

LEVEL: Grades 4-12

SUBJECTS: Environmental Education, Math, Science.

PROCESS: Through an interactive game, students gain an understanding of how forest ecosystems change.

OBJECTIVES: The student will:

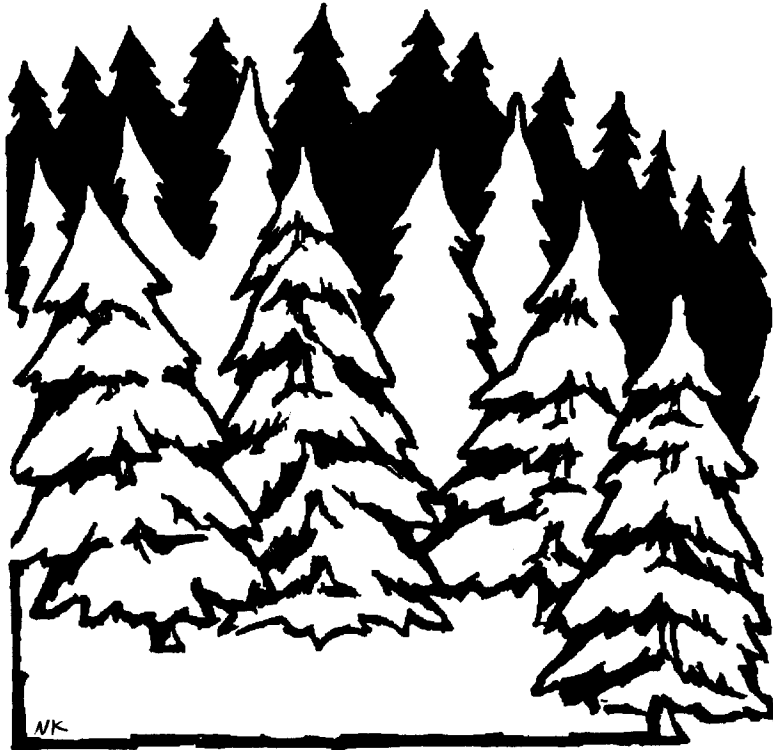
1. Evaluate the roles of at least five variables that cause change in a forest ecosystem.
2. Evaluate the changes to a forest ecosystem caused by tree harvesting.

TIMEFRAME: 45 minutes.

SKILLS: Analyzing, debating, evaluating, generalizing, hypothesizing, inferring, role playing, understanding cause and effect.

MATERIALS: Two different colored bandannas, string, "Role Cards," (attached) "Damage Cards."

VOCABULARY: Bobcat, ecosystem, harvest, interior, lumber mill, niche, stand, tree harvester, tree species.



ON THE EDGE OF CHANGE

OVERVIEW: Forest ecosystems are in a constant state of change. As trees live, grow, and die, changes in the makeup of the forest occur.

This activity focuses on the ecological changes that occur in a mature forest when it is disturbed. Although the ecological concepts portrayed in this activity could apply to any mature coniferous forest, an even-aged stand of lodgepole pine probably is most representative. An even-aged stand is a group of trees all the same age.

This forest ecosystem consists of "interior trees" and "edge trees." Interior trees have grown up in a crowded and very competitive environment. Individual trees compete for a finite amount of water, sun, and soil nutrients. Typically, the interior trees are thin and weak with poor root systems. The interior of the stand has its own micro-climate: sunlight, mois-

ture, temperature, and other factors that are relatively constant.

Edge trees are typically bigger. Because they grow on the edge of the stand, they do not have such intense competition for water, sun, and soil nutrients. Root systems are more developed. In many respects, edge trees serve to protect interior trees from wind, fluctuations in temperature, and some diseases.

When the edge trees are disturbed by natural factors like fire or by human factors like logging, changes occur to the interior of the stand. For example, if the edge trees on the windward side of the stand die or are removed, the interior trees become vulnerable to wind. Because of their weak root systems, newly exposed interior trees "windfall" easily.

As windfall creates larger gaps in the interior forest, changes to the micro-climate occur. Heat and

moisture are lost more easily during winter months as wind penetrates the forest. During the summer months the sun's rays filter to the forest floor more easily. These changes may stress the remaining interior trees, making them more susceptible to damage by existing insects and disease. Sometimes openings in the edge also allow easier access to the interior of the forest by certain animals or wind-borne parasites and disease.

Clearings created in the interior of the stand invite new species to fill the new niches available. The composition of both plant and animal species changes. Grasses and forbs grow where sunlight now penetrates to the ground; rabbits and big game species may move in to eat those plants.

How humans value these changes is a matter of perspective. To some people these changes may be viewed as bad. To others these changes may be good. Their value judgements may be determined by whether or not the forest changes were natural or human-caused. In either case, forest ecosystems are never stagnant. Change is the rule.

PROCEDURE:

PRE-ACTIVITY:

1. Prepare "Role Cards" as "Packet A." Each "Role Card" should be copied on stout paper and have a different identifying color. Lace the "Role Cards" on a string to hang around students' necks for visibility. The numbers below are for a class of 25 students. You may need to make adjustments for smaller or larger class sizes. Add extra students as interior or edge trees. One or two students could act as "scientific observers" to watch how the forest ecosystem changes throughout the course of the activity.

Packet A: 25 "Role Cards"

1 tree harvester

1 bobcat (wears bandanna as headband)

1 woodpecker (wears bandanna as headband)

8 edge trees

14 interior trees

2. Prepare the "Damage Cards" as "Packet B."

Packet B: 65 "Damage Cards"

3 rabbit damage

2 porcupine damage

5 insect damage

10 temperature damage

15 disease damage

30 wind damage

3. Preview each "Role Card" and "Damage Card" carefully.

ACTIVITY:

1. Discuss forest changes with the students and introduce vocabulary words. You might open with these questions:

-How has your neighborhood/school changed over time? Who or what caused the change? Are these changes good or bad?

-What "natural changes" have there been in the neighborhood/school?

-Do forest ecosystems change? If so, how? Who causes the change? Are these changes good or bad?

2. Explain the roles and rules of the activity. Students are to become parts of a changing forest ecosystem. Encourage students to act out the behaviors when appropriate (for example, rabbits hop). Make it clear that trees don't move until harvested or their role changes. *For safety reasons, have students WALK and not run during this activity.*

3. Take the class outside or to a gymnasium-like area.

4. Distribute Packet A. Each student receives one "Role Card" to hang around his or her neck. Scatter Packet B (the "Damage Cards") 20 feet from the perimeter of the playing area. Have the interior trees gather at the center. Edge trees surround the interior trees, facing out and holding hands. Living in the interior of the forest are the bobcat, who eats rabbits and porcupines, and the woodpecker, who eats insects. Be sure the bobcat and the woodpecker have different colored bandannas. See attached diagram.

DAMAGE CARDS

TREE

HARVESTER



DAMAGE CARDS

EDGE TREES

EDGE TREES

INTERIOR TREES
WOODPECKER

INTERIOR
TREES

BOBCAT
INTERIOR TREES

EDGE TREES

EDGE TREES

EDGE TREES

TEACHER



DAMAGE CARDS

5. The tree harvester begins the game by selecting and harvesting one edge tree. The harvester first takes the edge tree's card, then brings the edge tree to the "Damage Card" pile. Next the harvester brings the edge tree's card to the lumbermill (teacher). At the mill, the harvester describes what he or she plans to do with the wood. The teacher tallies points collected (they are on the edge tree's card).

- 1 point builds a kitchen table
- 3 points supplies a school with paper for one day
- 5 points builds a small house.

Before harvesting another edge tree, the tree harvester walks around the forest stand three times to find the best edge tree to cut. The harvester continues until he or she gathers enough points to produce one of the above wood products. The tree harvester does not cut down interior trees.

6. Meanwhile, the edge tree that was cut picks up and reads one of the scattered "Damage Cards" and assumes the new role described on the card. This student brings the "Damage Card" to one of the interior trees. This student may only access the interior trees through a place where an edge tree has been removed, however. In other words, damage enters the interior forest through a break in the forest edge. The student returns for another "Damage Card." Continue until activity is over.

7. When an interior tree collects any combination of five "Damage Cards," it dies and is not considered to be a harvestable resource. When an interior tree dies it must drop its "Role Card" (with string attached) and move outside to the "Damage Card" pile. There, the interior tree disperses the five "Damage Cards" in his or her hands. Then, the interior tree picks up a new "Damage Card" and assumes a new role.

8. Some special "Damage Cards" give students unique directions. Encourage this touch of drama if your groups age and personalities are conducive to it.

-If a **Rabbit Damage Card** is selected, the student **hops** to the interior trees. Rabbits cause

forest damage by eating young trees. Careful, bobcats love to eat rabbits! If the bobcat catches the rabbit **before** it delivers the "Damage Card," the rabbit becomes an interior tree by picking up any dropped interior tree card. This signifies that the rabbit has enriched the soil, allowing a sapling to grow. If no dropped interior tree cards are available, the rabbit remains dead until one becomes available. The bobcat returns the rabbit card to the "Damage Card" pile and then goes back to the interior of the forest to hunt. The bobcat may only prey on rabbits when they are in the interior of the forest.

-If a **Porcupine Damage Card** is selected, the student **crawls** (or pretends to crawl) to the interior trees. Porcupines eat the bark of trees and can kill them. Again, watch out for the bobcat! The bobcat can only catch you if it touches your underside (front waist - belt buckle area). Porcupines can protect their undersides by bunching up into tight balls. (Predators can usually kill porcupines only by attacking their undersides.) If the bobcat catches the porcupine **before** it delivers the "Damage Card," the porcupine becomes an interior tree by picking up any dropped interior tree card. Other rules apply, as above.

-If an **Insect Damage Card** is selected, the student **flies** into the interior forest by flapping his or her arms. Some insects or the diseases they carry can kill trees. Watch out for the woodpecker! The woodpecker may only catch you when it has one arm touching any interior tree. This signifies the woodpecker perched on a tree trunk. If the woodpecker catches the insect **before** it delivers the "Damage Card," the insect becomes an interior tree by picking up any dropped interior tree card. The woodpecker returns the insect card to the "Damage Card" pile and then goes back to the interior forest to hunt. Other rules apply, as above.

9. The game continues until:

-the tree harvester has collected enough points for his or her wood product, or

-there is an obvious change in the forest ecosystem, or

-the forest chaos is too much!

10. Post-activity discussion:

a. Tally the types of trees remaining (edge trees, interior trees without damage, interior trees with damage). Hypothesize why these results occurred.

b. Discuss the experiences of the different roles. Be sure to:

-have the tree harvester share how many points he or she acquired and the plans for the use of the trees.

-have the interior trees discuss what killed them. Was it one kind of damage or many kinds of damage working together? Which "Damage Card" was most common?

c. Have students describe the changes that took place in the forest. Have the scientific observers discuss their observations.

d. Why do some foresters advocate cutting small interior areas as a means of harvesting wood, rather than edge trees? Based on what you learned about the lumber quality of interior trees, when might this practice not be acceptable?

e. What are some other ways forest ecosystems can change? How would these changes affect the ecosystem? Are these changes good or bad?

f. Sometimes humans cause change to a forest ecosystem. Sometimes natural forces cause these changes. Which is better? Why do you feel this way?

g. How does timber harvesting affect forest ecosystems? How and when do tree harvesters reforest areas after cutting trees?

h. Do old, mature forests (old-growth forests) have value if they are left unharvested? When? Why?

i. In the Pacific Northwest, the Spotted Owl requires old-growth forests to survive. Tree harvesters need to cut large, old trees to provide lumber and maintain local jobs. Some people say it's a battle between two species (owls vs.

humans). Others say the owl symbolizes an ecosystem in trouble. What do you think?

j. Emphasize the fact that the use of natural resources is necessary. Knowledge of the effects of resource extraction and use leads to better forest management.

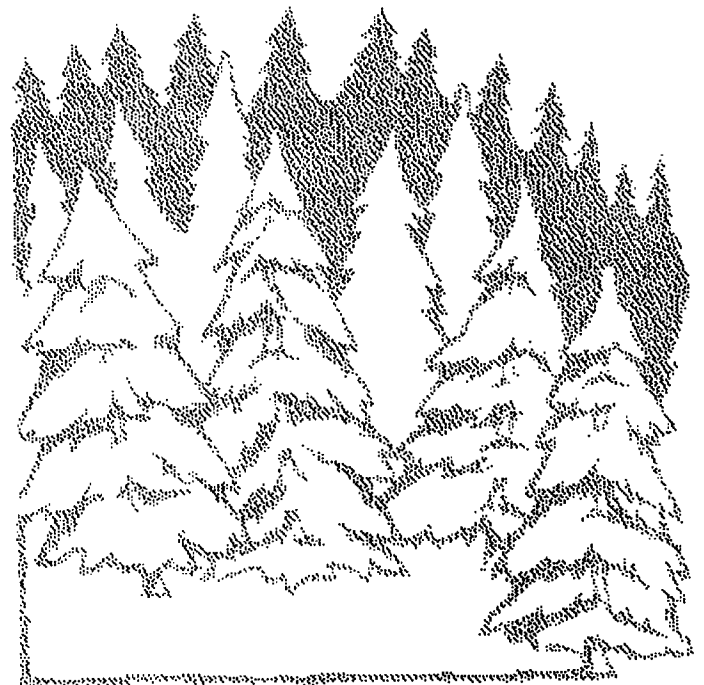
ASSESSMENT: Have students evaluate the causes and results of five changes to the forest ecosystem as a result of the tree harvesting described in this activity. Observe their evaluations for overall understanding of the lesson content.

EXTENSIONS:

1. Have students hypothesize the situation if a beaver or a fire, instead of a human, were to change the forest ecosystem.

2. Dig a little deeper into ecosystem debates. For example, use newspapers and other periodicals to follow the debate about "old-growth forests." What species may depend on undisturbed old forests?

RESOURCES: *Managing Forested Lands for Wildlife*, Colorado Division of Wildlife, 1987.



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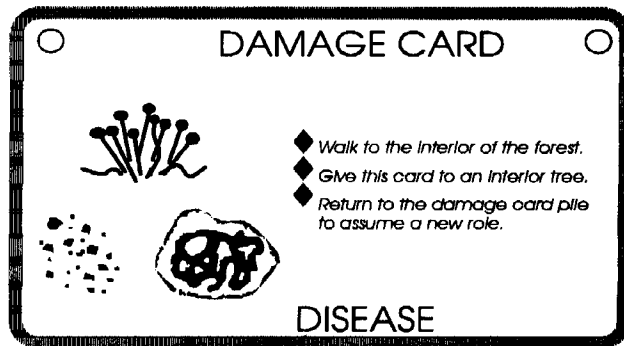
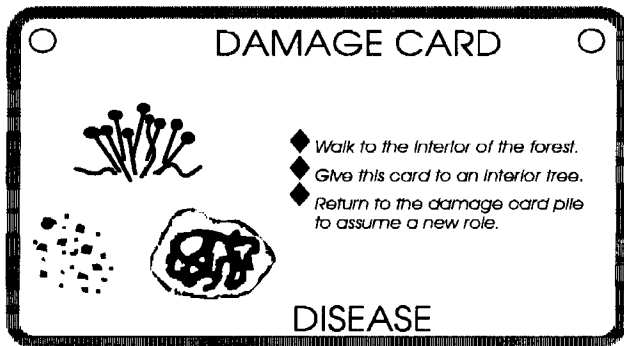
THE TOTAL NUMBER OF CARDS (AFTER ALL COPIES ARE MADE):

ROLE CARDS

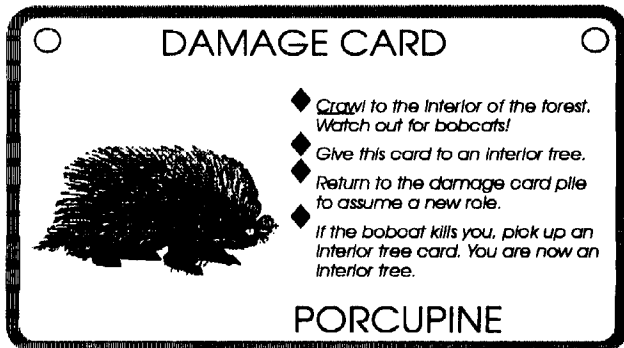
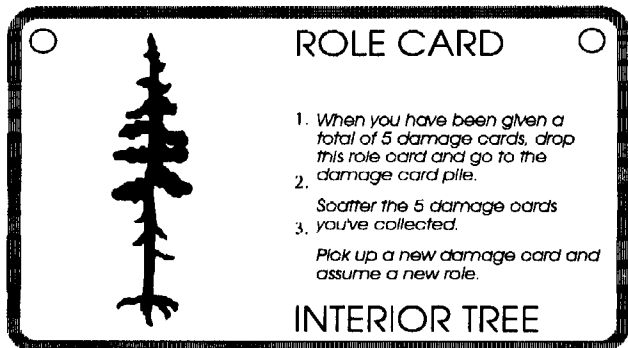
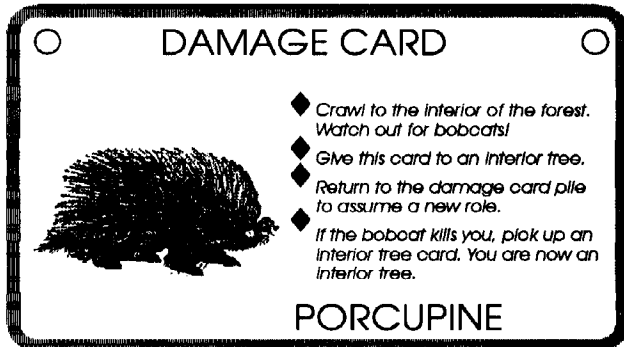
- 1 Tree Harvester
- 1 Bobcat
- 1 Woodpecker
- 8 Edge Tree
- 14 Interior Tree

DAMAGE CARDS

- 3 Rabbit
- 2 Porcupine
- 5 Insect
- 10 Temperature
- 15 Disease
- 30 Wind




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ROLE CARD



1. When you have been given a total of 5 damage cards, drop this role card and go to the damage card pile.
2. Scatter the 5 damage cards you've collected.
3. Pick up a new damage card and assume a new role.

INTERIOR TREE

ROLE CARD



1. When you have been given a total of 5 damage cards, drop this role card and go to the damage card pile.
2. Scatter the 5 damage cards you've collected.
3. Pick up a new damage card and assume a new role.

INTERIOR TREE


ROLE CARD



1. When you have been given a total of 5 damage cards, drop this role card and go to the damage card pile.
2. Scatter the 5 damage cards you've collected.
3. Pick up a new damage card and assume a new role.

INTERIOR TREE

ROLE CARD

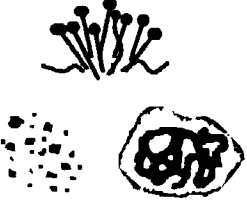


1. When you have been given a total of 5 damage cards, drop this role card and go to the damage card pile.
2. Scatter the 5 damage cards you've collected.
3. Pick up a new damage card and assume a new role.

INTERIOR TREE

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DAMAGE CARD



- ◆ Walk to the interior of the forest.
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.

DISEASE

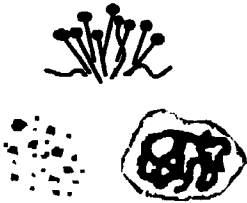
DAMAGE CARD



- ◆ Walk to the interior of the forest.
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.

DISEASE


DAMAGE CARD



- ◆ Walk to the interior of the forest.
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.

DISEASE

DAMAGE CARD



- ◆ Walk to the interior of the forest.
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.

DISEASE


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ROLE CARD

- ◆ Stand around the Interior trees.
- ◆ You are an older, healthier large tree with fine wood.
- ◆ Value 1 1/2 points.


EDGE TREE



ROLE CARD

- ◆ Stand around the Interior trees.
- ◆ You are an older tree that is beginning to rot on the inside. You do not have much value for lumber use.
- ◆ Value Zero points.


EDGE TREE



ROLE CARD

- ◆ Stand around the Interior trees.
- ◆ You are a younger tree, just reaching adulthood. Your wood is strong.
- ◆ Value 1/2 point.

EDGE TREE

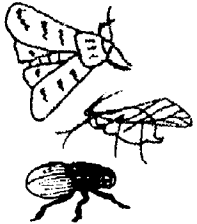


ROLE CARD

- ◆ Stand around the Interior trees.
- ◆ You are a mature tree that has had plenty of room to grow.
- ◆ Value 1 point.

EDGE TREE

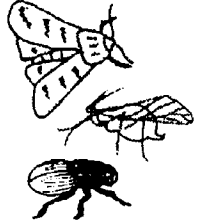
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DAMAGE CARD

- ◆ Fly to the Interior of the forest. Watch out for the woodpecker!
- ◆ Give this card to an Interior tree.
- ◆ Return to the damage card pile to assume a new role.
- ◆ If the woodpecker kills you, pick up an Interior tree card. You are now an Interior tree.

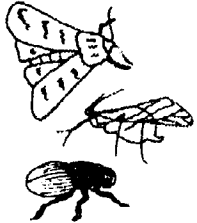
INSECT



DAMAGE CARD

- ◆ Fly to the Interior of the forest. Watch out for the woodpecker!
- ◆ Give this card to an Interior tree.
- ◆ Return to the damage card pile to assume a new role.
- ◆ If the woodpecker kills you, pick up an Interior tree card. You are now an Interior tree.

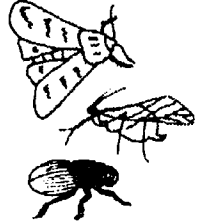
INSECT



DAMAGE CARD

- ◆ Fly to the Interior of the forest. Watch out for the woodpecker!
- ◆ Give this card to an Interior tree.
- ◆ Return to the damage card pile to assume a new role.
- ◆ If the woodpecker kills you, pick up an Interior tree card. You are now an Interior tree.

INSECT




DAMAGE CARD

- ◆ Fly to the Interior of the forest. Watch out for the woodpecker!
- ◆ Give this card to an Interior tree.
- ◆ Return to the damage card pile to assume a new role.
- ◆ If the woodpecker kills you, pick up an Interior tree card. You are now an Interior tree.

INSECT

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DAMAGE CARD



- ◆ Hop to the interior of the forest. Watch out for bobcats!
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.
- ◆ If the bobcat kills you, pick up an interior tree card. You are now an interior tree.

RABBIT


DAMAGE CARD



- ◆ Hop to the interior of the forest. Watch out for bobcats!
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.
- ◆ If the bobcat kills you, pick up an interior tree card. You are now an interior tree.

RABBIT

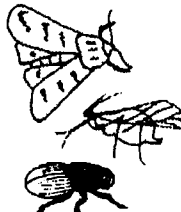
DAMAGE CARD



- ◆ Hop to the interior of the forest. Watch out for bobcats!
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.
- ◆ If the bobcat kills you, pick up an interior tree card. You are now an interior tree.

RABBIT

DAMAGE CARD

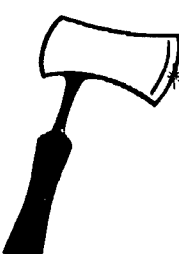


- ◆ Fly to the interior of the forest. Watch out for the woodpecker!
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.
- ◆ If the woodpecker kills you, pick up an interior tree card. You are now an interior tree.

INSECT

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ROLE CARD




1. Choose an edge tree. Take its card.
- 2.
3. Bring edge tree to damage card pile.

Report to lumber mill (teacher) to determine how the tree will be used and how many points its worth.

5.

TREE HARVESTER

ROLE CARD




1. Hunt for hopping rabbits and crawling porcupines.
2. Try to tag the rabbits. You must touch the belly button of the porcupines.
- 3.

If you catch a rabbit, or porcupine, bring their damage card to the damage card pile.

4.

BOBCAT

ROLE CARD

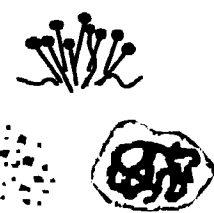


1. Hunt for insects flying to the interior forest.
- 2.
3. If you catch an insect bring its damage card to the damage card pile.

Return to the interior forest to hunt.

WOODPECKER

DAMAGE CARD




- ◆ Walk to the interior of the forest.
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.

DISEASE

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DAMAGE CARD



- ◆ Walk to the interior of the forest.
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.

WIND


DAMAGE CARD



- ◆ Walk to the interior of the forest.
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.

WIND

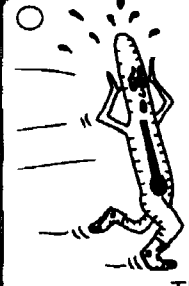
DAMAGE CARD



- ◆ Walk to the interior of the forest.
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.

WIND

DAMAGE CARD



- ◆ Walk to the interior of the forest.
- ◆ Give this card to an interior tree.
- ◆ Return to the damage card pile to assume a new role.

TEMPERATURE CHANGE