



Bone Box Resource Trunk Teacher's Guide



Heritage Fund

Bone Box Resource Trunk Inventory

Skulls (11 total)

- Beaver
- Black bear
- Bobcat
- Coyote
- Deer
- Gray fox
- Jackrabbit
- Javelina
- Mountain lion
- Raccoon
- Ringtail

Hides (10 total)

- Beaver
- Black bear
- Bobcat
- Coyote
- Deer
- Gray fox
- Javelina
- Mountain lion
- Raccoon
- Ringtail

Teacher's Guide binder

Resource DVD

Exploring Arizona's Natural Resources CD

America's Wildlife binder

America's Wildlife Curriculum DVD

Tracking Sheet

Mammalian Predators in Arizona book

Mammal Photo Envelope (11 photos)

- Beaver
- Black bear
- Bobcat
- Coyote
- Deer
- Gray fox
- Jackrabbit
- Javelina
- Mountain lion
- Raccoon
- Ringtail

Career Photo Envelope (5 photos)

- Environmental Education Outreach Coordinator
- Photographer
- Wildlife Aircraft Pilot / Wildlife Specialist I
- Wildlife Habitat Construction Technician
- Wildlife Law Enforcement Specialist

Habitat Photo Envelope (6 photos)

- Rock ledges and canyons
- Riparian
- Sonoran desert
- Spruce-fir forest
- Grassland
- Aspen forest



Heritage Fund

Greetings

This box contains a set of skulls, hides and other resources to use in your classroom. These are tactile objects and we want them to be touched by students. We want students engaged in the learning process.

For those of you that have used the bone box in the past, you will likely notice a few changes. In the spring of 2012, we initiated a renovation of this popular resource. The purpose was to improve the overall quality of the bone box by addressing feedback we had received from numerous educators in workshops, via email and phone communication, and in targeted focus groups. These resource trunks have been around for over 20 years and had never been through a major change. It was a renovation that was desperately needed to keep the resource relevant given today's educational demands. Some of the changes we made include activities that:

- have been correlated to the Arizona Department of Education academic standards, which were released after the original bone boxes were made available.
- efficiently integrate multiple academic disciplines, even those outside the life sciences.
- make better use of new and emerging technologies, specifically web-based applications.
- help students to develop higher order thinking and problem solving skills.
- provide English-language learners the opportunity to engage with the resources more effectively.

In addition, we wanted the bone box to seamlessly integrate into the Arizona Game and Fish Department's new wildlife education program. Focus Wild Arizona was developed in 2006 to better meet the needs of Arizona educators. More information about this award-winning program can be found at <http://www.azgfd.gov/focuswild>.

One goal of the Focus Wild Arizona program is to provide easier access to lessons and resources specific to Arizona. This included improved access to the bone box resources. In the past, teachers were frustrated because they could not see the lessons that accompanied the bone box until they had the trunk in their hands. Now, you no longer have to wait. Electronic copies of the lessons, pictures, videos, and more are available on the website. You can start planning your time well before your reservation. It also allows you to extend the learning beyond the short time you have the box. To access these materials, visit <http://www.azgd.gov/bonebox>.

While most of the changes have centered on creating more robust activities, there was a significant change in the contents, and this may impact how you use the materials. We have replaced the individual animal tracks with a new track sheet. While the tracks are a valuable resource, our research showed that many teachers struggled with ways to use them in more advanced ways. The track sheet addresses that problem. It is a large bed sheet with the tracks of some of the bone box animals printed on it. The tracks have been placed in a way to represent the movement of the animals across the space. Students now have the opportunity to engage in inquiry and problem solving activities while interacting with the sheet.

INTRODUCTORY LETTER

You have permission to copy any of the materials for your classroom use. In fact, we encourage you to put the included DVDs in your computer and copy them directly to your desktop. This will allow you access to the wealth of information and resources even after you have returned the box. We do ask, however, that you do not sell these materials. And if you use them, please cite them. For proper citation references, please send us an email to focuswild@azgfd.gov.

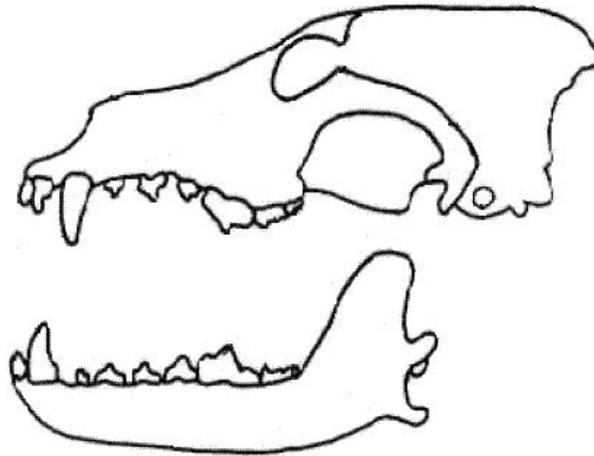
If you do remove pages from the Teacher's Guide to make copies, we ask that you put them back in their appropriate locations before returning the box. The entire Teacher's Guide can be found on the Bone Box Resource DVD. So, if you misplace any pages, simply find the PDFs on the DVD and print them out. This will ensure that any future users will have the same quality experience.

It is important to note that some cultures, particularly Native American ones, may have issues with some of the contents of this trunk. It may be taboo to touch or see pieces or pictures of certain wildlife. As a result, before using this Resource Trunk, make sure you are being sensitive to the diversity found in your classroom. Ask parents if they have problems with their children using these materials. To give you an idea of some of the difficulties you may encounter, check out the *Diné Traditional Teachings on Wildlife*. This book, designed for educators, focuses on the appropriate ways to use wildlife when teaching Navajo children. Although it is specific to the Navajo culture, it does provide useful insight. A PDF version of the book has been included on the Bone Box Resource DVD in the "Extension Items" folder.

As you become more familiar with the Bone Box Resource Trunk, we want to hear from you. Have you used the bone box in a unique way that you would be willing to share? Do you want additional materials included? It is possible that you may be selected to receive a follow-up survey. Please take the time to complete it. We value the feedback and will consider it as we move forward. But you don't have to wait for a survey. Feel free to send an email to focuswild@azgfd.gov and let us know what you think. We are already planning for the next renovation, and hopefully it won't take two decades!

As you can guess, a project of this magnitude involves many people. There are certainly more than can be recognized in this letter. However, a few people played pivotal roles. Melissa Steinman, a former teacher, did the majority of the creative work including the development of new lessons. The original research was compiled by Eric Proctor, the wildlife education coordinator for the Department. Eric also served as a guide throughout the renovation process. Mike Demlong, the wildlife education program manager, served as an editor and reviewer.

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



Background Info

This section is designed to provide important information about mammal biology. Detailed descriptions of important features of skulls and tracks are included. You will learn how to use skull characteristics to identify what an animal might eat and where it might live. In addition, since wildlife can be difficult to find in the outdoors, you will learn how to identify animals by the most readily available signs: the tracks they leave behind.

The Bone Box Resource Trunk contains replica skulls for 11 common Arizona mammals. Use the knowledge from this section to help you improve the learning experience for your students. The skulls are intended to be a tactile resource. Feel free to allow your students to handle them, to feel the difference between slashing incisors and grinding molars. If a skull does break, simply inform us when you return the box. This will ensure that we can make the necessary repairs or replacements to provide a quality experience for the teachers and students who will use the box when you are finished.

The Resource Trunk also contains a sheet with the tracks of a number of different animals painted on it. This track sheet is a valuable resource to guide inquiry learning and critical thinking. After identifying the animals that made the tracks, students can attempt to figure out what happened. Were all the animals there at the same time? What were they doing? How do they know?

As you read through the material, you will notice that some of the words appear in a **bold font**. These are vocabulary words that may be new to either you or your students. Definitions can be found in the glossary found later in this teacher's guide.

BACKGROUND INFORMATION

Tracks and skulls are examples of animal signs – clues that animals leave behind. They indicate the presence of wildlife even when the animals aren't directly seen. The Department's website provides some additional information to get you started on finding animal signs and increasing your chances to see wildlife. Please visit the following links to learn more:

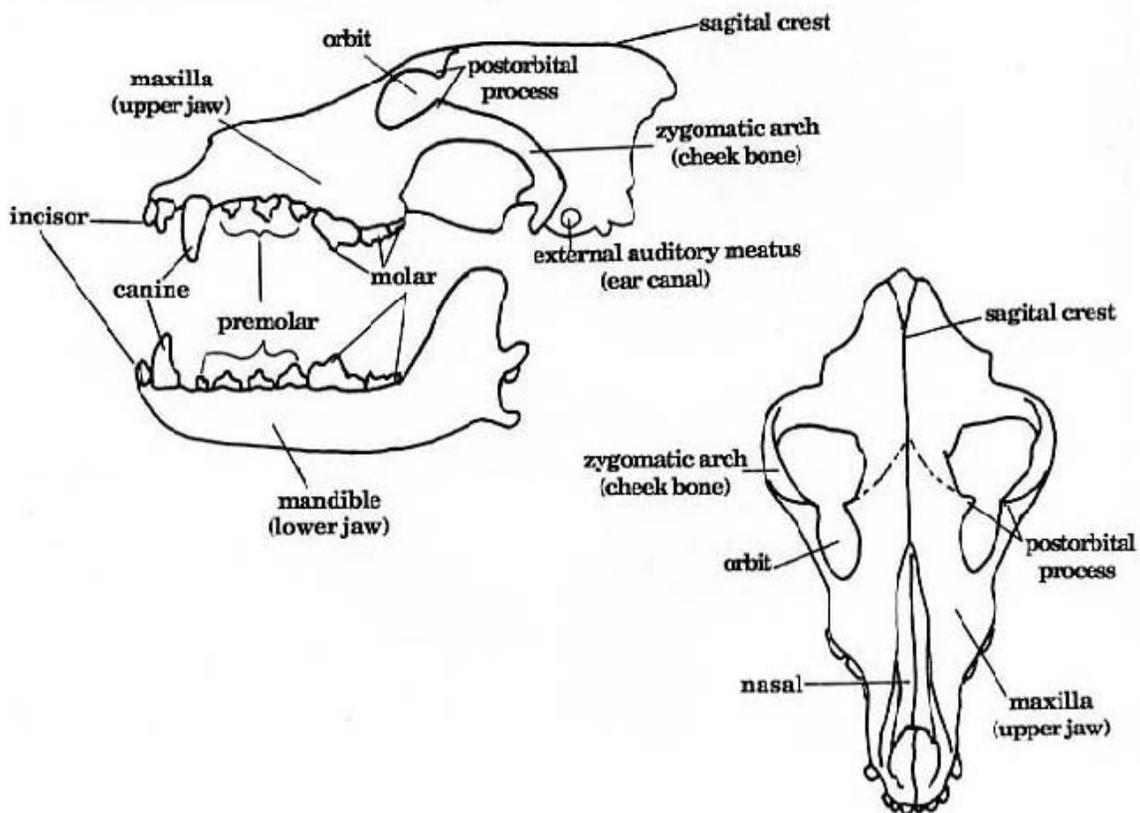
- Arizona wildlife viewing - http://www.azgfd.gov/outdoor_recreation/watchable_wildlife.shtml
- Arizona Watchable Wildlife Experience - <http://www.azwatchwildlife.com/>

In addition, a number of additional activities focused on observing animal signs are available as extension activities on the Bone Box Resource DVD provided with this resource trunk.



Skulls

Skulls can indicate many things about the habitat, behavior, and physical attributes of an animal. What did the animal eat? How big was it? Did it live in the forest, grassland, water, or even underground? Clues from a skull can often help us answer these questions. An animal's skull can provide insight into how good the animal's senses of vision and smell were. 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 often indicative of the animal's ability to smell. Long nasal bones hint at a good sense of smell. Animals with short noses generally have a poor sense of smell. These animals usually have good hearing or eyesight to compensate. Rabbits have a relatively poor sense of smell, but well developed eyesight and hearing. Coyotes, on the other hand, are well adapted with good eyesight, keen sense of smell, and keen hearing.

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.

BACKGROUND - Skulls

The eyes of most prey species are large and located towards the sides or 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, including front and back without turning the head. The beaver has eyes located towards the top of the head for the detection of predators while swimming!

Eyes of most predators are “forward looking” as in mountain lions, hawks, owls and humans. Forward facing eyes provide **binocular vision**, enabling 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 of the animal. Small eyes often indicate diurnal activity. Animals with small eyes relative to the size of their skull, such as bears and javelina, have poor eyesight. Animals such as bobcats and coyotes have large orbits, thus good eyesight. These animals often tend to be either nocturnal or crepuscular. The large eyes help them see in low light conditions.

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 provides sites for the large lower jaw muscles to attach, 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 four 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.

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 can eat efficiently. 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 against their counterparts in the upper jaw much like a pair of scissors. These teeth are used for ripping and tearing flesh. 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. As you can guess, omnivores that tend to eat more meat will usually have more sharp than flat teeth, and those that tend to eat more vegetation will have more flat than sharp teeth.

Not only do some animals have different types of teeth, they also have different numbers of teeth. For

BACKGROUND - Skulls

example, white-tailed deer have 32 teeth while a black bear has 42. A beaver only has 20 teeth! Biologists have developed an easy method to show the number and type of teeth that all mammals have. It is called a dental formula. The dental formula for a white-tailed deer is shown below:

$$\text{White-tailed deer: } \frac{0-0-3-3}{3-1-3-3} = 32$$

To understand the dental formula, we need to know some simple rules about what the numbers mean and where they come from:

1. Mouths are symmetrical, with the same number and type of teeth, from the left side of the mouth to the right. So, a dental formula only shows the teeth on one side of the mouth. To get the total number of teeth, the numbers in the formula must be multiplied by 2.
2. Some animals have different numbers and types of teeth on the top and bottom of their mouth. For example, a deer has three incisors on their bottom jaw but none on the top. To show this difference, the top teeth are represented above the line in the dental formula. The bottom teeth are below.
3. The different types of teeth always appear in the same order and location in the mouth. Incisors are always at the front. These are followed by the canines. The premolars and molars are found at the back. The numbers in the dental formula occur in the same order. So, the first number represents the number of incisors, the second is the number of canines, etc.

So, looking at the white-tailed deer's formula above, we know a number of facts about the animal, even if we have never seen its skull. As mentioned, it has a total of 32 teeth. Of these, 12 are on top and 20 on the bottom. (Remember: the dental formula only shows the number of teeth on one side! We have to multiply those numbers by two in order to get the totals.) Next, we know that the deer has no incisors or canines on top, and only two canines (one on each side) on the bottom. So, what does this tooth configuration tell us about the animal? Well, the deer lacks many of the teeth necessary for tearing meat and has many premolars and molars used for grinding. So, it is most likely an herbivore.

The table on the next page summarizes all of the features just discussed. It allows for a quick reference to compare the 11 skulls included in the Bone Box Resource Trunk.

Additional skulls can be found in some of the other resource trunks available from the Arizona Game and Fish Department. This includes a Bat Box and an Elk Box. Not all of the trunks are available at all Department offices. For more information about the other resource trunks, visit our website at <http://www.azgfd.gov/bonebox>.

Bone Box Skulls at a Glance

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

ANIMAL	NOSE	ORBIT	TEETH	DENTAL FORMULA
Beaver	Short	Large; toward top	Flat	$\frac{1-0-1-3}{1-0-1-3} = 20$
Black bear	Long	Small; toward front	Flat; few sharp	$\frac{3-1-4-2}{3-1-4-3} = 42$
Bobcat	Short	Large; toward front	Sharp	$\frac{3-1-2-1}{3-1-2-1} = 28$
Coyote	Long	Large; toward front	Flat and sharp	$\frac{3-1-4-2}{3-1-4-3} = 42$
Deer	Long	Large; toward side	Flat	$\frac{0-0-3-3}{3-1-3-3} = 32$
Gray fox	Long	Large; toward front	Flat and sharp	$\frac{3-1-4-2}{3-1-4-3} = 42$
Jackrabbit	Long	Large; toward side	Flat	$\frac{2-0-3-3}{1-0-2-3} = 28$
Javelina	Long	Small; toward side	Flat	$\frac{2-1-3-3}{3-1-3-3} = 38$
Mountain lion	Short	Large; toward front	Sharp	$\frac{3-1-3-1}{3-1-2-1} = 30$
Raccoon	Short	Large; toward front	Flat and sharp	$\frac{3-1-4-2}{3-1-4-2} = 40$
Ringtail	Short	Large; toward front	Flat and sharp	$\frac{3-1-4-2}{3-1-4-2} = 40$

Dichotomous Key to Bone Box Skulls

A common and useful tool for identifying living organisms is a **dichotomous key**. From the Greek *dicho* meaning “in two parts” or “in pairs,” dichotomous keys consist of a series of couplet statements. Each couplet contains two descriptions of a specific characteristic. The unknown organism is compared to each of the two statements to see which is a better description. Once a decision is made, directions are provided to the next appropriate couplet. This process continues until the identification of the unknown organism is made. Dichotomous keys are sometimes referred to as decision trees.

Some general rules of thumb to follow when you are using a dichotomous key:

- Always start at the first couplet. This is usually indicated by the number 1 or the letter A.
- Read both statements in the couplet carefully before making a choice. You do not want to jump at the first option just because it sounds like it might fit.
- Follow the directions at the end of the statement exactly. Often, people forget to skip to the appropriate couplet and simply move to the next consecutive one in the key.
- Take notes. It is easy to get lost or distracted as you move through the key, especially long ones.
- When you have identified the organism, go back and check your work. If possible, have someone else check to see if they come to the same conclusion.

There are dichotomous keys for just about all living things including insects, trees, wildflowers, and fish. The key on the next page can be used to help you or your students identify the skulls found in the Bone Box Resource Trunk*. In addition, the Arizona Game and Fish Department provides an excellent interactive key to help people identify common captive turtles. This web-based key is found at http://www.azgfd.gov/w_c/turtleID_chart.shtml.

** Please note: The skunk is not actually included in the Bone Box Resource Trunk. It is listed in the dichotomous key to provide a little more challenge to students and to show the similarities between animals.*

Key to Common Arizona Mammal Skulls

1a	Canines absent	Go to 2
1b	Canines present	Go to 4
2a	Upper incisors present	Go to 3
2b	Upper incisors absent; orbits fully enclosed by bone	DEER
3a	Large orange incisors; 8 molars on either the upper or lower jaw	BEAVER
3b	Incisors white; second set of peg-like incisors behind the top front pair; fenestration (lots of openings on maxilla)	RABBIT
4a	Cheek teeth flat with rounded cusps (similar to human teeth)	JAVELINA
4b	Cheek teeth a mixture of both sharp and flat teeth	5
5a	Short nasal bones: 3 lower cheek teeth on each side of jaw; cheek teeth narrow with pointed centers	6
5b	More than 3 lower cheek teeth on each side of the jaw	7
6a	4 upper cheek teeth per side of jaw (first and last cheek teeth are smaller than the others)	MOUNTAIN LION
6b	3 upper cheek teeth per side of jaw (last greatly reduced)	BOBCAT
7a	No or poorly developed postorbital process	8
7b	Postorbital process developed	9
8a	3 to 5 cheek teeth on side of upper jaw; no nasal sutures visible	SKUNK
8b	6 cheek teeth on each side of upper jaw; nasal sutures visible	RACCOON
9a	Molars with rounded cusps; some premolars absent (large gap between premolar and canine)	BLACK BEAR
9b	Cheek teeth sharp and evenly distributed	10
10a	U-shaped ridge on top of skull	GRAY FOX
10b	Single ridge on top of skull; upper incisors lobed in front	COYOTE

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 set of tracks; it just takes time to interpret the story.

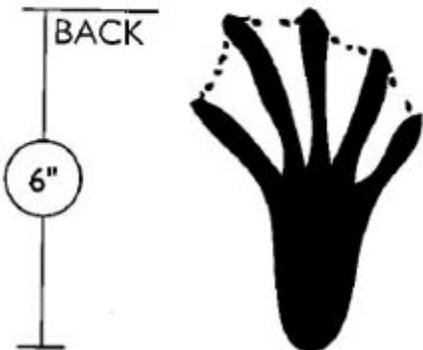
Interpreting tracks is not an easy task, and takes some detective work. There are a few broad principles to use (number of toes, overall shape of foot, claw marks, etc.), but none of these principles are hard and fast. There will always be a track that breaks every rule. The **substrate** in which the 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, windswept 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). Even lighting can affect the appearance. A track can look remarkably different in the morning and the afternoon! Shadows can both highlight and hide certain identifying features.

When interpreting the story behind tracks, look forward and back from your initial starting point. You may discover a day bed of a jackrabbit, or 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.

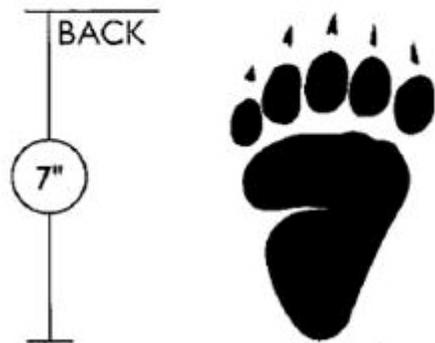
On the next few pages are animal tracks and some track features that may help identify the track-maker. In general, only a few of these features will be seen in any given single track. The examples below are of "perfect" tracks. Tracking an animal using footprints alone can be time and labor intensive. Today wildlife specialists use technology to track animals from remote locations. This technology allows them to track birds as they fly, mammals as they migrate and even fish as they swim. More information about tracking techniques is available in our Tracking Resource Trunk. Like the bone box, this trunk can be checked out for free from the Arizona Game and Fish Department. For more information about the Tracking Trunk or other resource boxes, visit <http://www.azgfd.gov/bonebox>. Currently, this trunk is only available from our main headquarters office in Phoenix. As additional locations are added, they will be included on the website.



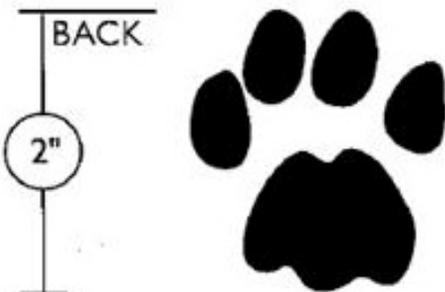
BEAVER



BLACK BEAR



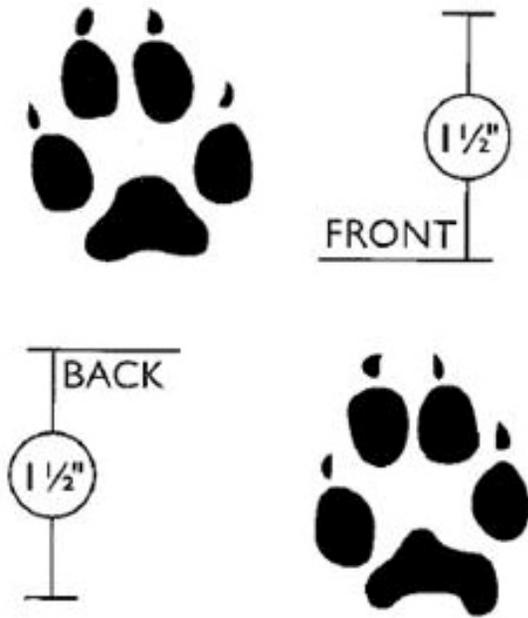
BOBCAT



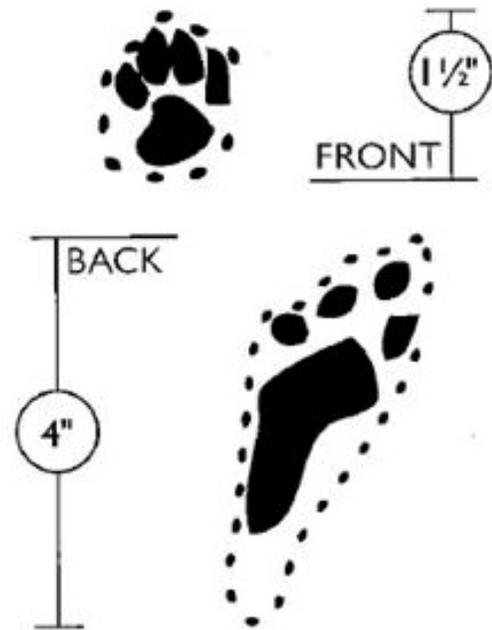
COYOTE



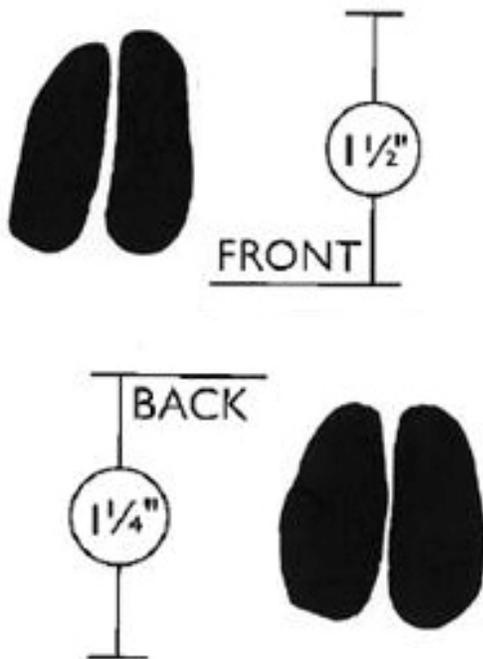
GRAY FOX



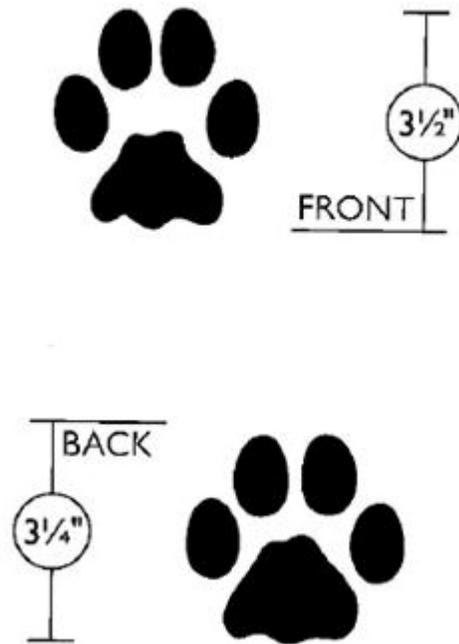
JACKRABBIT



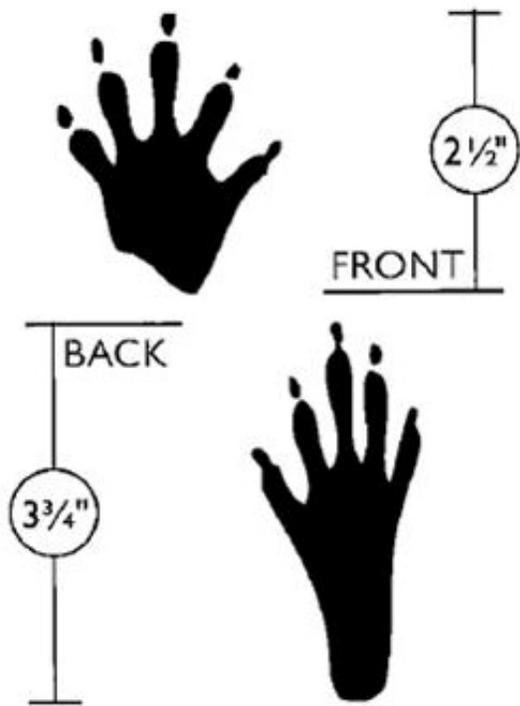
JAVELINA



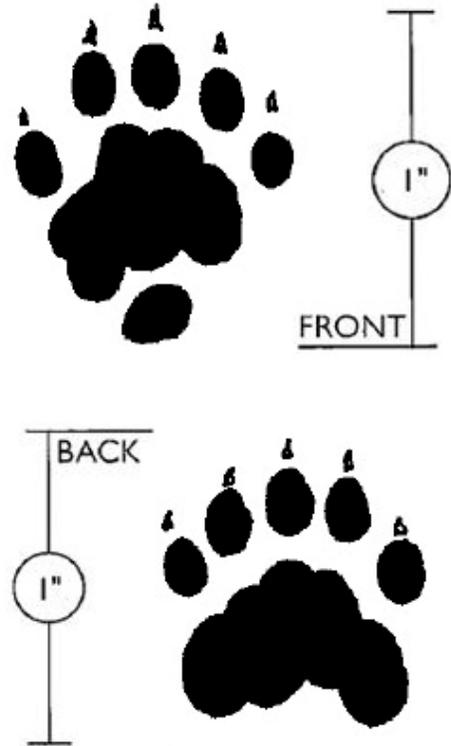
MOUNTAIN LION



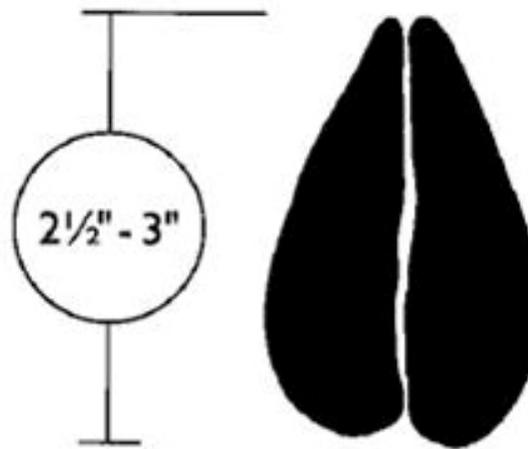
RACCOON



RINGTAIL



WHITE-TAILED DEER



Tracking Sheet at a Glance

This is a quick reference to the tracking sheet included in the bone box. It will give you some basic information about the animals represented and some helpful clues.

TRACKING SHEET IMAGE

Below is a representative image of the tracking sheet.



DESCRIPTION

This sheet was developed with a basic storyline in mind. The animals were “caught in the act” and the tracks help us determine what they were doing. In this case:

A mountain lion was walking along (tracks moving from the lower right to the upper left). Later, a coyote was walking through (tracks in the middle right side) and smelled the former presence of the lion. The coyote followed the tracks for a little while before noticing a jackrabbit (tracks in the middle left side). The coyote then chases the jackrabbit and the rabbit jumped away.

Students should be able to look at the sheet, identify the animals, find clues and come up with a similar story.

BACKGROUND - Tracks

CLUES AND HINTS

It may be necessary to ask some guiding questions to help move students to the correct interpretation. Here are some questions and answers that can help facilitate discussion:

- How many animals are represented on the sheet? How do you know? *Answer: There are a total of three animals. They are the mountain lion, coyote and jackrabbit. There are multiple tracks for each animal. For each different animal, the tracks appear in a repeating pattern which seems to indicate they belong to a single animal as opposed to multiple animals. Students should notice that even though the tracks may be from the same animal, not all of the prints are the same. This is the case in nature. Rarely do we find a “perfect” track. Sometimes, depending on the surface substrate, you only get partial tracks. Sometimes the tracks become more pronounced during different behaviors. For example, when an animal runs, it tends to push down harder. Therefore, these tracks may appear bigger and clearer.*
- Did all of the animals appear at the same time or did some pass through before others? How do you know? *Answer: The location and placement of the tracks hints at the behavior of each of the animals. They seem to indicate that the animals were not all present at the same time. When we look at the mountain lion, its tracks are consistent across the sheet. There is no change in stride length or walking pattern. This particular set of tracks indicates that the lion was not in a hurry, most likely walking through this area. It probably came through first. Later, a coyote entered the scene. In the beginning it was walking. Once it reached the location of the lion tracks, however, it changed direction. It appears to follow the lion. Like other canines (including domestic dogs), it likely picked up the scent of the lion (which had gone through this area earlier) and decided to follow it. In both of these cases, the coyote continues to walk. We can tell this by the similar gait observed in the tracks. Notice how the right and left feet alternate steps (see the picture to the right). A little while later, the coyote picks up the scent of another animal – the jackrabbit.*



In this case, the jackrabbit is actually there, most likely feeding on some grass. The coyote takes off running. Notice how the track pattern has changed (see the picture to the left). Now, the coyote places two left feet down and then two right feet down. This is indicative of a run. Once the coyote starts running, the jackrabbit takes off as well. We cannot tell from the information on the sheet whether or not the coyote successfully caught the rabbit. If a kill took place, it occurred off the confines of the sheet.



There are many ways to tell the difference between the tracks of canines (represented by the coyote) and felines (represented by the mountain lion). On the left is a relatively standard mountain lion track. On the right is a coyote. The tracking sheet is able to highlight a few main differences:



- Most felines have **retractable claws** and, therefore, do not leave toenail marks. Since cats rely on their claws to help them take down prey, they need them to be sharp at all times. If they ran with their claws exposed, they would have a better chance of breaking.
- The overall shape of the tracks is slightly different as well. If you were to draw a circle around each of the tracks, you would notice that the canine track tends to be more elliptical. It is longer than it is wide. The feline track is much more round.
- Another difference between the tracks is the amount of space between the main pad and the toes. Notice that the coyote track is much more compact. There is very little space. The lion, however, has a large amount of empty space between the toes and the main pad.



Natural History Notes

This section includes general information and fact sheets about each of the animals in the bone box. In cases where Arizona has more than one species (such as deer), information is provided about all of the representatives even if skulls or hides of all species are not included in the box.

There are two types of fact sheets used. When available, “Wildlife Field Notes” are used. These are published in the Arizona Game and Fish Department’s award-winning magazine *Arizona Wildlife Views* and a different animal is featured in each issue. To learn more about this magazine, visit <http://www.azgfd.gov/magazine>. Electronic copies of the provided “Field Notes” are included on the Bone Box Resource DVD. Additional animals can be downloaded from the “Resources” section of our web site.

When “Wildlife Field Notes” are not available, the fact sheet comes from the “Mammals of Arizona” booklet. Published a number of years ago, this free booklet makes a great classroom resource. The full version can be found on the Bone Box Resource DVD in the resource trunk. You can also download it and two similar booklets from the “Resources” section of our website, <http://www.azgfd.gov/focuswild>.

Some of the animals in the bone box are common visitors to urban environments or other areas where people recreate. Sometimes this can be a problem. As a result, the Arizona Game and Fish Department provides numerous resources focused on “Living with Wildlife.” These resources can be found at a convenient website http://www.azgfd.gov/w_c/urban_wildlife.shtml. Electronic copies of many of these resources have also been put on the Bone Box Resource DVD.

NATURAL HISTORY NOTES

The Department's website provides a wealth of information about each of the animals in the bone box, including photos and videos. Please visit the following links to learn more:

- Beaver - http://www.azgfd.gov/h_f/game_bever.shtml
- Black bear - http://www.azgfd.gov/h_f/game_bear.shtml
- Bobcat - http://www.azgfd.gov/h_f/game_bobcat.shtml
- Coyote - http://www.azgfd.gov/h_f/game_coyote.shtml
- Cottontail rabbit - http://www.azgfd.gov/h_f/game_cottontail_rabbit.shtml
- Foxes - http://www.azgfd.gov/h_f/game_foxes.shtml
- Javelina - http://www.azgfd.gov/h_f/game_javelina.shtml
- Mountain lion - http://www.azgfd.gov/h_f/lion_splash.shtml
- Mule deer - http://www.azgfd.gov/h_f/game_mule.shtml
- Raccoon - http://www.azgfd.gov/h_f/game_raccoon.shtml
- Ringtail - http://www.azgfd.gov/h_f/game_ringtail.shtml
- White-tailed deer - http://www.azgfd.gov/h_f/game_cues.shtml



Black Bear

BY STAN CUNNINGHAM • ILLUSTRATION BY ZACKERY ZDINAK

Scientific Name: *Ursus americanus*.

From the Latin *ursus* meaning bear or “destroyer” and *americanus* referring to where this species is found. Early scientists recognized 18 subspecies, but used much less rigorous methods in making distinctions than those used today. Size and color differences do exist, however, throughout North America.

Description: Southwestern black bears average 28–33 inches at the shoulder when on four feet, and about 6 feet tall when standing up. Adult females average 145 pounds; males 275. Some males weigh more than 400 pounds, but they are rare. In the Southwest, 75 percent of black bears are actually dark or reddish brown or even blond. A black female may have both black and brown cubs, but they are all black bears.

Distribution: Black bears inhabit 38 states, 11 Canadian provinces, and seven Mexican states. In Arizona, they occupy southeastern, central, and northeastern mountain ranges. Due to less reliable food sources above the Mogollon Rim, density is half to a third of that found in central and southeastern Arizona. Interestingly, they are rarely seen in coniferous areas north of the Colorado River.

Habitat: Black bears inhabit most forest types, are common in interior chaparral adjacent to forests, and during prickly pear fruiting season, even use the Sonoran desert. Riparian areas are important in all vegetation types. They seek large trees, high cover, tree canopy of greater than 50 percent, and steep slopes. Large trees are important for cubs to avoid predation.

Biology: Hibernation is the central component of a black bear’s annual cycle. A hibernating bear generally does not drink, eat, defecate, or urinate for

up to seven months. During hibernation, metabolic activity is generated from energy stored in fat. A bear’s heart rate can drop to 8–10 beats per minute, lowering their metabolic rate 25–50 percent.

Breeding occurs in early summer, although fertilized embryos remain in the fallopian tubes and development does not begin until the female constructs or enters her den. If the female is healthy, the fetus implants in the uterine wall and a 90-day gestation period follows. If she is not in good shape, the fetuses abort. Cubs are born in January or early February and weigh only 8–10 ounces at birth. Litter size averages two.

During the breeding season, males travel long distances trying to impregnate as many females as possible. Females with yearlings or no cubs are receptive to males. Females with new cubs avoid males since they often kill cubs. It is assumed that male black bears recognize and do not kill their own cubs, but this has yet to be demonstrated.

Cubs generally remain with their mothers 14–18 months, denning with them the second winter. The bond is broken when adult females come into estrus. Young bears, especially immature males, must leave to avoid encounters with adult males and often disperse long distances. Conversely, female bear cubs often establish their home range adjacent to their mother’s. Natural life expectancy of black bears varies regionally, but 20 years or more in the wild is not uncommon.

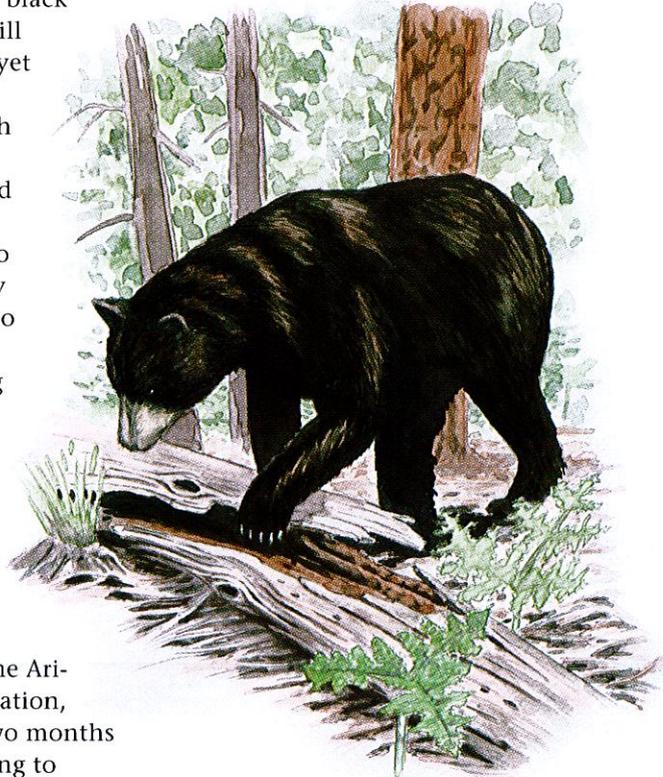
More than 75 percent of the Arizona black bear’s diet is vegetation, primarily grass for the first two months after leaving the den, switching to

early maturing fruits and animal matter (primarily insects) in midsummer, and important mast species late summer and fall. Areas that provide several species of acorns are premium habitat.

Status: Increased interest by hunters prompted the reinstatement of black bears as big game animals in 1968. The most important restriction in black bear hunting is the female quota system, which closes a hunt unit after a certain number of females have been taken.

Management: Because of their high selection for cover, research on the effects of forest thinning is important for the preservation of black bear habitat. ♣

Research biologist Stan Cunningham has focused his career on the study of large mammals, including mountain lions, bighorn sheep, and black bears.

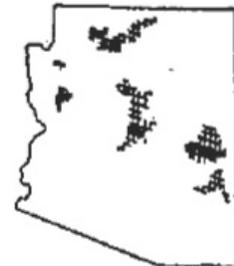


Beaver: *Castor canadensis*

Spanish name: castor; nutria

Description: The largest rodent in North America, weighing up to 80 pounds. Beaver fur is dense, fine and rich brown in color. Hind feet are webbed and the tail is broad, flat and hairless. They can reach 3-4 feet in length and 15 inches in height.

Range: Most major rivers and streams of the state.



Habitat: Mountain and desert streams or rivers having cottonwood, willow, or aspen nearby.

Niche: An aquatic herbivore, feeding almost exclusively on the bark of trees. Semi-nocturnal. Beaver are preyed upon by larger carnivores.

Life History: Following a four-month gestation period a litter of 1-4 kits are born in late spring or early summer. Life span may be 10-12 years.

Comments: Beavers change the environment to suit their needs by constructing dams. They are found in many desert rivers such as the Salt, Verde, Colorado, and Gila. Formerly found in the Santa Cruz, and others. They are also found in high mountain lakes and streams.



Bobcat

SCIENTIFIC NAME: *Lynx rufus*. From the Latin *lynx* meaning “light,” in reference to its shining eyes, and *rufus* meaning red, which refers to its sometimes reddish color. Scientists describe 11-14 subspecies of bobcats, with *Lynx rufus baileyi* only occurring in Arizona. Bobcats also are called wildcats, bay lynx, catamounts, barred bobcats, pallid bobcats, red lynx, and cat lynx.

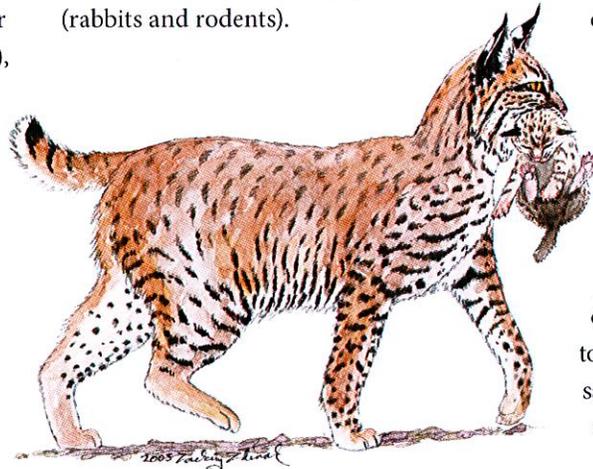
DESCRIPTION: The bobcat is named for its short “bobbed” tail (4-8 inches long), which is its most distinguishable feature. Bobcats are medium-sized cats—2-2 1/2 feet long and weighing from 12 to 30 pounds (males are larger than females). They have conspicuous side whiskers and a neck ruff; fur colors range from reddish tan to gray with whitish undersides and mottled dark spots. Their long erect ears are tipped with black tufts.

DISTRIBUTION: Bobcats are distributed throughout Arizona and are found in all habitat types. Bobcats are frequent visitors in urban areas. They are distributed throughout the rest of the United States, but are more frequently found in the western states.

HABITAT: Although found in all Arizona habitat types, the highest bobcat population densities are found in Sonoran desert-scrub, Great Basin conifer woodland, and chaparral habitats. In general, bobcats prefer areas with rocky terrain, thick cover, and abundant prey populations.

BIOLOGY: Bobcats’ primary prey is cot-

ontail rabbits and jackrabbits. Unlike their cousins the lynx, however, bobcats often prey on other species—rodents, reptiles (including rattlesnakes), birds, and, less frequently, ungulates such as mule deer, whitetail deer, javelina, and pronghorn. Bobcats can be active at any time, but are considered to have a crepuscular (dawn and dusk) activity peak. This activity pattern is based on activity patterns of most of their prey species (rabbits and rodents).



Home ranges vary greatly in size based on the quality of the habitat and the sex of the bobcat, but are found to range from about 1 to 20 square kilometers. Bobcats will mark their home ranges by deposits of urine, feces, and scrapes.

Bobcats become sexually mature at 12 to 24 months of age. The peak breeding period is late winter or early spring, with birth following 50 to 60 days later. Litter sizes are generally two to four kittens. Young disperse from their mothers at age 1.

STATUS: Bobcats are designated as both furbearers and predators in Arizona, and are considered abundant throughout the state

in appropriate habitat. Bobcats are often harvested for their furs, which can be quite valuable. Although they are not threatened, bobcats are listed under Appendix II of the Convention on International Trade in En-

Bobcats are distributed throughout Arizona and are found in all habitat types.

dangered Species of Wild Fauna and Flora (CITES) because of their similarity to other threatened species and the commercial value of their pelts. Arizona, along with several other states, has demonstrated to the U.S. Fish and Wildlife Service that the management and harvest of bobcats within Arizona is not detrimental to the species, and continued harvest and sale of bobcat pelts is currently allowed under the CITES agreement.

MANAGEMENT: Harvest of bobcats is allowed during the trapping season and the sport-hunting season for predators and furbearers. Last year there were about 265 bobcats harvested through a combination of trapping and hunting. The Arizona Game and Fish Department monitors bobcat population and harvest by periodically assessing the population age structure through tooth analysis and through hunter surveys. The Department’s Research Branch is currently testing bobcat survey methods, such as track and scent-post surveys for future use. 🦋

■ Pat Barber is the Game Branch’s predator and furbearer biologist.

Coyote: *Canis latrans*

Spanish name: coyote

Description: Very dog-like, with pointed muzzle and sharp, erect ears. The fur is thick, fairly long and coarse, grayish or tawny; underparts lighter. The bushy tail is often tipped with black. Height: 18-24 inches, length: 32-40 inches, weight: 20-40 pounds.

Range: Statewide

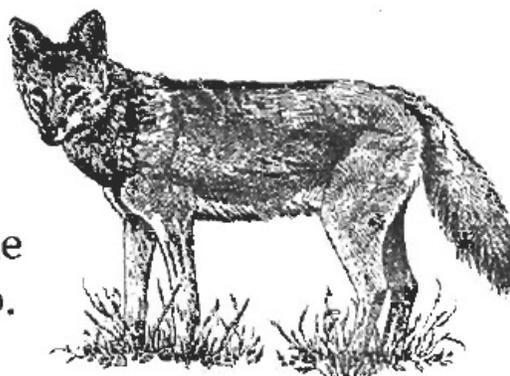
Habitat: Perhaps the most adaptable animal in the state. Lives in the driest deserts, pine forests, and within city limits.



Niche: A predator that preys on nearly every prey species – but who also eats a wide variety of plant and insect material, scavenges garbage cans, and readily eats carrion. Coyotes are occasionally preyed upon by lions.

Life History: An average litter contains 4-5 pups, but like most dogs, can have many more. Pups are born in spring.

Comments: Coyotes have more than held their own despite extreme pressure from humans in the past. Now nearly every state has a coyote population. History tells us there were no coyotes east of the Mississippi River 200 years ago.



Mule Deer: *Odocoileus hemionus*

Spanish names: venado bura; bura; venado;
venado mula

Description: A large deer that may weigh more than 200 pounds. The summer coat varies from yellowish to reddish; winter coat is dark gray. Insides of legs, underparts and rump are whitish. The short, stumpy tail is tipped with black. Males (bucks) have branched or forked antlers.

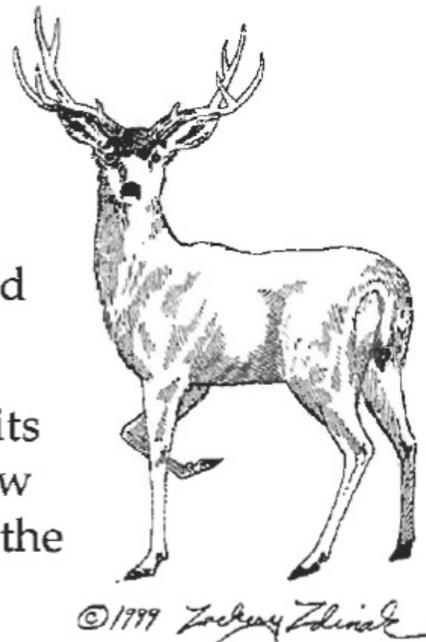
Range: Most of the state, from the highest mountains to the low desert plains.

Habitat: Forest, chaparral and desert scrub communities.

Niche: A large herbivore whose diet varies depending on season, vegetative type where it lives, and climatic conditions. Deer are preyed upon by large predators, particularly mountain lions.

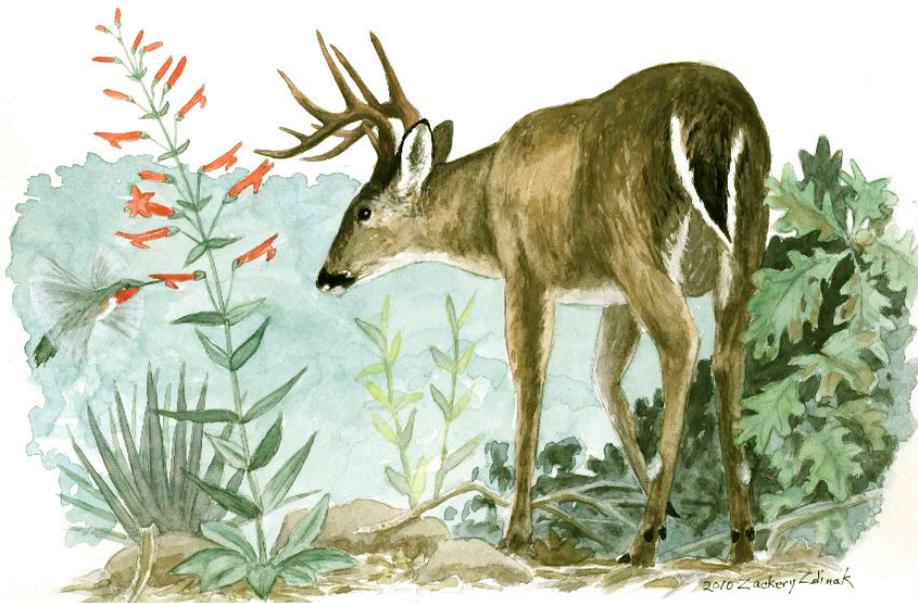
Life History: Fawns, usually twins, are born in midsummer. Deer may live to 10 years in the wild but average only 3 to 3 ½ years.

Comments: This deer is named for its large ears. Bucks grow and shed new antlers annually. The main forks of the antlers are equally branched.



Coues' White-tailed Deer

ILLUSTRATION BY ZACKERY ZDINAK



SCIENTIFIC NAME: *Odocoileus virginianus couesi*. The genus name *Odocoileus* is derived from the Greek words *odous*, which means “tooth,” and *koilos*, which means “hollow.” This is a reference to the hollow teeth of deer. The species name *virginianus* is a Latinism meaning “from Virginia,” for the region where the type specimen was collected for naming. The subspecies *couesi* is in reference to naturalist Elliot Coues, who described this species in great detail in 1875. The common name “Coues” often is mispronounced “cooz,” but it is properly pronounced “cows.”

These deer do not live in large herds, but tend to remain in small groups or as individual animals.

DESCRIPTION: The Coues' white-tailed deer is a smaller subspecies of the white-tails of the eastern United States. Coues' whitetails stand 28–32 inches high at the shoulder and measure about 56 inches

from head to tail. A large, mature male can weigh up to 125 pounds and mature females weigh up to 80 pounds, but the average weight is less.

The deer's coat is grayish in winter and closer to mahogany in summer. When fleeing perceived danger, whitetail deer display the prominent, bright white outside edge and underside of their broad, triangular, flag-shaped tail (hence their common name). White hair encircles the eyes and muzzle. Fawns are born with white spots across their back, which disappear after a couple of months. The antlers of a mature male Coues' whitetail buck differ from those of a mule deer in that they have one main beam that curves forward and individual tines that branch off the main beam. Coues' whitetails are extremely wary.

DISTRIBUTION: In Arizona, Coues' whitetails can be found from the White Mountains west along the Mogollon Rim to central Arizona, and in suitable habitats in southeastern and southcentral Arizona. Their range also enters southwestern New Mexico and northern Mexico.

HABITAT: Occupying a wide variety of habitats at elevations of 3,000–10,000 feet, Coues' whitetails show preference for the lower third of that range. Habitat types include upper Sonoran desertscrub, oak-juniper woodland, chaparral, ponderosa pine and mixed-conifer forest. Reliable water sources are necessities within their habitats.

BIOLOGY: These deer do not live in large herds, but tend to remain in small groups or as individual animals. The breeding season, or “rut,” occurs in December and January. Polygamous bucks continually search for receptive does and will challenge other males for access to females. Does give birth to twin fawns in late July and August.

Only males of this species produce antlers. Bucks cast their antlers in late spring and immediately begin to grow a new set, which are fully formed by early October.

Whitetail deer are browsers: They prefer forbs, but also consume shrubs, mast, cacti fruits and grasses.

STATUS: The overall population of Coues' whitetails has declined during the past 20 years, but this has not been nearly as steep as the declines seen in mule deer. At present, the population is stable. This is a hunted species with a relatively stable harvest.

MANAGEMENT NEEDS: The extended drought has been the biggest factor affecting the habitats on which these deer rely. Other factors include human encroachment and climate change. The challenge is to protect, preserve and enhance existing critical habitats, so that when precipitation returns to normal levels, this species will flourish and expand in number and range. 🦌

■ Johnathan O'Dell is the Arizona Game and Fish Department's statewide wildlife specialist for game species.

Gray Fox

BY TERRY B. JOHNSON • ILLUSTRATION BY ZACKERY ZDINAK

SCIENTIFIC NAME: *Urocyon cinereoargenteus*. Genus derived from the Greek *uro*, for tail, and *kyon*, meaning dog. Specific epithet formed from the Greek words for ash-colored (*cinereus*) and silver (*argenteus*).

DESCRIPTION: Adult gray foxes are even smaller than coyotes. They stand about 14-15 inches tall at the shoulder, and measure about 32-44 inches from nose to base of the 16- to 18-inch tail. They weigh just 6-10 pounds in the Southwest. Females are slightly smaller than males. In both sexes, the fur is coarse and mostly gray in color, with flashes of reddish along the sides of the neck, flanks, legs, and underside of tail. The belly and undersides are typically buffy. The tail is variable, but always tipped black. The face is distinctive: a rather long, narrow muzzle that is set off by relatively large, triangular ears.

HABITAT: Generally occupies more open habitats, from low desert at 100-foot elevation or lower well up into brushy and sparsely wooded, rocky slopes and canyons up to and above 9,000 feet in elevation. Plant communities most often occupied include desertscrub, desert grassland, chaparral, and oak and pine woodland. Urban settings with ample cover also often provide safe haven.

DISTRIBUTION: West Coast (scrub and mountains) of the United States through the American Southwest and throughout the states east of the Great Plains. Also occurs in southern Canada and southward into Mexico. Occurs virtually statewide in Arizona.

BIOLOGY: Gray fox biology is pretty well known. Adults den in hollow trees, cavities under logs and bushes,

rock crevices, and sometimes burrows—both self-excavated and appropriated from other species. Some dens are well up in trees (to 30 feet or more), reflecting this species' ability to climb trees with surprising alacrity. Gray foxes sometimes leap from tree limb to tree limb, in a manner more typically associated with tree squirrels.

Like most foxes, gray foxes are territorial. They mark their territorial boundaries with urine, feces, and with scent from glands on either side of the anus. The scent gland products are quite pungent, and the odor may seem reminiscent of skunk.

Breeding occurs from January to April. Litters average two to seven pups, born about 51 to 53 days after impregnation. The kits emerge from the den at 5 weeks of age, and stay with the parents for another 10 to 11 weeks. Then they become independent and may wander far and wide. Sexual maturity occurs at about 1 year of age.

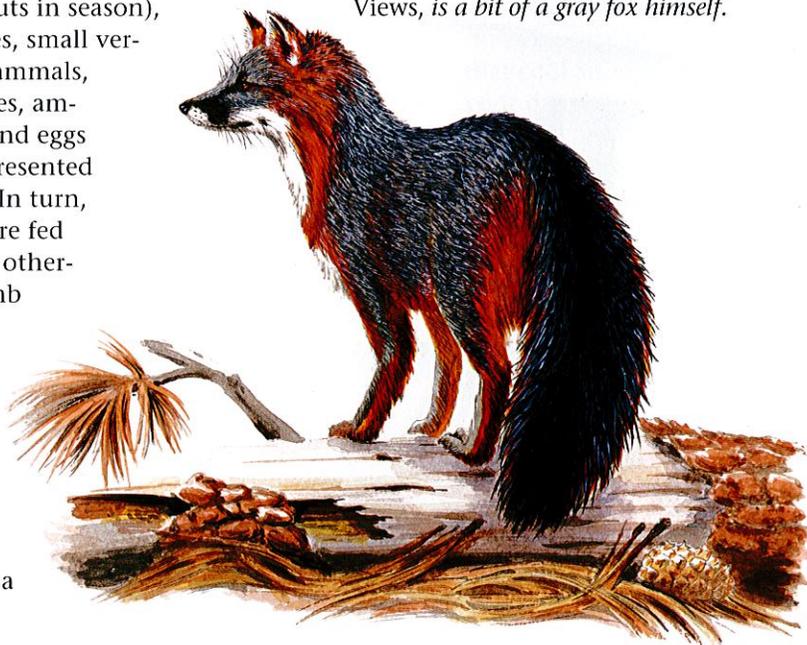
Gray foxes forage widely (day or night), and their tastes are varied. Plant material (especially fruits and nuts in season), invertebrates, small vertebrates (mammals, birds, reptiles, amphibians), and eggs are well represented in the diet. In turn, gray foxes are fed upon by, or otherwise succumb to, golden eagles, coyotes, bobcats, and any other predator of sufficient size to pose a threat.

A variety of diseases are associated with gray foxes, including rabies—outbreaks of which have recently been noted in southern Arizona, the Flagstaff area, and other parts of the state. Canine distemper can be a real problem where unvaccinated domestic dogs are allowed to run free.

STATUS: The gray fox is not on the Department's list of *Wildlife of Special Concern in Arizona*, nor is it being considered for federal listing. The species is considered quite common here; no population declines have been noted, other than short-term, local die-offs associated with disease outbreaks. Take by hunters and trappers is regulated by the Department; the numbers of gray foxes harvested each year seems more closely aligned with fur prices than with anything else.

MANAGEMENT NEEDS: None. 🦋

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Terry B. Johnson, chief of the Department's Nongame and Endangered Wildlife Program and regular contributor to Wildlife Views, is a bit of a gray fox himself.



Kit Fox

SCIENTIFIC NAME: Two species of arid-land foxes, the kit fox (*Vulpes macrotis*) and the swift fox (*Vulpes velox*), were initially considered to be similar but separate. Recently the two have been grouped as a single species (*Vulpes velox*) with two subspecies, *V. v. macrotis* (kit fox) and *V. v. velox* (swift fox). Swift foxes are not found in Arizona, but inhabit the central prairies as far west as Colorado and New Mexico.

Kit foxes are the smallest wild canines in North America. *Vulpes* is Latin for “fox,” *velox* is Latin for “swift,” and *macrotis* is a Latin word derived from Greek words meaning “long ears.”

DESCRIPTION: Adult kit foxes usually weigh 3–5 pounds. Males average 4 pounds, slightly heavier than females (3.7 pounds). Overall coat color is pale, ranging from buff to gray with seasonal variations. Fur on shoulders and front legs is distinctly reddish, the bushy tail is gray-black and darkest on the tip, and underparts are white. Adults have abundant white-tipped guard hairs that give them a “grizzled” appearance. Overall length from nose to tail tip is 1.9–2.8 feet. Ears appear large relative to the body and head, and are larger than those of other small North American canids.

DISTRIBUTION: Kit foxes inhabit arid regions and are most common in low-elevation, desert-like habitats in the western United States. In Arizona, they are distributed widely across the southern, western and northeastern portions of the state.

HABITAT: Throughout their range, kit foxes are primarily associated with desert shrub or shrub-grass habitats. They appear not to need free-standing water, meeting their water requirement through metabolic processes instead. Dens are vitally important to kit foxes, providing more moderate habitat temperatures in both summer and winter, a factor that greatly reduces the animal’s water needs.

Kit foxes are almost entirely nocturnal. They produce a series of alarm, fear or distress sounds, including barking, to alert other kit foxes of danger.

BIOLOGY: Kit foxes primarily eat small mammals (particularly rodents such as kangaroo mice, pocket mice and wood rats), but these opportunistic predators may prey on numerous species of mammals, birds, reptiles and insects. The number of kit foxes and the density of kit fox and prey populations fluctuate as a result of unreliable desert precipitation.

Kit foxes are almost entirely nocturnal. They produce a series of alarm, fear or distress sounds, including barking, to alert other kit foxes of danger. They growl to intimidate other kit foxes or other canid species.

The breeding season occurs during December and January, with three to six pups born during February and March. Pups are independent of their parents at 4–5 months of age. Pair formation begins during

October and November, with pairs remaining together at least until young are weaned. Males seem to provide most of the food for females and litters during pup rearing. Females are very attentive to young pups.

Kit foxes may live to be 8 or 9 years old, but generally, 90 percent to 95 percent of a population is less than 5 years old. Their primary sources of mortality include vehicles, great horned owls, bobcats and coyotes. Juveniles typically have a lower survival rate than adults.

STATUS: Though kit fox populations have declined in recent years due to drought and local habitat disturbance, they are still common throughout their range in Arizona.

MANAGEMENT NEEDS: Kit foxes fill a unique niche in Arizona, inhabiting arid regions with sparse vegetation. These habitats have undergone extensive modification over the past century, and the abundance of kit foxes has declined substantially in many areas. As with other species that rely on fragile desert environments, the kit fox’s greatest management need is for humans to identify and preserve these habitats. 🦊

■ Ron Day is the predator and furbearer biologist for the Arizona Game and Fish Department.



ILLUSTRATION BY ZACKERY ZDINAK



Javelina

BY JOHN PHELPS, GAME BRANCH, AND
TERRY B. JOHNSON, NONGAME BRANCH
ILLUSTRATION BY NATHAN REDWOOD

SCIENTIFIC NAME: *Tayassu tajacu*. Both the genus and specific epithet are of native Brazilian origin, probably meaning “gnawer of roots” and “peccary,” which in turn means “one who makes paths through the forest.” Known in Central and South America as the “collared peccary,” derived from pale collar of hair across the shoulders and upper back. “Javelina,” which applies to the more northerly populations, is derived from the Arabic *jabali* or *jabaliy*, meaning spear, a reference to the weapon (javelin) historically used to hunt wild boars.

DESCRIPTION: Javelina are not rodents, as some people believe. Although generally referred to as “New World pigs,” technically they are not pigs, either. They are best described as “pig-like.” Arizona javelina average 19-inches tall at the shoulder and 35 inches from snout to vent; weight 35 to 60 pounds. Reds (piglets or piglings) are several inches tall and about as long. Newborns weigh about one pound. Javelina hair is coarse, wiry, and variably colored, ranging from pale gray to dark brown or black. Seasonal molts affect pelage color. Reds are reddish-brown (hence the name) or tan, with a dark stripe down the middle of the back.

DISTRIBUTION: From Argentina north to Arizona, New Mexico, and Texas. In Arizona, from the southeastern corner west to Cabeza Prieta National Wildlife Refuge, north to Cataract Canyon, and along (mostly below) the

Mogollon Rim. Distribution here has increased in recent decades, perhaps in conjunction with a general warming trend in winter temperatures.

HABITAT: Sonoran or Chihuahuan desertscrub vegetation at elevations below 3,500 feet, upward through riparian canyons and semidesert grasslands to scrub oak, chaparral, and open oak-pine woodland at 4,500-6,000 feet. Sometimes occurs in other vegetation types (e.g., open pine forest edges) at higher elevations. Caves, overhangs, mine shafts, and similar cover are essential for refuge from harsh weather and cold nights. Tropical in origin and cannot tolerate cold weather, lacking the guard hairs that insulate many other mammals against the cold.

BIOLOGY: In Arizona, the javelina’s year-round breeding season peaks in January-March. Gestation lasts 145 days. Birthing peaks in June-August, with litters of one to four (average two). The precocial young move with the herd within hours of birth. Weaning occurs at six weeks. A scent gland at the base of the spine secretes a strong musky-smelling oil. Javelina have terrible eyesight, but their hearing and sense of smell are excellent.

Herds average eight to nine animals (of any age class), but may contain as many as 37. Average herd home range is about one square mile. Season (weather), availability of food and water, and presence of other herds dictate herd movements. A portion of the home range is defended against other herds. The initial herd response to danger is usually sudden flight, at speeds of up to 25 mph. Sows with reds may also retreat to cover while other herd members try to drive off a non-human predator.



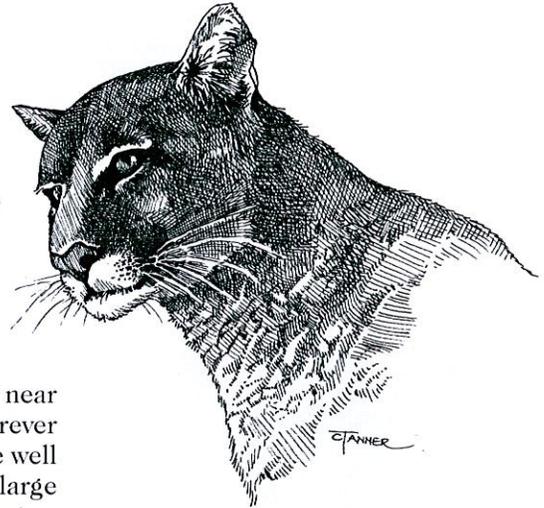
The javelina’s pig-like snout, razor-sharp canines, and powerful grinding teeth and jaws reflect the animal’s food habits. Javelina are mainly herbivorous, but may consume animal matter as it becomes available. They root for bulbs and tubers, and nibble spine-laden prickly pear cactus pads with seeming impunity. Succulent plants of any type, green grass, acorns, cactus fruits, and beans from mesquites and other leguminous shrubs and trees are also diet mainstays.

STATUS: Javelina are widespread and relatively common in Arizona. The population cycles up and down with weather patterns and occasional disease outbreaks. Statewide surveys indicate a relatively stable population subject to local changes. The javelina has never been a candidate for federal listing as threatened or endangered and is not a state species of special concern.

MANAGEMENT NEEDS: The javelina is managed as a “big game” animal in Arizona. Predation, weather, disease, and habitat condition control their numbers. Special management is sometimes needed in agricultural areas to minimize crop depredation, and in urban settings to resolve local conflicts or to provide movement corridors that connect increasingly fragmented patches of javelina habitat. 🦏

Mountain Lion

BY TERRY B. JOHNSON, NONGAME BRANCH CHIEF
ART BY CINDI TANNER



SCIENTIFIC NAME: *Felis concolor*. Genus from Latin *felis* meaning a cat. Derivation of specific epithet unclear; translates from Latin as "dwell with," perhaps an indication of its ubiquity in historical times.

DESCRIPTION: Adults 70 to 190 pounds in weight and 5.5 to 7.5 feet in length (including 1.5- to 3-foot tail). Height at shoulders 26 to 31 inches. Females smaller than males, in length and weight. Adults typically uniformly tawny to grayish overall. Dark brown to blackish along sides of nose and backs of ears. Tail tipped dark brown to black. Melanotic individuals uncommon. Kittens spotted. Eyeshine greenish gold.

DISTRIBUTION: From Southern Canada to southern South America (Patagonia). Largely eliminated from eastern U.S. Essentially statewide in Arizona, though much less common in southwestern corner. In Arizona, found from ca. 75 feet above sea level (near Yuma) to above 9,000 feet (in many areas).

HABITAT: Most commonly inhabits rocky foothills, canyons, and mountains. Known from low-elevation desert scrub to high-elevation conifer forests.

BIOLOGY: Once among the most widely distributed terrestrial mammals, the mountain lion is known by many common names, including panther, puma, and cougar. Although typically a secretive and elusive animal, by any name it is well

known in terms of biology.

Mountains lions are at or near the top of the food web wherever they occur. Their 30 teeth are well suited to tearing flesh. The large canines are especially impressive. Their prey are mainly deer and other medium to small mammals, but also include elk, desert tortoises, and a variety of other wildlife, livestock, and domestic animals. Kills are often cached (covered with scraped-up vegetation and leaf litter), with the lion returning again and again to feed. In turn, they are killed by humans (mainly) and other mountain lions, but also sometimes by wolves, bears, or even porcupine quills).

The cougar's home range can be huge. Ten or so animals may occupy 100 square miles, but individuals may overlap considerably. Wanderers may turn up almost anywhere. Dispersing individuals may move 100 miles or more from their natal grounds. Feeding areas may include 25 or more square miles.

Chiefly nocturnal, but cougars may be active at any time. They do not hibernate. They often den in caves or overhung cliffs, but may use any well-concealed spot, such as a fallen log or exposed root ball.

At 2 or 3 years of age, mountain lions are capable of breeding. They mate only briefly, not for life. After ca. 90 days of gestation, the female bears two to six kittens (usually two). Most young are born in spring to midsummer. The young stay with the female for a year,

sometimes two, as they learn to hunt. Females breed every two or three years.

STATUS: As a species the mountain lion is not endangered. In Arizona, the statewide population may exceed 3,000. Thus, it is not included on the Department's draft list of *Wildlife of Special Concern in Arizona* (AGFD in prep.), and is not listed or proposed for listing by the U.S. Fish and Wildlife Service as endangered or threatened. One putative subspecies, the Yuma puma (*Felis concolor browni*) has been considered a candidate for federal listing, but its taxonomic validity is questionable at best.

MANAGEMENT NEEDS: Its needs are few: sufficient habitat to support healthy prey populations, and sufficient wild country to afford minimal contact with humans and their livestock and domestic animals. Movement corridors between backcountry habitats are essential to gene flow, but many are increasingly becoming difficult gauntlets for transient lions to survive. Education is needed to help humans recognize the invaluable ecological role played by mountain lions. Enhanced awareness of how humans should behave in lion country is also needed. 🐾

Desert Cottontail

SCIENTIFIC NAME: *Sylvilagus audubonii*. From the Latin *sylva* meaning “woodland” and *lagos* meaning “hare.” The word *audubonii* refers to John James Audubon, an early American naturalist, hunter and wildlife artist.

DESCRIPTION: One of three cottontail species found in Arizona, this is the most abundant and widespread. Back fur typically is reddish to brownish to grayish, usually tipped with black. The belly is white. The top of the tail is black, but the underside is white; hence the name “cottontail.” Cottontails with paler back fur tend to live in drier climates. Compared to

The desert cottontail is a popular small game animal, particularly with young hunters.

its distant cousins the jackrabbits, the desert cottontail has shorter legs and smaller feet. Its hind feet are significantly larger than its front feet. It has extremely large ears, which helps to distinguish it from eastern and mountain cottontail species.

DISTRIBUTION: Desert cottontails are the most numerous and widespread cottontail in the western United States and central Mexico. They are found from northern Montana south to the State of Puebla in Mexico, and from the Dakotas, Nebraska, Kansas, Oklahoma and Texas west to California.

This rabbit is documented in every county in Arizona.

HABITAT: The desert cottontail lives in a wide variety of habitat types and elevations, but occupies more arid areas than other cottontails. In Arizona, this rabbit is probably most abundant in thick desert scrub, chaparral or pinyon-juniper stands associated with rocky cover. However, desert cottontails are common in nearly all habitats in Arizona, except in mixed-conifer forests and other habitat types above 7,500 feet in elevation. At these higher elevations, it is replaced by the smaller mountain cottontail (*Sylvilagus nuttallii*). The desert cottontail completely overlaps the range of the eastern cottontail (*Sylvilagus floridanus*) in Arizona.

BIOLOGY: Desert cottontails are extremely prolific, breeding from January to September or, in warmer localities in Arizona, year-round. They build a shallow excavated “nest” in the ground, lined with grasses and their own fur. Two or three young are born after a 28-day gestation period. Females average five litters per year, and juvenile females reach sexual maturity 80 days following birth.

Desert cottontails feed on grasses, forbs, shrubs and even acorns. Though they

can receive their moisture needs from the foods they consume, cottontails will drink free water when they find it.

Adapted to harsh desert environments, this rabbit’s physiology minimizes overheating and water loss. Large ears dissipate heat when temperatures are extreme, and a higher-than-normal lethal body temperature allows it to survive in some of the hottest locations in North America.

The abundance and density of desert cottontails can fluctuate dramatically in response to precipitation and habitat condition. Documented densities of desert cottontails range from 0.6 per acre in “bad” years to more than six rabbits per acre in favorable conditions.

Precipitation, and corresponding habitat conditions, regulate desert cottontail abundance. The list of predators that feed on cottontails is long; from snakes, hawks, owls and eagles to foxes, coyotes, bobcats, mountain lions, black bears and humans. Predation does not regulate cottontail populations; rather, predators (other than humans) are more greatly influenced by the number of rabbits.

STATUS: The desert cottontail is a popular small game animal, particularly with young hunters. In Arizona, hunters harvest around 80,000 cottontails (all species combined) a year.

MANAGEMENT NEEDS: There are no special management needs for this abundant and adaptable rabbit, so long as habitats receive protection from development. 🐾

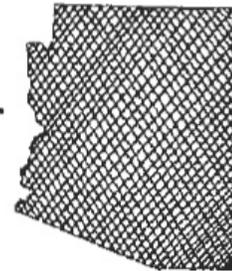
■ Formerly the small game biologist for the Arizona Game and Fish Department and a frequent contributor to this magazine, Mark Zornes has returned to Wyoming.



Jackrabbit: Blacktailed: *Lepus californicus*
Antelope: *Lepus alleni*
Spanish name: liebre

Description: Blacktailed: A large hare with very long, black-tipped ears and long, powerful hind legs. Usually gray with a black tail and white underparts. Weight: 5-8 pounds. Antelope: A large hare with ears even larger than the blacktailed jackrabbit. Ears do not have black tips. Gray, with white underparts and white patches on the sides, which “flash” as it runs. Weight: 6-8 pounds.

Range: Blacktailed: Statewide. Allen’s: Central one-third of southern Arizona.



Habitat: Blacktailed: Adapted to most environments of the state, but prefers open, semi-shrubby areas. Allen’s: Open grassland and desert scrub.



Niche: Both species are herbivores, preyed upon by all larger predators including hawks, eagles, and coyotes.

Life History: Jackrabbit young are born furred, in contrast to the naked cottontail young. Two young are born in each of about four litters per year.

Comments: Both jackrabbits are found in some areas of south-central Arizona.



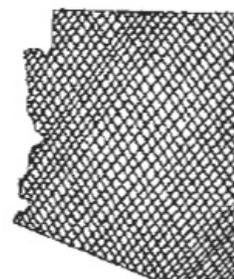
Raccoon: *Procyon lotor*

Spanish name: mapache; osito lavador

Description: A medium-sized mammal with thick, grayish-brown fur. The head is marked by a prominent black facemask. The tail is bushy with black rings. Raccoon front feet look and function like small hands.

Range: Most of the state, within range of water.

Habitat: Primarily river and stream bottoms, lakeshores, and swampy areas.



Niche: Raccoons are nocturnal omnivores, feeding largely on animal material, but readily using fruits, nuts, berries, corn, and other farm produce. Preyed upon by coyote, bobcat, lion, and great horned owl.

Life History: Litters of 2 to 7 young are usually born in spring.

Comments: One of the most adaptable animals of Arizona. Raccoons have learned to adapt to many human land uses such as farming, urbanization, and campgrounds.



Ringtail: *Bassariscus astutus*

Spanish name: cacomixtle

Description: A small, slender mammal with a small head, large ears and eyes, short legs, and a long, bushy, ringed tail. Brownish to grayish in color, pale underparts. The tail is blackish with white bands. Ringtails may reach 30 inches in length (including tail), 6 inches in height and weigh about 2 to 2 ½ pounds.

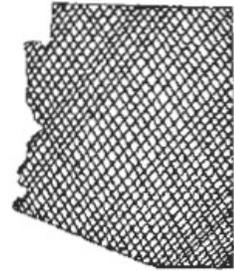
Range: Statewide

Habitat: A canyon dweller, living near water.

Niche: A small, nocturnal carnivore, which feeds on rodents, reptiles, insects, and birds. Larger predators, including the great horned owl, prey upon it.

Life History: Litters of 2-4 are born in late spring and early summer. Ringtails live up to 8 years in captivity.

Comments: Often called the “ringtailed cat” – it is not a cat, but a member of the same family as the raccoon and coati. Another common name is “miner’s cat” from its habit of taking up residence in buildings or mines, including miners’ cabins – even when occupied by the miner.



ecceles'ial-as'tic, 1 e-kl'e'sh-ee-as'tik; 2 e-kl'e'sh-ee-as'tik. **I. a.** Ecclesiastical. **II. n.** One officially set apart for the service of the church. [ekklēsia, assembly.]—**ecceles'ial-as'ti-cal**, **a.** Of or pertaining to the church. **-ly**, **adv.**—**ecceles'ial-as'ti-cism**, **n.** 1. Devotion to the principles of the church or to its privileges and forms; also, the spirit that leads to such devotion. 2. Systematically exercised ecclesiastical authority.—**ecceles'ial-ol'o-gy**, **n.** 1. **Theol.** The science of organic Christianity. 2. The science of church architecture and decoration.—**ecceles'ial-ol'o-g'ic** or **-i-cal**, **a.**

Ecceles'ial-as'ti-cus, 1 e-kl'e'sh-ee-as'ti-kus; 2 e-kl'e'sh-ee-as'ti-cūs, **n.** A book of the Apocrypha resembling in form the Proverbs of Solomon.

Ecclesi', **abbr.** Ecclesiasticus.

Echel'us, **n.** To increase or enlarge.

ech'e-lon, 1 ech'e-lon; 2 ech'e-lōn, **n.** 1. **Mil.** An arrangement of troops in form of steps. 2. **Naut.** A similar disposition of vessels. [échelle, ladder, < L. *scala*, < *scando*, climb.]

ech'e-vinat, **n.** The warden of a glid; a municipal magistrate. [**F.** ult. < OHG. *scēffen*, order.]

Ech'id'na, 1 i-ki'd'ne; 2 e-ki'd'na, **n.** An egg-laying mammal of Australia having a tubular snout and strong spines intermixed with fur; a porcupine ant-eater. [**L.**, **adder.**]

ech'in-, } 1 ek'in-, i-kai'no-; 2 ēc'in-, e-d'i'no-. From **ech'in'o-**, } Greek *echinos*, hedgehog; combining forma.

-ech'i-nal, **a.** Of or pertaining to a sea-urchin.—**ech'i-nate**, **a.** Set or armed thickly with prickles; bristly; spiny.

ech'i-na'te'd;—**Echi'ni-da**, **n. pl.** A family of echinoderms, including the sea-eggs.—**ech'i'nid**, **n.**—**ech'i'ni-dan**, **n.**—**ech'i'ni-form**, **a.** Having the form of a sea-urchin or a sea-egg.—**ech'i'ni-derm**. **I. a.** Echinodermation. **II. n.** One of the Echinoderms. [echinos, sea-urchin; *derma*, skin.]

by its entering the shadow of another body, as when the moon enters the shadow of the earth. (2) The partial or total hiding of the sun by the intervention of the moon. 2. Figuratively, any hiding or obscuring. [ekleipsis, < *ek*, out, + *leipō*, leave.]

e-clip'sis, 1 i-klip'sis; 2 e-clip'sis, **n.** **Gram.** 1. Same as **ELLIPSIS**. 2. Suppression of sound of certain radical consonants, as in *Gauche*. [**L.**; see **ELLIPSIS**.]

e-clip'tic, 1 i-klip'tik; 2 e-clip'tic. **I. a.** Pertaining to eclipses or to the ecliptic. **II. n. Astron.** (1) That plane, passing through the center of the sun, which contains the orbit of the earth. (2) The apparent path of the sun around the celestial sphere.

ee'log, } 1 ek'log; 2 ēē'log, **n.** A short pastoral poem; **ee'logue**, } bucolic. [eklogē, selection.]

e-col'o-gy, } 1 i-ko'l'o-jī; 2 e-cō'l'o-gy, **n.** 1. The branch of **zool'o-gy**, } biology treating of habits, breeding, and organic adaptation; biologies. 2. The division of botany treating of the relations between vegetable organisms and their environment. [oikos, home, + *-logia*.]—**ee'o-log'ic**, **-i-cal**, **a.**—**ee'o-log'i-cal-ly**, **adv.**—**e-col'o-gist**, **n.**

econ., **abbr.** Economics, economist, economy.

e-con'o-my, 1 i-kon'o-mī; 2 e-cōn'o-my, **n.** [**-mies'**, **pl.**]

1. Disposition to save; frugality. 2. Cheapness of operation or production. 3. Practical, systematic management of the affairs of a household, of society, or of the state; as, domestic *economy*; political *economy*. 4. In religion, any system of regulations and ceremonies. [oikonomia, < *oikos*, house, + *nomos*, manage.] **Syn.**: see **FRUGALITY**; **LEGISLATION**.—**ee'o-nom'ic**, **a.** 1. Relating to economics, to money matters, or to the means and methods of living well. 2. Economical.—**ee'o-nom'ic-al**, **a.** 1. Careful and provident; frugal; prudent. 2. Economic.

Glossary

This section provides definitions for some of the words that were used in the Background section of this guide specific to skulls and tracks. Words that are included in the glossary were highlighted in a **bold font** in the main text. Additional words that may be useful but were not necessarily included in the background information have been included as well. These definitions are written to help educators understand the concepts and are not necessarily written at a student comprehension level. It may be necessary to modify the definitions for your specific students.

Glossary

B

binocular vision – eyesight that incorporates images from two eyes to provide depth perception

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

cheek teeth – the premolar and molar teeth

crepuscular – dawn and dusk activity

D

dichotomous key – a classification tool in which a series of statements about specific characteristics leads to the identification of an organism

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

GLOSSARY

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

posterior – back surface of the animal

R

retractable claws – claws that can be extended and exposed when in use but can be withdrawn back into the pads of the feet when not needed

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

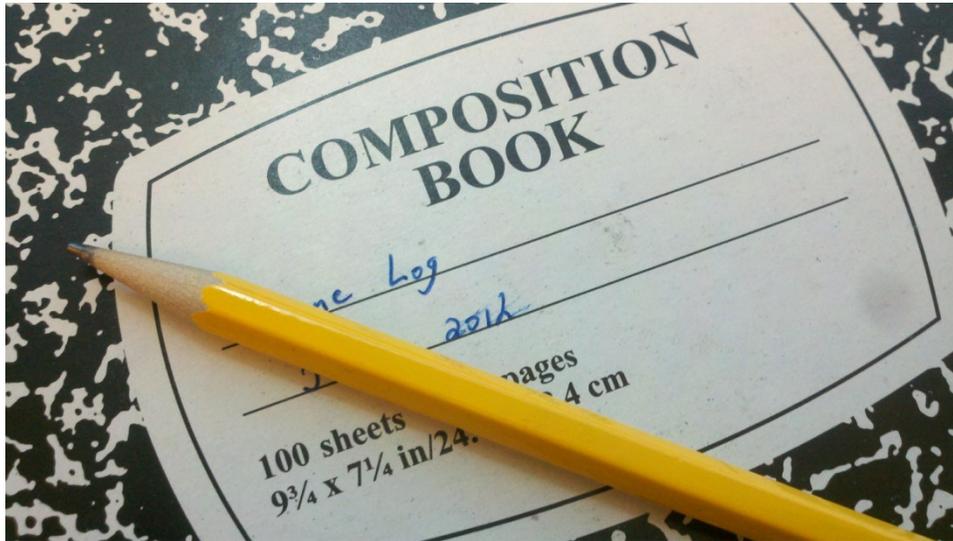
S

skull – the bone of an animal's head

substrate – a surface or material that underlies something

Z

zygomatic arch – lower jaw muscles attachment sites, and forms the surface upon which the lower jaw hinges. This arch also protects the eye.



Assessment

This section provides some possible questions that could be incorporated into a pre- and/or post-assessment of student learning regarding concepts covered with the Bone Box Resource Trunk. These are simply suggestions. We provided examples of three different types of questions: multiple choice, true/false, and essay. Similar questions may be found in different question types. It is advised that you select questions that are appropriate for your students and add them to other test questions rather than simply use all of the questions as outlined here.

Assessment Options

MULTIPLE CHOICE QUESTIONS

For each question there is only one correct answer. The correct answer is underlined.

Which animal has eyes located near the top of its head?

- a. Beaver
- b. Javelina
- c. Black bear
- d. Mountain lion

What type of animal would most likely have eyes located at the front of its head?

- a. Carnivore
- b. Herbivore
- c. Omnivore
- d. Scavenger

What does binocular vision allow an animal to do?

- a. See at night
- b. Judge distances
- c. View in many directions
- d. Identify small movements

During a hike, you found a skull with relatively large orbits. What would be a good hypothesis for this animal?

- a. It runs fast.
- b. It stands upright.
- c. It comes out at night.
- d. It has a good sense of smell.

What statement best describes the teeth of omnivores?

- a. They have no teeth.
- b. They have mostly flat teeth.
- c. They have mostly sharp teeth.
- d. They have both sharp and flat teeth.

Which primary set of teeth would be more highly developed in carnivores rather than herbivores?

- a. Molars
- b. Incisors
- c. Canines
- d. Premolars

ASSESSMENT OPTIONS

Which primary set of teeth are used for biting and cutting?

- a. Molars
- b. Incisors
- c. Canines
- d. Premolars

The dental formula for a jackrabbit is shown below. Which of the primary teeth are missing?

$$\text{Jackrabbit: } \frac{2-0-3-3}{1-0-2-3}$$

- a. Molars
- b. Incisors
- c. Canines
- d. Premolars

The dental formula for a javelina is shown below. How many total teeth does a javelina have?

$$\text{Raccoon: } \frac{2-1-3-3}{3-1-3-3}$$

- a. 9
- b. 10
- c. 19
- d. 38

While playing at the park, you discover a skull. You know it is a mammal but you are unable to identify the species. You count the teeth. The dental formula you discovered is below. What type of animal would this most likely be considered?

$$\text{Unknown Mammal: } \frac{1-0-0-3}{1-0-0-3}$$

- a. Carnivore
- b. Herbivore
- c. Omnivore
- d. Scavenger

Which of the following animals has retractable claws and would NOT usually leave tracks with claw marks?

- a. Bobcat
- b. Ringtail
- c. Gray fox
- d. Black bear

Which of the following animals would leave a track with five toes?

- a. Bobcat
- b. Coyote
- c. Raccoon
- d. Jackrabbit

ASSESSMENT OPTIONS

TRUE-FALSE QUESTIONS

The correct answer appears in all CAPITAL LETTERS at the end of the statement.

- The skull of a normal adult mammal will always have the same number of teeth on the top of the mouth as the bottom. FALSE
- The skull of a normal adult mammal will always have the same number of teeth on the left side of the mouth as the right. TRUE
- Molars are primarily used for cutting and slicing food. FALSE
- Carnivores tend to have more teeth than herbivores. FALSE
- The size of the orbit is often indicative of an animal's ability to smell. FALSE
- Nocturnal animals often have large eyes. TRUE
- Eyes located towards the sides or back of the head improve an animal's ability to judge distances. FALSE
- Canine and feline tracks are nearly indistinguishable. FALSE
- The tracks of wild cats, like bobcats and mountain lions, will usually not have claw marks. TRUE
- All non-hoofed mammals have five toes on each foot. FALSE
- The beaver is the largest rodent in North America. TRUE
- Javelina are closely related to pigs. FALSE
- The ringtail is the official state mammal for Arizona. TRUE
- A dichotomous key is a useful tool to help identify living organisms. TRUE

ESSAY QUESTIONS

Answers will vary so correct answers have not been included.

- Why is binocular vision important to predators?
- How does the placement of a beaver's eyes help it survive in its environment?
- Compare and contrast the four primary teeth: incisors, canines, premolars, and molars.
- Explain how the skull of an unknown mammal can be used to help determine where the animal might live and what it eats.
- A friend has discovered a skull that she claims belongs to a nocturnal carnivore. What features would you look for to determine if she is correct?
- How does the Earth substrate affect the quality of tracks?



Lesson Plans

This section provides a few activities to get you started with the Bone Box Resource Trunk in your classroom. It is not intended to provide the full spectrum of lessons that can be implemented with this resource. Instead, it contains a small sample of new and unique activities. No matter what grade you teach, from kindergarten through high school, you will find at least one idea that can work for you and your students in your classroom. Additional lesson plans can be found on the Bone Box Resource DVD. In addition, as new lessons are developed that pertain to the Bone Box Resource Trunk, they will be added to the Bone Box website (<http://www.azgfd.gov/bonebox>). If you wish to find additional lessons that can help you bring wildlife issues into your classroom even when you don't have the Bone Box Resource Trunk, visit the Focus Wild Arizona website (<http://www.azgfd.gov/focuswild>).

Did you use the resource trunk in a unique way? We'd love to hear from you. If you are willing to share your ideas or lesson plans, please send them to focuswild@azgfd.gov. We may add them to our website and give you credit.



Persons, Places and Things!

Classification; Parts of Speech

Time Frame: 30-45 minutes

Grade: K-1; ELL Literacy

Overview:

Introducing nouns for the first time can be challenging for students. In this lesson you will use physical items to introduce students to the skill of categorizing, while also introducing them to what a noun is. Students will observe and compare the pelts, skulls and photographs from the Department’s Bone Box Resource Trunk. Based on these observations, they will organize and classify the items into three different categories: Person, Place or Thing.

Author: Melissa Steinman

Essential Questions

- What are the characteristics of a noun?
- Why are good observation skills important?
- Why is classification an important tool for science and learning?

Objectives

- Observe common objects and identify similarities and differences.
- Categorize objects based on similarities and differences.
- Explain the reasons for grouping certain objects together.

Arizona Department of Education Standards

Kindergarten

ELA Common Core

- L.K.5a

1st Grade

ELA Common Core

- L.1.5a
- L.1.5b

Materials and Resources

- Paper
- Markers
- AZGFD bone box resource trunk:
 - Animal Photos
 - Habitat Photos
 - Career Photos
 - Pelts
 - Skulls

Teacher Preparation

- Preview the items in the resource trunk.
- With the paper and markers, create three signs, one labeled “PERSON,” another labeled “PLACE,” and the third labeled “THING.”
- Place the signs in three places around the classroom that are highly visible to the students.

Procedures:

1. Hand out one item from the bone box to each student, a photo, a skull or a pelt. If the class is small, some students may have more than one item.
2. Show the students the three locations in the classroom that you have marked with signs for Person, Place and Thing.
3. Select one student at a time and have them explain to the class what their object is,

what category it belongs in and why. Then have them walk and physically place their item in that category.

4. When the next student is selected, have them repeat step 3 and then identify one thing that is either similar or different from the item before theirs.

Differentiated Instruction:*Extensions:*

- Some of the photos show people, places and things. Create a Venn diagram on the floor using tape. Label each side with any two of the categories (Person, place and thing) and have the students place the items in their appropriate category. Photos that include both categories would be placed in the center of the Venn diagram.

Modifications:

- Instead of labeling three categories, simply place the items in a pile and tell the students to place them into categories, without any further direction. After they are finished, have them describe to you the similarities of each item that made up a category.

Reflection:

Use the space below to reflect on the success of the lesson. What worked? What didn't? What changes would you make? These notes can be used to help the next time you teach the lesson. In addition, the Department would appreciate any feedback. Please send your comments to focuswild@azgfd.gov.





Charting Mammal Life Spans

Life spans

Time Frame: 45-60 minutes

Grade: 2

Overview:

Different animals have different life spans. A variety of factors can contribute to these differences. In this activity, students will have the opportunity to explore one or more of these factors that may contribute to length of life. Students will practice 2-digit subtraction and create pictographs to explore these differences and communicate their learning.

This lesson is a modification of the “Charting Animal Life Spans” activity available from the Arizona Game and Fish Department’s Focus Wild Arizona education program (<http://www.azgfd.gov/focuswild>).

Author: Carol Gibson, Eric Proctor

Essential Questions

- What factors contribute to the survival of wildlife species?
- How can graphs be used to help people solve problems and communicate results?

Objectives

- Compare numbers and use proper vocabulary to describe their relationship.
- Put a list of 2-digit numbers in order least to greatest.
- Subtract 2-digit numbers using regrouping.
- Formulate questions about relationships between numbers.
- Create a pictograph.
- Interpret information on a pictograph.

Arizona Department of Education Standards

2nd Grade

Mathematics

- 2.NBT.5
- 2.MD.10
- 2.MP.1
- 2.MP.3
- 2.MP.4
- 2.MP.6
- 2.MP.8

Science

- S1.C1.PO1
- S1.C2.PO2
- S1.C3.PO1
- S1.C3.PO2
- S1.C3.PO3
- S1.C4.PO1
- S1.C4.PO2
- S4.C2.PO2



Materials and Resources

- *Average Life Spans of Common Arizona Mammals* (one per group)
- Sample pictograph
- Animal cards with photo and life span
- Easy-to-remove labels or stickers
- Large butcher paper (one per group)
- Markers
- Blank transparency
- Overhead projector
- *How Many Candles?* Picture book by Helen Griffith (optional)



Teacher Preparation

- Make a copy of the *Average Life Span in Years* worksheet for each student.
- Gather enough markers (or crayons or colored pencils) and paper for each group to use.
- Use the Bone Box Resource DVD (or the Focus Wild Arizona website – <http://www.azgfd.gov/focuswild>) to print out pictures of the following animals:
 - Black bear
 - Bobcat
 - Coyote
 - Jackrabbit
 - Javelina
 - Mountain lion
 - Raccoon
 - Ringtail
 - White-tailed deer
- On the front of each picture, attach a label with the name of the animal. On the back, put the life span of that animal. Use a label or sticker to cover the life span.
- Make an overhead of the sample pictograph.

Background Information:

Mammals are a group of living organisms with some common characteristics. These include the presence of hair or fur, live birth, and the production of milk. Even with these similarities, however, mammals are quite diverse. They come in different shapes and sizes. They have different diets. They even live for different lengths of time. Some rodents may survive for a year or two, while humans can live to be over 100 years old.

In this lesson, students will make estimate the life spans of some common Arizona mammals and then compare those predictions with real data. They will analyze the data using two-digit subtraction. Finally, they will create pictographs to communicate the differences in life spans.

Optional Introduction:

1. Show the students the front cover of the *How Many Candles?* book by Helen Griffith.

Read the title and ask students what they think the name means. If no one guesses that it's about birthday candles, guide them to this idea. Continue the discussion. How many candles were on their last cake? Who would have the most candles in their family?

2. Read the book aloud. Be sure to stop occasionally to discuss. What is a life span? Do short life spans contain all the same stages?
3. When the reading is finished, continue the discussion.

Procedures:

1. Divide the class into nine small groups.
2. Give each group an animal card. Ask students to estimate (and write down on their card) how long they believe their life form generally lives.
3. Have students arrange themselves in order from shortest to longest life based on their predictions. Ask students to explain their reasons. Encourage dialog and allow students to adjust their estimates.

4. Have students remove the sticker covering the actual average life span. (Explain *average* briefly only to clarify that some animals may live longer, and some may live shorter lives.) Were they correct? Demonstrate how to subtract to find how close their estimates were. Introduce the vocabulary words: *most, least, equal, more than, less than, and greatest* as appropriate. Post vocabulary on a word wall to remind students of proper terminology.
5. Have the students line up in order again, this time using the average life spans.
6. As a group, find out the range of the life spans by subtracting the shortest from the longest.
7. Hold a brief discussion of why some animals live longer than others. Ask students to generate ideas. Perhaps, for example, they believe that body size affects life span.
8. Hand out the *Average Life Spans of Common Arizona Mammals* chart to each group. Have students examine it. Does the new information support any of the ideas they generated? Why or why not?
9. Have students formulate new questions based on the data. Possible questions include "Why do two different rabbits, the cottontail and the jack rabbit, have such different life spans?" or "Do closely related animals, such as raccoons and ringtails, bobcats and mountain lions, or coyotes and foxes, have similar life spans?"
10. Have each group choose one of the questions. Selected questions should involve the comparison of at least two animals. You may also require students to use the animal that they were provided in the beginning of the lesson.
11. Place the sample pictograph on the overhead. Review how to read pictographs.

Ask some comprehension questions. Which animal has the greatest life span? Which animal lives the least number of years? Which animals have equal life spans? If students do not have a basic understanding of pictographs, review the supplemental activity provided with this lesson.

12. Groups should develop a pictograph that looks at their chosen question. Charts **MUST** use correct terminology! Groups are to prepare the pictograph, but individuals are responsible for being able to answer any of the following questions about the relationships between the life spans:
 - a. What animal has the greatest life span?
 - b. What animal lives the least years?
 - c. Do any of the animals have equal life spans?
 - d. How much is one animal's life span more than or less than another's?
13. Allow group time for planning and creating the pictograph.
14. Once each group has completed their graphs, have them share. Teacher interviews groups and individuals to check for understanding.
15. Students can check each other's work by exchanging charts and calculating the differences.
16. Individual students should write a short reflection. Potential topics include:
 - a. What they understand or are unsure of about life spans.
 - b. Questions they still have about 2-digit subtraction
 - c. What they liked about creating pictographs? What other uses pictographs might have?

Differentiated Instruction:*Extensions:*

- Use the *Average Life Spans in Years* chart to have students compare mammals with other types of wildlife and plants. Have students create a new pictograph.
- Have students think about their own life. They should be able to come up with something that can be represented by a pictograph and make the graph.
- Provide fact sheets about the various animals. Have students read and compare to see if there are other factors, such as diet or habitat, which may contribute to life span.
- Require students to convert their pictograph into both horizontal and vertical bar graphs.

Modifications:

- Do not introduce the *Average Life Spans of Common Arizona Mammals* chart. Have students make pictographs using only information from the original nine animals.
- Create a class pictograph instead of individual group ones.

**Reflection:**

Use the space below to reflect on the success of the lesson. What worked? What didn't? What changes would you make? These notes can be used to help the next time you teach the lesson. In addition, the Department would appreciate any feedback. Please send your comments to focuswild@azgfd.gov. We'd love to see student samples of the pictographs, as well!

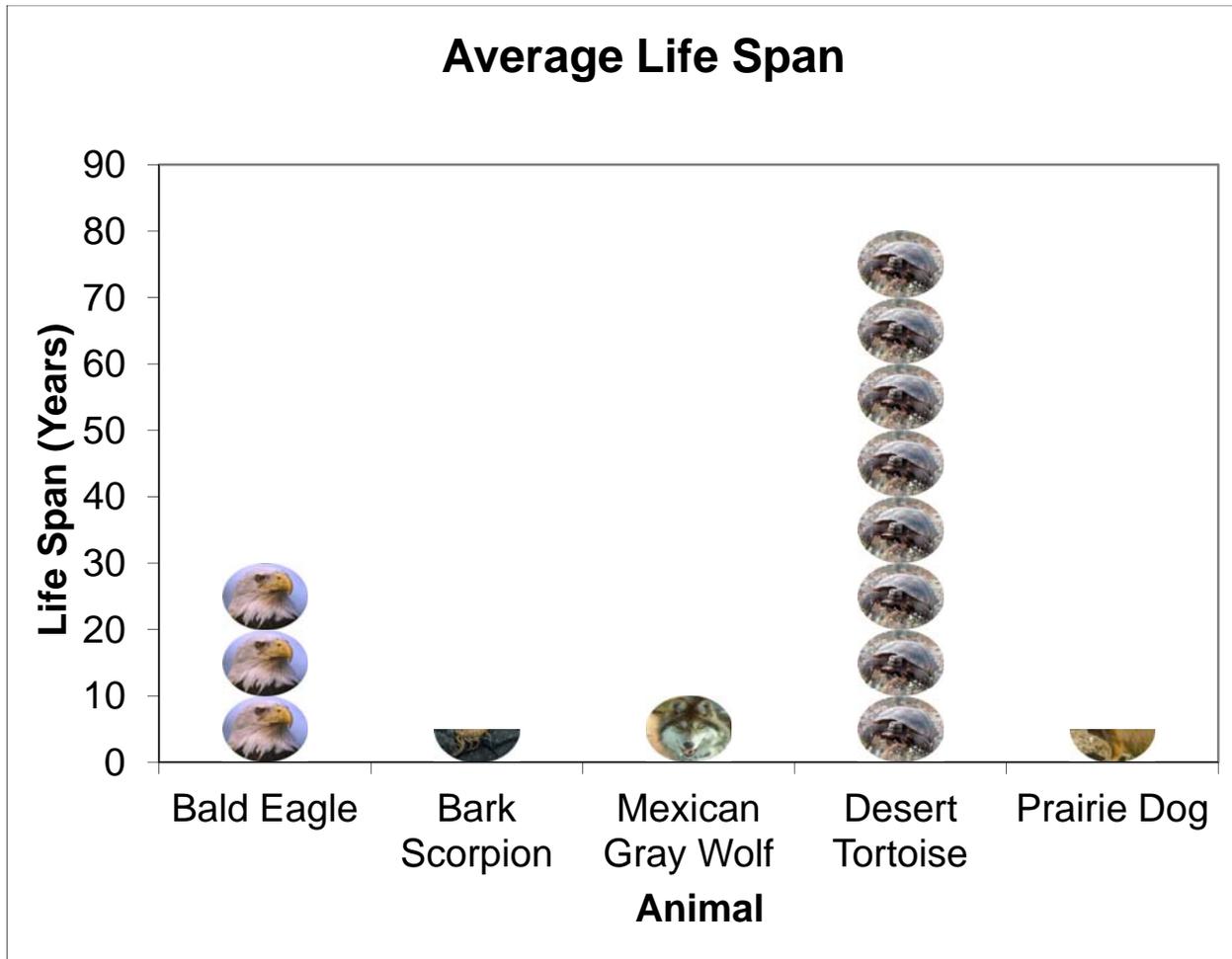
Average Life Spans of Common Arizona Mammals



Mammal	Life Span in the Wild (Years)	Life Span in Captivity (Years)
Mountain lion	10-15	18
Elk	15	26
White-tailed deer	8	Up to 17
Black bear	18	36
Desert bighorn sheep	10-12	24
Pronghorn	10	11
Javelina	7-13	21
Coyote	14	21
Kit fox	20	
Coati	12-15	17
Ringtail	16	
Raccoon	20	
Bobcat	32	
Bats	5-30	
Jackrabbit	13	
Cottontail	1-2	
Striped skunk	6	10
Pocket gopher	4-5	
Packrat	2-3	7
Kangaroo rat	9	
Shrew	1.5	

From Pinau Merlin's article "Longevity – The Long and Short of It," in the May/June 2005 issue of *Arizona Wildlife Views*

Sample Pictograph



Data for the pictograph was provided by the Phoenix Zoo (<http://www.phoenixzoo.org>) and the Arizona-Sonora Desert Museum (<http://www.desertmuseum.org>). Pictures were provided by the Arizona Game and Fish Department and the Arizona-Sonora Desert Museum.



Introductory Pictograph Lesson

Consider using this sample activity if your students need a more detailed introduction into pictographs prior to teaching the “Charting Animal Life Spans” lesson.

1. On the board, write down the following food types: pizza, hot dog, spaghetti, and fish. Leave some space beneath each one.
2. Inform the students that the class is going to have a vote. We want to know which food item is liked by the greatest number of people. Each person is going to get the opportunity to vote for one of the four foods on the board.
3. One at a time, call out the food and ask the students to raise their hand. Count the number of hands and write this number under the name.
4. When all students have voted, ask the class which food had the most votes. Which had the least?
5. Describe the purpose of graphing. Sometimes scientists use graphs and pictures to better understand numbers.
6. Ask the students to decide on an easy to draw picture that could be used to represent each of the items. Have a volunteer draw these pictures. Explain that each of these pictures will represent the number of students that voted for that food. Each picture may represent more than one person. Decide on how many students each picture will represent. Two would be a very good number. Ask the students what we would draw if there were only one person. If they do not come up with it on their own, guide them to the idea that we would draw half of the picture.
7. As a class, make a pictograph using the data and the pictures. Draw the x- and y-axes explaining that the food goes on the bottom while the numbers go on the side. Have a student draw the pictures while the other students count the number of pictures that are necessary.
8. When the all the food items have been drawn, discuss the pictograph. Which food had the most votes? Which had the least? Are these the same as we said before? What is the purpose of a pictograph?
9. Divide the class into groups of four students.
10. Explain that they will now have to make a new pictograph in their groups.
11. Pass out a bag of M & Ms to each group. Instruct them to make a pictograph showing the number of candies for each color.
12. Before beginning, brainstorm ways to complete this assignment. Make sure they are aware that they need to group the candies by color first.
13. Give the groups time to work on their pictographs. As they work, move around the room and talk to the groups. Ask them questions to make sure they understand how to interpret these graphs.



Relevant Picture Books

Although not required, it is recommended that students be introduced to the idea of life span by using a picture book. Below is a list of suggested titles along with a brief description. The first book is highly recommended and was used in the suggested procedures.

How Many Candles? by Helen Griffith

- A dog wishes to surprise his master with a cake for his tenth birthday. He is aware that this is seventy in dog years. He has several encounters with different animals, including a turtle that believes it is such a short time to a swarm of gnats that claim that nothing can live that long.

Helen the Fish by Virginia Kroll

- After a long life of three years, a goldfish dies. The child is made to understand that death is part of life and that life continues. Eventually, the child gets a fish for her friend.

Winter Fox by Jennifer Brutschy

- A little girl loses her bunny to a hungry fox. When she goes out with her father to hunt the fox, she realizes how thin and alone the fox is and asks her father not to kill it.

Gray Fox by Jonathan London

- This book follows the life of a fox from a young pup to his eventual death on the highway. Then, his own children grow up and go out into the world.

Tracks in the Sand by Loreen Leedy

- This book introduces children to the life cycle of sea turtles, from mating to egg develop and hatching.

Do you have other ideas for some related picture books? Send your suggestions to focuswild@azgfd.gov. We'll try to incorporate them into future versions of this lesson.



Wild Stories

Animal Communication; Habitats; Storytelling

Time Frame: 3-4 hours

Grade: 3-6

Overview:

Many people have seen wild animals in pictures or on the television, and if they are lucky, they have had the chance to hear their calls. For others, the sights and sounds of the wild are a mystery, contained only in the pages of books and the Internet. In this lesson, students will help teach younger students about a few common wildlife species by using standard computer software to write a children’s book equipped with animal sounds.

Author: Melissa Steinman

Essential Questions

- What are the elements of an effective children’s book?
- How do we communicate science to a young audience?
- How do Arizona wildlife interact within a shared habitat?

Objectives

- Identify common Arizona wildlife species.
- Observe and compare characteristics of different animals.
- Write and present a children’s book focused on Arizona wildlife.

Arizona Department of Education Standards

<i>3rd Grade</i>		<i>4th Grade</i>	
<i>ELA Common Core</i>	<i>Science</i>	<i>ELA Common Core</i>	<i>Science</i>
○ W.3.2	○ S4.C3.PO1	○ W.3.2	○ S4.C4.PO2
○ W.3.4a	○ S4.C4.PO1	○ W.3.4a	
○ W.3.5		○ W.3.5	<i>Technology</i>
○ W.3.6	<i>Technology</i>	○ W.3.6	○ S1.C4.PO1
○ W.3.8	○ S1.C4.PO1	○ W.3.8	○ S6.C2.PO5
	○ S6.C2.PO5		
<i>5th Grade</i>		<i>6th Grade</i>	
<i>ELA Common Core</i>	<i>Technology</i>	<i>ELA Common Core</i>	<i>Technology</i>
○ W.3.2	○ S1.C4.PO1	○ W.3.2	○ S1.C4.PO1
○ W.3.4a	○ S6.C2.PO5	○ W.3.4a	○ S6.C2.PO5
○ W.3.5		○ W.3.5	
○ W.3.6		○ W.3.6	
○ W.3.8			



Materials and Resources

- Access to computers or laptops
 - AZGFD bone box resource trunk
- *Animal Facts Worksheet* (one per student)
- Optional example of children’s books.
These could include:
 - *Where do I sleep?* By Jennifer Blomgren
 - *Sounds of the Wild: Nighttime* by Maurice Pledger

Teacher Preparation

- Copy the *Animal Facts Worksheet*.
- Set up stations around the classroom, one for each animal in the bone box. Stations should include the pelt, the skull, a copy of the fact sheet from the Bone Box Resource Trunk Teacher’s Guide, and a computer or laptop.
- Prepare the computers. Each computer should have images and wildlife sounds for the different animals. These can be copied from the Bone Box Resource DVD or downloaded from <http://www.azgfd.gov/bonebox>.

Background Information:

In this lesson students will research local Arizona wildlife and use this information to write and create a children’s book. Using readily available presentation software such as Microsoft PowerPoint, students will embed animal sounds into their book to make it more engaging. This will help build and reinforce important technology and literacy skills.

Many teachers realize that one of the best ways to show that you understand a concept is to teach it to someone else. Having students share their knowledge through a unique creative product can be an extremely effective learning tool. In addition, students are often more engaged and motivated if they know that their work will be seen by others. When they are finished, students will have the opportunity to share their books with younger children. If done correctly, the books the children write should correlate with kindergarten and first grade science standards. This includes identifying some local wildlife and comparing habitats. As a result, the books will be meaningful and tie in with the curriculum.

This lesson asks students to use computers and presentation software to create a children’s

book that include animal sounds. If you do not have access to traditional presentation software (such as Microsoft PowerPoint), the Internet provides numerous free alternatives. Two of the most common are Google Docs and Prezi.

Google Docs (<http://docs.google.com>) allows users to create different types of documents, including spreadsheets and presentations. These documents are created and stored online, so they are accessible anywhere in the world. They can also be shared so multiple users can collaborate on a single document. A Google account is required and can be acquired for free.

Prezi (<http://prezi.com>) is another free web-based presentation tool that offers some unique features. Some of these features may make this option a little too complicated for younger audiences. Like Google Docs, it can be accessed anywhere and a free account is required.

Procedures:

1. List the names of the animals from the Bone Box Resource Trunk on the board. Explain to the students that all of the animals in the bone box are native to Arizona. This means

that their natural habitat exists somewhere in our state.

2. Explain that even though these animals are common, many people will never see them. The only way they may experience these animals, and learn about them, is through books. As a result, it is extremely important that animal books be accurate. Unfortunately, most of these books are written for adults.
3. Inform students that they are being challenged to write a children's book that includes information for at least three of these animals. The book will be written for either kindergarten or first grade students. In addition to written information about each animal, the book will also include pictures and sounds.
4. Divide the students into small groups of three to four students. Let them know that they will not have to write the book by themselves.
5. Explain that authors have to do research before they write a book. This ensures that the information is accurate. Point out the stations set up around the room. Each station includes information about one of the animals from the bone box. In addition, there is a fact sheet, pelt, skull, and a computer with pictures and sounds of the animal. They will have the opportunity to visit 4-6 stations to learn as much about the animals as they can before writing their book.
6. Hand out the *Animal Facts Worksheet*. Instruct them to answer as many questions as they can about each animal they visit.
7. Remind the students that they will not see all of the animals. They must be selective about which animals they want to see. They will use at least three of their chosen animals in their book.

8. Give the students time to rotate through the stations and complete the *Animal Facts Worksheet*.
9. Gather the class back together. Ask the groups if they discovered anything about the animals that surprised them. Hold a brief discussion about the information they learned.
10. Inform the students that children's books are usually short, include large pictures and have one or two sentences on each page. The words should be written with the audience in mind. So, they should not include any big words that kindergarten or first grade students would not understand. If you wish, read some example picture books, or allow students to explore some books on their own.
11. Have the students begin planning their book. They should choose the three animals they will use and brainstorm ideas for a story theme. Examples include:
 - a. Where do I sleep?
 - b. Where do I live?
 - c. Who lives near me?
 - d. Am I awake during the day or the night?
12. Give students time to write a rough draft. They should not worry about pictures or sounds at this point, just the words and story.
13. When students are finished, have them share their rough drafts with other groups or turn them in to you for comments.
14. With feedback from you or their peers, have the students edit their story. At this point, they should begin to look at illustrations. They can include photographs (like the ones included on the Bone Box Resource DVD and available at <http://www.azgfd.gov/bonebox>) or attempt to draw their own pictures.

15. Inform the students that the final draft of their stories will actual be written on the computer using Microsoft PowerPoint (or another presentation software of your choice). This will allow them to easily add their pictures and include sounds of the animals. Each page of the book should be a new slide.
16. Give the students time to write their “book” using the appropriate software. Student-drawn illustrations can be scanned and inserted into the slides. Photographs and animals sounds can be downloaded from

the Internet or copied from the Bone Box Resource DVD.

17. Before completing the books, remind students to make sure that their names as well as the intended audience (kindergarten or first grade) is written on the front cover (i.e., first slide) of the “book.”
18. Present the books in class. If possible, make arrangements have your students read their “books” to a lower level class. This will make the work more powerful for your students.

Differentiated Instruction:

Extensions:

- Have the students create a video podcast of their book with narration and animal sounds.
- Have the student create a short movie script using the presentation slides as the story board and animal sounds that will be included in the movie.

Modifications:

- Allow students to work individually or in groups on their books.
- Provide the students with children’s books about animals and have them add sounds where appropriate.
- Have students create a picture book with few, if any, written words much like author David Weisner modeled in books like *Tuesday* and *Flotsam*. Students can then tell their story rather than write it.
- Have students create their books on paper rather than using computers.

Reflection:

Use the space below to reflect on the success of the lesson. What worked? What didn’t? What changes would you make? These notes can be used to help the next time you teach the lesson. In addition, the Department would appreciate any feedback. Please send your comments to focuswild@azgfd.gov. We’d love to see student samples of the books, as well!



Animal Facts Worksheet

Follow the directions provided by your teacher to study some common Arizona animals. Complete this sheet as you learn. Use one column for each animal. Space for additional animals can be found on the back. Do not forget to answer the questions at the end.

Animal Name:			
What colors do you see in the animal's fur?			
Would you describe the fur as soft, prickly, rough, long, short, or thick?			
What does this animal like to eat?			
Are the teeth sharp, flat, or both?			
Does this animal come out during the day or the night?			
Do the eyes appear to be big or small?			
Are the eyes located in the front of the head, on the side, or on the top?			
What type of habitat does it live in?			
What other animals live in the same types of habitat?			
Use words to describe its sound.			
Other interesting facts you learned:			

Animal Name:			
What colors do you see in the animal's fur?			
Would you describe the fur as soft, prickly, rough, long, short, or thick?			
What does this animal like to eat?			
Are the teeth sharp, flat, or both?			
Does this animal come out during the day or the night?			
Do the eyes appear to be big or small?			
Are the eyes located in the front of the head, on the side, or on the top?			
What type of habitat does it live in?			
What other animals live in the same types of habitat?			
Use words to describe its sound.			
Other interesting facts you learned:			

Of the animals you observed, which ones would you like to include in your book?

What will be the theme of your book?



The Price of Survival

Adaptations; Economics

Time Frame: 2-3 hours

Grade: 7-8

Overview:

Many animals are successful in their environment because they have adapted over time to survive under those specific conditions. However, changes occur. Forests are clear cut and become grasslands. Wetlands have dried to become deserts. These changes can be costly, if not fatal, to the animals living in these areas. They have to move or quickly adapt to the new environment. In this lesson, students will identify some of the adaptations that help animals survive. Then, they will purchase adaptations that will help them best survive in an environment and struggle through natural and human-caused changes.

Author: Melissa Steinman, Eric Proctor

Essential Questions

- What factors contribute to the survival of wildlife species?
- What are some common adaptations found in Arizona wildlife species?
- How does the perceived value of an object affect its purchase price?

Objectives

- Identify adaptations found in at least eight common Arizona mammals.
- Analyze and prioritize the “value” of specific adaptations for survival.
- Analyze the impact of three environmental changes on the survival of an animal.

Arizona Department of Education Standards

<u>7th Grade</u>	
Science	Social Studies
○ S3.C1.PO1	○ S4.C5.PO3
○ S3.C1.PO2	○ S4.C5.PO4
○ S4.C3.PO2	○ S4.C5.PO6
○ S4.C3.PO3	○ S5.C1.PO1
○ S4.C3.PO5	○ S5.C1.PO2

<u>8th Grade</u>	
Science	Social Studies
○ S3.C1.PO1	○ S4.C5.PO3
○ S4.C4.PO1	○ S5.C1.PO1
○ S4.C4.PO3	○ S5.C1.PO2
○ S4.C4.PO5	

Materials and Resources

- AZGFD bone box resource trunk
- *Adaptations Bidding Sheet* (one per person)
- *Draw an Animal* (one per person)
- *Survival Scenario Analysis* (one per person)
- *Survival Scenarios*
- *Adaptation Analysis*
- *Game and Fish Bucks* (at least \$250 per group)

Teacher Preparation

- Preview the items in the Bone Box.
- Prepare copies of the *Adaptations Bidding Sheet*, *Draw an Animal*, and *Survival Scenario Analysis*.
- Copy the multiple *Game and Fish Bucks* sheets. Cut out each of the bills. Organize into groups of \$250.
- Cut out the Survival Scenario cards, shuffle them, and place them in a pile.

Background Information:

All animals and plants have adaptations that help them survive in their environment. These adaptations can be physical or behavioral. Physical adaptations are usually visible features on the organism such as camouflage coloration

and sharp teeth. Behavioral adaptations are actions organisms do to survive. These include howling to communicate and migrating. While these adaptations are incredibly important to survival, they do come at a cost. Each adaptation takes time and energy to develop.

For successful organisms, the threat to survival without a specific adaptation will be greater than the biological cost to develop that same adaptation. Thus, an animal that does not need to communicate will usually not develop the ability to communicate. That animal will use the precious energy for more important adaptations.

In this lesson, students will have the opportunity to explore the concepts of physical and behavioral adaptations. In the process, they will participate in an auction that will highlight the idea of biological cost in terms that people can understand: money and the common rules of economics. Each team of students will have a limited budget to “purchase” adaptations that will help their imaginary animal best survive in the Sonoran Desert. Then, their animals will be challenged to survive as conditions within that environment change.

Procedures:

1. If students are not already familiar with the animals in the Bone Box Resource Trunk, provide time for the students to work with the materials.
2. Hand out the *Adaptations Bidding Sheet* to each student. Explain that this sheet identifies some common adaptations that can be found in Arizona wildlife species.
3. Explain that each adaptation is either physical or behavioral. If necessary, explain these concepts.
4. Inform students that they are to review the list of adaptations. For each one, they must identify it as a physical or behavioral adaptation. Then, they should identify one or more of the animals from the Bone Box Resource Trunk that display this adaptation. Students should record their answers in the

appropriate boxes on the *Adaptations Bidding Sheet*.

5. Inform the students that they will now be participating in an auction. If you wish, you may show short Internet video clips of real auctions to get students excited about the activity.
6. Divide the class into teams of four. Each team will need to create a team name and appoint a person to each of the following jobs:
 - *Bidder* – is the only member allowed to place a bid on behalf of the team.
 - *Banker* – is in charge of paying for the adaptations once the auction is complete.
 - *Accountant* – is in charge of keeping track of the team’s remaining monies.
 - *Adaptation Tracker* – keeps track of which adaptations the team has won during the auction.
7. Inform the teams that they will be designing an animal that has specific adaptations to survive in the Sonoran Desert. Provide a little background information on this ecosystem. Some points to include:
 - It is one of the hottest deserts in the world with summer temperatures that can exceed 120°F even in the shade!
 - It averages more than 300 days of sunshine per year.
 - It has mild winters, with evening temperatures rarely dropping below 32°F.
 - It is one of the wettest deserts in the world, with up to 15 inches of rain per year.

- There are two primary rainy seasons: the violent summer monsoon thunderstorms and the gentler winter rains.
8. Inform the students that not all teams will be able to get the adaptations they want. Instead, they will be given \$250 to spend on adaptations. They must determine how that money will best be spent.
 9. Allow the teams ten minutes to decide on how much money they are willing to spend and on which adaptations. They should document their budget on the *Adaptations Bidding Sheet*.
 10. Hand out the Game and Fish bucks. Each team should receive various denominations totally \$250.
 11. Begin the auction. It can be run in several ways:
 - Loud auction: The auctioneer/teacher shouts out a bid and the bidder for each team raises their hand to place the bid. This is a very high energy auction and is highly participatory. However, it can get chaotic and sometimes the bidders do not follow the wishes of the rest of the team.
 - Silent auction: As each item comes up for bid, each team is given 15 seconds to write their highest bid on a sheet of paper. When the auctioneer/teacher gives the signal, all the bids are raised. The highest bid wins the adaptation. This style takes less time and is much quieter. It does encourage team work.
 12. Once all of the adaptations have been purchased, students should record the final purchase prices for each of their

adaptations on the *Adaptations Bidding Sheet*.

13. Hand out the *Draw an Animal* sheet. Instruct students to be creative and draw a picture of their animal. It should include all of the adaptations they purchased. They should take care NOT to include adaptations from the list that they did not win during the auction.
14. Hand out the *Survival Scenario Analysis* worksheet. Students should write down each of the adaptations they purchased in the appropriate spaces.
15. Inform the students that, as is common, some changes have occurred recently to the Sonoran Desert habitat where their animal lives. They will determine if their adaptations help their animal survive in the modified environment.
16. Pull one of the *Survival Scenario* cards at random. Read the description and have the students discuss which adaptations they think will be the most beneficial for survival.
17. Use the *Adaptations Analysis* sheet to identify the beneficial and detrimental adaptations. Have students complete the *Survival Analysis* worksheet for this scenario.
18. Repeat steps 16 and 17 as appropriate using additional scenarios. Students should be exposed to at least three different scenarios but the total number is up to you.
19. When all of the scenarios are completed, students should complete the *Survival Analysis* worksheet.



Differentiated Instruction:*Extensions:*

- Rather than dictating which adaptations are beneficial and detrimental in each scenario, have students argue for or against each one. Accept responses that are well justified and supported.
- Eliminate the pre-determined adaptations on the *Adaptations Bidding Sheet* and provide students with the opportunity to identify animal adaptations.
- Require teams to research and develop their own survival scenarios and identify which adaptations would be beneficial and detrimental. Each team can run their scenario with the class.

Modifications:

- Students can complete each of the worksheets as a team rather than individually.
- If teams get carried away and all of them are out of money before the auction ends, you may consider an “economic stimulus” or “biological bailout” and give each team some additional money.
- Distribute the selected *Survival Scenarios* to the teams to work on independently rather than as a class.

Reflection:

Use the space below to reflect on the success of the lesson. What worked? What didn't? What changes would you make? These notes can be used to help the next time you teach the lesson. In addition, the Department would appreciate any feedback. Please send your comments to focuswild@azgfd.gov.



Adaptations Bidding Sheet

The table below lists some common adaptations found in various mammal species. For each one, determine whether it is an example of a physical or behavioral adaptation and identify some Arizona mammals that exhibit that adaptation. Then, based on the scenario presented in class, determine which ones you are willing to purchase and how much you are willing to spend in the adaptation auction. Once the auction has taken place, record the amount of money you spent for each of the adaptations you purchased.

Adaptation	Physical or Behavioral Adaptation?	Representative Mammals?	Your Budgeted Cost	Your Purchase Price
Diurnal				
Nocturnal				
Body size: large				
Body size: small				
Eye location: front				
Eye location: side				
Excellent sense of smell				
Runs fast				
Teeth: Mostly flat				
Teeth: Mostly sharp				
Has lots of babies				
Long parental care period				
Sharp claws				
Coloration: gray/black				
Coloration: tan/brown				
Fur: heavy coat				
Fur: light coat				
Lives in a community				
Able to communicate				
Large ears				
Hibernates				
Swims				



Draw an Animal

In the space below, draw a picture of your animal. Be sure to include the adaptations you just purchased during the auction and show how they help the animal survive in the Sonoran Desert.



Survival Scenario Analysis

In the column labeled “Your Adaptations,” write in each of the adaptations you purchased from the auction. Then, in the box labeled “Scenario #1,” write a brief description of the new survival scenario that was presented to you. With the help of your teacher, determine if each adaptation will be beneficial or detrimental for your animal’s survival in the new scenario. If it is beneficial, put a “+ 1” in the appropriate box. If it is detrimental, put a “- 1” in the box. If it has no impact, put a “0” in the box. Add up the scores and put your total in the box at the bottom of the column. Repeat for any additional scenarios.

Your Adaptations	Scenario #1:	Scenario #2:	Scenario #3:	Scenario #4:	Scenario #5:
Score					

Total the scores from all of the scenarios: _____

Based on this score, do you feel that your animal is well adapted to handle changes to the environment? Why or why not?

Select one of the adaptations you purchased. Describe the environments in which this adaptation would be the most beneficial.

Of all the original adaptations presented to the class, which one seemed to be the most valuable? Least valuable? How do you know?



Survival Scenarios

<p style="text-align: center;">Low Rainfall During Monsoons</p> <p>Most of the plants and animals have been in survival mode during the hot months of May and June, anxiously awaiting the arrival of moisture provided from the summer monsoon season. Unfortunately, this year provides very little relief. Less than a half an inch of rain falls, which significantly limits the primary growing season for the large shrubs and trees.</p>	<p style="text-align: center;">Monster Wildfire</p> <p>An extended drought, increased temperatures from climate change, and a collection of invasive grasses have come together for a potentially lethal combination. Lightning during a summer monsoon strikes ground, igniting a dry tree. The fire quickly spreads throughout the dry desert community, growing to a size larger than the Phoenix metropolitan area, and destroying most of the plants in the process.</p>
<p style="text-align: center;">Hotter Summer Days</p> <p>Climate change has resulted in more of the sun's energy to pass through the atmosphere. The result: hotter temperatures, particularly in the summer when the days are longer.</p>	<p style="text-align: center;">Frosty Winter</p> <p>This year there is a particularly cold winter. Temperatures repeatedly drop to below freezing, resulting in an abnormal number of frost days. These frosts threaten the survival of a number of plants that cannot tolerate extended periods of cold temperatures.</p>
<p style="text-align: center;">Early Spring</p> <p>Climate change has significantly altered the predictability of the seasons. Milder winters have resulted in the early onset of Spring. Flowers begin blooming earlier than expected.</p>	<p style="text-align: center;">Overpopulation</p> <p>Years of policies focused on the removal of large predators have been successful. Your species' primary predator has been completely eliminated from the environment. Combined with highly successful reproduction, your species has seen a significant increase in its population size. In fact, it has moved well beyond the carrying capacity for the area.</p>

<p style="text-align: center;">Chemical Pollutant</p> <p>A production plant, located on the banks of a local stream, has been storing their waste chemicals in an underground storage tank for many years. The plant recently learned that this tank has a leak and waste chemicals have been seeping into the nearby stream. The toxin is likely present in many plants, as well as the animals that eat them.</p>	<p style="text-align: center;">Dam Construction</p> <p>Demand for electricity during the hot summer months has caused power companies to initiate rolling blackouts around the Phoenix area. Without power, temperatures inside homes rise and cause a potential health risk for some people. The power company received a permit to dam a nearby river to be able to increase electricity during peak hours. The newly created lake increases recreation opportunities but has also flooded habitat.</p>
<p style="text-align: center;">Moves to a Higher Elevation</p> <p>Food has been scarce lately. As a result, your species is forced to look elsewhere. It has begun climbing a nearby mountain. The change in vegetation provides new opportunities for food. However, there are new challenges including different predators and weather.</p>	<p style="text-align: center;">Invasive Burros</p> <p>Brought by miners and early explorers, burros (wild donkeys) are not native to the area. However, there is political pressure to protect them. Burros are herbivores but they impact the habitat differently than our native deer. Plants lack the appropriate adaptations and are permanently damaged or killed when the burros browse. In addition, the burros' hooves can dramatically damage the soil.</p>
<p style="text-align: center;">Housing Development</p> <p>An increase in the number of people moving into Arizona has resulted in the development of two rather large housing communities. These developments have leveled thousands of acres of natural desert. With the roads, telephone poles, electric wires, water pipes and other infrastructure that comes with developments, most native wildlife have been displaced from the immediate area.</p>	<p style="text-align: center;">Disease</p> <p>A deadly disease has been discovered and is making its way through your species' local population. The disease causes muscle atrophy and major hemorrhaging. Death occurs within weeks. Although the exact cause is not known, it seems to be spread through fecal matter and is most prominent in larger animal communities.</p>



Adaptation Analysis

The table below identifies the common adaptations that have been used throughout this activity and how they could fare under the different survival scenarios. A “+” indicates that the adaptation will be beneficial to the animal in that particular scenario. A “-” indicates that it will be detrimental. A “0” indicates there is no apparent benefit or problem with that adaptation. Of course, these ideas are only speculation. Scientists still debate how different adaptations may impact an animal. It is possible that arguments could be made for different answers. These are simply guides to get you started. We encourage students be given an opportunity to argue for or against different adaptations.

Adaptation	Low Rainfall	Monster Wildfire	Hotter Summer	Frosty Winter	Early Spring	Overpop.
Diurnal	-	0	-	+	+	0
Nocturnal	+	0	+	-	0	0
Body size: large	-	0	-	+	0	-
Body size: small	+	0	+	-	0	+
Eye location: front	0	0	0	0	0	+
Eye location: side	0	0	0	0	0	+
Excellent sense of smell	+	+	0	+	+	0
Runs fast	0	+	0	0	0	0
Teeth: Mostly flat	-	-	0	0	+	0
Teeth: Mostly sharp	+	+	0	0	0	0
Has lots of babies	-	-	-	-	+	-
Long parental care period	-	-	-	+	0	+
Sharp claws	+	+	+	+	0	+
Coloration: gray/black	0	0	-	+	0	0
Coloration: tan/brown	0	0	+	0	0	0
Fur: heavy coat	0	-	-	+	0	0
Fur: light coat	0	+	+	-	0	0
Lives in a community	+	0	0	+	0	-
Able to communicate	+	+	0	0	0	0
Large ears	0	0	+	-	0	0
Hibernates	+	0	+	+	-	0
Swims	0	+	+	0	0	0

Adaptation	Chemical Pollutant	Dam Construct.	Moves Higher	Invasive Burros	Housing Develop.	Disease
Diurnal	0	0	-	0	-	0
Nocturnal	0	0	+	0	+	0
Body size: large	+	0	-	0	-	0
Body size: small	-	0	+	0	+	0
Eye location: front	0	0	+	+	0	0
Eye location: side	0	0	+	+	0	0
Excellent sense of smell	+	0	+	0	0	+
Runs fast	0	0	-	+	+	0
Teeth: Mostly flat	0	+	+	-	0	0
Teeth: Mostly sharp	0	0	0	+	0	0
Has lots of babies	0	0	0	0	0	-
Long parental care period	0	+	0	0	0	+
Sharp claws	0	0	+	+	+	0
Coloration: gray/black	0	0	+	0	-	0
Coloration: tan/brown	0	0	-	0	+	0
Fur: heavy coat	0	0	+	0	0	-
Fur: light coat	0	0	-	0	0	+
Lives in a community	+	0	0	+	0	-
Able to communicate	+	+	+	+	+	+
Large ears	0	0	-	0	+	0
Hibernates	0	0	+	0	-	+
Swims	-	+	-	0	-	0

ONE DOLLAR

1

GAME AND FISH BUCKS

FIVE DOLLARS

5

GAME AND FISH BUCKS

TEN DOLLARS

10

GAME AND FISH BUCKS

TWENTY DOLLARS

20

GAME AND FISH BUCKS



On the Wild Side

North American Model

Time Frame: 2-3 hours

Grade: High School

Overview:

Different wildlife species generate different emotions in people. Animals that are not as cute and cuddly can have a hard time getting public support for their conservation and management. As a result, organizations have to get creative to educate people about these animals. In this lesson, students will select and study a mammal from the Arizona Game and Fish Department’s Bone Box Resource Trunk in order to “give a voice” to the animal. Their final product will be a video narrative modeled after the popular BBC *Walk on the Wild Side* program.

Author: Shelly Petersen, Melissa Steinman

Essential Questions

- How can human activities harm and benefit wildlife?
- How do we communicate science?

Objectives

- Identify at least three management practices that have resulted in the increase or reduction of animal ranges in the United States.
- Search for and identify reliable and relevant websites to explain the historic and current range of a wildlife population.
- Write an engaging script to accompany a pre-recorded video.

Arizona Department of Education Standards

ELA Common Core

- W.HS.3b
- W.HS.3d
- WHST.HS.4a

High School

Science

- S3.C1.PO1
- S3.C1.PO5
- S4.C3.PO1
- S4.C3.PO2
- S4.C4.PO4

Materials and Resources

- AZGFD Bone Box Resource Trunk materials:
 - Field Notes
 - Wildlife Views video segments
 - *America’s Wildlife* DVD
 - Mammalian Predators in Arizona
- Online access to sample videos of the BBC series *Walk on the Wild Side*
- Computers or laptops (one per group)
- Internet access

Teacher Preparation

- Preview the *America’s Wildlife* DVD. Determine if you will watch the video as a class or allow groups to watch it separately.
- Prepare the computers. At a minimum, all computers should have one of the wildlife views video segments. This can be copied from the Bone Box Resource DVD or downloaded from <http://www.azgfd.gov/bonebox>.
- Search the Internet for sample footage of BBC series *Walk on the Wild Side*. Preview the videos and find ones appropriate for the classroom.

Background Information:

The history of wildlife management in the United States is a unique one, complete with missteps and successes. We can look back on the past, and determine what actions and principles have resulted in the best success. Today, we recognize seven general principles that are still used by wildlife managers to guide policies and actions. They are:

- Wildlife is held in the public trust.
- Commerce in wildlife is regulated.
- Hunting and angling laws are created through a public process.
- Everyone has the opportunity to hunt and fish.
- Hunters and anglers fund conservation.
- Wildlife is an international resource.
- Science is the basis for wildlife policy.

Together, these seven concepts form what is called the North American Model of Wildlife Conservation. This model is credited with being one of the most successful wildlife conservation stories in the world. For more information about the North American Model, check out the “America’s Wildlife: Yesterday, Today and Tomorrow” curriculum that can be found in the Bone Box Resource Trunk and on the Arizona Game and Fish Department’s Focus Wild Arizona education program website: <http://www.azgfd.gov/focuswild>.

In this lesson, students will have the opportunity to explore the North American Model as it pertains to a specific wildlife species. Then, they will create a humorous, yet educational video that tells the story of conservation through the eyes of this animal. They will attempt to create a viral video that can help spread the message of conservation to

audiences that have previously showed little to no interest in the survival of that species.

Viral videos are video recordings that use social media sites and other Internet websites and tools to become popular. They spread when people share the video link with their friends through email, Facebook, etc. They are often amateur videos. However, many companies have discovered they can use the concept to create an interest in their product or message with very little money. They have even been used for political campaigns.

Procedures:

1. Ask students why some animals, such as bald eagles, generate a lot of public support for conservation and protection, yet others like the Yaqui catfish do not get the same interest. Lead a discussion that focuses on human perceptions toward wildlife and how bigger, “cuter” species often get more attention. People often want to donate time or money to help animals that they can connect with on a personal level. It can be hard to do that for a slimy fish or scaly lizard!
2. Explain that one way to deal with this public apathy is to educate people about these less “cuddly” animals – to present them in a unique and memorable way.
3. Present the following challenge to the students: “The Arizona Game and Fish Department is interested in creating a set of viral videos that could be used to generate public support for wildlife species. You have been hired as the consultant responsible for researching and developing these videos.”
4. Inform the students that the videos are to be modeled after a BBC series called *Walk on the Wild Side* in which a group of comedians added humorous dialogue to engaging nature footage.

5. Show some of the *Walk on the Wild Side* videos available on the Internet.
6. Divide the class into groups of 2-3 students. Assign each group one of the animals from the Bone Box Resource Trunk.
7. Inform students that the Arizona Game and Fish Department has already provided them with video footage of their animal. They simply need to research the animal and develop a script. For their presentation, they will read the script live while the video plays.
8. Explain that while the main purpose of the BBC series was comedy, their videos should focus on content. Humor, however, can be an effective tool to teach that content and is especially important in viral video marketing. It just can't replace the content.
9. Assign each group a computer and give them some time to view their video segment. They should begin brainstorming ideas.
10. After a few minutes, inform them that they are going to watch a movie focused on the history of wildlife conservation in North America. They should pay attention to how history has impacted their animal and find ways to incorporate this information into their script.
11. Watch *America's Wildlife* as a class or allow the groups to watch it on their own.
12. Once the video is completed, have students begin researching their animal in more

detail. They can use the materials in the Bone Box Resource Trunk or any additional resources they may discover on the Internet or in the library. Some questions to focus their research include:

- a. What was the range of this species when the Declaration of Independence was signed? What is the range today?
 - b. What are a few of the causes for the change in range over time?
 - c. What management practices have been used to conserve this species and its habitat?
 - d. What plants and animals share the habitat with this species? Have they experienced similar changes?
13. Once the research is complete, provide time for the students to create a script. They should be able to introduce some interesting facts about the animal's biology while describing its management history and challenges. It should be written in an entertaining way that makes it appear as if the animal itself is telling the story.
 14. Provide students with time to practice presenting the script with the video running.
 15. Begin presentations. Dim the lights and show each video without sound to the class. As their animal video plays, students should act out their script.



Differentiated Instruction:

Extensions:

- Rather than presenting live, students can use digital recorders and video editing software to add their voices to the movie clips. Free web-based tools, such as **www.screencast-o-matic.com**, may be useful. Students can then post videos to YouTube or other sharing sites. Be sure to send the links of these videos to our education program at **focuswild@azgfd.gov**.
- Explore the North American Model of Wildlife Conservation in more depth. Lessons 1 and 2 of the “America’s Wildlife: Yesterday, Today, and Tomorrow” curriculum provide additional ideas to utilize the video while Lesson 3 explores the history in detail.
- Have students read and analyze the “New Noah’s Ark” scientific papers by Ernest Small. These focus on human perceptions of endangered species. They can be found on the Bone Box Resource DVD and are available online at **http://www.azgfd.gov/bonebox**.

Modifications:

- Eliminate the additional research. Students can use the information from the Bone Box Resource Trunk fact sheets and the *American’s Wildlife* movie.
- Rather than presenting live, allow students to record their voice-over in a room by themselves and then play it for the class.



Reflection:

Use the space below to reflect on the success of the lesson. What worked? What didn’t? What changes would you make? These notes can be used to help the next time you teach the lesson. In addition, the Department would appreciate any feedback. Please send your comments to **focuswild@azgfd.gov**. We’d love to see student samples of the videos and scripts, as well!