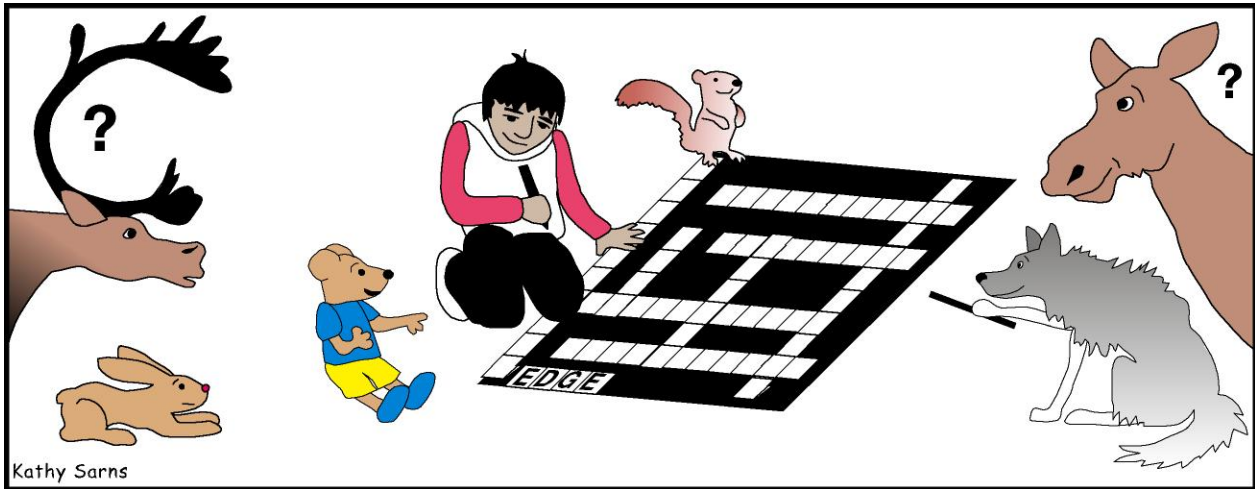


BOREAL FOREST AND TUNDRA CROSSWORD PUZZLE



Grade Level: 6-12

Alaska State Content Standards (2006): none

Subject: Science

Skills: Vocabulary building

Duration: 25 minutes

Group Size: individual

Setting: indoors

OBJECTIVE

Students will be able to define the terms used when describing boreal forest and tundra ecosystems or fires.

TEACHING STRATEGY

Students will complete crossword puzzles.

- Puzzle #1 (easy)
- Puzzle #2 (moderate)
- Puzzle #3 (difficult)

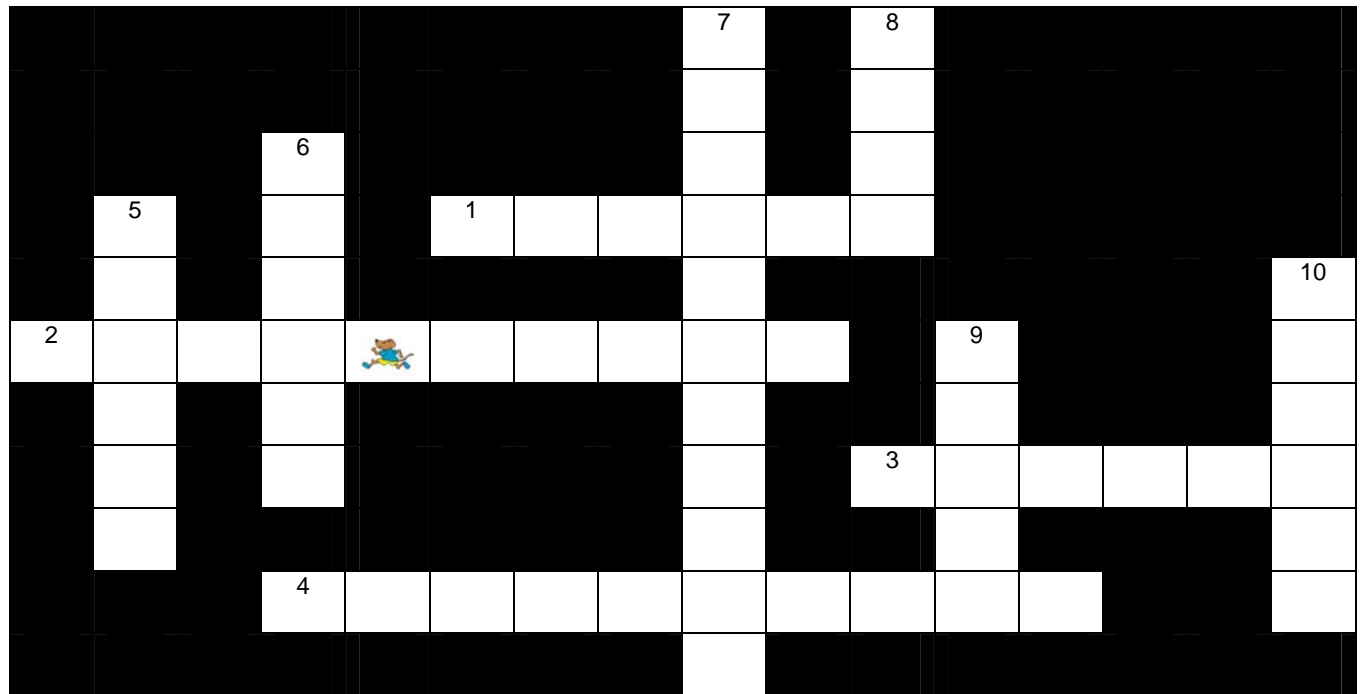
PROCEDURE

1. Review the terms on the crossword puzzles. Give one or more puzzles to each student and have them complete.
2. When everyone is finished, review the vocabulary words and their meanings.

EVALUATION

The puzzles can be used as the evaluation.

BOREAL FOREST AND TUNDRA CROSSWORD PUZZLE #1



ACROSS

- 1) The northern most forest in the world
- 2) "The big fish eats the little fish." (*Two words.*)
- 3) The most likely to burn tree in the boreal forest.
- 4) Most natural wildland fires are caused by this.

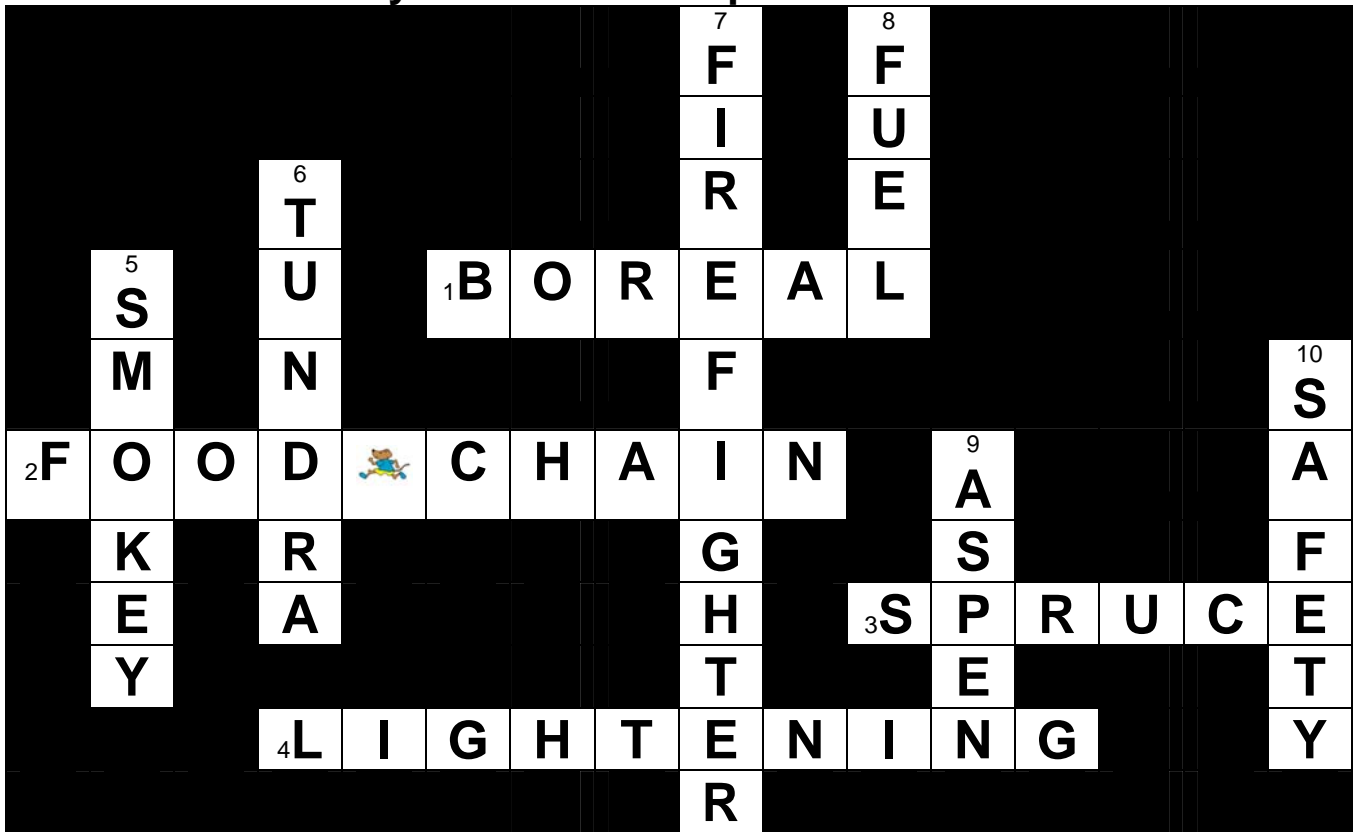
DOWN

- 5) He says "Only you can prevent forest fires."
- 6) A mostly treeless landscape in Alaska.
- 7) The person that puts out fires.
- 8) Anything that burns.
- 9) A common broadleaf tree.
- 10) The most important thing when managing fires.

BOREAL FOREST AND TUNDRA CROSSWORD PUZZLE

#1

Key – Easiest level puzzle



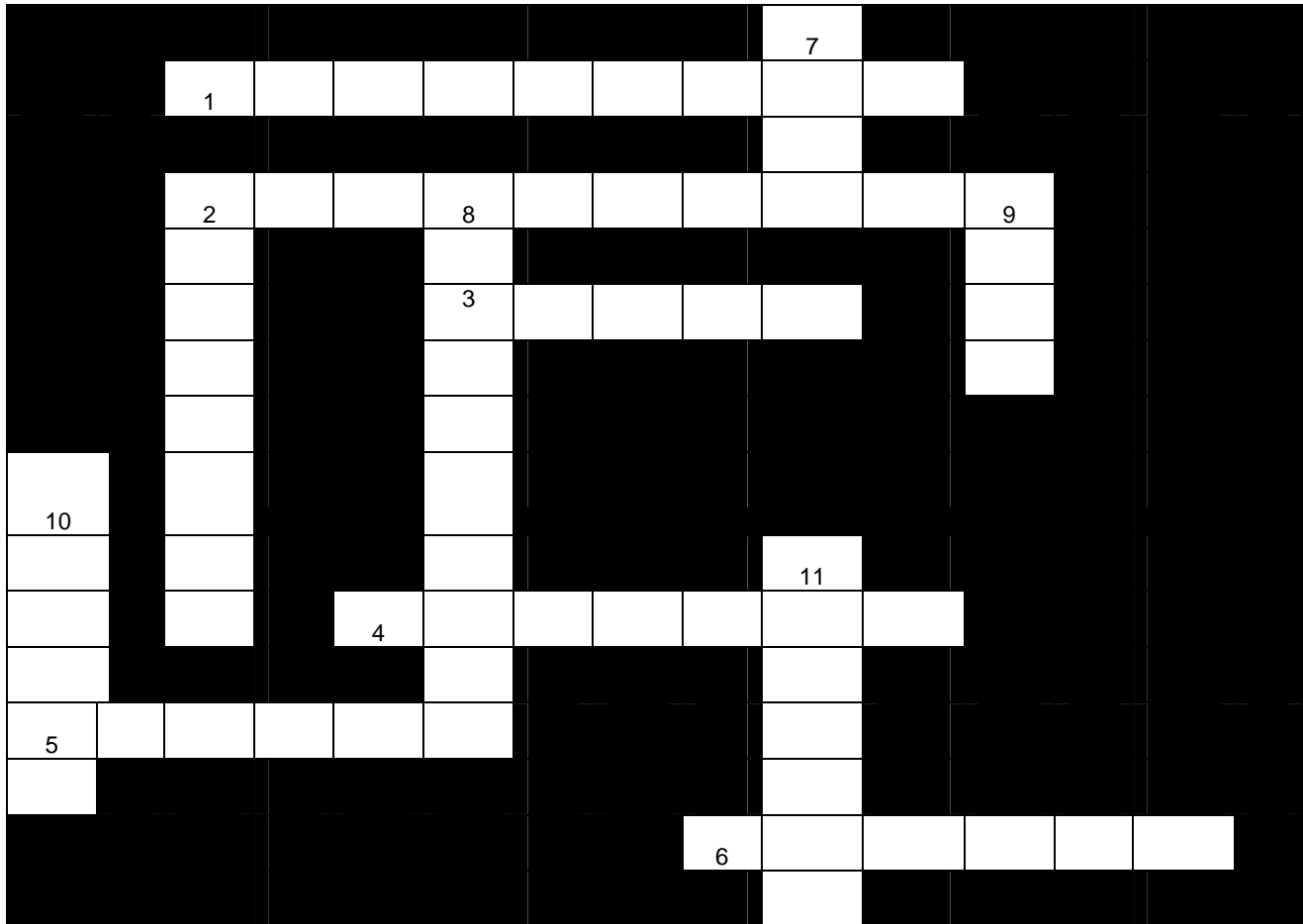
ACROSS

- 1) The northern most forest in the world (boreal)
- 2) "The big fish eats the little fish."
Two words. (food chain)
- 3) The most likely to burn tree in the boreal forest. (Spruce)
- 4) Most natural wildland fires are caused by this. (lightening)

DOWN

- 5) He says "Only you can prevent forest fires." (Smokey)
- 6) A mostly treeless landscape in Alaska. (tundra)
- 7) The person that puts out fires. (firefighter)
- 8) Anything that burns. (fuel)
- 9) A common broadleaf tree. (aspen)
- 10) The most important thing when managing fires. (safety)

BOREAL FOREST AND TUNDRA CROSSWORD PUZZLE #2



ACROSS

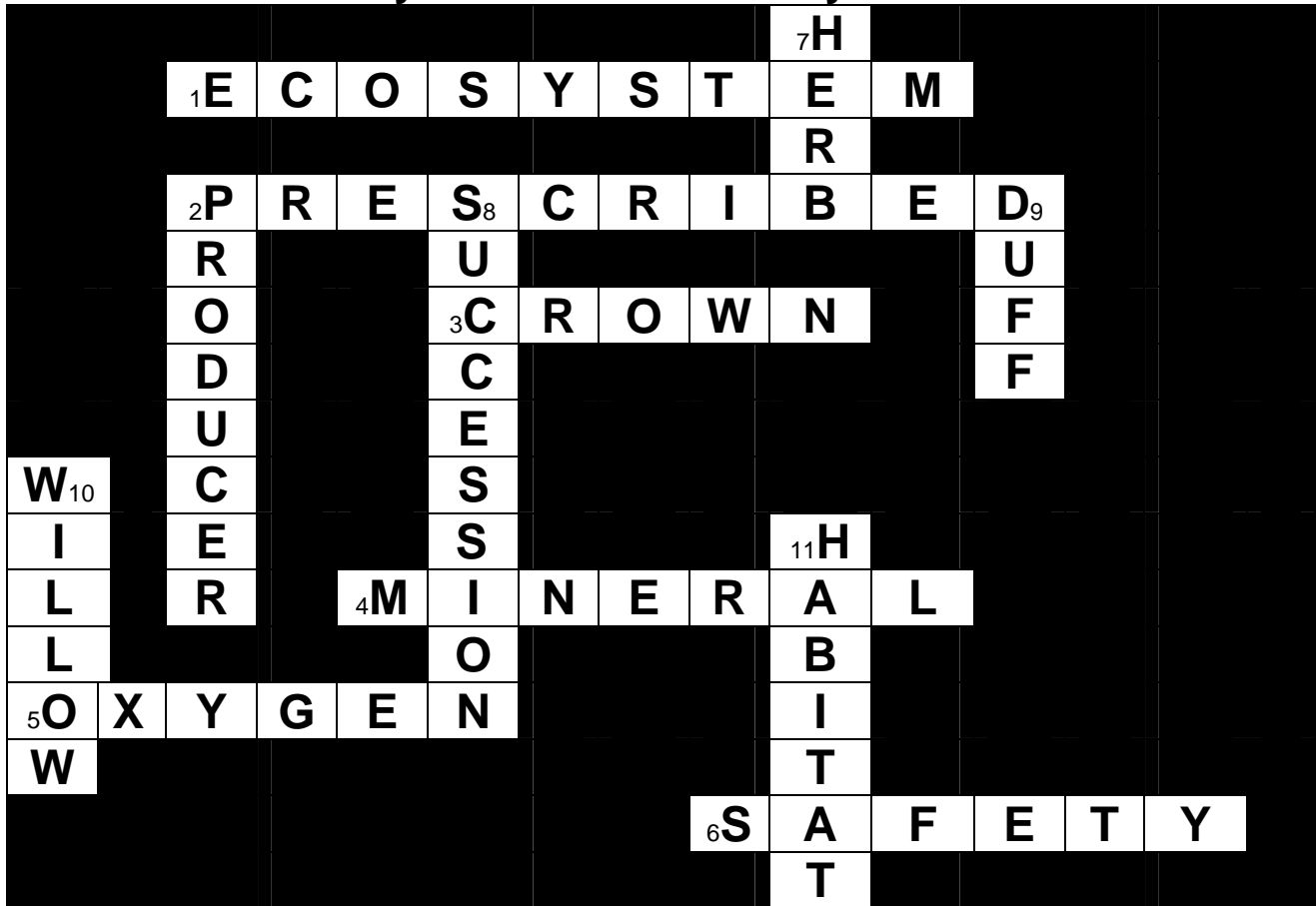
- 1) All living and non-living things in an area.
- 2) A carefully monitored fire that managers use to meet goals.
- 3) A fire in the upper forest canopy.
- 4) The type of soil exposed in heavily burned areas of a fire.
- 5) The gaseous element that fire needs to burn.
- 6) The most important thing when managing fires.

DOWN

- 2) An organism that makes its own food.
- 7) The earliest stage of succession is the _____ stage.
- 8) The natural orderly change in plant and animal communities over time.
- 9) The organic soil layer made up of decaying plant parts.
- 10) The favorite food of moose.
- 11) The natural home of a plant or animal.

BOREAL FOREST AND TUNDRA CROSSWORD PUZZLE #2

Key – Moderate Difficulty Puzzle



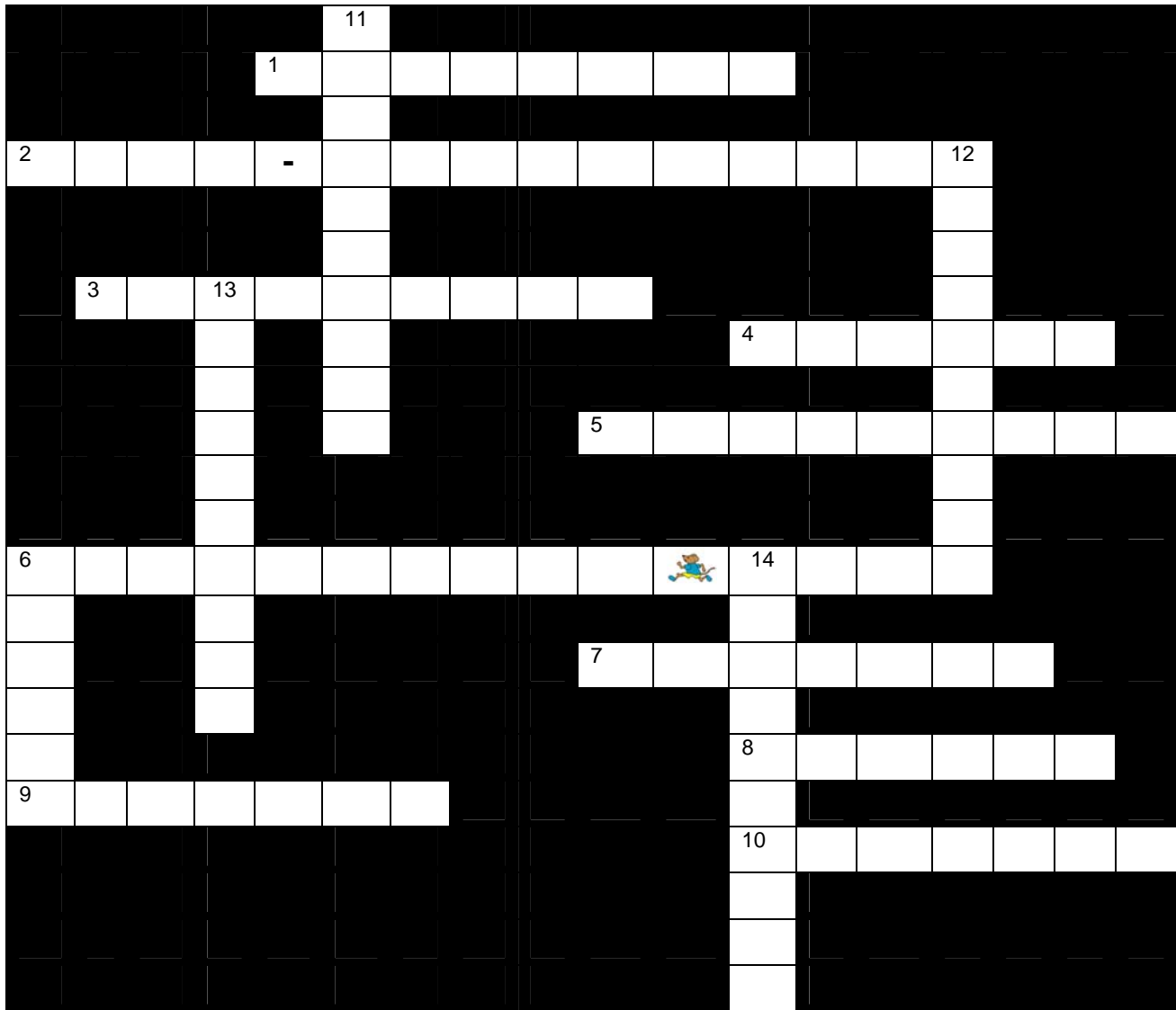
ACROSS

- 1) All living and non-living things in an area. (ecosystem)
- 2) A carefully monitored fire that managers use to meet goals. (prescribed)
- 3) A fire in the upper forest canopy. (crown)
- 4) The type of soil exposed in heavily burned areas of a fire. (mineral)
- 5) The gaseous element that fire needs to burn. (oxygen)
- 6) The most important thing when managing fires. (safety)

DOWN

- 2) An organism that makes its own food. (producer)
- 7) The earliest stage of succession is the _____ stage. (herb)
- 8) The natural orderly change in plant and animal communities over time. (succession)
- 9) The organic soil layer made up of decaying plant parts. (duff)
- 10) The favorite food of moose. (willow)
- 11) The natural home of a plant or animal. (habitat)

BOREAL FOREST AND TUNDRA CROSSWORD PUZZLE #3



ACROSS

- 1) A straight line study plot for research and monitoring.
- 2) A _____ cone that requires heat to open.
- 3) Fire adds _____ to the soil.
- 4) The most important thing when managing fires.
- 5) All living and non-living things in an area.
- 6) Provides the course of action taken with regard to wildland fires in Alaska.
- 7) A fire that burns fuels on the ground but not in the canopy.
- 8) Ground layer that freezes and thaws each year.

- 9) Plants with needle-like or scale-like leaves.
- 10) A stem-like root that resprouts after fires.

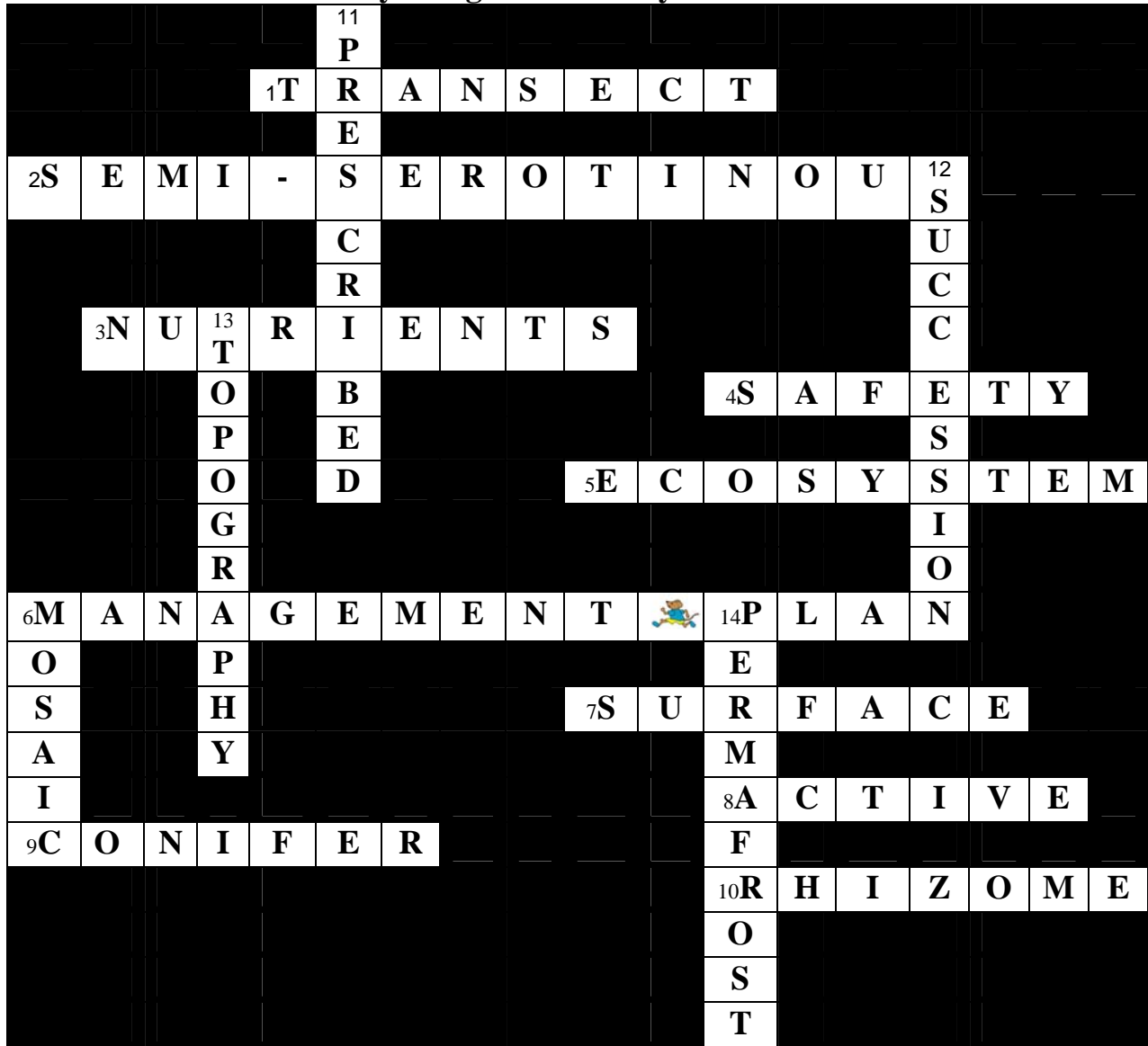
DOWN

- 6) Patchwork pattern of vegetation.
- 11) A carefully monitored fire that managers used to meet goals.
- 12) The natural orderly change in plant and animal communities over time.
- 13) The physical features of a region.

14) A layer of soil that remains frozen.

BOREAL FOREST AND TUNDRA CROSSWORD PUZZLE #3

Key – Higher Difficulty Puzzle



ACROSS

- 1) A straight-line study plot for research and monitoring.
- 2) A ____ cone that requires heat to open.
- 3) Fire adds _____ to the soil.
- 4) The most important thing when managing fires.
- 5) All living and non-living things in an area.
- 6) Provides the course of action taken with regard to wildland fires in Alaska.
- 7) A fire that burns fuels on the ground but not in the canopy.
- 8) Ground layer that freezes and thaws each year.

- 9) Plants with needle-like or scale-like leaves.

- 10) A stem-like root that resprouts after fires.

DOWN

- 6) Patchwork pattern of vegetation.
- 11) A carefully monitored fire that managers used to meet goals.
- 12) The natural orderly change in plant and animal communities over time.
- 13) The physical features of a region.
- 14) A layer of soil that remains frozen.

EFFECTS OF FIRE ON WILDLIFE POPULATIONS

While fires kill some individual animals, the most important effects of fire on wildlife populations are due to changes in the vegetation. In tundra most of these changes last for less than 10 years, but in the boreal forest fire begins a series of changes that may last from 50 to 200 years. The most important effect of fire on wildlife in the boreal forest is that it creates and maintains the mosaic of forest ages and types. The fire-maintained mosaic provides habitat for a greater abundance and diversity of wildlife than would otherwise occur.

The following lists the effects of fire on the animals found in boreal forests or tundra ecosystems.

- | | |
|------------|--|
| Moose | Moose generally benefit from fire because their preferred foods are shrubs and saplings. These plants are most abundant and most productive in burned areas. Habitat for moose is generally improved for about 1 to 30 years following fire depending on the impact of the burn and other factors affecting plant succession. However, fires in stands that lack aspen, birch, willow or other browse plants do not benefit moose. |
| Caribou | Scientists disagree about the effects of fire on caribou. Since caribou rely on lichens for winter food some scientists are concerned that fires may reduce the amount of winter habitat for them. Lichens are slow growing and may require 50 to 100 years to recover from a fire. However research into the effects of fire on the size of various caribou herds has not shown any clear pattern. Some herds have increased following large fires while others have declined. At present most caribou biologists think that fire is less important than other factors in determining the size and health of caribou populations. |
| Dall Sheep | Unknown. Sheep may temporarily benefit from increased nutrient-rich plant growth in the few years following fire if a fire occurs in alpine tundra or a forested area near treeline. |
| Muskox | Unknown. Muskoxen could potentially benefit from increased nutrient-rich plant growth in the few years following fire. |
| Bear | Fires generally benefit bears by increasing plant growth and berry crops, and possibly by increasing numbers of prey animals. Heavily burned sites that clear large areas of forest may reduce black bear numbers but are unlikely to affect |

brown bear populations. A severe burn may adversely affect salmon streams and reduce bear populations.

Wolf	Research on the effects of fires on wolves has not been conducted.
benefit from	Wolves are known to hunt in burn areas and they could increased populations of moose and other prey.
Coyote and Fox	The effects of fires on coyotes and foxes have not been thoroughly researched. However these animals often hunt in burned areas and likely benefit from increased populations of small mammals such as voles and lemmings.
Weasel	Weasels prey on small mammals and their numbers are likely to reflect the availability of prey. Since voles are generally more abundant in early successional stages, weasels likely benefit from fire.
Marten	Scientists once thought that fires reduced marten habitat but research on this subject has revealed that marten often benefit from fire both in the short-term and long-term. Marten may benefit from fire in the short-term due to increased populations of voles, their primary prey. Research indicates that marten numbers generally return to or exceed preburn levels within 10 years following fire. While marten do appear to need mature forest for denning sites, small islands of unburned forest within a large burn can provide adequate cover. Marten thus benefit from sporadic fires that create or maintain the forest mosaic. Large fires that completely clear out forests from extensive areas may be harmful to marten but such fires are more likely to result from fire suppression which allows accumulation of fuel. Thus complete fire suppression must be considered detrimental to marten populations in the long-term.
Wolverine	Unknown.
Lynx	Fires are considered generally beneficial to lynx because they increase food for snowshoe hares, the primary prey of lynx. In one study by the Alaska Department of Fish and Game, scientists found that the harvest and evidence of lynx were higher in a recently burned area than in nearby mature forest. Some biologists think that lynx may require mature forests for cover. If so lynx would benefit most from fires that maintain the forest mosaic.

Voles	The effects of fire on vole populations depend upon the impact of the fire and the rate at which plant succession occurs. In lightly burned areas where plant regrowth occurs quickly and where adequate ground cover exists, voles may quickly repopulate a burn site and numbers inside burn areas may eventually exceed those in unburned areas. However, in heavy burns where little cover remains and where vegetation is slow to recover, small mammals may not re-invade burn sites for several years. Also different species of small mammals may respond differently to fire. Research indicates that red-backed voles quickly re-invade burn areas (where conditions are suitable) while tundra voles may not use burned areas for several years. Information on other species is lacking.
Lemming	The effects of fire on lemming populations are unknown.
Porcupine	Porcupines need mature forest for winter habitat but use burned areas for feeding in spring and summer. They are likely to benefit from small burns but be harmed by large fires. No research has been done on the effects of fire on porcupine populations.
Beaver	Beaver benefit from fire because they require young forest or earlier stages of succession where birch aspen and willow predominate. Beaver cannot survive well in forests dominated by spruce.
Muskrat	Research on the effects of fire on muskrats in Alaska is lacking. Elsewhere fire has been shown to benefit muskrats by helping maintain marshlands and increasing growth of plants used by muskrats. In permafrost areas fire may lead to thawing of permafrost and the formation of wetlands and ponds. The value of such ponds to muskrats has not been researched but they may provide additional habitat.
Red and Northern Flying Squirrels	Red and northern flying squirrels live in mature forests, which suggests that fire would be harmful to them. Fire is more likely harmful to red squirrels since they require large stands of spruce to get adequate seeds for winter. Northern flying squirrels feed on mushrooms and berries that may be more abundant in early post-fire successional stages. Large burns that remove extensive forest areas are undoubtedly

harmful to flying squirrels but smaller fires that help maintain the forest mosaic likely improve habitat for them.

Ground Squirrel
primary

No research is available. However some scientists think that fires benefit ground squirrels by promoting lush growth of their food plants.

Woodchuck and Marmot

No information is available. Lush plant growth following fire could provide short-term benefits.

Hare

Snowshoe hares benefit from fires that maintain the forest mosaic. They feed on young willow, aspen and birch shrubs and saplings. Since these are more abundant and productive in burn areas, hares generally benefit from the increased food created by fires. However, hares also require dense black spruce or willow and alder thickets for cover, particularly during winter. Thus large fires that remove extensive areas of forest can reduce hare numbers. Fire suppression that leads to fuel accumulation and the potential for large fires pose a threat to hare habitat.

Loons and Grebe

No research is available. Fires that blacken the soil surface and remove some, or all, of the insulating organic mat can lead to the formation of ponds from the thawing of permafrost in some areas. These wetland areas could potentially provide habitat for these birds if the ponds were large enough and productive enough to support populations of small fish.

Ducks, Geese, and Swans

Little research information is available for Alaska but elsewhere fires are used to maintain wetland habitat for wildlife. Some biologists think fires may benefit Alaskan waterfowl by helping maintain marshlands and/or increasing plant and invertebrate productivity in wetland areas. Fires that blacken the soil surface and remove some or all of the insulating organic mat can lead to the formation of ponds from the thawing of permafrost in some areas. These wetland areas could potentially provide habitat for waterfowl if the ponds supported suitable aquatic vegetation and insect populations.

Shorebirds	Although no information is available it can be speculated that fire is beneficial for the same reasons as with waterfowl.
Owls	No research has been done on the effects of fires on owls. Several species of owls would likely benefit from fires because they feed on small mammals in open habitats. These include northern hawk owl, short-eared owl, great-horned owl, and great gray owl. Boreal owls, great-horned owls, and great gray owls nest in mature trees so fires that remove large forest areas may be harmful to them. Sporadic fires that maintain the forest mosaic should be beneficial.
Grouse	The effects of fire on grouse vary by species. Spruce grouse, which live mainly in mature, white spruce forests, are likely harmed by fire in the short-term. On the other hand, sharp-tailed grouse that need shrub lands and ruffed grouse which live in young deciduous forest benefit from occasional fires that maintain their habitat. Willow ptarmigan also benefit from fire; during winter they feed mainly on buds of birch, aspen and willow along forest edges or in young forest.
Hawks and Falcons	The effects of fire on hawks vary by species. Some species, including rough-legged hawks, red-tailed hawks, and American kestrels feed on small mammals in open habitats. They benefit from increased feeding areas that result from fire. Sharp-shinned hawks and goshawks feed and nest in mature deciduous or mixed forests; in the short-term, fires likely reduce their populations. However, complete fire suppression could lead both to a reduction in the extent of deciduous forests (as these are replaced by spruce forests) and to large heavily burned areas that would clear out extensive areas of mature forest. Sporadic fires that maintain the vegetation mosaic are beneficial to these species.
Woodpeckers	Black-backed woodpeckers, three-toed woodpeckers and hairy woodpeckers quickly respond to the increase in bark beetle populations that occur immediately following fire. Scientists think that black-backed woodpeckers may be nomadic and depend upon fires in the boreal forest to create suitable feeding and nesting habitat. Northern flickers benefit from fires as they nest and feed in open deciduous or mixed

forests or recent burns. Downy woodpeckers do not use recently burned forests, but they depend upon sporadic fires to maintain their habitat - areas of young deciduous forest.

Swallows Swallows feed in open areas and two species (tree swallows and violet-green swallows) nest in old woodpecker holes in dead trees. Fires likely benefit these species by clearing out forests and improving woodpecker habitat.

Thrushes The effects of fire on thrushes vary by species. Robins and gray-cheeked thrushes use early successional stages and benefit from fire. The effects on hermit thrushes are unclear as they are found both in mature forests and in forest openings. Varied thrushes and Swainson's thrushes prefer mature or old mixed forests.

Chickadees and Creepers Black-capped and boreal chickadees and brown creepers prefer old mature forests for feeding and nesting and may be adversely affected by fire.

Warblers Fires benefit some species of warblers including yellow warblers, orange-crowned warblers, and Wilson's warblers, as these species prefer shrub habitats. Yellow-rumped warblers and Townsend's warblers prefer mature forests. Populations of these species may decline as a result of fire.

Crossbills Fires reduce habitat for crossbills as these birds feed mainly on the seeds of mature spruce trees.

Sparrows Most sparrows, including white-crowned, golden-crowned, Lincoln's and Savannah sparrows prefer the early successional stages resulting from fire. Dark-eyed juncos nest in all ages of forest but are also most abundant in early successional stages.