Murder Ewe Wrote

Objectives: Students will analyze information about a biological problem and solve the mystery.

Background: This activity introduces a mystery that is happening to bighorn sheep animals in a specific habitat. The mystery is solved by piecing clues together from different sources: environmental, physical, human interference, and biological cycles.

Black Hill's bighorn sheep, *Ovis canadensis,* live in an ecosystem characterized by rugged mountains, canyons, and small grassy valleys. Bighorn sheep are tan-to-brown in color, weigh 75-200 pounds, and stand about two-and-a-half to three-and-a-half feet tall. Adult males are called rams, adult females are called ewes (pronounced like "yous"), and young are called lambs. They eat grasses and forbs (broad-leafed plants) in mountain meadows and rocky cliff areas. They are usually found in herds numbering 10 to 100. Rams are very muscular and known for their large curling horns, which they use in dramatic collisions with other rams during the breeding season. Ewes have small horns that do not curl very much. Bighorn sheep should not be confused with the shaggy, white mountain goat found around Mount Rushmore.

The current population of Rocky Mountain bighorn sheep was introduced to the Black Hills in the early 1900's. The population has become fairly well established since the destruction of the native bighorn sheep, Audubon's Bighorn, by market hunters in the late 1800's. The Audubon bighorn are extinct. Limited hunting of the Rocky Mountain bighorn is currently allowed under strict regulations.

Throughout recorded history, bighorn sheep herds were known for precipitous die-offs. The reasons for these population crashes have remained a mystery and only recently have they been thoroughly investigated. Die-offs still occur, but with proper wildlife and ecosystem management techniques, they are less severe. The bighorn sheep die-off example used in this activity is fictional, but is based on several case studies of bighorn population crashes in the west.

Procedure: Make one copy of the Mystery Fact Cards, and one Mystery Story and Mystery Questions sheet for each group of four to five students. Discuss the background information about bighorn sheep. Tell students that as a class, they will be solving a mystery about bighorn sheep using the fact cards. Divide into groups of four to five students and distribute the Mystery Story to each group. Have them read the story as a class or in their groups.

1. Share the following guidelines with the students:
   a. Using the story and fact cards, the class can solve this ecosystem mystery.
   b. Once given a fact card, students may not pass or trade it with others.
   c. Only as a group, using good communication skills, can the mystery be solved.
   d. The fact cards will be read to the class one at a time in order.
   e. As the facts are read aloud, the class will begin to piece together the solution to the mystery.

    f.   It will be helpful to focus on the cause, weapon, and motive as well as previewing the Mystery Questions.

2. Distribute a set of Mystery Questions to each group. Distribute one fact card to each student. Remind students they may not trade fact cards. Have students read their fact cards one at a time in order. As fact cards are read, let students decide how to organize the information and begin to solve the mystery. Students may struggle at first with the wealth of information, but that is part of the process. A possible strategy is to designate students as recorders of specific information for the class. Good group communication and participation are critical. Beware of letting a few students dominate the activity. It may be helpful for you to preview the questions and answers.

3. Discuss the questions as a class or have student address them in their small groups. Leave ample time for thorough discussion of the mystery questions.

Mystery Questions and Answers:
For teacher use

1. How many bighorn sheep died between the summer and February 5th? *(Approximately 202)*
2. What unusual wildlife behavior could have been an early clue that something was wrong with the herd? *(On January 18th, tourists were getting very close to the bighorn. Wild animals very rarely let humans approach them.)*
3. Why did so many of the herd die in such a short period of time? *(Once the disease established itself in the unhealthy herd, deaths occurred quickly.)*
4. Why did the rams die earlier than the ewes? *(Rams were tired and worn out because of fighting during the breeding season.)*
5. Why were there only a few lambs in December, though there were many in the summer? *(The lungworm is passed from the ewe's body to the placenta and into the body of the fetus. Lambs are more likely to succumb to an infection of lungworm.)*
6. How do bighorn sheep get lungworms? What is the lifecycle of the lungworm? *(Bighorn sheep accidentally eat small snails while they graze. These snails are a host for lungworm larvae. The larvae penetrate the intestinal wall and travel to the lungs where they become adults. Lungworms lay eggs in the lungs, which hatch and the larvae enter the air passages. Here they are coughed up and swallowed by the bighorn. The lungworm larvae are excreted in the fecal pellets and seek the host snail.)*
7. Why don't all bighorn sheep die of pneumonia/lungworm? *(Many bighorn herds are infected with both lungworm and bacteria. Healthy herds are usually able to cope with these disease-causers. Unhealthy herds cannot.)*
8. What is the relationship between the pneumonia bacteria and the lungworm? *(In weakened, stressed, or young bighorn, the lungworm lesions provide suitable sites for the pneumonia-causing bacteria to grow.)*
9. Who or what caused the die-off of the bighorn? *(No one intended to harm the bighorn sheep. Numerous factors working together caused the population crash.)*

Extension: Many plants and animals experience population crashes. For example, the population of pronghorn antelope at Wind Cave National Park has plummeted in the past five years due to many ecological challenges. Research some of the possibilities of why prairie ungulates like the pronghorn may be experiencing population crashes. Could there be a parasitic invasion? Discuss some solutions about how these challenges could be changed, researched, or solved.