August, except Nuttall's which breeds February through July). Females need to be a minimum of 3 months before they will breed. Young are born in a fur and grass lined depression dug by the female. Rarely do they dig extensive burrows for nesting. The desert and Eastern cottontails have an average of 3 (2-5) young, while Nuttall's have an average of 5 (4-6) young. The young are able to leave the nest in 2 weeks and are on their own around age 5 weeks.

**Jackrabbits** – Jackrabbits have a much longer gestation period than cottontails, averaging 43 days. They also breed all year, giving birth to an average of 2 (1-6) young per hutch. Females do not breed in the year they are born. Young will nurse for 12 to 13 weeks, but are supplementing their diet with vegetation at 3 weeks. Jackrabbits can run 35 M.P.H. for up to a half mile if the need arises.

## Natural History Note

### Raccoon

### Procyon lotor

**Identification:** Raccoons are medium-sized, weighing from 12-35 pounds with a body that is peppered black and white and a black facial mask. The tail of the raccoon is its distinguishing feature, with alternating bands of black and yellowish white.

**Habitat:** A riparian animal (found near permanent water).

**Niche:** Raccoons are nocturnal omnivores, eating more animal material than plant. When ample food is available, they will be selective in what they eat, and when food is scarce, they will eat anything. Food items include insects, amphibians, mollusks, reptiles, eggs, waterfowl, fruits, nuts, and grains. Or anything else that is available. Predators include the mountain lion, bobcat, coyote, and great horned owl.



**Life History:** Young (2-7, average 4) are born in spring and are on their own by the following winter. The gestation period is 63 days and the young are weaned at 2-4 months. Females have one litter a year, but if they lose their embryos or are not impregnated, females will ovulate a second time in a season.

In the colder parts of their range, raccoons may become dormant, but they do not hibernate. In most of Arizona, the weather is not cold enough to induce dormancy, thus raccoons are active all year.

**Natural History Note**  
**Ringtail**  
**Bassariscus astutus**

**Identification:** Ringtails are small (2 lbs.) elongated animals, with large eyes and rounded ears. The tail has 6 to 7 alternating rings of black and white, ending in a black tip. The body is tan with pale under parts and the eyes are encircled with white. Similar to cats, their claws are partially retractable.

**Habitat:** Ringtails are found in the rocky walls of canyons and cliffs and in chaparral near water.

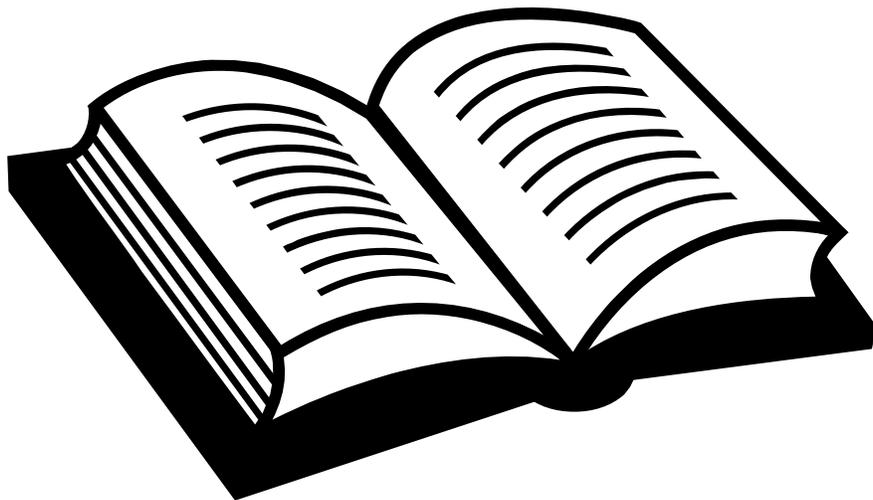
**Niche:** These small nocturnal omnivores are great mousers, eating more flesh than plant material. Their diet includes rodents, birds, lizards, small snakes, frogs, insects and cactus fruits. They are preyed upon by bobcats, great horned owls, coyotes, and any other large predator that can catch them.



**Life History:** Three to four young are born in May and June, covered with downy white fur. Their eyes open at 4-5 weeks of age. Young are weaned at four months of age and leave their parents to find their own territories. Dens are usually in caves, mine shafts, rock piles, crevices, hollow trees or unused buildings. They will use woodrat dens, after first eating the occupants.

**Comments:** Ringtails are excellent climbers, being able to rotate their hind feet 180°.

# Glossary



## GLOSSARY

### A

**anterior** – front surface of an animal

**antler** – a bony growth on the forehead of deer that is grown and shed every year

### B

**bez tine** – the second tine on elk antlers that guards they eyes

**brow tine** – the first tine of deer antlers that guards the eyes.

### C

**canid** – any animal belonging to the dog family

**carnassials** – the last upper premolar and first lower molar teeth that slide against each other like the blade of scissors. These teeth are adapted for cutting meat.

**carnivore** – a meat-eating animal

**carrion** – dead animal matter

**cast** – to shed

**cheek teeth** – the premolar and molar teeth

**crepuscular** – dawn and dusk activity

### D

**dichotomous** – dividing into 2 parts; refers to the antler branching, especially mule deer

**diurnal** – daytime activity

**dorsal** – back surface of an animal

**digitigrade** – a type of locomotion where the animal places its toes on the ground (i.e. deer, javelina, bighorn sheep)

## **E**

**ecology** – the study of the interrelationships between animals, plants and the environment they live in

## **F**

**fenestration** – openings in an otherwise solid surface

## **H**

**habitat** – the area in which a plant or animal lives

**herbivore** – a plant-eating animal

**heterodont** – different types and shapes of teeth to serve special functions

**horn** – a bony structure found on the foreheads of bighorn sheep, goats, cattle, etc. that is covered by keratinized epidermal tissue called the sheath

## **M**

**mammal** – a class of animals possessing hair and mammary glands for nursing young

**mandible** – the lower jaw of an animal

**maxilla** – the upper jaw of an animal

## **N**

**niche** – the role or function of a plant or animal in its environment

**nocturnal** – night activity

## **O**

**omnivore** – an animal that eats both plants and other animals

**orbit** – the area of the skull where the eye is located

## **P**

**pedicel** – a small, narrow, bony attachment site from which antlers grow

**plantigrade** – a type of locomotion where the animal places the heel, sole, and toes of its foot on the ground (i.e. human, bear, raccoon)

**posterior** – back surface of the animal

## **R**

**riparian** – an area where there is running water or water near the surface such as along the banks of streams and rivers

## **S**

**sheath** – the outer covering of horns composed of nail-like or hair-like materials

**skull** – the bone of an animal's head

## **T**

**tine** – a pointed branch of an antler

## **V**

**velvet** – the skin that covers and nourishes growing antlers

## **Z**

**zygomatic arch** – the arch of bone extending from under the orbit to near the ear opening. Also called the cheekbone