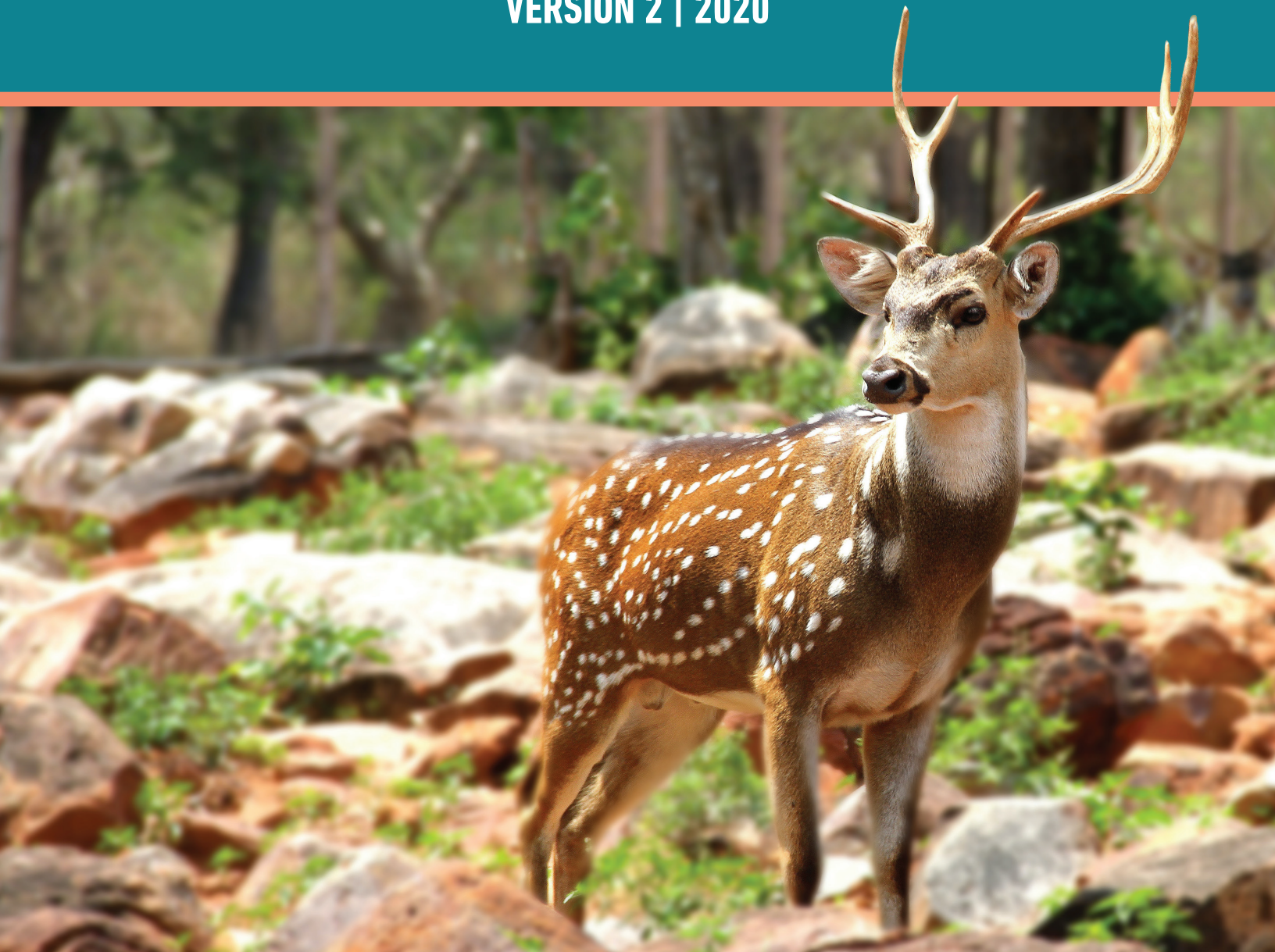# AN EDUCATOR'S GUIDE TO DEER

AN INTERDISCIPLINARY CURRICULUM OVERVIEW

VERSION 2 | 2020

CERVID TAXON ADVISORY GROUP MISSION

The mission of the Cervid Taxon Advisory Group (TAG) is to provide guidance and recommendations to North American institutions to promote responsible captive management of wild cervidae, moschidae and tragulidae species and support global activities and programs that enhance their survival in the wild.

CERVID TAG PROGRAM LEADER:

Michelle Hatwood, Freeport McMoRan Audobon Species Survival Center

CERVID TAG EDUCATION ADVISOR:

Dr. Brian Ogle, Beacon College

For more information, please see the most recent version of the Regional Collection Plan:
Hatwood, M. (eds.) 2020. Cervid Taxon Advisory Group 2020 AZA Regional Collection Plan–Fourth edition Association of Zoos and Aquariums, Silver Springs, MD.

CREDITS:

Edited by: Maxwell Aaronson, Beacon College

Graphic Design Co-Collaboration by:
Brittany Strozzo, Beacon College Instructor and Sophia Pikus, Beacon College

ASSOCIATION OF ZOOS & AQUARIUMS&

NOTE TO EDUCATORS

CERVID TAG EDUCATION ADVISOR:

This curriculum guide is designed to introduce students, of various grade levels, to the diverse group of animals in the deer family. The guide was developed as a tool for educators of differing backgrounds, content areas, and specialties. The goal of this guide is to introduce students to conservation and the study of the natural world while practicing those important content-specific skills.

A variety of multidisciplinary activities are found throughout this guide, which have been designed to promote performance in multiple content areas. Each activity outline will include appropriate grade levels, procedures, background information, and educator notes. These activities may be presented to students as they have been written or they can be adjusted as needed. Real-world applications of science and math are built into lessons so students can develop a deeper understanding. All activities are aligned to the Next Generation Science Standards. Student worksheets have been created and are included in this workbook, as well as teacher instructions for each activity. There are some activities that require the student to develop their own worksheet or a data table to encourage student growth. However, if you do need examples, or would like to create a worksheet for your class, examples are provided within the resources at the end of the workbook.

The lessons and activities presented are designed to be delivered in a full group setting. However, these activities may easily be divided into smaller pieces for use in a rotation or small group setting. This is ideal for educators in zoos wishing to utilize these activities for special events, public programming, or as part of your exhibit interpretation tool kit.

We hope that you and your students find this information beneficial in developing science, math, and language arts skills while learning about these fascinating creatures.

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SECTION 1: THE OVERVIEW OF DEER BIOLOGY

WHAT ARE DEER?

One of the most commonly recognized mammals in North America today is the deer. Many of us have seen them while driving down the road, or even possibly in our backyards. However, have you ever stopped to think about what adaptations these unique animals possess? Additionally, have you ever stopped to think about how many different deer species there are around the world. Today, there are a total of 3 recognized families, 72 species, and 34 subspecies occurring throughout North America, South America, Eurasia, and Northern Africa; with introduced populations in Cuba, New Guinea, Australia and New Zealand.

CLASSIFICATION

Deer belong to the mammalian family known as *cervidae* which is a sub group of a set of animals known as **ungulates**. Today, Merriam-Webster defines ungulate as a "group of herbivorous vertebrates with hair and digits ending in a cornified sheath." Literally, ungulate refers to any animal with hooves – a hoof being an enlarged toenail. However, in practice, the use of the name "ungulate" has been inconsistent. While it was originally used to refer to the "true" ungulate or the orders **Artiodactyla** (*hoof having an even numbered of well-developed digits*) and **Perissodactyla** (*hoof having an odd number of well developed digits*), the word ungulate over time has expanded to seven different Mammalian orders….. some of which have no hooves whatsoever! This broadening of the definition was based on presumed family relationships, some of which have been largely considered to be artificial due to recent advances in taxonomic science.

The body weight is supported entirely on the ends of one, two or three digits clad in a hoof. A foot structure is comparable to a human walking on tip toes. A long stride length coupled with an increased number of strides promotes movement that is swift and energy efficient. Limb adaptations in other species allow flight, swimming, hopping, gliding, climbing, leaping, and swinging hand over hand. Deer belong to the group referred to as **Artiodactyla**.

BASIC DEER BIOLOGY

Foraging (obtaining food) not only includes the mechanical eating, but any behavior employed to search, recognize, and obtain food items. A feeding behavior should provide maximum energy gain with minimal energy expense, and minimal risk of predation while foraging. Deer are herbivores that are designated by their dietary behavioral preference of browsing, or grazing. Deer digest their food utilizing a four-chambered stomach. Animals that complete this form of digestion are called **ruminants**. When these animals graze, chewed vegetation is swelled and enters into the **rumen**. The rumen is the largest chamber in the stomach and this is where the food is broken down by micro flora, and then formed into small, round clumps called cud. The animal will periodically return the cud to the mouth where it is re-chewed. Once the cud has been turned into a pulp, it then passes into the next stomach chamber. The order in which the food will travel through the digestive track is the rumen, then the reticulum, then the omasum, and finally into the abomasum. The abomasum is also known as the "true" or acidic stomach and this is where traditional digestion occurs.

Because deer are commonly preyed on by predators, they have several adaptations that allow them to survive. For example, being a ruminant, they are able to graze in open areas for a short period of time and can literally "dine and dash." Their eyes are placed on their heads so that they have great peripheral vision. It is believed that they have a vision field of 300 degrees! In addition, their eyes have a special membrane attached to their retina, which enhances their vision in low light. In order to hide from predators, deer are uniquely camouflaged to blend into their surrounding environment.

Most mammals develop some form of a social grouping. Individuals living within social groups tend to have an increased chance for survival, which is due to alertness of individuals and group defense against predators. Related females often form social units whereas the males either live alone or in bachelor groups. Social behavior is any kind of interaction between two or more animals, usually of the same species. Courtship, aggression, and cooperation are all examples.

Each species of deer display unique behaviors that allow them to effectively communicate with members of the herd, and that allow them to survive tough climate conditions. Vocalization, are not uncommon and deer have many, varied types of vocalizations. Different forms of vocalizations include grunts, bugles, and mews. Vocalizations are typically used for mother and calf communication, such as locating one another. Bugles in male elk are used to attract females and claim territory. Physical, or non-verbal, communication is essential for survival. In animals, it is not just about body language either! Many species of animals, including deer, use scent to communicate. Deer will use feces and urine to detect potential mates, increase social bonding, and to claim individual territories. Several different forms of body language are used for communication with other herd mates. Posturing may be used as an aggressive maneuver, to claim social status, or to warn off potential threats. White-tailed deer flash the base of their tail when alarmed, which alerts the herd and allows them to escape together.

Male deer are called stags, bucks, bulls, or hart, depending on the species of deer. Female deer are called cows, does, or hinds.

ARE DEER ANTELOPE?

There may be confusion regarding the differences between deer and antelope. Both are ungulates and both are ruminants. So, does that make a deer a type of antelope? The answer is no. They are more like distant cousins than exact relatives.

One of the prime examples that exist between deer and antelope is the presence of antlers as opposed to horns. Antlers are a temporary structure that grown seasonally. When antlers emerge they are covered in a substance called velvet. The velvet is essential in providing the antler with proper nutrition and blood supply for growth. Once the antler is fully grown, the velvet sheds and the bare antler remains. The antler is typically shed once the rut, or mating season is completed. For most species this will occur in early winter; however, tropical deer species do not have a normal antler cycle and can shed and regrow antler any time of the year. Antlers are used to attract mates, defend against predators, and to battle other males for the right to breed. Typically, males will only grow antlers. However as with most examples in nature, there is always an exception to rule. For example, both men and female reindeer grow antlers.

Horns are a permanent structure that is seen at birth. The horn will continue to grow and develop throughout the animal's life span. These bony structures are hollow and connected directly to the skull. Once a horn is broken or lost, it will not regrow. In some species, both males and females will have noticeable horns. The pronghorn antelope, which is native to North America, sheds its horns annually. Because of this, it is placed into a separate family named antilocapridae, even though it is called an antelope.

In addition to possessing antlers instead of horns, deer and antelope have distinctive ranges. Deer inhabit all continents, except Australia and Antarctica. Antelope are limited in origin, and are only found in Africa and some parts of Eurasia.

SECTION 2: THE OVERVIEW OF DEER BIOLOGY

EXPLORATION OF DEER SPECIES

Deer are found in every continent, except Australia and Antarctica. They inhabit a wide variety of habitats and climates. Some species, such as the muntjac, are found in rain forest near the equator. Yet, reindeer are found far north and live on the frozen tundra, deer are also as varied in size and appearance as their habitats. The largest species of deer is the moose, which can be nearly six feet at the shoulder and weigh almost a ton (that's 2,000 pounds!). The smallest species of deer is the pudu, weighing less than thirty pounds and standing less than two feet tall.

The Cervid Taxon Advisory Group TAG has listed eight species of focus, representing all five continents in which deer are found. Throughout the next section, you will find out more information about these eight unique species. This information will help you as you visit your local zoo on your next field trip, as well as enhance lessons found throughout the workbook.

EDUCATION EXTENSION!

- Have students write about a time in which they were able to view a wild deer up-close. Instruct them to include their thoughts and feelings about the encounter. This writing activity may take the form of a short story or even a poem.

- Create a public education display, such as a tri-fold display board, to teach about deer. Students may select one specific species, or select a continent and explore the various species found in a particular region. Be sure to focus on habitat and conservation status.

- If possible, include technology into this activity. Students may wish to explore the possibility of creating a video that be uploaded onto social media such as YouTube or Instagram to share with friends, family and community members.

PROFILES FOR NORTH AMERICAN DEER SPECIES

SPECIES PROFILE 1: WHITE-TAILED DEER

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Artiodactyla

Family: Cervidae

Genus: Odocoileus

Species: O.virgnianus

Distribution/ Habitat

The white-tailed deer (*Odocoileus virginianus*) is one of most common species of deer in North America. In North America, the white-tailed deer can be found in almost every state except Utah, California, Nevada, and Alaska. It can also be found all throughout Canada. Deer can be found in a variety of habitats. Although, they are primarily found in shrub-lands, woodlands, and forests. Deer use the vegetation of these wooded areas for forage and cover.

Morphology

Across the world, there are 39 subspecies of white-tailed deer, with seventeen of those subspecies being native to North America. The weight and height of the white-tailed deer vary by geographical region. One example of this would be with the Key Deer variation of the white-tailed. Mature Key bucks weigh about 36 kilograms (79 lbs) and mature Key doe's weigh 29 kilograms (64 lbs). The largest recorded subspecies is native to the Northeast/Great Lakes region. Fully grown bucks weigh on average 100 kilograms (220 lbs) while as fully grow doe weighs on average 66 kilograms (145 lbs).

The white-tail deer can easily be recognized by its tail with white on the underside. The deer is also known for its light-brown coat, although some variations have coats ranging from a shade of brown to an almost gray color.

All male white-tails grow antlers during the months of April and May. Antlers serve various purposes. Not only do antlers provide defense against predators, but they are an integral part of the deers social behavior.

Diet

White-tailed deer are considered herbivorous, which means they exclusively eat plants. The white-tailed diet consists primarily of fruits, seeds, acorns, leaves and grass. In more human populated areas, plant growth facilities such as orchards or vineyards are known to be a common food source for deer.

Behavior

White-tailed deer are always on constant alert. When startled, they wave their signature white-tails and proceed to flee. White-tailed deer can run on average 30 miles per hour (48 km). The deer possess complex social behavior. During the late spring and summer, a basic social unit is comprised of does, their fawns and yearlings, and fully grown males. During a rut (mating season), male deers will compete amongst themselves to mate with a desired female deer.

PROFILES FOR NORTH AMERICAN DEER SPECIES

SPECIES PROFILE 2: ELK

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Artiodactyla

Family: Cervidae

Genus: Cervus

Species: Cervus elaphus

Distribution/ Habitat

In North America, the elk population tends to be more present in the western half of the continent, ranging from northwest Canada and as south as Texas. Elk are considered to be "habitat generalists", which means they can thrive in different kinds of environments, and can be found in a variety of different habitats, predominantly grasslands, wetlands, shrub lands and forests. While they are considered generalists, elk cannot be found in humid ecosystems such as Florida or Louisiana, or frozen environments such as the tundra.

Morphology

Currently, there are 22 subspecies of elk that can be found across the world, with four of those subspecies being native to the North American continent. The four subspecies of elk are:

- Rocky Mountain Elk (*C.canadensis nelsoni*) can be found in the western Rocky Mountain Region. They are known for having the largest antlers amongst the elk sub-species

- Roosevelt's Elk (*C. canadensis roosevelti*) are primarily found in the coastal Pacific Northwest, and are regarded as one of the largest land mammals, as bull's weigh on average 1,100 lbs (500 kg) and cows weigh on average 600 lbs (272 kg)

- Tule Elk (*C. canadensis nannodes*) are native to the central California region, and are considered out of the North American subspecies. Typically, adult bulls weigh 450-700 lbs, and adult cows weigh 375-425 lbs.

Each subspecies of elk can be distinguished by their unique geographical location and body features.

Diet

An elk's diet consists of mainly grasses, forbs, shrubs, tree bark and twigs. Elk will sometimes supplement their diets with a mineral lick, as the licks contain essential nutrients such as sodium, magnesium, phosphorus, and sulfates. These licks help elk grow a healthy set of antlers, and maintain a healthy coat for the winter.

Behavior

Elk are considered to be the "noisiest" out of all the ungulates. Adult bulls are known to make a "bugling" sound in order to attract cows, as well as establish dominance to other bulls. When in danger, a loud barking sound is made. Cow's and their yearlings and calves live in loosely organized herds, with other cows and their young. Bulls on the other hand, will live with other males in a "bachelor group" or sometimes alone.

PROFILES FOR NORTH AMERICAN DEER SPECIES

SPECIES PROFILE 3: CARIBOU (REINDEER)

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Artiodactyla

Family: Cervidae

Genus: Rangifer

Species: Rangifer tarandus

Distribution/ Habitat
In North America, Caribou can be found exclusively in Canada and Alaska, ranging from Alaska, all throughout Canada, and as south as the United States-Canadian border. Caribou can also be found in the northern regions of Europe and Asia. Caribou tend to prefer boreal and subboreal forests, and the Arctic tundra while migrating.

Morphology
Currently, there are seven subspecies of caribou that can be found worldwide, with four of those subspecies being native to the North American continent. The four subspecies are:

- Woodland Caribou (*R.t. caribou*) can be found in the southern region of Canada, and in the Northwestern region of the United States.

- Barren-ground Caribou (*R.t. groenlandicus*) can be found all across Canada's Northwest Territories and Nunavut.

- Grant's Caribou (*R.t. granti*) can be found throughout Alaska and the territory of Yukon.

- Peary Caribou (*R.t. pearyi*) can be found on islands in the Canadian Arctic Archipelago, the Northwestern territories and Nunavut

Unlike most species in the Cervid family, both male and females can grow antlers as well!

Diet
Caribou's diets consist of leaves, grass, berries, assorted fungi and lichens. Lichens are a critical piece in the caribou diet, especially during the winter migratory months. Lichens are rich in carbohydrates, which gives the caribou energy to produce body heat during the harshest of winters.

Behavior
Caribou are known for their long migration routes between summer and winter ranges. Large herds of up to 500,000 caribou will travel up to 3,000 miles to reach their new range. While caribou are known for their long migration routes, some sub-species of caribou such as the Peary caribou, are sedentary (non-migratory).

PROFILES FOR NORTH AMERICAN DEER SPECIES

SPECIES PROFILE 4: MOOSE

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Artiodactyla

Family: Cervidae

Genus: Alces

Species: A. alces

Distribution/ Habitat

Moose are native to North America. The moose tend to occur in the northern half of North America, with populations in Alaska, most of Canada, the northern half of the United States (Washington to Northern New England, and the northern part of the Rocky Mountains. Moose tend to occur in forested areas such as hardwood forests. Moose can also be found around lakes, rivers and ponds.

Morphology

Currently, there are five known subspecies of moose in the world, four of which are native to North America. The four subspecies of moose are:

- Eastern moose (*A.a. americana*) can be found all throughout the northeastern region of North America. The eastern moose tend to range from Ontario, and all the way through central New York

- Alaska moose (*A.a gigas*) can be found in Alaska as well as the western region of the Territory of Yukon. The Alaska moose is the largest subspecies of moose in North America; a fully grown female can weigh as much as 800 lbs and a fully grown male can weigh up to 1,600 lbs.

- Western moose (*A.a. andersoni*) can be found in the eastern half of the Yukon Territory, the southern half of Nunavut, all throughout British Columbia, western Ontario, and parts of the Upper Midwestern region.

- Shiras moose (*A.a. shirasi*) can be found within the Rocky Mountain region, starting from southern British Columbia and ending in southern Colorado. Shiras moose is also known to be the smallest subspecies of moose in North America.

Moose are well known for their antlers. Like most members of the deer family, only the males can grow antlers. Depending on the subspecies, moose antlers can grow up to 50 inches or more.

Diet

The moose is what is called a "browser." A browser feeds specifically on leaves, twigs, and bark of hardwood and softwood trees. Moose like to feed upon aquatic plants as well during the summer season as well.

Behavior

While the moose are large animals, they are surprisingly agile; they have the ability to gallop for short distances at a maximum of thirty-five miles per hour! Moose antlers also serve as paddles for swimming. Moose can swim up to twelve miles per hour.

MOOSE AND CLIMATE CHANGE

As rising temperatures as a result of global warming continues to impact the environment, the moose is one of the many species that will be negatively impacted by this change.

The moose as a species, is native to the cold temperature, and specific adaptations such as a thick coat that provides insulation. Adaptations such as the dense coat used for insulation allow moose to thrive in cold weather but not in warmer climates, where they struggle to keep their bodies cool. When exposed to warmer climates, they have the risk of experiencing heat stress. In periods of heat stress, these animals will stop foraging and may develop additional health problems. Summer months are essential to winter survival as this when moose gain most of their body fat to sustain through winter.

Another result of heat stress is a weakened immune response, which leave the animals vulnerable to parasites. Certain species of parasites such as the winter tick are commonly known to feed upon moose. The winter tick is responsible for an estimated forty percent decline in New Hampshire's moose populations. As the temperature increases, winter tick populations will grow as the winter seasons become warmer and shorter.

Climate change is responsible for altering natural habitats. The vegetation these animals require for food and shelter are also experiencing a reduction in density, demonstrating health issues, and an overall decline in total numbers. This is especially true for trees such as fir and hemlock, which are a critical part of the moose diet.

SELECTED SPECIES

The following species have been selected by the Cervid TAG as special species of focus. They are listed by continent, with their scientific name and their conservation status as defined by the IUCN Red List.

ASIA

- **Western Tufted Deer** (*E.c cephalophus*) – Near Threatened

- **Père David's Deer** (*Elapharous davidianus*) – Extinct in the Wild

- **Reeves' Muntjac** (*Muntiacus reevesi*) – Least Concern

- **Barasingha** (*Rucervus duvaucelli*) – Vulnerable

- **Eld's Deer** (*Rucervus eldii*) – Endangered

- **Greater Malayan Chevrotain** (*Tragulus napu*) – Least Concern

SOUTH AMERICA

- **Southern Pudu** (*Pudu puda*) – Near Threatened

NORTH AMERICA

- **Moose** (*A.alces*) – Least Concern

- **Elk** (*Cervus elaphus*) – Least Concern

SECTION 3: OVERVIEW OF HUNTING

CONSERVATION OF DEER

Conservation of living organisms in today's modern world can no longer focus upon the development of protected ares for the confinement of wild species. Modern conservation techniques need to include approaches for both captive and wild populations, while delicately balancing the needs of the human population. Programs should decrease the impacts felt from human development and reduce the competition for food, space, and water. All animals, especially large herbivores, are feeling the pressures created by the development of the human infrastructure around the world. Once plentiful grazing areas are now being replaced by farming operations, migration routes are disrupted by fences and roads, and un-regulated hunting activities has taken a drastic toll on many species. Illegal hunting (poaching) and trade of species has created a market in which the animal or select animal parts, have become more valuable dead than alive. In areas where war and conflict are active, wild species are continuously impacted, and minimal effort is made to maintain habitat or recognize conservation status. The AZA Cervid TAG is not opposed to legal hunting as a conservation tool. Regulated hunting is used by many states in this country to control overpopulated species and keep large ungulates in balance with the environment. Legal, regulated hunting does not negatively impact species sustainability.

Large vertebrates around the world are rapidly engaging conflicts with humans. As historical ranges and migration routes are disrupted, animals are migrating through new settlements, feeding on crops, and defending their young against threats. These animals are listening to their instincts dictated by genetics that were designed to endure hardships and keep their kind alive.

Hope is on the horizon for many species as we continue to improve our relationship and interactions with these animals. Although progress is being made in many places, it is slow. Practical solutions are continuously being developed to improve human life without destroying wild lands. Human behaviors that have existed for centuries are being altered, which is securing a better way of life through new, sustainable practices that not only protect the wildlife, but increase quality of life for the human. For example, in Central Asia, incentives are offered to herders that vaccinate their herds, which in return reduce disease in livestock that can be transmitted to local wildlife. Communities that comply with their agreement to reduce herd size, and not to poach wild animals, receive a financial bonus at the end of the year. There is no bonus if anyone in the community breaks the agreement.

THE ROLE OF ZOOS IN DEER CONSERVATION

Deer species across the globe are in decline are experiencing threats from illegal hunting, habitat loss, and habitat decline. The Cervid TAG is working with member institutions to support global programs and actions to enhance survival of animals, both in captivity (ex-situ) and in their native ranges (in-situ).

The Cervid TAG is working closely with member institutions to promote a continued growth of deer found in zoological institutions. This includes encouraging zoos to invest in the expansion of exhibits, herds, and research.

All actions can be seen in the TAG's 5-Year Action Plan found within the Regional Collection Plan.

SECTION 4: LESSION GUIDE

PREDATOR OR PREY?

In this activity, students will use animal artifacts to compare physical adaptations for survival.

Keywords: Predator, Prey, Anatomy

Objective(s):

- (3-LS3-1) Analyze and interpret data to make sense of phenomena using logical reasoning

- Develop scientific writing skills

- (MS-L4-2) Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

Recommended Grades: Grade 3 and up

Evaluation

- Student developed report

- Discussion participation

Materials: Skulls (deer, mountain lion or wolf, bear, and rodent)

Time Required: 30 minutes

Procedure:

1. Have students observe their given skulls and write down initial thoughts and observations. Encourage students to look at all parts of the skull.

2. Using an educated inference, have students select which skull belongs to predator (carnivore) and prey (herbivore). For older students, give them more options for skull groups. Examples may include: gnawer, ruminant, or omnivore.

3. Once students have made their choices to proper skull classification, instruct them to write a passage or short essay, explaining their answers. Details should include observational findings supported by available resource materials.

4. Have a classroom discussion to why they believe their answers are correct.

DISCUSSION QUESTIONS

- What physical features of each skull lends itself to food consumption?
- Are there any structures that support jaw muscles? Which skull had the bigger zygomatic arch?

BACKGROUND IN BEHAVIOR

Animal behavior is an important element of caring for these animals in the wild and when they are under human care. Deer exhibit a variety of behaviors. All of these behaviors serve a variety of purposes, but all are important to understand.

Researchers use a tool called an ethogram when studying animal behavior. This ethogram is a part of a series of procedures designed to ensure validity of data. An ethogram is a list of specific behaviors the researchers will examine during their observation period. The behaviors are specific enough to prevent confusion and to provide the researcher with the ability to record the specific actions of an animal.

The inclusion of animal behavior in your teaching allows students to conduct a field investigation. These investigations can be simple or complex. The study of behavior allows students to engage in the scientific process while enhancing their critical thinking skills.

BEHAVIOR SLEUTHS

In this activity, students will develop behavior observation charts, also known as ethograms to record expressed animal behavior.

Keywords: Ethogram, Behavior

Objective(s):

- (HS-LS2-8) Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce

Recommended grades: Grades 6 and up

Evaluation:

- Student developed graph

- Participation in class discussion

Materials: Ethogram and a writing utensil

Time Required: 45 minutes

Procedure:

1. Discuss potential behaviors. Complete research via multiple sources.

2. Develop an ethogram that will be used to record animal behaviors. Be sure to research potential behaviors you may witness to complete the chart. For beginning students, provide a list of behaviors.

3. Visit your local zoo or wildlife sanctuary to observe a deer species. Spend 20 minutes recording behaviors that you see the animals expressing.

4. Once you return to the classroom, develop a graph that displays the different types of behaviors and/or the amount of time spent completing each behavior. This is called an activity budget. Create a chart that demonstrates the classroom data average.

5. Have students complete a simple summary comparing their individual ethogram data to the class set of data. To challenge older students, have them develop a lab report that includes data sets, analysis, and methods.

STUDENT ETHOGRAM

Procedure: Write your list of behaviors in the provided column. Every two minutes, mark the specific behavior/s that you see the animal doing.

Animal: _____

Start Time: _____

Behavior List	Initial 0 min.	2 min.	4 min.	6 min.	8 min.	10 min.	12 min.	14 min.	16 min.	18 min.	20 min.

DIAGRAMMING THE DIFFERENCE

Keywords: Horns, Antlers, Venn Diagram

Objective(s):

- (3-LS3-2) Use evidence to support the explanation that traits can be influenced by the environment.
- (3-LS3-1) Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.

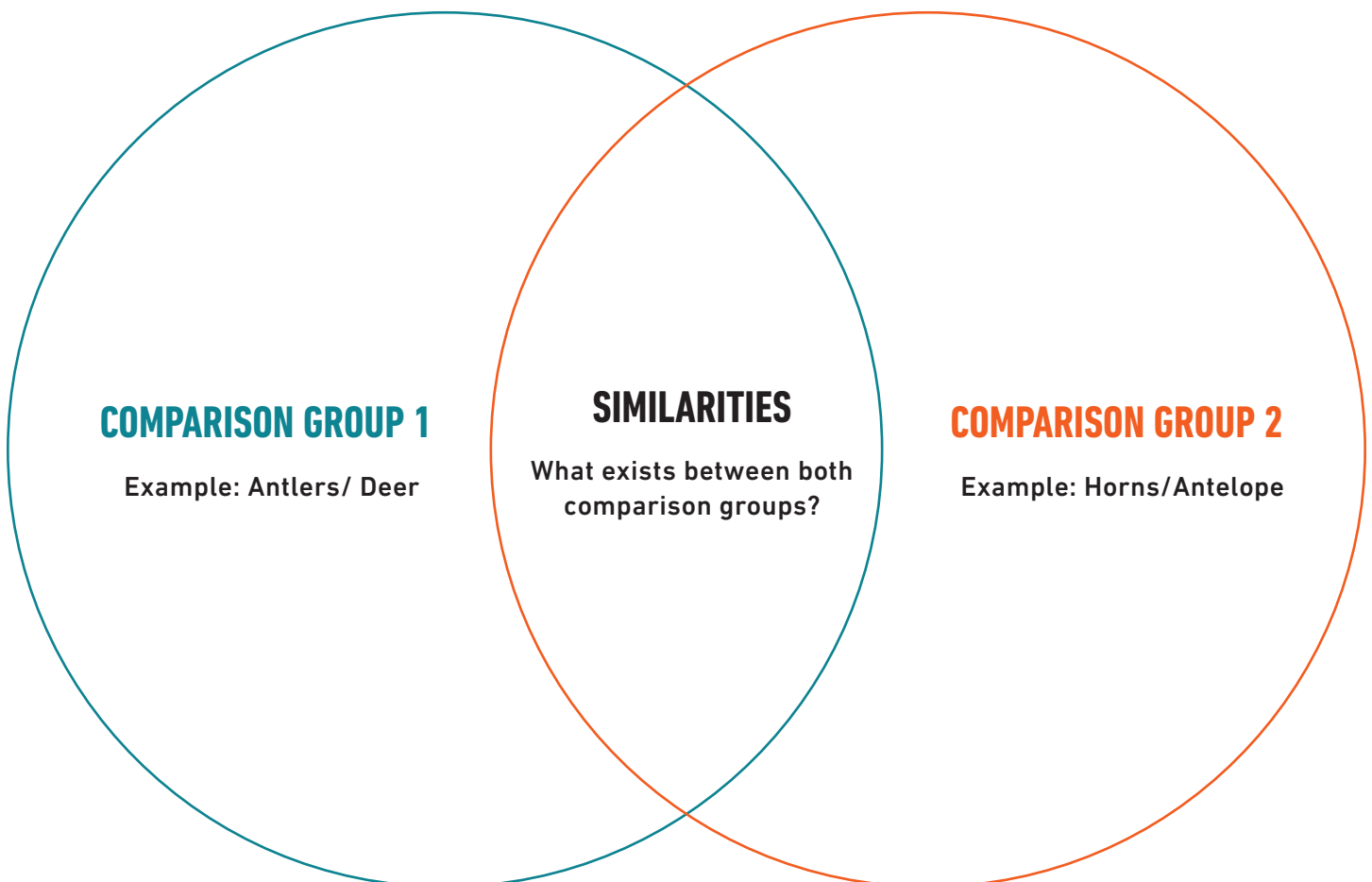**Recommended grades:** Grades 5 and below

Evaluation: Student developed diagram
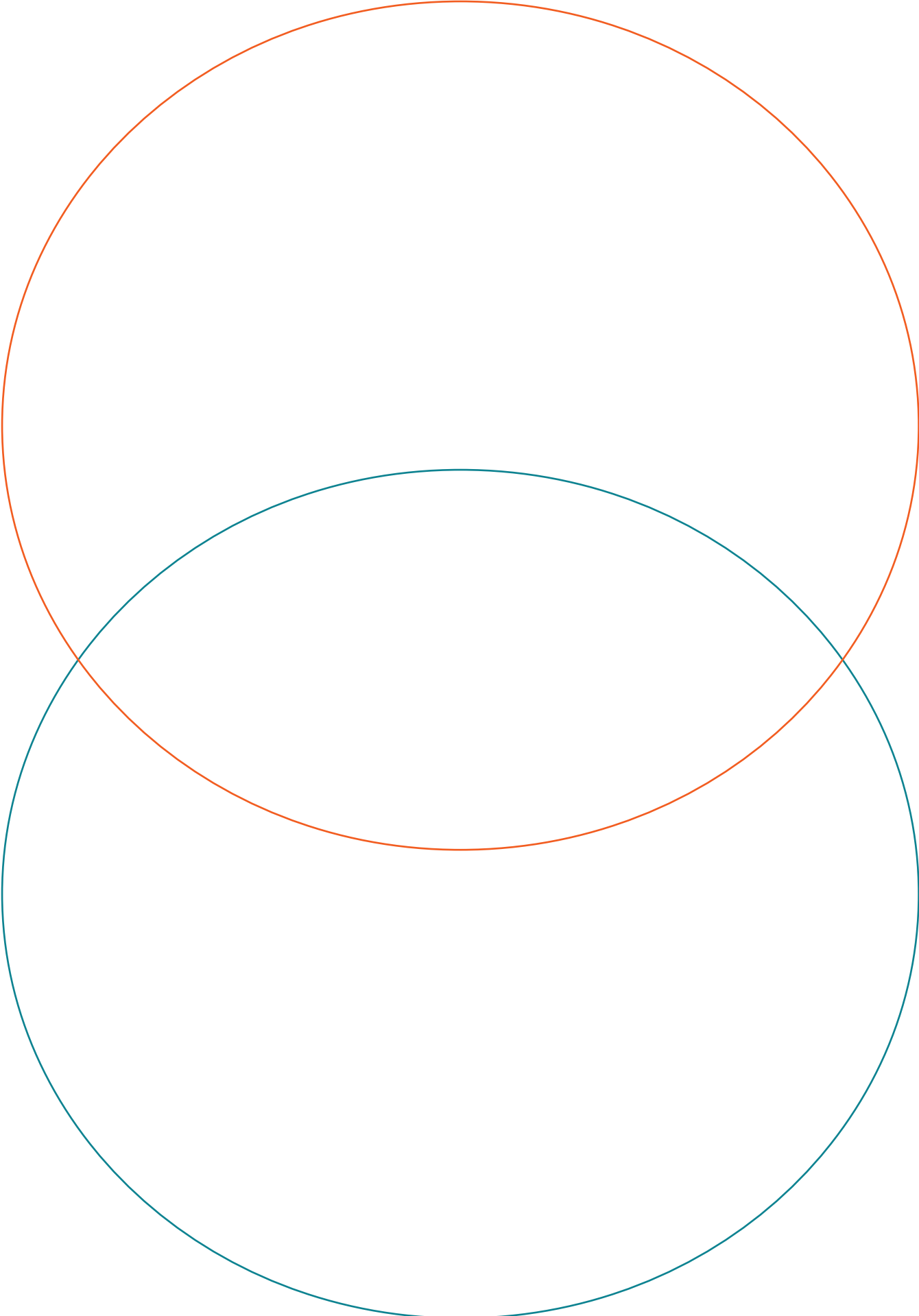
Materials: Paper and writing utensil

Time Required: 15 minutes

Procedure:

1. Read the background information about horns and antlers to the class
2. Have students create a list of characteristics that describe each structure.
3. From this list, have students fill the provided student worksheet of the Venn Diagram.
4. For older students, you can take this one step further and create a chart that demonstrates the differences between deer and antelope overall.

COMPARISON GROUP 1

Example: Antlers/ Deer

SIMILARITIES

What exists between both comparison groups?

COMPARISON GROUP 2

Example: Horns/Antelope

DIAGRAMMING THE DIFFERENCE

MEASURING UP!

Keywords: Antlers, Proportions, Deer

Objective(s):

- (MS-LS4-4) Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

- (MS-LS4-6) Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

Recommended grades: Grades 4 and up

Evaluation: Participation in activity and discussion

Materials: Masking tape, tool for measuring, antlers, bathroom scale, blank classroom wall

Time Required: 45 minutes

Procedure:

1. Have students research several of the species from the list provided in the guide to determine the physical size (height, length) of the largest and smallest deer species. Select varying species for comparison.

2. Once the physical size have been determined, use a blank wall and masking tape to create an outline of theses deer species. This will allow students to make connections to physical size and the differences that exist within the deer family.

3. Once you complete this, use a different part of the wall to create the size of the animal's head and the antlers. Create this at a level that is appropriate for your students. Have them stand in the middle (head) and compare their arm span to that of the span of the antlers. For some species; such as elk, you may want to compare height of the rack to that of the individual students.

4. If you have antlers available (moose, white-tail, elk), use the bathroom scale to weigh them. Record your observations of the weight. You may also measure to find the exact height and width of each. Compare how much a pair of antlers weigh in proportion to the animal's body weight.

DISCUSSION QUESTIONS

- How much would your antlers have to weigh to be the same proportion as the ones measured?
- How would you be able to carry that additional weight with you?
- What physical adaptations would you need in order to support the weight?
- Which animal had the heaviest set of antlers in comparison?

POPULATION CURVE

When a population does change in numbers, this can be represented by a population curve. The population will always be influx due to external pressures on a given population. For example, a rise in the population of prey animals will result in the rise of a predator population. As the predator population become larger, the prey population will decrease. As the prey population decreases over time, so will the predators. This process will then repeat once there are fewer predators to keep the prey population under control. There are two different types of growth that a population can endure. The pattern of a steady increase is called an S-shaped (or sigmoid) curve, while a population that experiences rapid changes is called a J-curve. The example of the changing predator and prey populations can be represented by a J-shaped curve. A population with limited external pressures will be represented by an S-shaped curve. Each population will reach an equilibrium or carrying capacity. This means that the population is unable to grow any further due to the lack of resources available in the ecosystem.

There are many techniques used for the monitoring the size of animal populations. The simplest form is that of a direct observation and counting of physical individuals. This is easy to complete for larger species. Different statistical calculations using proportions can also be employed when estimating population numbers.

BARAGSINGHA SURVIVAL GAME

This game allows students to gain an understanding of population dynamics and how environmental resources affect population health.

Keywords: Population, Carrying Capacity, Ecosystem, Interaction

Objective(s):

- Identify external pressures and resources that influence carrying capacity

- Describe changes in an ecosystem and how this impacts population size

- Demonstrate graphing and data recording skills

Recommended grades: All grades

Evaluation:

- Completion of data chart

- Participation in game and discussion

Materials: Large outdoor playing area, paper, and writing utensil

Time Required: 45 minutes

Procedure:

1. Designate a large playing space in an outdoor area. Mark two parallel lines on the ground 30 to 50 feet apart. If needed, define outer boundary lines.

2. As a group, review the essential resources of a habitat: food, water, shelter, and space. All deer need good habitat to survive. Review the type of habitat that the Barasingha is found in, and how this species of deer survive.

3. Count off the group into four separate groups. Those that were assigned Group 1, should line up on one of the marked lines. This group becomes the Barasingha.

4. The Barasingha need to find food, water and shelter to survive. When a Barasingha is looking for food, it should clamp it's "hooves" over its stomach. When it is looking for water, it holds it's "hooves" over its mouth. When it is looking for shelter, it holds its hooves over its head. A deer can choose to look for any one of its needs during each round or segment of the activity; the deer cannot, however, change what it is looking for during that round. It can change what it is looking for in the next round, if it survives.

5. The remaining students act as the food, water, and shelter. Each student is allowed to choose at the beginning of each round which component they will be doing that round. The students depict which components they are in the same way deer show what they are looking for (i.e., hands on stomach for food, and so on). Have them line up on the opposite line from the Barasingha..

6. The activity starts with all players lined up behind their respective lines (deer on one side, and habitat components on the other side)-and with their backs facing the students along the other line. Begin the first round by asking all of the students to make their signs-each deer deciding what it is looking for, each habitat component deciding what it is. Give the students a few moments to put their hands in place-over stomachs, over mouths, or over their heads. The two lines of students normally will display a lot of variety- with some students portraying water, some food, and some shelter. As the activity proceeds, sometimes the students confer with each other and all make the same sign although do not encourage it. For example, all the students in habitat might decide to be shelter. That could represent a drought year with no available food or water.

7. When deer see the habitat component they need, they should run to it. Each deer must hold the sign of what it is looking for until getting to the habitat component student with same sign. Each deer that reaches its necessary habitat component takes the "food," "water," or "shelter" back to the deer side of the line. "Capturing" a component represents the deer successfully meeting its needs and successfully reproducing as a result. Any deer that fails to find its food, water, or shelter dies and becomes part of the habitat. That is, any deer that died will be a habitat component in the next round and so is available as food, water, or shelter to the deer that are still alive.

8. **Game Changer:** If you are playing with multiple classes, split the two groups evenly. You will have two groups representing resources in the environment, one group representing the deer and one group representing the wolves (predators).

9. For extension, have students record the number of deer that survive each round. Graph the data so you are able to see the changes in population.

DISCUSSION QUESTIONS

- What kind of population curve was created?
- Did both the predator and prey populations show similar trends?
- If you wanted to maintain a consistent deer population, what steps would you need to take?

WE ARE ALL CONNECTED

Keywords: Habitat, Diversity, Interdependence

Objective(s):

- (MS-LS2-2) Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems

Recommended grades: All grades

Evaluation: Participation in class discussion

Materials: List of animals, yarn, pictures of various habitats

Time Required: 30 minutes

Procedure (Part 1):

1. Before starting activity, facilitate a classroom discussion about the attributes of a proper habitat, including habitats featured in the pictures you have printed.

2. Give each student a list of different organisms that correlate with a specific habitat picture.

3. Have students work in small groups to determine which organism belongs to each habitat.

Procedure (Part 2):

1. In a large open area such as gymnasium or a field, instruct students to stand in a circle with one student holding onto the ball of yarn.

2. The student holding the ball of yarn to the student across from them in the circle, continue this process until all students have a section of yarn in their hands. Make sure to keep it random, as the yarn should overlap several times.

3. For older students, you may implement a specific habitat from one of the pictures you have printed. Then connect the yarn ball in the order of that habitats food chain. That process will create a visual representation of a true food web found within that habitat

4. Once all students have a piece of yarn, have one student to release their section of the yarn strand. As tension is released, and the yarn loosens, the rest of the students must tighten their strands of yarn in order to compensate. Repeat this several more times.

   - Each section dropped should impact several others further into the activity

5. Discuss with the class, the interdependence of organisms within an ecosystem.

DISCUSSION QUESTIONS

- What value do these habitats have?
- What determines value?
- What consequences existed as a result of the removal of a specific section.

CARIBOU MIGRATION

Students will explore the impacts climate change may have on Caribou migration paths.

Keywords: Migration, Human Impact

Objective(s):

- (HS-ESS3-3) Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

- (HS-LS2-2) Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Recommended grades: Grades 6 and up

Evaluation: Participation in discussion and completion of activity

Materials: Writing utensil, map of caribou migration route, and a piece of scrap paper.

Time Required: 60 minutes

Procedure:

1. Have students research the migration paths of caribou in Alaska and Canada.

   - Examine the ways in which they use the landscape, including sea ice to make their journey.

   - Discuss why the animals would need to migrate each season.

2. After the discussion, hand students the map of a caribou migration route, then bring up the following points

   - Certain caribou populations rely on sea ice to reach their destination.

   - Caribou travel an average 2000-3000 miles per year.

3. Facilitate a classroom discussion about climate change:

   - Ask students what are some possible consequences climate change might have on migration patterns of animals, particularly caribou.

   - Emphasize the effects of sea ice and how this is impacting animals in northern climate zones.

4. For advanced students, have them find alternative routes the animals may have to take if the sea ice is no longer present during the migration season. You can also ask students to mark natural resource pipelines along the migration.

   - As a extension, ask students examine other factors that influence the success of caribou migration (fences, pipelines, major roads, etc). Would the loss of sea ice cause the animals to face more scientifically during their migration route.

ROCKY MOUNTAIN ELK CENSUS ACTIVITY

Keywords: Population, Census, Harvest

Objective(s):

- (HS-LS2-2) Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales

Recommended grades: Grades 6 and up

Evaluation: Completion of data chart and corresponding graphs

Materials: Student activity sheet, and writing utensil.

Time Required: 60 minutes

Procedure:

1. Before starting the activity, facilitate a classroom wide discussion on the importance of monitoring population numbers for wildlife. After, the discussion; provide students with the Population Data Chart. For this activity, we will be exploring the population of elk .

2. The initial adult elk population has been divided into the categories of bull and cow, with the starting population being provided on the data table.

3. Spring reproduction will equal the number of adult cow from the previous year, multiplied by 1.7. This will equate the number of bull and cow produced.

4. Round to the nearest whole number and divide by two. After dividing if there is .5, that number will be dropped for buck and added for cow. For year 1, we assume all does were adults the previous year

5. The harvest will equal the adult bucks multiplied by .80, round to the nearest whole number. No doe or fawn will be harvested.

6. Total deer for the following year will use the following equations

    - Bull=adult bull+reproduction of bull- harvest bull

    - Cow=adult cow+reproduction of cow.

7. Total population will equal the total buck for next year+total doe for next year.

8. Using the total elk for next year, return to step one of the next column, and repeat for the remaining years.

9. Once the students have completed their data chart, instruct them to create a graph of their choice that represents the data presented in the chart.

CENSUS–STUDENT ACTIVITY SHEET

Population Data Chart

Rocky Mountain Elk (*Cervus elaphus nelsoni*)

	Year One		Year Two		Year Three		Year Four		Year Five	
	Cow	Bull	Cow	Bull	Cow	Bull	Cow	Bull	Cow	Bull
Adult Elk Population										
(+) SPRING Reproduction 1.7 per adult cow (fawns)										
(–) FALL Harvest 80% of adult bulls										
Total to begin new year										
Total Population										

ONE DEER, TWO DEER...WHAT'S THE LIMIT?

In this activity, you will be a wildlife manager and attempt to calculate impacts of variables that will influence your deer population.

Keywords: Population management

Objective(s):

- Describe the positive and negative ecological impacts of deer.

- Describe how abiotic and biotic factors can impact wildlife populations.

- Implement math skills; graph development and plotting, as well as calculating.

Recommended grades: Grades 6 and up

Evaluation: Completion of charts and graphs

Materials: Large outdoor playing area, paper, and writing utensil

Time Required: 60 minutes

Procedure:

1. Cut out the provided population influence cards. Separate them into appropriate piles (reproduction, condition, and management)

2. Instruct students to create a graph with the following constraints:

   - YEAR 1: Spring, Summer, Fall, Winter

   - YEAR 2: Spring, Summer, Fall, Winter

   Continue this process until you have marked a total of ten years

3. Read the scenario out-loud to the class:

   - You are the manager of a deer population. You have a beginning population of 100 animals. The carrying capacity of the habitat is 150 animals. The point of the activity is to end up with a viable population after 9 years. If at any time, your population reaches less than 10 or more than 250 individuals, you no longer have a viable "herd" and will watch the other students until the conclusion of the activity.

4. Once you have read the scenario, draw the cards in the following sequence: condition card, reproduction card, condition card, management card, condition card, reproduction card, and so forth.

   - As each card is drawn, it is read aloud to the entire class. You will roll your die and follow the instructions to determine your herd population new size.

5. Once you have completed the cycle for all ten years, discuss the results with the class.

   - Did populations "managed" under different strategies by different students show different trends? How do these compare? Would you "manage" differently if given a second chance?

   - Have students write a brief statement regarding the following prompt: Some wildlife managers have said that wildlife management involves more management of people than of wildlife. Explain what they might mean by the comment.

Condition Card

Condition Card

A fire has roared through the forest, resulting in a critical toss of habitat for the herd.

Decrease herd by the number equal to five times your roll.

Condition Card

Disease has struck the heard.

Decrease herd equal to roll.

Condition Card

A good water supply has contributed to lush browse and has had a dramatic impact on the survival of your heard.

Increase your herd by five times your roll.

Management Card

Management Card

One-hundred acres of the forest has been clear cut for a house subdivision alerting critical habitat.

Decrease your herd by three times your roll.

Management Card

Habitat acquisition has increased the area of available and suitable habitat.

Increase your herd by five times your roll.

Management Card

Scientific research has been successfully accomplished concerning the reproductive capabilities of the herd.

Increase or Decrease (*students choose which one before rolling the die*) the heard by two times your roll.

Reproduction Card

Reproduction Card

Several acres of forest are now camping.

Increase your herd by one times your roll.

Reproduction Card

There are no predators in the area. All offspring this season will survive.

Increase your herd by three times your roll.

Reproduction Card

Good ground cover allows for successful offspring growth.

Increase your herd by two times your roll.

Have students research management related issues and decisions to develop their own cards to be used for the game.

Condition Card

Condition Card	Condition Card	Condition Card

Management Card

Management Card	Management Card	Management Card

Reproduction Card

Reproduction Card	Reproduction Card	Reproduction Card

LOCAL ICON OR LOCAL MENACE?

Keywords: Population management

Objective(s):

- (MS-LS2-2) Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems

- (MS-LS2-5) Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Recommended grades: Grades 6 and up

Evaluation: Participation and relay of information during discussion.

Materials: Resources for research, paper and writing utensils

Time Required: 90 minutes

Procedure:

1. Many individuals have a complex relationship with local wildlife. They enjoy watching the animals from a distance, but become upset when the animals destroy property or become a nuisance. In North America, deer often cause damage to gardens and landscaping that has been put into place by homeowners.

2. Split the class into small groups. Each group will represent a specific viewpoint on a wildlife conflict.

3. Have students research about potential benefits, costs and conflicts that exists with sharing your home with deer. Resources should include newspaper articles, online databases, and academic sources.

4. Read the provided scenario to the group. Once the group has heard the scenario, give them some time to collaborate. Each group should find sources and information that supports their viewpoints.

5. Once the research has been completed, come back together as a group to debate the topic. The format should be that of a public hearing. Thus means each group should be given ample time to discuss their findings and to create counter-points during the discussion. The instructor should serve as a mediator and facilitate a consistent flow of idea sharing.

6. Once the debate has taken place, try to develop a plan that will benefit all interested parties. For older students, you may elect to have one group serve as the city council that observes the public hearing. Once the debate has concluded, they can retreat to vote on a plan of action, citing sources and examples given during the debate.

SCENARIO

Concern over the increasing development of suburban neighborhoods near a local lake and wooded area has individuals worried about the impacts on the habitat and wildlife. A new proposal from a local naturalist group has been presented to the city council. The new proposal calls for the lake and surrounding habitat to be turned into a wildlife management area, with an emphasis on deer. This has the local homeowners upset because they have been continuously attempting to push the deer away from the area. They claim that the local deer population is too large and that the animals are eating all of the expensive landscaping. The city council has called a special town meeting in which interested partied may express their views on the new proposal.

Recommended Groups

Homeowners: Concern about proposal, conflict with deer

Land Developers: Worried about home sales if conflict continued; can see potential economic gain from selling land to the city.

Naturalist group: Wants to see protected area for wildlife.

Natural Resource District Representative: Wants a mixture of protected area, land use for resident, and controlled deer population.

CREATIVE COMMUNITY CAMPAIGNS

A service learning project in which students are able to learn about human-deer conflicts.

Keywords: Convservation

Objective(s):

- Practice verbal learning reasoning skills

- Scientific writing skills to interpret information

- Use deductive reasoning and/or inductive thinking ability to create an effective argument

Recommended grades: Grades 6 and up

Evaluation: Completion of final project

Materials: Resources for research

Time Required: 60 minutes or more

Procedure:

1. Read the conservation background information to students.

2. As a group, discuss ways that humans and deer populations are in conflict, both intentionally and non-intentionally. For example, motor vehicle collision.

3. Once you have brainstormed a list of human-deer conflicts, have students elect which topic they would like to develop a community campaign for.

4. Discuss the purpose of a community campaign. What are the realistic goals that the campaign should achieve? What is the primary purpose of the campaign, and when is the target audience to receive your messages?

5. Campaigns should include background information and practical ways that the community can help. Use creative ways of delivering the message. For example, develop a video that can be shared on social media or creating a community action night.

EDUCATION EXTENSION!

- Turn this into a service learning opportunity!

- If you successfully create a community campaign, share your results with the members of

- The Cervid TAG, as well as members of your local zoo, nature center, and natural resources district. Many of the above-mentioned groups may be willing to participate in your community campaign.

EDUCATOR TIPS

BEGINNING THE LESSON

It is important for educators to gauge the current knowledge about a subject matter before beginning a themed lesson. This will allow you to effectively tailor the individual activities to match student ability, and focus on class interests if time allows. We recommend using one of the following two tools to assess student's knowledge. These tools will not only provide you with a base understanding of students' ability, but will also be an easy assessment tool for the end of the program. A base outline of two simple activities is listed below. On the next page, instructions for assessing student learning using these tools are provided.

K-W-L CHARTS

This tool is very simple in nature, and provides educators with a multitude of assessment possibilities. This should be done at the very start of the program, before any activities related to the curriculum is completed, as well as the very last activity of the program. To start, have students divide a piece of paper into three equal columns. Once the columns are created, have the students label the pieces. Reminder, students need to write their names on the paper! The first column will be labeled with a K, which stands for KNOW. In this column, students will list everything they know about a prompt that you provide. In this instance, the prompt will be DEER. In the middle column, the W will stand for WANT or WISH to know. Students should list everything they want to learn about DEER. Once this is completed, have students hand you their papers. You will hang onto these until the very end. Once you have completed all activities and curriculum components, pass the charts back to the students. Instruct them to complete the final column, which is L. L stands for LEARNED, and the students will write everything they learned about DEER in this final column. Once they have completed this column, have them give you the charts.

GRAFFITI WALLS

This is a very simple tool for educators. At the very start of the program, place one large piece of paper in a place that is accessible to the students. Provide students with a marker and instruct them to write anything they know or think about a given prompt, which is written at the top of the paper. It is recommended for activities in this guide to use the word DEER. Give students several minutes to complete this task. Pick up the paper and place it in a safe place until the end of the program. Once you have completed at activities and curriculum pieces, place the blank side of the paper in area accessible to all students. Repeat the activity as before.

ASSESSING STUDENT LEARNING

In order to demonstrate the effectiveness of any curriculum, it is important to demonstrate and provide evidence of student learning. A simple way of assessing student learning using either the K-W-L Chart or Graffiti Wall is provided below.

K-W-L CHARTS

Assessing Student Learning: In order to document the evidence of student learning, compare the K column to that of the L column. For instance, you will be looking at the number of statements made in each column. Additionally, you should compare the number of correct statements to that of incorrect statements in each column. For example, are there more statements made in L compared to K? Is there an increased amount of correct statements provided?

Assessing Customer Satisfaction: The students that participate in your programs are the number one customer you aim to satisfy, on varying levels. In order to examine if your programs are meeting the needs and wants of these customers, you can use the K-W-L chart as a preliminary measure. To do this, look at the statements made in the W column. You can compare these statements to those that directly relate in the L columns. The higher percentage of matching statements between W and L usually means the students are learning what they are interested in. Additionally, you can use the W column to compare with themes presented in the program. This will allow you to adjust future programs and develop programs that better match customer wants

GRAFFITI WALLS

The evaluation for a Graffiti Wall is very similar to that of the K-W-L chart. Compare the number of correct statements to those of incorrect statements for the pre and post measures.

Additionally, explore that type of statements that are made by the participants. Statement types you may wish to explore include: Declarative, Exclamatory, and Imperative. It is important to note if the statement is a fact or opinion. You can take this one step further by noting if the statement is a general or vague statement compared to that of a specific or concise statement. For example, the statement "wolves are easier to train that bears" would be classified as a Exclamatory (opinion/specific). A statement "Golden eagles can live to be 60 years old" would be classified as a Declarative (fact/specific) statement. You should be able to see a change in statement types, moving from general to specific statements, as well as from opinions to facts

GLOSSARY

- **Antler:** One of a pair of non-permanent (deciduous) bony structures located on the head of ungulates from the family Cervidae. Antlers are almost always branched, and grow from pedicels on the frontal bones. They are generally shed and regrown every year.

- **Artiodactlya:** Hoofs that have an even numbered of well-developed digits.

- **Browser:** Herbivore which eats primarily leaves, shoots, twigs of trees, bushes, forbs, and other vegetation which is up off the ground.

- **Buck:** A male belonging to the smaller deer species (White-tailed Deer).

- **Bull:** A male belonging to the larger deer species (Elk, Caribou,Moose).

- **Cow:** A female belonging to the larger deer species (Elk, Caribou,Moose).

- **Crepuscular:** Active primarily around dawn and dusk.

- **Cursorial:** Adapted for running.

- **Dimorphism:** The existence two distinct forms of a single species that differ in one or more characteristics, such as coloration, size, or shape. Example: males have horns, females do not.

- **Graminivore:** An animal that eats mainly grass.

- **Hoof:** The hard, keratinized sheath covering the toes of certain mammals.

- **Horn:** One of a pair of hard, permanent structures on the frontal bones of the head in member. True horns consist of a bony core covered with a sheath of keratinous material.

- **Perissodactlya:** Hooves that have an odd amount of well-developed digits.

- **Rumen:** Largest chamber in a ruminants stomach which is partially responsible for food breakdown.

- **Ruminant:** Animals that digest their food using a four-chambered stomach.

- **Ungulate:** A mammal with hooves.

ADDITIONAL RESOURCES

DEER BIOLOGY & MORE INFORMATION

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Note: Generally bad to cite an entire website. In that the APA 7th edition manual says you cannot. "To mention a website in general, do not create a reference list entry or an in-text citation. Instead, include the name of the website in the text and provide the URL in parenthesis (see Section 8.22 for an example)" (p. 350).

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BARASINGHA SURVIVAL GAME

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WE ARE ALL CONNECTED

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ROCKY MOUNTAIN ELK CENSUS & ONE DEER, TWO DEER*

 *This activity was adapted from Deer Population, written by Robert Cooper, Wilmington Area School District (https://ecosystems.psu.edu/outreach/youth/sftrc/lesson-plans/wildlife/9-12/deer-population) and *White-tailed Deer Issues* written by Barbara Neuburger, General McKlain High School (http://ecosystems.psu.edu/youth/sftrc/lesson-plans/wildlife/9-12/deer-issues)

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