Jacquelyn Fallon

SECTION 2

Natural Systems

Subjects:

physical education, biology, mathematics, geography

Approximate lesson time:

1 hour

Materials:

stopwatch,

Wolf Population Chart,

open playing area,

Wolf Turf cards (Prepare enough cards so the poundage totals about 350 pounds per student and one den per pack. This will allow for about 75 percent survival, which illustrates the point of the game.)

Wolf Turf

Students collect food cards to simulate wolves searching for food.

STUDENT OBJECTIVES:

Upon completion of this lesson, students will be able to

1. Predict how food availability affects wolf populations.
2. Analyze the relationship between pack size and habitat.
3. Calculate their wolf pack's food needs and food acquisition.

VOCABULARY:

carrying capacity • territory • predator • limiting factor • cache • rendezvous site

TEACHER BACKGROUND:

Most wolves live within and defend a home range known as a territory. A wolf spends much of its life hunting, traveling and raising pups within that territory. Occasionally, an individual wolf or the entire pack may wander out of the territory exploring or searching for food. Wolf packs are generally very protective of their territory, and pack members will urinate, leaving their scent throughout the territory to indicate "ownership" of the area. If other wolves come into the resident pack's territory, the resident pack may chase the intruders out or fight with them. Wolves have been known to kill each other over territory.

Wolf pack territory averages roughly 10 square miles per wolf in the pack. Territory ranges in size from 25 square miles or less to over 1,000 square miles, depending on the number of wolves in the pack and the amount of food available. Because wolves generally hunt within the boundaries of their territory, a large enough population of prey animals needs to exist within that territory to sustain the pack over time. The territory can be likened to a refrigerator: it holds the food for the family. Larger packs of wolves often need to have larger territories than smaller packs because they need more area in which to find food. Wolf packs, large or small, may not travel as far (and therefore have a smaller territory) if there is a high density of prey available. The maximum number of wolves or wolf packs an area can support over time is known as its carrying capacity.

The extent to which a wolf pack will defend its territory can be correlated with food availability. If the resident pack is having difficulty finding enough food, this stress may cause them to be especially aggressive in keeping out invaders who might compete for food. Territory boundary disputes with neighboring packs may escalate during times of food stress. Territory size and configuration may also fluctuate over time.

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The factors, such as food and space, that cause wolf population numbers to increase or decrease over time are known as limiting factors.

By the time young wolves reach two or three years of age, they are likely to leave their home pack's territory. This is called dispersal. Scientists think they may be searching for a mate or better access to food. Sometimes a young wolf will wander as many as 500 miles or more from home and then return to the pack. In other cases, a wolf may "disperse," or leave the pack, and never return. A dispersing wolf faces many challenges, including the hardship of hunting alone and avoiding detection by other wolves that may kill the disperser for invading their territory.

In this game, students act out the pattern of a wolf pack searching for food. The format of this game is modeled most closely after wolf packs' summer travel patterns (although other seasons are represented) in which adult wolves travel alone or in small subgroups and return to the rendezvous site with food for the other pack members and the pups. Pups stay in these rendezvous sites for several months after birth until they are strong enough to travel. The pack uses the rendezvous site as a gathering point while the pups are there.

Like wolves, students may cache food or store it for later. Wolves often do this by digging a shallow hole in the earth, placing the food into it, and pushing dirt back over the hole with their noses. During times of scarce food, wolves will dig up these caches to sustain themselves. In general, wolves eat 4–5 pounds of meat per day but can go a week without eating anything.

In this game, "wolf recycling" is the limbo place students will go after they "die" of starvation until they are "born" as a new pup.

ACTIVITIES:

1. Divide the class into wolf packs of about five members each.
2. Either outdoors, in a gymnasium or in a cleared classroom, spread out the Wolf Turf cards with dens or foods printed on them. There should only be enough food in the game area for 75 percent of the wolves to survive.
3. Assign each pack an approximate area (a territory) within which they should search.
4. Define areas for the "rendezvous site," "cache" and "wolf recycling."

Round 1:

A. When the game starts, one pack member at a time may walk around quickly in search of food or a den site. They should pick up one card and then must return to the rendezvous site. Students continue searching for food and returning to the rendezvous site for three minutes. After gathering time is up, stop the students and instruct them to add up how much food the pack has collected.

National Science Education Standards

Unifying Concepts and Processes

Systems, order, and organization

Evidence, models, and explanation

Change, constancy, and measurement

Evolution and equilibrium

Science as Inquiry

Abilities necessary to do scientific inquiry

Understanding about scientific inquiry

Life Science (5–8)

Regulation and behavior

Population and ecosystems

Life Science (9–12)

Interdependence of organisms

Matter, energy, and organization in living systems

Behavior of organisms

For more correlations, please see Appendix IV.

B. Explain that for every 450 pounds of meat that a pack has collected (an average season's food supply), one wolf survives in the pack. If they have enough cards for all wolves in the pack to survive, the pack remains the same for the next round. If any pack has extra food cards, they get to "cache" them in a secret place and keep them for the next round. If the pack has not collected enough food, the wolves who collected the least amount of food are the first ones to starve. Dead wolves go to "wolf recycling" near the teacher to wait to return as pups in another round. If the wolves have a "den site" card, they can hang on to it for future rounds. *Example: A pack of seven students needs to have collected 3,150 pounds of meat if all members are to survive. If they collected only 2,250 pounds, they lose two wolves.*
C. Collect all the food cards that are not in a cache and redistribute them in the play area again. Tally the populations of each pack and the amount of food found, and record the wolf population on the Wolf Population Chart.

Round 2

A. Same procedure as round 1. This time, however, add the following element: if wolves encounter wolves from a rival pack, they can growl at them and settle the conflict with "rock, paper, scissors." The losing wolf has to give up any food cards s/he has and return to the rendezvous site for 30 seconds before hunting again.
B. After three minutes, packs count their food. Again, each wolf must have collected 450 pounds of food to survive. If anyone has not collected enough food, they may unearth "cached" food and add that to their total. If any pack has 100 pounds of extra food and a den site card, they can trade those in for one pup (someone from wolf recycling). Pups will not hunt during the next round; they just hang out at the den and encourage other pack members to feed them. If the pack does not have enough food for all members to survive, the pups are the first to starve.
C. Collect all the available food cards and redistribute them in the play area again. Tally the populations of each pack and record them on the Wolf Population Chart.

Play as many rounds as you have time for. Four to 12 rounds should give you a sufficient data set for discussion. At the end of the game, graph out the populations of each pack and the food found each time.

Discuss:

1. How does the number of wolves in each pack affect that pack's survival?
2. How does the number of packs in the game affect the student's ability to collect food?
3. How can wolf populations increase in this game?
4. How can wolf populations decrease in this game?
5. Discuss the definitions of carrying capacity and limiting factor. How are these illustrated in this game?

ASSESSMENT:

Students will write a one-page reflection paper on what they learned about wolf territory and pack interactions from this activity. Students will answer a short quiz about pack territory dynamics.

Quiz

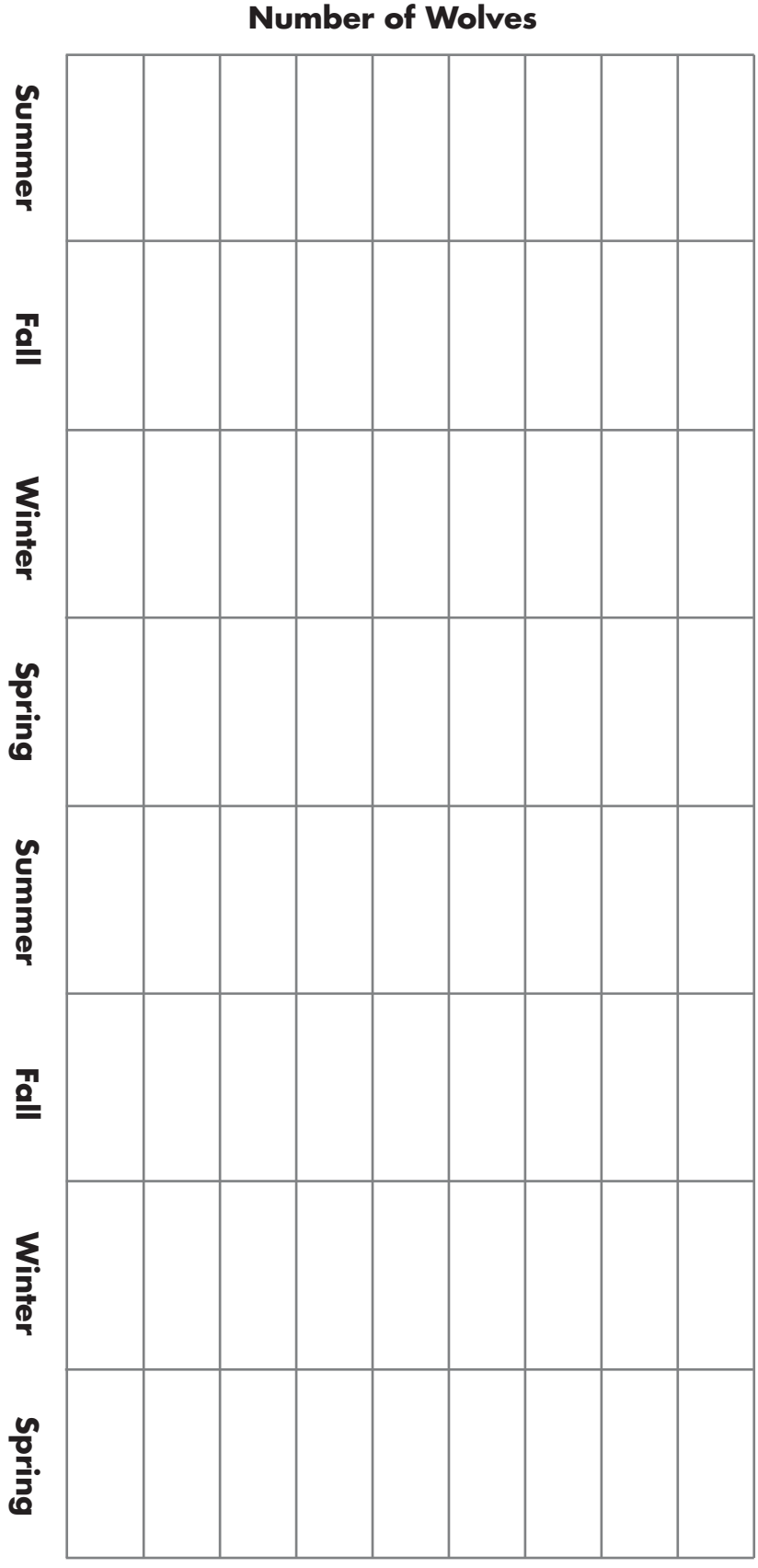
1. What happens if there is not enough food to feed all members of the wolf pack? *Some wolves will die.*
2. What happens if there is more than enough food to feed a pack? *All pack members can survive, and the pack may produce pups.*
3. What kinds of prey give wolves the most energy per kill? *Elk and bison provide lots of meat for the whole pack. Antelope give less meat per kill, so a pack would have to catch more antelope to feed all pack members.*
4. How is territory size correlated with food availability? *Depending on prey density, a larger territory may provide a larger amount of food.*

EXTENSIONS:

1. Play the game again. Add/remove food cards to demonstrate impacts, such as human hunters, roadkills, competing predators, seasonal changes, etc. Consider adding one card that says "One wolf killed for depredating on livestock." Discuss how human management affects wolf populations.
2. Make another wolf population chart that illustrates what would happen in a theoretical wolf population with zero mortality:
   - First year = 2 adults + 6 pups
   - Second year = 2 adults + 6 yearlings + 6 pups
   - Third year = 2 adults + 6 subordinate adults + 6 yearlings + 6 pups
   - And so on.
3. Play the game with an alternative set of prey species representing another ecosystem.

Janice Templeton

WOLF POPULATION CHART



WOLF TURF CARDS
(cut apart)

elk 500 lbs.	bison calf 400 lbs.	elk calf 50 lbs.	mule deer 200 lbs.
pronghorn antelope 100 lbs.	elk 500 lbs.	moose calf 200 lbs.	Ravens follow you. Lose 10 lbs. for each card collected.
elk calf 50 lbs.	mule deer 200 lbs.	elk 850 lbs.	elk 500 lbs.
Steal a kill from a mountain lion. 100 lbs.	elk 500 lbs.	elk 500 lbs	mule deer 200 lbs.
den	den	den	den

WOLF TURF CARDS
(cut apart)

elk 500 lbs.	Grizzly steals your kill. Lose 500 lbs.	elk 850 lbs.	elk 500 lbs.
mule deer 200 lbs.	elk calf 50 lbs.	moose calf 200 lbs.	Ravens follow you. Lose 10 lbs. for each card collected.
elk 500 lbs.	bison calf 400 lbs.	elk 850 lbs.	elk calf 50 lbs.
elk calf 50 lbs.	Steal a kill from a mountain lion. 100 lbs.	elk 500 lbs	mule deer 200 lbs.
den	den	den	den

Pack Food Budget

NAMES OF PACK MEMBERS _____

_____

_____ _____

_____

_____

ROUND ONE - Summer

1A. Amount of food collected (in lbs.) _____

1B. Number of pack members_____ x 450 lbs. per member = _____

(this is the number of pounds needed for all pack members to survive)

1C. 1A minus 1B = _____

If 1C is a positive number, put that number in your "cache," and you can use it on future rounds. If 1C is a negative number, put 0 in the cache, and you lose one pack member if it is -1 to -450 lbs., two pack members if it is -451 to -900 lbs. and so on.

1D. **Cache**: _____

(buried food)

ROUND TWO - Fall

2A. Amount of food collected (in lbs.) _____

2B. Number of pack members_____ x 450 lbs. per member = _____

(this is the number of pounds needed for all pack members to survive)

2C. 2A minus 2B plus 1D (from cache above) = _____

If 2C is a positive number, put that number in your "cache," and you can use it on future rounds. If 2C is a negative number, put a 0 in cache, and you lose one pack member if it is -1 to -450 lbs., two pack members if it is -451 to -900 lbs. and so on.

2D. **Cache:** _____

(buried food)

Pack Food Budget

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ROUND THREE - Winter

3A. Amount of food collected (in lbs.) _____

3B. Number of pack members_____ x 450 lbs. per member = _____

(this is the number of pounds needed for all pack members to survive)

3C. 3A minus 3B plus 2D = _____

If 3C is a positive number, put that number in your "cache," and you can use it on future rounds. If 3C is a negative number, put 0 in your cache, and you lose one pack member if it is -1 to -450 lbs., two pack members if it is -451 to -900 lbs. and so on.

3D. **Cache:** _____

(buried food)

ROUND FOUR - Spring

4A. Amount of food collected (in lbs.) _____

4B. Number of pack members_____ x 450 lbs. per member = _____

(this is the number of pounds needed for all pack members to survive)

4C. 4A minus 4B plus 3D = _____

If 4C is a positive number, put that number in your "cache," and you can use it on future rounds. If 3C is a negative number, put 0 in your cache, and you lose one pack member if it is -1 to -450 lbs., two pack members if it is -451 to -900 lbs. and so on.

4D. **Cache:** _____

(buried food)

At this point, your pack can trade in 100 pounds of food and a den card to receive a "pup" (recycled wolf who had previously died).