

LEVEL: Grades 4-8

SUBJECTS: Environmental Education, Science, Geography, Physical Education, Math.

PROCESS: Through an active simulation game, students learn about the limiting factors that cause the desert bighorn sheep to be considered an indicator species.

OBJECTIVES: The student will:

1. Identify the four "needs" of desert bighorn sheep.
2. Define what an indicator species is.
3. Explain why it is important to be aware of an indicator species.
4. Describe four impacts of domestic livestock on desert bighorn sheep.

TIMEFRAME: Two 45-minute periods.

SKILLS: Comparing similarities and differences, counting, developing psychomotor skills, developing vocabulary, differences, discussing, kinesthetic learning, listening, role playing, synthesizing, understanding cause and effect.

MATERIALS: Colored copy paper, rope, hoola hoops, "Life Cards," "Food Cards," "Space Cards," "Escape Terrain Cards," "Water Cards" (attached).

VOCABULARY: Bedding grounds, benches, bottlenecks, browse, brush, compete, domestic animals, ecosystem, escape terrain, ewe, forage, forbs, graze, habitat, immunity, inbreeding, indicator species, lamb, limiting factor, mortality, parasites, periphery, precipitation, predation, ram, ridge, space, spur, tank, typography, umbrella species, washes, weaned.



ENVIRONMENTAL CHECK UP

OVERVIEW: Have you ever seen a majestic bighorn sheep? They live in the Rocky Mountains, right? Well, not all species of bighorn sheep do. One species of bighorn is called the desert bighorn sheep. They live in the Canyonlands of Utah and the deserts of Arizona and New Mexico, and some parts of California. This activity focuses specifically on the desert bighorn of Utah.

The landscape of the canyonlands consists of sheer cliffs, broad benches, and deep, dissected canyons. The climate is normally hot and dry. There is little precipitation (between 20 and 25 cm/year). The vegetation varies from steep slopes with little vegetation, to sparse shrubland, to semi-desert grassland, to juniper-pinon woodland, and thickets along the rivers.

Desert bighorns are very sensitive to changes in the environment; therefore, they are often referred to as an "indicator species"

or an "umbrella species." A healthy, thriving herd of bighorns is indicative of a healthy, thriving ecosystem. An unhealthy herd of bighorns tells us that the ecosystem is overused or impacted to the point of not being able to support the wildlife that reside there. Recent on-going studies by biologists (see Resources) indicate that for a herd of bighorns to survive long term, there must be a minimum of 100 animals in the herd.

Bighorns are generally a medium gray-brown with white on the rump, backs of legs, and muzzle. This coloring allows them to blend in with the rocky landscape that surrounds their habitat. Desert bighorn depend primarily on their sense of sight to detect danger. They have good hearing. Their sense of smell is used to distinguish between foods, detect enemies, and identify their young.

Desert bighorns need food, water, escape terrain, and space.

they must pay the teacher a "Life Card" for each death card they are holding (ask a few students to help collect these to speed the process if you like). Students collect "Life Cards" if they are holding birth cards.

7. Count the total number of "Life Cards" that students are still holding. Remember the goal is to keep herds over one hundred.

8. Repeat the procedure three more times without restoring "Life Cards" to those who lost them. Move in the outer boundaries by two to three feet each round to represent a narrowing habitat.

9. Now, replay the game, this time cutting the number of "Life Cards" to three for each student. Play four rounds again and record the results. Compare the results of the two sizes of herds after playing four rounds with different beginning amounts of "Life Cards." Ask students if there were any apparent advantages to having a larger herd. Why do they see them as advantages or disadvantages?

10. Ask students to describe some of the cards they drew from the food, water, space, and escape terrain areas. Review vocabulary words that aren't familiar. How did it feel when they drew some of the death situations?

11. Ask students to explain why they think bighorn sheep are an indicator species. Have them give examples of bighorns sensitivity to their environment.

12. What were some of the controlling conditions (also called limiting factors) that determine whether a sheep lived or died? What are some ways humans can help improve bighorn ecosystems?

13. Have students name wild animals that would also benefit from an improved desert bighorn ecosystem.

ASSESSMENT:

1. Have students draw or describe an ideal desert bighorn sheep habitat. Be sure they explain why they included the things they did. How did they provide for the needs of the desert bighorn sheep? What are four ways that

domestic livestock could alter the ideal desert bighorn sheep habitat students have drawn?

2. Have students give the definition of "indicator species" and describe what qualities the desert bighorn sheep have that make them a good indicator species.

EXTENSIONS:

1. Have students make a clay or salt dough model of the ideal bighorn habitat.

2. Invite a local wildlife officer to talk to the class about other indicator species, perhaps one from your area. Is there something that can be done to help an indicator species in your area?

3. Challenge students to report on different indicator species. Ask your local wildlife officer for ideas.

4. Have students find the Utah Canyonlands on a map. Research what the area is like and what other animals live there. Find out what human involvement is in this area i.e. recreation, ranching, industry, etc.

RESOURCES:

An Analysis of Composition, Distribution, and Habitat Use of Reintroduced Desert Bighorn Sheep in Arches National Park, Utah, Shirlene C. Haas and Gar W. Workman, 1990.

The Desert Bighorn: Its Life History, Ecology, and Management, Gale Monson and Lowell Sumner, editor, The University of Arizona Press, Tucson, Arizona, 1980.

Bighorn Sheep in the Rocky Mountain Region: Reports of Five Scientific Advisory Committees to the National Park Service (DRAFT), 1991.



competitors for food and water in some areas. Domestic livestock (cattle, horses, burrow, sheep) are significant competitors with bighorn for food and water. Domestic sheep have created the most severe competition for bighorns as they have similar feeding habits and carry parasites and diseases detrimental to bighorn.

Harassment by other bighorn, other large animals, or people can cause individual bighorn to become run down physically, perhaps from an improper diet due to nervous tension. Even hikers and photographers trying to get close enough for a good look can upset desert bighorn. Bighorn seem to be little disturbed by people passing at a distance whether they are walking, driving a car, or riding in a motor boat. They are panicked into a frenzy by low-flying helicopters used to count them. Some bighorn strains are very nervous and others are very calm.

Human impact is most noticeable on the periphery of bighorn escape terrain. Permanent developments are sometimes built on bighorn grazing areas or key lambing areas and will, as a result, cause the bighorn to move away. Many of the scarce water sources of the desert bighorn are completely taken over by people. They are used for irrigation, recreation, and mining. Sometimes, however, humans improve the bighorn habitat with attempts to improve forage conditions and access to water holes.

Bighorns most commonly use established pathways that are dictated by the topography of the land. Unfortunately roadways, fences, and canals built by people tend to cross bighorn travel routes. This limits their movement from feeding grounds to water, from water to bedding grounds, from winter feed to spring feed, from summer feed to fall feed and back again. Restraining the movement of bighorn sheep also creates bottlenecks so herds become isolated from other herds and inbreeding occurs. This condition weakens the immunity and health of the herd, creating a serious concern for the longevity of the herd.

Much bighorn habitat is presently under the protection and management of the United States Fish and Wildlife Service, National Park Service, many state parks, and the Bureau of Land Man-

agement. New regulations for land use of bighorn range are being implemented so that there will be less impact on these animals.

PROCEDURE:

PRE-ACTIVITY:

1. Read Overview information thoroughly. It is essential to your understanding of this activity. You may want to photocopy it for students.

2. Photocopy at least 100 "Life Cards" on yellow paper. Make ten copies of the "Food Cards" on green paper, ten copies of the "Space Cards" on white paper, ten copies of the "Escape Terrain Cards" on brown paper, and ten copies of the "Water Cards" on blue paper.

3. Using a playing field or gymnasium, set up a playing field as shown in the illustration. Use a rope or line to indicate the boundaries of the field. Within the playing field mark four areas with a rope or hula hoop.

4. Place "Food Cards" in one, "Escape Terrain Cards" in another, "Water Cards" in another, and "Space Cards" in the last marked area.

ACTIVITY:

1. Give each student six "Life Cards." Each "Life Card" represents a live sheep. Distribute at least 100 "Life Cards" among the students the first time this game is played.

2. Choose two students to be a predator and a poacher. Since predators and poachers are not serious threats, these two people may only walk to tag the other students as they move between the card areas.

3. Students are safe as long as they are in a card area or beyond the lines that mark the boundaries at each end of the playing field.

4. Each student who is tagged must give one "Life Card" to the person who tagged them.

5. The students are to move to each card area, collecting one card at each area. Sometimes their cards have death or birth situations.

6. Upon arrival at the ending boundaries,

they must pay the teacher a "Life Card" for each death card they are holding (ask a few students to help collect these to speed the process if you like). Students collect "Life Cards" if they are holding birth cards.

7. Count the total number of "Life Cards" that students are still holding. Remember the goal is to keep herds over one hundred.

8. Repeat the procedure three more times without restoring "Life Cards" to those who lost them. Move in the outer boundaries by two to three feet each round to represent a narrowing habitat.

9. Now, replay the game, this time cutting the number of "Life Cards" to three for each student. Play four rounds again and record the results. Compare the results of the two sizes of herds after playing four rounds with different beginning amounts of "Life Cards." Ask students if there were any apparent advantages to having a larger herd. Why do they see them as advantages or disadvantages?

10. Ask students to describe some of the cards they drew from the food, water, space, and escape terrain areas. Review vocabulary words that aren't familiar. How did it feel when they drew some of the death situations?

11. Ask students to explain why they think bighorn sheep are an indicator species. Have them give examples of bighorns sensitivity to their environment.

12. What were some of the controlling conditions (also called limiting factors) that determine whether a sheep lived or died? What are some ways humans can help improve bighorn ecosystems?

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EXTENSIONS:

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FOOD CARDS:

GOOD GRASS!

OOPS! POISON WEED! YOU'RE DEAD.

SPRING FORAGING IS GREAT!

BROWSING ON BLACKBRUSH IS GOOD.

HABITAT IMPROVEMENTS MAKE MORE FOOD AVAILABLE.

DROUGHT MAKES FOOD SCARCE. YOU ARE DEAD.

NOT ENOUGH GOOD FOOD MAKES YOU MINERAL DEFICIENT. YOU DIE.

A MOIST YEAR HAS GROWN GOOD RICE GRASS.

DOMESTIC SHEEP HAVE OVERGRAZED YOUR AREA. YOU DIE.

EARLY SPRING BRINGS EARLY GRASS! YUM!

GOOD FORAGING! YOU'RE FAT!

GOOD GRAZING MAKES YOU HEALTHY.

COMPETITION WITH CATTLE AND BURROS DEPLETES YOUR FOOD SUPPLY. YOU DIE.

GOOD GRASS!

OOPS! POISON WEED! YOU'RE DEAD.

SPRING FORAGING IS GREAT!

BROWSING ON BLACKBRUSH IS GOOD.

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COMPETITION WITH CATTLE AND BURROS DEPLETES YOUR FOOD SUPPLY. YOU DIE.

WATER CARDS:

TRAFFIC NOISE FROM HIGHWAY SCARES YOU FROM YOUR ONLY WATERING HOLE. YOU DIE.

RIVER RAFTERS SPOOK YOU FROM COMING DOWN TO THE RIVER FOR WATER. TOO MANY DAYS PASS. YOU DIE.

IT IS A WET YEAR AND THERE ARE LOTS OF WATER HOLES.

WATER CARDS:

DOMESTIC LIVESTOCK IS NOT ALLOWED IN YOUR RANGE. MORE WATER AND LESS COMPETITION!

COMPETITION WITH MULE DEER FOR YOUR ONLY WATER HOLE LEAVES YOU DEHYDRATED. YOU DIE.

COMPETITION WITH CATTLE FOR YOUR WATERING HOLE IS TOO MUCH FOR YOU. YOU DIE OF DEHYDRATION IN THIS HOT, DRY CLIMATE.

FENCES BUILT ACROSS TRAVEL ROUTES KEEP YOU FROM GETTING TO WATER HOLES YOU HAVE ALWAYS USED. YOU DIE.

A DROUGHT YEAR CAUSED THE TANK YOU DRINK FROM TO BECOME LOW AND DANGEROUS TO DRINK FROM WITH ITS STEEP SIDES. YOU FALL IN AND CANNOT GET OUT. YOU DIE.

WILDLIFE OFFICERS CUT A RAMP DOWN TO A DEEP DRINKING HOLE MAKING IT SAFE TO DRINK FROM.

WILDLIFE OFFICERS CARVE INDENTIONS INTO THE ROCK TO MAKE MORE WATER COLLECTING HOLES.

A SMALL DAM IS BUILT TO PROVIDE STORAGE OF WATER FOR WILDLIFE.

FENCES ARE BUILT AROUND THE PERIMETER OF YOUR RANGE TO KEEP DOMESTIC LIVESTOCK OUT.

ESCAPE TERRAIN CARDS:

COMPETITION FOR SPACE WITH DOMESTIC LIVESTOCK STRESSES YOU OUT. YOU ARE NOT EATING PROPERLY. YOU BECOME ILL AND DIE.

DOMESTIC SHEEP MOVE INTO YOUR AREA. YOU ARE EXPOSED TO A DISEASE THEY ARE INFECTED WITH. YOU HAVE NO IMMUNITY, AND DIE.

NEW LAWS PROHIBIT DOMESTIC LIVESTOCK FROM GRAZING ON YOUR RANGE.

THE OPENING OF NEW TRAILS BRINGS MORE HIKERS THAN EVER INTO YOUR ECOSYSTEM. THEY ARE TOO CLOSE FOR COMFORT. YOU BECOME STRESSED, ILL, AND DIE.

NEW LANDS ARE SET ASIDE FOR BIGHORN HABITAT.

A NEW WILD BURRO PROGRAM CAPTURES MOST OF THE BURROS INHABITING YOUR RANGE. THIS MEANS LESS COMPETITION.

NEW HOUSING DEVELOPMENTS CONTINUE CREEPING INTO THE OUTER PERIMETERS OF YOUR RANGE. YOU ARE STRESSED AND DIE.

NEW ROADS AND INCREASED TRAFFIC BLOCK SPACE AND BRING MORE STRESS TO YOUR ENVIRONMENT. THE HERD BOTTLENECKS AND INBREDS. YOU DO NOT EAT WELL, BECOME SICK, AND DIE.

PEOPLE ARE BECOMING MORE AWARE OF BIGHORN NEEDS. THEY ARE IMPROVING YOUR HABITAT.

ESCAPE TERRAIN CARDS:

CATTLE ARE NO LONGER ALLOWED TO GRAZE IN YOUR RANGE...LESS COMPETITION FOR FOOD.

A CHOICE TO NOT USE HELICOPTERS TO DO COUNTS ON BIGHORN IS A DEFINITE IMPROVEMENT ON YOUR STRESS LEVEL.

A YEAR OF HIGH PRECIPITATION ALLOWS WILDLIFE TO SPREAD OUT AND NOT HAVE TO COMPETE FOR JUST A FEW WATER HOLES.

SPACE CARDS:

COMPETITION FOR SPACE WITH DOMESTIC LIVESTOCK STRESSES YOU OUT. YOU ARE NOT EATING PROPERLY. YOU BECOME ILL AND DIE.

DOMESTIC SHEEP MOVE INTO YOUR AREA. YOU ARE EXPOSED TO A DISEASE THEY ARE INFECTED WITH. YOU HAVE NO IMMUNITY, AND DIE.

NEW LAWS PROHIBIT DOMESTIC LIVESTOCK FROM GRAZING ON YOUR RANGE.

THE OPENING OF NEW TRAILS BRINGS MORE HIKERS THAN EVER INTO YOUR ECOSYSTEM. THEY ARE TOO CLOSE FOR COMFORT. YOU BECOME STRESSED, ILL, AND DIE.

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A YEAR OF HIGH PRECIPITATION ALLOWS WILDLIFE TO SPREAD OUT AND NOT HAVE TO COMPETE FOR JUST A FEW WATER HOLES.

ESCAPE TERRAIN CARDS:

A HELICOPTER COUNTING BIGHORN SHEEP COMES TOO CLOSE. IN YOUR PANIC TO ESCAPE, YOU LOSE YOUR FOOTING AND FALL INTO A RAVINE. YOU ARE DEAD.

YOU HAVE GIVEN BIRTH TO A SET OF TWINS AND HAVE SAFE BEDDING GROUNDS. COLLECT TWO LIFE CARDS.

YOU HAVE GIVEN BIRTH TO A SINGLE LAMB. COLLECT ONE LIFE CARD.

ESCAPE TERRAIN CARDS:

YOU ARE THE PROUD PARENT OF TWIN LAMBS. COLLECT TWO LIFE CARDS.

YOU WERE NOT CLOSE ENOUGH TO YOUR ESCAPE TERRAIN WHEN A HUNTER SNUCK UP ON YOU. YOU DIE.

AS A LAMB, YOU DO NOT MAKE IT TO THE CLIFF OVERHANG IN TIME TO AVOID THE DEATH CLUTCH OF THE EAGLE. YOU DIE.

A SEVERE STORM HITS. YOU RUN INTO A CAVE AND ARE UNHARMED.

AN EAGLE DIVES FOR YOU, BUT YOU QUICKLY DUCK UNDER A CLIFF OVERHANG AND ESCAPE IT.

YOU SLIP ON THE ICY ROCK AND BREAK YOUR LEG. YOU LIMP TO A WASH, BUT ARE UNABLE TO GET ADEQUATE FOOD AND STARVE TO DEATH.

YOU EASILY OUT-MANEUVER A COYOTE IN THE ROCKY TERRAIN.

FROM YOUR VANTAGE POINT ON THE ROCKY RIDGES AND BENCHES YOU EASILY SPOT HUNTERS AND QUICKLY ESCAPE OVER THE RIDGE.

DOMESTIC LIVESTOCK PREFER THE LOWER, MORE OPEN, LESS ROCKY AREAS; YOU HAVE ABUNDANT SPACE.

ESCAPE TERRAIN CARDS:

A HELICOPTER COUNTING BIG-HORN SHEEP COMES TOO CLOSE. IN YOUR PANIC TO ESCAPE, YOU LOSE YOUR FOOTING AND FALL INTO A RAVINE. YOU ARE DEAD.

YOU HAVE GIVEN BIRTH TO A SET OF TWINS AND HAVE SAFE BEDDING GROUNDS. COLLECT TWO LIFE CARDS.

YOU HAVE GIVEN BIRTH TO A SINGLE LAMB. COLLECT ONE LIFE CARD.

YOU ARE THE PROUD PARENT OF TWIN LAMBS. COLLECT TWO LIFE CARDS.

YOU WERE NOT CLOSE ENOUGH TO YOUR ESCAPE TERRAIN WHEN A HUNTER SNUCK UP ON YOU. YOU DIE.

AS A LAMB, YOU DO NOT MAKE IT TO THE CLIFF OVERHANG IN TIME TO AVOID THE DEATH CLUTCH OF THE EAGLE. YOU DIE.

A SEVERE STORM HITS. YOU RUN INTO A CAVE AND ARE UNHARMED.

AN EAGLE DIVES FOR YOU, BUT YOU QUICKLY DUCK UNDER A CLIFF OVERHANG AND ESCAPE IT.

YOU SLIP ON THE ICY ROCK AND BREAK YOUR LEG. YOU LIMP TO A WASH, BUT UNABLE TO GET ADEQUATE FOOD AND STARVE TO DEATH.

ESCAPE TERRAIN CARDS:

YOU EASILY OUT MANEUVER A COYOTE IN THE ROCKY TERRAIN.

FROM YOUR VANTAGE POINT ON THE ROCKY RIDGES AND BENCHES, YOU EASILY SPOT HUNTERS AND QUICKLY ESCAPE OVER THE RIDGE.

DOMESTIC LIVESTOCK PREFER THE LOWER, MORE OPEN, LESS ROCKY AREAS; YOU HAVE ABUNDANT SPACE.

LIFE CARDS:

LIFE

LIFE