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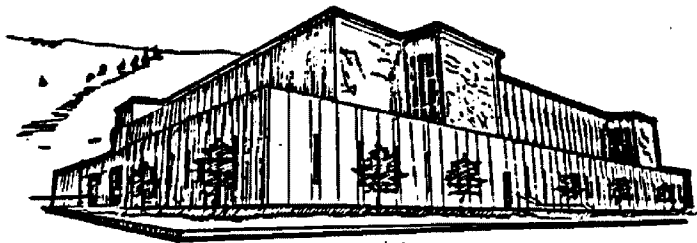
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University of
Montana

SUSSEX SCHOOL BACKYARD NATURE AREA PROJECT

by

Yukiko Maeda Tanaka

B.A., University of Minnesota, 1980

presented in partial fulfillment of the requirements


for the degree of

Master of Science

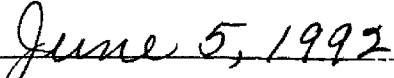
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TABLE OF CONTENTS

PART I. Sussex School backyard nature area project

- 1. Introduction-----1
- 2. Sussex school-----2
- 3. Original setting of the backyard-----6
- 4. Students' perception on the backyard--10
- 5. Initial planting-----16
- 6. Ideas for additional planting-----27

PART II. Sussex School backyard nature area guidebook

- 1. Fall
 - * Fox squirrel -----35
 - * Burdock-----38
 - * Silver Maple-----41
 - * Fall makes everybody a poet-----43
 - * Meet a tree-----44
 - * Fall in the Pattee Canyon Area
 - Ponderosa pine-----46
 - Kinnikinnick-----48
 - Wood rose-----50
 - Snowberry-----52

2.	Winter	
*	Animal tracking-----	54
*	Snow crystals-----	57
*	Snow sculpture-----	59
*	Maple syrup, maple sugar-----	62
*	Trees in winter-----	65
*	Air pollution-----	66
3.	Spring	
*	Dandelion-----	68
*	Bull thistle-----	73
*	Pineapple weed-----	75
*	Spring ephemerals-----	77
*	Bird watching-----	80
*	Silver maples in spring-----	84
*	Build a tree-----	86
4.	Summer	
*	Microenvironment-----	89
*	Serviceberry and chokecherry-----	91
*	Spotted knapweed and tansy-----	93
*	Let's make your own garden!-----	95

LIST OF ILLUSTRATION

*	Fig.1	Sussex Nature Area Base Map-----	7
---	-------	----------------------------------	---

I-1 INTRODUCTION

The Sussex School is an alternative school in Missoula, Montana with approximately 70 students ranging from kindergarten through 8th grade. From fall 1990 to spring 1991, I had an opportunity to do an environmental education internship at the school. The purpose of the internship was to convert their backyard into an actively used nature area where students would experience positive encounters with nature. During the internship, I gave students several presentations on native plants of western Montana, took them for a field trip to Pattee Canyon, and planted native plants at two locations. I also regularly attended 5/6 grade science classes and occasionally attended the students' weekly meetings.

The campus of the Sussex School is located on property which was formerly an old farm. The northwestern portion of the campus, the proposed site for the nature area, has not been used since the school acquired the property. The majority of plants are introduced species. Due to shade produced by large silver maple trees and moisture from irrigation ditch, unlike the natural conditions of the Missoula Valley, a large portion of the area is capable of supporting shade-tolerant species. Although this site is

currently not a primary natural area, approximately 3,000 square meters of land on campus, if actively used, could provide students valuable opportunities to attain ecological awareness.

Due to limited budget and manpower, this project used preexisting resources (including non-native plants) as much as possible. Initial planting of native plants was restricted to two locations. Students were involved in the process of planning as well as actual planting and care afterward.

A major portion of this project is to propose a guidebook for the Sussex backyard nature area. After devoting Part I of this professional paper to background information, Part II presents the guidebook which will be distributed among Sussex students and teachers. I hope students will wish to spend more time in their backyard after reading this guidebook.

I-2 SUSSEX SCHOOL

In 1971, Bente Winston, founder and director of the Sussex School, and five other families who wished to actively participate in the education of their children started a parent-cooperative school in a small house on Sussex Street. The school took its name from its first location. In 1979, due to growing

enrollment, Sussex School moved to one of Missoula's historic homes built in the late nineteenth century. The school now occupies about 1 ha at 1800 South Second West.

From the school's inception, parents have played an integral part in the direction, operation and maintenance of Sussex. School policy requires parents to contribute 24 hours per quarter. Parents participation hours not only keep the school running smoothly and economically, but also afford parents the opportunity to be directly involved in their children's daily life at school. Jobs performed by parents include teaching specialty topics ranging from forest ecology to rock climbing, classroom and research assistance for teachers, board and committee work, lunch supervision, library work, cleaning and maintenance, telephone work, driving on field trips, and fund raising.

Sussex School is incorporated as a non-profit educational organization and is licensed by the state of Montana. A Board of Directors consists of seven parents, one student, and one member from the community. Parents hold general meetings every quarter in order to discuss Board decisions, school policies and future goals.

As educational goals at Sussex school, students develop:

- Self-discipline, high self-esteem, and creative expression;
- a lifelong confidence in their ability to learn and enjoy the process of learning;
- appreciation of diversity and beauty both in human cultures and the natural world;
- confidence in their own authority and responsibility for their own behavior;
- a strong social consciousness to assist them in group problem solving.

To meet these goals, Sussex School ensures that:

- teaching responsibilities reflect the knowledge, training and enthusiasm of the teachers in the particular subject areas;
- students/teacher ratio varies depending on age group and subjects taught;
- a non-competitive environment allows growth to proceed at a pace suited to the needs and potential of the individual student;
- students of all ages can interact, make friends, and enjoy learning together;
- parents are significantly involved;

- the school is integrated into the life of the community.

The school has two buildings with classrooms. During the day, the students move between the buildings for various classes. Students, ages 5-14, are organized into five basic learning groups for academic subjects and a varying number of learning groups for non-academic subjects. The placement of students in the learning groups is determined by age, motivation, maturity and social/emotional needs. All students are given instruction in the basic subjects of language arts, mathematics, science and social studies. Fine arts, music, physical education and foreign language classes offer elective options. Class size varies from 8 to 16 students depending upon student age and subject area.

At Sussex, there is a fundamental belief that the school extends its resources beyond the school buildings. Field trips are commonly planned to local museums, libraries, forests, rivers and the University of Montana laboratories. In the spring, students take a week long science/social studies field trip. In the past, students have participated in the Yellowstone Park Science Program, the Teton Science Center in Wyoming, and a hiking trip through the rain forest

along the Olympic Peninsula.

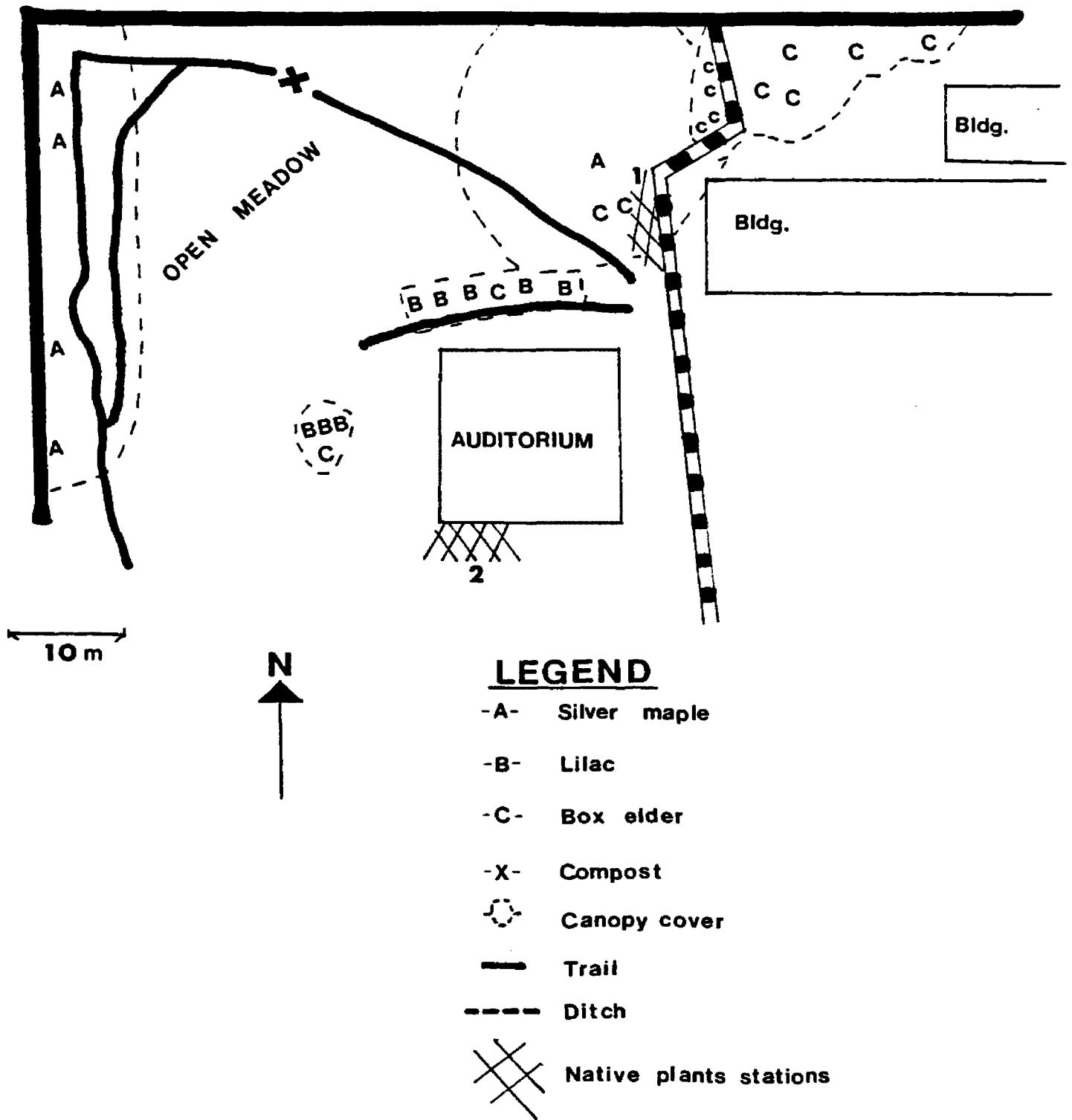
I-3 ORIGINAL SETTING OF THE BACKYARD

Northwestern portion of the campus, the proposed site for the nature area, covers approximately 3,000 square meters. A map of the area is presented in Figure 1.

The western corner of the area is defined by five large silver maple trees (Acer saccharinum L.). The natural distribution of silver maple ranges from New Brunswick to southern Ontario and South Dakota, southward to Florida (Britton, 1908). It is not native to western Montana, but is extensively planted here for ornamental purposes. Silver maple is one of the most rapid-growing trees. It attains a maximum height of about 40 meters and trunk diameter of about 1.4 meters (Britton, 1908). The flowers appear during the earliest spring in dense clusters, much ahead of the leaves.

In the Sussex backyard, these five trees as well as one large silver maple north of the auditorium (this one is called the "reading tree" by Sussex students) make a large portion of the area very shaded during spring, summer, and early fall.

Fig.1 SUSSEX NATURE AREA BASE MAP



Lilacs (Syringa vulgaris L.) located north of auditorium are the children's favorite during spring. They love the dense pyramidal clusters of sweet-scented flowers and play with them and put them on their hair. Lilac is native of south-east Europe (Polunin, 1969), but grown widely for ornamental purposes. It is a deciduous shrub and grows at a height of 2 to 7 meters.

In the northeastern part of the area near the irrigation ditch, there are several box elder trees (Acer negundo L.). These trees also are called ash-leaved maple or black ash. They are widely distributed throughout the United States. In Montana, they are found along streams in the eastern part of the state (Hart, 1976). Box elder is also rapid-growing and extensively used in planting along roads and in parks. Trees attain a maximum height of about 23 meters and a trunk diameter of 1.5 meters (Britton, 1908).

In the eastern Montana, native Americans and pioneers tapped a sweet syrup from box elder (Hart, 1976). Native Americans also preferred its wood for cooking meat and making fires for the Sun Dance because box elder burns hotter and maintains coals longer than do most other woods (Hart, 1976).

Plants of pioneer species, generally called "weeds", cover the majority of the area of the backyard. The most notable one is burdock (Arctium

minus (Hill) Bernh.). It is a biennial herb. The first year's growth is a rosette of very large dull-green leaves that somewhat resemble those of rhubarb hugging the ground. During the second year, the plant shoots up as high as 1,8 meters with a stout stalk, many smaller leaves, and flower heads that are lavender-purple. The most distinguishing and disagreeable characteristic of this species is the adhesiveness of the mature heads. The involucral bracts are tipped with hooked spines that cling to clothing or the fur of animals, thereby dispersing the seeds. Burdock is a native of Eurasia and has been used extensively as a vegetable (Taylor, 1990). The entire plant is edible. Especially the mild and tender first year taproots are excellent to eat and commercially grown and sold in the United States as well as in Asia. Other "weeds" found in the area include mints (Lamium species), white clover (Trifolium repens L.), shepherd's purse (Capsella bursa-pastoris (L.) medic.), field mustard (Brassica compestris Rapa L.), pineapple weed (Matricaria matricarioides (Less.) Porter), dandelion (Taraxacum officinale Weber), bull thistle (Cirsium vulgare (Savi) Tenore), cheat grass (Bromus tectorum L.), and crab grass (Digitaria sanguinalis (L.) Scop.).

Trails shown on the map (Figure 1) are not well established or maintained. However, these are routes

children know and take to get around in the backyard.

The compost site shown on the map was built by Sussex students and maintained by them.

Water in the irrigation ditch runs from May to September and provides moisture for plants in the eastern part of the backyard.

Squirrels live in the silver maple trees throughout the year and eat the seeds of the maples. Numerous birds visit the area in spring.

I-4 STUDENTS' PERCEPTION ON THE BACKYARD

Although today's world offers young people many choices and opportunities, their experience with natural areas and ecological processes is very limited (Waxman, 1990). One needs to go to nature to acquire a sense of the interrelatedness of all things and see oneself as an essential part of this interrelatedness. Ecological awareness comes from day to day encounters with nature. In order for children to acquire a sense of interrelatedness of nature, they should have easy access and opportunities for experience with natural areas.

The authors of "Growing Up Green" (Skelsey and Huchaby, 1973) state that where environmental problems do touch children personally, the emphasis is often on

the ugly and not nearly enough time is allotted to finding and appreciating the beautiful. Children need positive encounters with nature.

Harvey (1989) studied the relationship between children's experiences with vegetation and their environmental attitudes and knowledge. She carefully studied schools in southern England with maximum variability of vegetation on school grounds. The sample was nearly evenly divided by sex: 425 girls and 420 boys. The children's ages varied from 8 to 11. Because children's experiences with vegetation do not occur only on school grounds, their past experiences with vegetation also were measured. The amount of vegetation, the diversity of vegetation, the complexity of environmental features, and the accessibility of vegetation were four particular aspects of the school landscape that she examined.

Harvey (1989) found that students with rich experiences with vegetation (in the past and on the school grounds) had higher botanical knowledge than did students from schools without vegetation. Students from schools with vegetated landscapes clearly showed higher scores for pastoralism and lower scores for human dominance over nature. The examples of statements she used to measure human dominance were "people should be able to cut down trees whenever they want to" and "I

am glad that man can change nature". The examples of statements she used to measure pastoralism were "I really enjoy nature" and "I like places where there are lots of plants and trees". The result of Harvey's research shows that children's experiences with vegetation on their school ground help them acquire a set of values and feelings of concern for the environment.

Surprisingly, in a nationally representative sample of science teachers of secondary schools in the United States, Keown (1986) noted that 16 percent of the teachers never used the outdoors for educational purposes and that the majority of teachers used it fewer than three times a year. Because the major factors restricting the use of the outdoors as a teaching resource were travel cost, class size, and lack of support from the administration, the school backyard, if planned and developed as a teaching resource, would alleviate some of these difficulties (Harvey, 1989).

When I was doing my internship at Sussex , I seldom saw students in the backyard during the fall and winter quarters. The weather was probably too cold for children to want to eat lunch outside. When students (5/6 graders) were taken out to the backyard for the science class to design an improved composting

site, very few students showed enthusiasm. During winter, although there were interesting animal tracks, I never saw children's foot prints on snow in the backyard. Spring was different. When weather became warm and lilacs were blooming, I saw all children from kindergarten through 8th graders having a good time in the backyard. Boys were on the reading tree and little children were picking dandelion and pineapple weed. Many students were eating their lunch outside.

When I interviewed recent Sussex graduates who go to public high schools in Missoula, I recognized that the same environment (Sussex campus) not necessarily perceived in a similar manner by students. When I asked what they remembered about Sussex campus, some of them said that they remembered the skating rink and not much else while some others had nice memories of identifying plants using guidebooks in spring and still missed the crabapple orchard which had to be cleared when the auditorium was built about 5 years ago. Each student's perception was different and probably experiences provided by parents also played an important role in forming their attitude toward nature. One recent Sussex graduate suggested that if there were more flowering plants and plants with edible fruits, spring and fall in the backyard could be more enjoyable.

I hope the Sussex Backyard Nature Area Guidebook will make children more curious about the area and allow them to go out there more often all around the year. Smaller children may be able to go out there with their teacher and do some activities from the guidebook while older students may want to go out there by themselves with the guidebook in hand to deepen their relationship with nature.

In Japan, school year starts in April and ends in March. Because there is only one month summer vacation, students are in school a fair amount of time during the growing season. My personal experience in elementary school located in the rural central Japan was full of outdoor activities.

On the campus of that elementary school, there were numerous native trees, shrubs and annual plants. Also, there were various exotic species such as tulips and cultivated roses. Besides those plants that were cared for by teachers and parents, each class of about 30 students had a garden plot whose size was about 5 meters by 10 meters. Children planned what to plant (vegetables, herbs, flowering plants etc.) and were responsible for pulling weeds, watering and keeping records of growth. Even first graders had a plot of their own. For them, teachers and parents had to provide some help. There were chickens and rabbits at

school, so even during weekends and holidays, children had to take turns and go to school to feed them.

There was a river nearby, and we often had field trips to the river, so that we could observe the riparian environment in different seasons, collect stones, learn about basic geomorphology, and have lunch. There were also all day field trips in spring and fall to nearby forests. Teachers taught students how to distinguish edible plants from poisonous ones, poisonous snakes from harmless ones, and all the basics children in the area should know about the local forests. However, those field trips were meant to be fun and students spent most of the time exploring by themselves.

When I think back to that elementary school, there were so much learning from hands-on experience. At least most of the learning experiences which were significant enough to still remember occurred outdoors. Later when I moved to Tokyo and went to high school there, I could not believe that some high school students thought a chicken had four legs, had never seen a frog in their life, and could not tell the difference between a dandelion and field mustard. Chickens and frogs were not in the zoo in Tokyo and dandelion and field mustard were not in floral shops. Most schools in the big cities in Japan such as Tokyo

do not have much vegetation on their campus. I think both the quality and length of time spent in nature as a child will influence the knowledge base about nature. Only with a positive experience, can children acquire a set of values and feelings of concern for the environment.

I-5 INITIAL PLANTING

Originally, my objective was to plant as many different kinds of native plants as possible in locations with different micro-environments within the Sussex backyard. However, I soon realized that budget and manpower were very limited. Especially after I learned that Sussex school already had tried an extensive native plant planting in 1989 and failed to keep any of those plants alive, my goal for the initial planting became one of continuity. If children planted anything, I wanted them to see the plants grow.

I gave three slide presentations on native plants of western Montana to the 5/6 grade science class before asking for their ideas on where and what they wanted to plant. They wanted to select only one or two locations where visibility is high, so they could manage the area. Their greatest concern was possible trampling damage by the younger children.

The first choice of location by students was near the irrigation ditch under the reading tree. That location was suitable for very shade-tolerant species. It was also one of the locations recommended by Mr. John Pierce, a native plant specialist for the Forest Service, when he visited the Sussex school ground. He also recommended the location west or south of the auditorium for sun-loving, drought-tolerant species, and students agreed on that location also.

There were several ideas on how to obtain native plants to be transplanted to the Sussex backyard. The first idea was to go to nearby forests and let the children dig out what we wanted. Although the plants we would bring back would be abundant there, this practice may leave children with the idea that they could go out in the forests and disturb the natural environment whenever they wanted. In addition to this possible negative influence on the students, root damage associated with transplanting often makes it difficult for the plants to survive. The second idea was to go out for the annual native plants dig-out organized by the Montana Native Plant Society (MNPS). With the help of experts from MNPS, native plants would be removed from areas of the National Forest where the Forest Service planned to bulldoze. This idea excited students; however, there was no native

plants dig-out organized by the MNPS in the spring of 1991. The third idea, which we adopted, was to purchase native plants from Bitterroot Native Growers, Inc. This company in Corvallis, Montana specializes in growing and selling native plants for the purpose of reforestation, reclamation of mined lands, riparian restoration, and soil stabilization. Bitterroot Native Growers, Inc. sells container grown native plants, so root damage associated with transplanting can be reduced.

We decided to purchase 5 seedlings each of snowberry (Symphoricarpos albus (L.)Blake), wood rose (Rosa woodsii Lindl.), russet buffaloberry (Shepherdia canadensis (L.)Nutt.), big sagebrush (Artemisia tridentata Nutt.) and 2 seedlings of mountain mahogany (Cercocarpus ledifolius Nutt.). Big sagebrush and mountain mahogany are sun-loving, drought-tolerant species and the plan was to plant them to the south of the auditorium. The rest of the plants are shade-tolerant species and they were to be planted near the irrigation ditch.

In late April when the ordered seedlings arrived at Sussex, I was unable to visit the Sussex campus for about 2 weeks. Students, without much help from adults, then decided to plant only one location near the irrigation ditch. They dug out the soil and mixed it

with compost from their composting site. They planted all of the plants, including mountain mahogany and sagebrush, at this location. When I visited campus after they had planted, I saw students' proud faces of accomplishment and their lovely hand-made signs for each of the plants. Although I knew that drought-tolerant species would not do well under a big silver maple tree, I decided not to discuss it with the children immediately and would observe how those plants would do. I postponed the discussion with students and transplanting until next school year. Those two species as well as the others survived the hot and dry summer of 1991.

Snowberry (Symphoricarpos albus (L.) Blake) is a low to medium (60 cm to 150 cm), clonal shrub of open forest and adjacent grasslands. It is a widespread species and often found in the ponderosa pine (Pinus ponderosa Dougl.ex laws) and Douglas-fir (Pseudotsuga menziesii (Mirb.)Franco) zones (Lee and Pfister, 1978). Snowberry shrubs are easily found along trails in both the Pattee Canyon and Rattlesnake areas in Missoula, especially when bearing white berries. Its forage value for deer and elk is fair (Lee and Pfister, 1978) and birds love to eat the berries. It is deciduous and very shade-tolerant. Leaf shape is highly variable on the new shoots. Mature leaves are oval-shaped, dull

green colored and rather thick. Flowers are pinkish and bell-shaped, and the fruit is white, spherical, berry-like and about 1 cm in diameter. Fruits are somewhat persistent into the fall or winter.

Flathead Indians used mashed berries of snowberry as a medicine for cuts and burns. They also made an eye-wash from the bark of snowberry (Hart, 1976). Nez Perce Indians and Kutenai Indians made a brown tea from Snowberry twigs (Hart, 1976). White berries of Snowberry are also excellent as a natural dye (Robertson, 1973).

Wood rose (Rosa woodsii Lindl.) is a medium shrub (100 to 200 cm) of the foothills, plains and lower elevations in the mountains (Morris et al., 1962). It also is called wild rose; however, there are several species called "wild rose" in Montana, and they are generally difficult to identify.

Wood rose is deciduous, has prickly, branched stems and pink showy flowers that bloom from late May through June and July (Craighead et al., 1963).

It is a good food source for deer (Morris et al., 1962) and also for humans. Rosehips can be eaten raw or made into jelly. It is a good source of Vitamin C. They adhere to the plant over winter and can be picked and eaten when other fruits are unavailable. The native Americans, early settlers, as well as rural

inhabitants of Europe and Asia used rosehips of various kinds for food (Craighead et al., 1963).

Russet Buffaloberry (Shepherdia canadensis (L.)Nutt.) is a medium (100 to 200 cm) understory shrub of the coniferous forest at medium elevations (Morris et al., 1962) It should not be confused with Buffaloberry (Shepherdia argentea (Pursh)Nutt.) which is a tall shrub to small tree of bottom lands in plains (Morris et al., 1962). It is deciduous, has silvery leaves , and flowers which are small, dioecious and yellow (Lee and Pfister, 1978). The fruit is berry-like, reddish and bitter. Unlike berries of buffaloberry (Shepherdia argentea (Pursh)Nutt.) which are very sweet and enjoyed by Eastern Montana Indians, berries of russet buffaloberry (Shepherdia canadensis (L.)Nutt.) are bitter and soapy to human taste. However, birds apparently have different tastes from humans and these berries are excellent food source for songbirds (Morris et al., 1962).

Big sagebrush (Artemisia tridentata Nutt.) is a widespread evergreen shrub of about 60 cm to 300 cm and covers many of inter-mountain valley floors of the Rockies. It is also found as an understory in open ponderosa pine (Pinus ponderosa Dougl. ex laws) and Douglas fir(Pseudotsuga menziesii (Mirb.)Franco) forest stands (Morris et al., 1962). It is tallest of

sagebrushes. Although it is very drought-tolerant, when moisture and light are abundant, it becomes treelike. Its evergreen leaves are aromatic and covered with silky-silvery hair. Flowers are inconspicuous and silver-green in color.

Big sagebrush has very high winter forage value for antelope, deer, elk and moose (Craighead et al., 1963). Flathead Indians drank a tea made from big sagebrush for colds and pneumonia. They also used big sagebrush for fire when other kinds of firewood were not available (Hart, 1976). Native Americans also extracted a light yellow dye from big sagebrush. Volatile oils with a pleasant sage odor can be extracted from the leaves.

Mountain mahogany (Cercocarpus ledifolius Nutt.) is an evergreen tall shrub (treelike) of rocky slopes and montane forests (Morris et al., 1962). It is also aromatic and grows well on dry sites. Grazing value is high, especially for deer (Morris et al., 1962). Their roots were used by Native Americans as a source of a natural dye to make beautiful reddish color (Hungry Wolf, 1989).

In June of 1991, members of MNPS donated yarrow (Achillea lanulosa Nutt.), western aster (Aster occidentalis (Nutt.) T. and G.), blue flax (Linum lewisii Pursh) and wild strawberry (Fragaria vesca L.). Since

it was only a few days before Sussex started summer vacation, I made a flower bed to the south of the auditorium and planted them without student participation.

Yarrow (Achillea lanulosa Nutt.) is one of 2 native species of yarrow found in Rockies (Craighead et al., 1963). However, yarrow (Achillea) is one of the most common plants in the world and grows in dry to moderately moist soil in sunny areas from valley bottoms to mountain tops throughout North America as well as in Europe (Hart, 1976). European yarrow (Achillea millefolium L.) has been introduced and now widespread. It is very difficult to distinguish the native yarrow from the European yarrow (Craighead et al., 1963).

Yarrow is a perennial herb with a strong, but pleasant odor. It spreads by short rhizomes (Taylor, 1990). It grows to a height of about 30 to 100 cm (Craighead et al., 1963). The leaves are narrow and have a fern-like appearance. The flower heads are white and bloom densely in clusters. Flowering season is long, from May to September.

The latin name for yarrow is Achillea, which is derived from Achilles who supposedly used an extract from the plant to treat soldiers wounded in the battle of Troy (Taylor, 1990). Native Americans also

extensively used yarrow for medicinal purposes. Flathead and Kutenai Indians crushed the leaves, either by chewing them or by mashing them in water, and then wrapped them around cuts and wounds to stop bleeding (Hart, 1976). Flathead and Cheyenne Indians also used a hot cup of tea made from leaves of yarrow for fever and colds.

Western aster (Aster occidentalis (Nutt.) T. and G.) is one of 35 species of asters found in Rockies (Craighead et al., 1963). Like yarrow, it is difficult to identify the different species of asters. Asters are perennial herbs and bloom in late summer. Asters are one of daisy-like plants in sunflower family, and the western aster has heads composed of yellow disc flowers surrounded by blue to pink ray flowers. Western aster is a native plant growing over much of western North America (Taylor, 1990). The leaves, stems, and flowers of many species of aster are consumed by big game animals and leaves of several species also were boiled and eaten by various tribes of native Americans (Craighead et al., 1963).

Blue flax (Linum lewisii Pursh) is an attractive perennial herb and widely distributed from Alaska to Mexico (Craighead et al., 1963). It has very slender stems and sky-blue, saucer-shaped flowers. Cultivated flax also looks like blue flax, but unlike blue flax,

is an annual plant (Craighead et al., 1963). Blue flax blooms in June and July in Missoula. It grows well on dry plains, hills, and open ridges, often among sagebrush (Craighead et al., 1963). Because flax has long tough fibers in the stem, native Americans used the stems for making ropes (Craighead et al., 1963).

Wild strawberries of different species are found in temperate zones of Europe, Asia, North America and south into Andes (Craighead et al., 1963). Two species occur in Rockies and Fragaria vesca L. is one of them.

Strawberry is a low, perennial herb and spreads by means of runners. Flowers with five white petals start to bloom in May. The portion that we eat is the enlarged flower receptacle which becomes sweet, juicy, and red upon ripening (Craighead et al., 1963).

Numerous seeds develop on each receptacle. Native Americans ate the berries and also made tea from the leaves. Berries are also eaten by variety of wildlife including robins, black and grizzly bears and small rodents.

At the time of transplanting, I did not realize that Fragaria vesca L. preferred moist soil. South of the auditorium of Sussex backyard could be too dry for that species to survive. Until the spring of 1992, it was difficult to determine how many of the plants to

the south of the auditorium had survived.

In late September, dormant roots of arrowleaf balsamroot (Balsamorhiza sagittata Nutt.) were planted at both locations (two of them at most sunny portion of the location planted by the children and three of them at the location south of the auditorium). In this way, I thought, students could compare how plants grow under different micro-environments.

Arrowleaf-balsamroot (Balsamorhiza sagittata Nutt.) has bright yellow flowers that resemble the true sunflowers and arrow-shaped leaves covered with silvery hairs. It blooms from late spring to early summer on dry soils of valleys and hills. It is widespread in western North America and exceptionally adaptive. It often dominates its habitat. It is a perennial herb arising from a deep-seated, woody root. Flathead, Kutenai, and Nez Perce Indians peeled young flower stems and ate the tender inner portion raw (Hart, 1976). Bighorn sheep eat the leaves and flowers of balsamroot while horses prefer the flowering heads (Craighead et al., 1963).

All the planted native plants require minimum management. However, twice a year, in the late spring and early fall, removal of competing weeds is desirable. In the fall of 1991, weeds almost covered the entire area of the location under the reading tree.

After removing the weeds, I was very happy to find that all of the native plants that students had planted had survived.

I-6 IDEAS FOR ADDITIONAL PLANTING

Now that two stations are established, what is next? What plants would students like to see everyday and enjoy learning about? Where should they be planted?

When I talked with students and recent graduates, they expressed interest in having plants whose flowers bloom or berries are ready for picking while Sussex is in session. I felt that they also enjoyed ethnobotany, so native plants which were used historically by native Americans would be a good choice. Because most of plants on Sussex campus are deciduous, adding evergreen native species would be another choice.

Of the two locations, expanding the location near the irrigation ditch is my first recommendation. The area along the irrigation ditch from north to south has light conditions similar to a forest understory to open stream banks. Although the established location is in the very shaded area, expansion of the location to the south would allow less shade-tolerant species that still require a fair amount of moisture. Kinnikinnick

(Arctostaphylos uva-ursi (L.) Spreng.), oregon grape (Berberis repens (Lindl.) G. Don), and heartleaf arnica (Arnica cordifolia Hook.) are some attractive native species which prefer moist, partially shaded areas. Kinnikinnick is one of the native plants which most of Sussex students probably already know. It is widespread in forests around Missoula, as an understory species of ponderosa pine (Pinus ponderosa Dougl. ex Laws.) and Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) forests. It is a small, evergreen, trailing shrub and forms a dense bright mat. Pale pink flowers are waxy and found in clusters. Leaves are small, shiny and leathery. The bright red berries ripen in late summer and persist through the winter. They are about the size of a pea and tasteless when eaten raw. Kutenai Indians fried the berries in a frying pan until they popped like popcorn, and supposedly, they tasted sweet and agreeable (Hart, 1976). Native Americans, early explorers and mountain men were very fond of sweet-smoking kinnikinnick leaves (Hart, 1976). Kinnikinnick is found throughout the northern latitudes of North America as well as Europe and Asia (Hart, 1976).

Oregon grape (Berberis repens (Lindl.) G. Don) is another attractive evergreen ground cover that is widespread in forests around Missoula as an understory

species of conifer forests. Hollylike foliage turns beautiful shades of red or purple in late summer. Dense clusters of bright yellow flowers bloom in spring, yielding grape-like small purple berries by fall. Oregon grape root was an important medicine for Native Americans and pioneers. Its usage was very extensive, from cleaning wounds and cuts to treating kidney problems, stomach troubles and rheumatism (Hart, 1976). Modern science has verified many of Oregon grape's medicinal properties which include antiseptic and antibacterial characteristics, a stimulant of involuntary muscles and a diuretic (Hart, 1976). Berries are also edible. Today, Indians and non-Indians make tasty jams and jellies from them.

Heartleaf arnica (Arnica cordifolia Hook.) is one of the most common and conspicuous flowers in the Rockies. It can be found in partially shaded areas of ponderosa pine and Douglas-fir forests and also at higher elevation of spruce-fir zone (Taylor, 1978). It is about 20 cm to 30 cm tall and has distinctive heart-shaped leaves. Flower heads are yellow, showy and sunflower-like, but much smaller in diameter (5 cm to 7 cm). Flowering season is in late spring and early summer. Heartleaf and other species of arnica have long history of medicinal use. The dried leaves can be ground into a powder and used as disinfectant. Fresh

leaves can be crushed and rubbed on sores for a similar effect (Taylor, 1978).

Southeast of the auditorium is relatively sunny and along the irrigation ditch, chokecherry (Prunus virginiana L.), serviceberry (Amelanchier alnifolia (Nutt.)Nutt.ex Roem.) and golden currant (Ribes aureum Pursh) may be planted. All three of these have showy flowers in spring and edible fruits in fall.

Chokecherry (Prunus virginiana L.) is a large shrub to a small tree with brilliant green leaves in spring, showy white blossoms in May, and purplish-red fruits in fall. It is deciduous and mostly found along creeks and ravines, but also in open wooded areas of valleys and foothills. Chokecherry was considered to be one of most important berry plants by Indian tribes of Montana. They sun-dried the berries and stored them for winter use (Hart, 1976). Pioneers and explorers also ate chokecherries. Birds love their berries also. Even today, chokecherries are widely used for making variety of jellies, wines, syrups, and jams. The seeds and leaves of chokecherry are mildly poisonous (Williams, 1974).

Serviceberry (Amelanchier alnifolia (Nutt.)Nutt.ex Roem) is a large shrub to small tree and , like chokecherry, is found mostly along stream banks and moist hillsides. Their long feathery racemes of white

flowers appear before the leaves, usually about the first week of May (Hart, 1976). They bloom before chokecherry (Williams, 1974). Their berries become ripe in July, so Sussex children will not be around to pick them. Fruits of serviceberry were used by Native Americans in a similar way to chokecherry. They also make excellent jams, jellies, pies, and wines as well as delicious addition to pancakes and muffins (Hart, 1976). Serviceberry is a favorite food source for a variety of wildlife species. Bear, grouse, birds, and other species eat the berries while elk, deer, moose and mountain sheep enjoy young stems and leaves (Hart, 1976).

Golden currant (Ribes aureum Pursh) also grows near streams and in foothills; however, this species is fairly drought tolerant according to Bitterroot Native Growers Inc.'s wholesale catalogue (1991), and is excellent for planting on disturbed areas. Golden currant has leaves shaped like a miniature maple and small tubular-shaped yellow flowers which bloom in the end of April to June. Sweet, yellow, edible fruits is ripe in August and September. They are also excellent for jams and jellies. Birds, black bears and rodents love the berries. Deer and elk browse its leaves when more appetizing food is not available (Williams, 1974).

If the native plant garden south of auditorium is

expanded, more drought tolerant native herbs may be planted. Having bitterroot (Lewisia rediviva Pursh) and buttercup (Ranunculus glaberrimus Hook.) there would be really attractive. Bitterroot is the state flower of Montana and buttercup blooms in March as the first noticeable wildflower in this area. But these attractive native herbs are not currently available through Bitterroot Native Growers Inc., and it is very difficult to transplant them from their native habitat. Most of wildflowers (herbs) available now through Bitterroot Native Growers Inc., which is the only nursery around here to sell native plants, bloom in summer when Sussex students are not on campus.

When I talked with Sussex students and recent graduates, many of them expressed their wish to have a picnic table in their backyard. This could be done if weeds in the open meadow are somewhat controlled. However, children play with these weeds, and also controlling weeds without using chemical herbicide requires manpower, which is not readily available at Sussex. Judging from the species of weeds growing at present, the moisture and shade conditions there is not as dry and sunny as native bunchgrasses would prefer. If the school decides to change the area, planting native field mint (Mentha arvensis L.), which was widely used by Native Americans for its fragrant and

germicidal properties, to replace the currently the growing weedy mint (Lamium species) and burdock (Arctium minus (Hill)Bernh.) is worth trying.

PART II SUSSEX SCHOOL BACKYARD NATURE AREA GUIDEBOOK

Fall



Yekko



FOX SQUIRREL (Sciurus niger)

When the weather becomes cooler and the daytime becomes shorter, you know that fall is approaching Missoula and school will start again soon. Guess who were waiting for you at Sussex all summer? The squirrels were. They live on the Sussex campus throughout the year. This is their home.

You know how they look, don't you? They are the ones with long bushy tails and cute round eyes. Do you know where their nests are? They live high up in the

silver maple trees, skyscraper apartments built at the forks or near the tops of the trees. It is difficult to find their nests during spring and summer, but when the maple leaves fall off, you will see them. They look like bird's nests, but are quite large. When you see squirrels coming in and out, you know for sure that those are their nests.

When the weather turns cold, some insects on the Sussex campus hibernate and some others lay their eggs and die. But, not squirrels! They keep themselves quite busy all through fall and prepare for cold and snowy winter. Staying active all winter except on extremely cold stormy days, squirrels have to collect enough food and store it before snow covers the ground. Because they love nuts and seeds, they collect maple seeds which are readily available and store them in little holes they make in the ground. One of these holes are called a "cache". Squirrels have an extremely good memory to recover their cache in winter. If the seed production of the maples is low on a particular year due to spring frost, squirrels face a hard winter.

There are many different kinds of squirrels in the world. Fox Squirrel (Sciurus niger) is the kind of squirrel living on Sussex campus. It is much bigger than red squirrel (Tamiasciurus hudsonicus) which lives

in many of the forests around here in western Montana.

The fox squirrel is not a native animal of Montana. The original home of the fox squirrel is in the eastern part of America. Then, how did they come to Sussex campus? A long time ago, people who were moving from the eastern states brought the animal and introduced them into the western states. Now, fox squirrels live in many city parks, on large estates and on school grounds in the western states including Montana. You will also see a lot of them living on University of Montana campus.

They do well where people are around, but they would not survive in the deep forests of the Rockies.



BURDOCK (Arctium minus (Hill) Bernh.)

What are burdocks good for? "Bur fights", some of you might say. When their flowers become dry, their seed-burs are so good at clinging to clothing and hair of people and fur of animals. When you try to pull them out, the burs break up and each small part has to be removed separately. Why does the burdock have these disagreeable characteristics? Because, in this way, the seeds can be carried around by animals and people,

so that they can become widespread. In fact, the burdock is widespread. This plant is a native of Europe and Asia, but is now very common on moist soil across North America.

By the way, the burdock does not have any flowers in its first year's growth. It is a "biennial" plant, meaning that they complete their life in 2 years. The first year's growth is a group of very large dull-green leaves that somewhat resemble those of rhubarb hugging the ground. During the second year, the plant shoots up as high as 1.8 meters with a stout stalk, many smaller leaves, and lavender-purple flowers which become the sticky seed-burs.

The entire plant of the burdock is "edible". Of course, it does not mean every part of the plant is "tasty". The most delicious part, if properly cooked, is the roots of the first year growth. They are so good, that farmers grow and people eat them in Europe and Asia as well as in the United States.

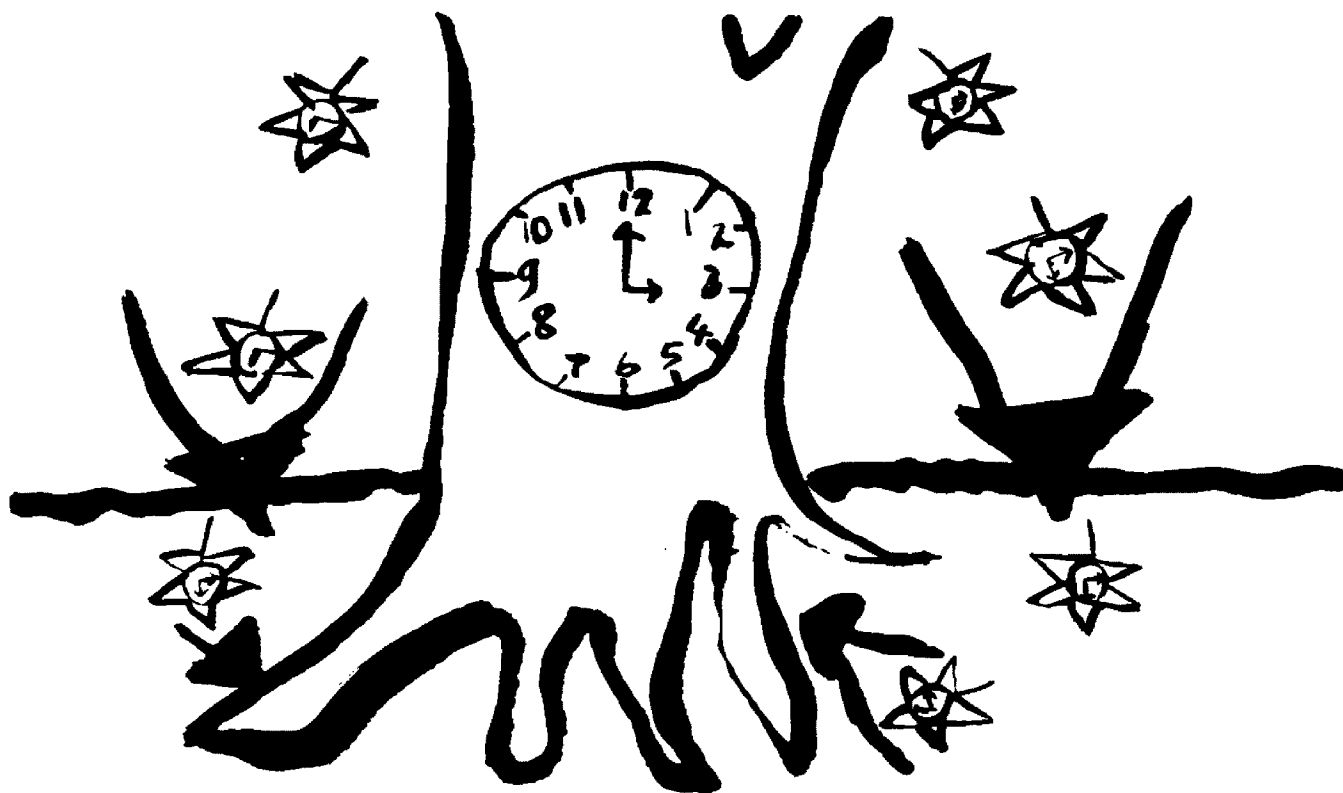
If you would like to try one recipe, here it is:

KINPIRA GOBO (Burdock roots stir-fry)

- * 1 cup burdock roots, washed, peeled, very thinly sliced and soaked in water for 1 hour.
- * 1 cup carrots, thinly sliced.
- * 1 tablespoon sesame seed oil.
- * 1/2 tablespoon soy sauce.

Heat oil in a wok or frying pan. Add burdock roots and carrots. Stir-fry for 5 minutes. Cover and cook for another 2 minutes. Add soy sauce. Stir to mix well. Serve on rice.

Burdock roots have also been used in herb medicine for hundreds of years. People boiled burdock roots in water and used that water to wash burns, wounds and skin troubles.



Silver Maple (Acer saccharinum L.)

Why do maple leaves turn yellow in fall? There are many silver maple trees on the Sussex campus, and they sure look pretty when leaves turn yellow. During spring and summer, when leaves were green, they worked so hard to convert sunlight into the food energy and supported the entire body of big maple trees. Maple leaves become yellow as the result of old age. When they become old, the green pigment disappears and make

them look yellow, red and orange. Without the green pigment, which is called chlorophyll, the leaves can no longer produce food. This means that the growing season of the maple trees is over. They will stand quietly until spring comes back again.

By the way, how do they know when the spring will come? Well, they can detect the time of the year fairly well from the length of daytime and change of temperature. You see, they are not dead during winter. They are quietly preparing for the spring.

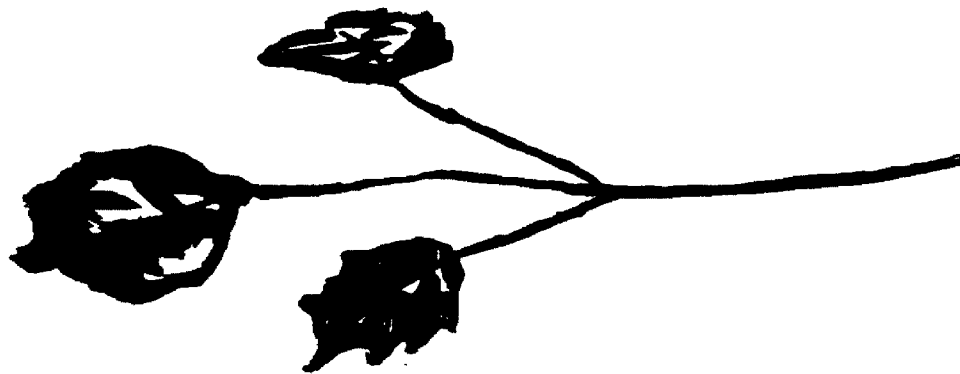
Unlike vegetables in gardens and fields, maple trees do not expect people to give them fertilizer. This is because they RECYCLE! Those beautiful yellow leaves gradually turn brown and die. Once they fall on the ground, bacteria and fungi will break them down and help them turn into soil. Soil is fed this way and this is why it can keep giving nutrients to trees. Nutrients are going around the circle.

Fall makes everybody a poet

This is a fun activity for people of all ages. It is best when played with 10 to 15 people. If there are less than 10 people to play, each person may pick three words instead of two.

If a particular word is chosen by several people, you can decide the number of times the word is used.

1. Go out to the backyard nature area.
2. spend 5 minutes thinking/feeling nature without talking to anybody, and pick two words that come to you.
3. Return to the classroom and writes those words in a small piece of paper.
4. Collect those words and write them up on the blackboard.
5. Discuss and decide how to arrange those words to make the best poem out of them.



Meet a tree

This is a game from a book called "Sharing Nature With Children" by Joseph Cornell. The book is full of fun nature games.

1. Pair off the group.
2. Blindfold your partner and lead him/her carefully to a tree that you choose.
3. Help your partner to explore his/her tree and feel its uniqueness.
4. Lead your partner back safely to where you began. You may take different route to return.
5. Remove the blindfold and let your partner try to find the tree with his/her eyes open.
6. Change the role and repeat.

Now, you have a special tree on the Sussex campus.

That's your tree.



FALL IN THE PATTEE CANYON AREA

- * Ponderosa pine (Pinus ponderosa Dougl.
ex laws)
- * Kinnikinnick (Arctostaphylos uva-ursi
(L.) Spreng.)
- * Wood rose (Rosa woodsii Lindl.)
- * Snowberry (Symphoricarpos albus (L.) Blake)



Ponderosa pine

Have you ever seen live pine trees with fire scars on them? There are many of them in the Pattee Canyon area. Ponderosa pine, with long needles and large cones with sharp prickles, are very long-lived, and mature trees have very thick, flaky barks. When the forest fire occurs, if the intensity is not too great, the bark protects the inside of the trees from being killed by the heat.

The majority of forest fires in this area are caused by lightning. Thanks to the fire fighters, most of them are stopped before spreading out to destroy

people's houses. But, before the early settlers started to live in the Missoula area (1870's), there was nobody to stop forest fires. So, if lightning started a forest fire, it did not stop without some natural cause (rain, stream, clearing from previous fire, etc.). Wild fire was a part of the natural system for thousands of years and, in fact, plants and animals here are well adapted to the wild fire.

Ponderosa pine prefers a sunny place and grows well on dry soil. Now, without frequent forest fires, many places in the Pattee Canyon became very crowded with trees and too dark for young ponderosa pine trees to grow up. In those places, more shade-tolerant Douglas-fir trees, with short needles and smaller cones, and often used as the Christmas trees, are gradually taking over.

Chipmunks, red squirrels and numerous birds love to eat the seeds of the ponderosa pine.

Native American people used the pitch of the ponderosa pine for many different purposes. Crow Indians used it as a glue, Nez Perce Indians used it as torches, and the Flathead Indians used it as medicine for rheumatism and backache.



Kinnikinnick

On a sunny day in the fall, if you have a chance to visit the picnic area in Pattee Canyon, you will be greeted by numerous bright red, roundish berries on the ground. These are the kinnikinnick berries. Kinnikinnick is also called bearberry.

Kinnikinnick forms a mat over the ground and its leaves stay green all winter. So, deer enjoy eating the leaves and twigs during fall and winter. The berries are eaten by rodents.

Have you ever tried to eat kinnikinnick berries yourself? They are rather dry and tasteless. Kutenai

Indians say that fried berries taste better. They put the berries in a frying pan with oil, hold it over a low fire, and let them pop like popcorn. Fried kinnikinnick berries are supposed to taste sweet and agreeable.



Wood rose

In the spring of 1991, students from the 5th and 6th grade science class planted wood rose seedlings (young plants) under the reading tree. They seem to like their new home, because they are doing well.

There are many, many wood roses in Pattee Canyon. In the fall, you will see them bearing red rose hips. Rose hip is the fruit of the rose bush. Surrounding the seeds is the edible pulp.

Rose hips are so nutritious, full of Vitamin C, Vitamin A, and carbohydrate. There is a story about a group of Canadian explorers in the early 1800's who lived on nothing but rose hips for almost a month!

Well, if you were lost in the wilderness, rose hips might save your life, too.

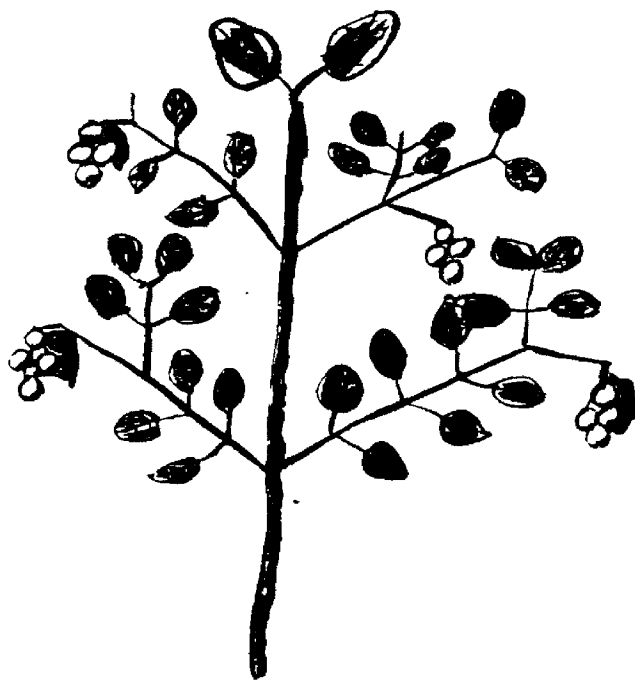
The following is a recipe of the rose hip tea from Kim Williams;

Rose hip tea

- * 1/2 cup fresh or frozen rose hips, washed and with blossom and stem ends removed.
- * 1 small piece of cinnamon stick.
- * 1 medium-size piece of orange peel.
- * 1 quart boiling water
- * honey to taste

Place rose hips in teapot and mash them with wooden spoon. Add the cinnamon stick and orange peel. Pour boiling water into the teapot and wait for 10 minutes. Pour through strainer into cups. use honey for sweetening. Makes 4 cups.

Kim Williams lived in Missoula for many years and wrote wonderful books on edible wild plants and nature conservation. You can read them at the Missoula Public Library.



Snowberry

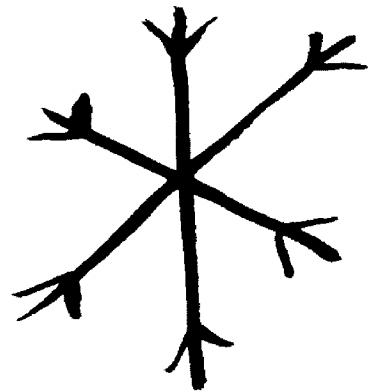
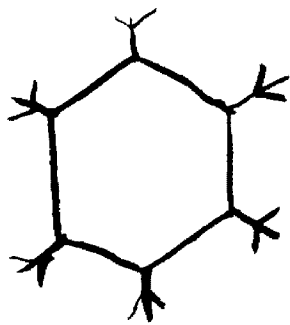
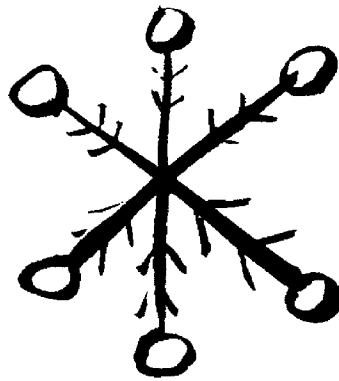
If you hike along the trails in the Pattee Canyon area in the fall, you may notice shrubs with lovely white round berries and oval-shaped thick green leaves. These are the snowberry shrubs. The snowberry is widespread in the forests around Missoula. Because it grows very well in shady places, 5/6 grade science students planted 5 seedlings (young plants) of snowberry near the reading tree in the spring of 1991.

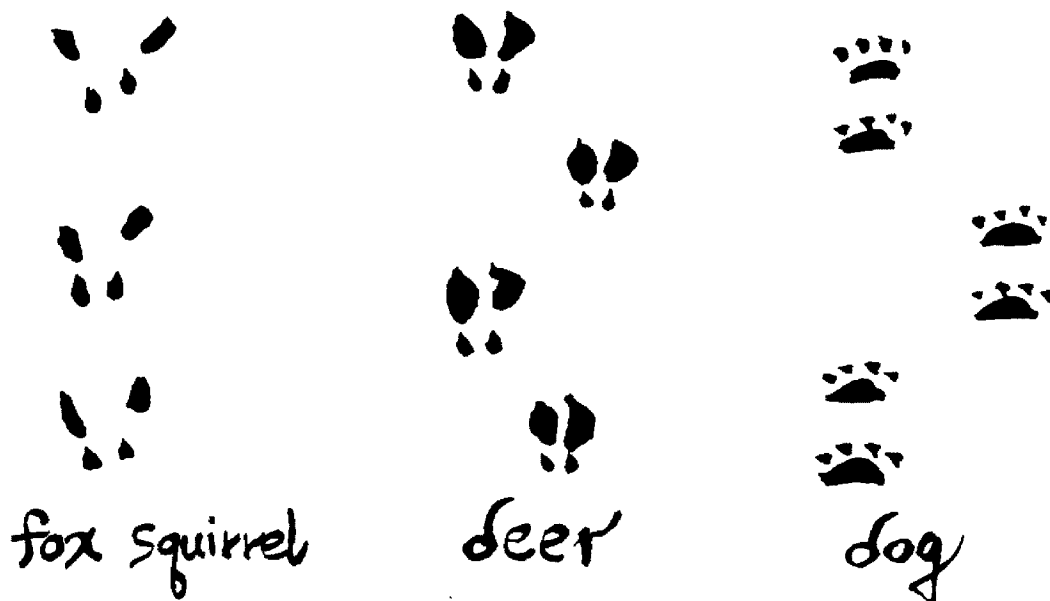
Snowberry is a native plant of Montana. Flathead Indians, for a long time, used mashed berries of snowberry as medicine for cuts and burns. They also made eye-wash from the bark of snowberry. Native American people of some other tribes made a brown tea from snowberry twigs.

Unfortunately, snowberry is not for people to eat. However, birds like to eat them and deer likes to eat their leaves.

Ripe berries of snowberry give a beautiful yellow color when used as a dyestuff. However, you need quite a lot of berries to dye a small amount of yarn or cloth, and you may want to leave those berries for the birds.

Winter





ANIMAL TRACKING

Animals leave footprints in the snow. The Native Americans, especially Inuit (eskimo) people have acquired a remarkable skill to read animal track on snow.

People don't have the ability of tracking animals by scent like dogs do. But, by learning to read animal tracks, we can find out the story left by the passage of animals.

Mike Jimenez, a wildlife biologist for the state of Montana, works hard to protect wild animals in the state. Some of you may have already heard his lecture. He reads and follows animal tracks in the snow and does

a lot of outdoor work during winter.

Once when Mike was following the track of a mountain lion, he realized that the tracks were going around a circle and the mountain lion was also following his tracks! The mountain lion is a very curious and also intelligent animal.

On the Sussex campus, tracks of fox squirrels and dogs can often be found after a snow fall. Once your eyes become alert, you will begin to notice them.

If you have an opportunity to visit the Rattlesnake Recreational Area, take your cross country skis and go up straight the Sawmill gulch. Soon you will reach a large open area (meadow). There, you will have a good chance of finding deer and elk tracks before people cover them with their ski tracks.

Remember! A perfect track is hard to find. Besides, after the sun has shone on it, a track in snow becomes enlarged and distorted. So, just as a detective, you have to use your imagination to interpret the evidence.

When you find a good track, there is a nice way to preserve it.

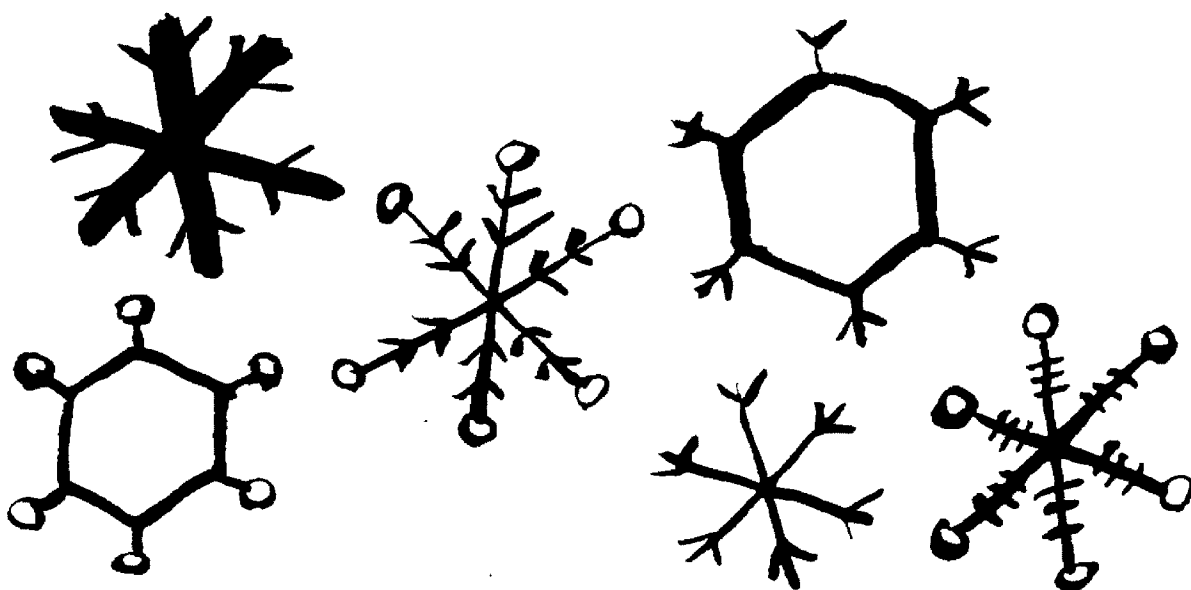
The following is the way that Mike preserves the animal tracks he finds out in the field:

Animal track cast

1. Spray "snow-print wax" into the track.
2. Let it dry for 10 minutes.
3. If the snow is wet, repeat the spraying and drying to form two layers of wax over the track.
4. Mix water and the Plaster of Paris in a can.
5. Pour the mixture into the track.
6. Wait for 10 minutes or longer to allow mixture to set hard.

Without the help of the snow-print wax, it is very difficult to make a cast before the track melts. This product can be purchased from the Kinder Print Company, P.O.Box 16, Martinez, CA, 94553 (1-800-227--6020).

If you would like to learn more about animal tracks, " A Field Guide to Animal Tracks" by Olaus Murie (Peterson field guide series, Houghton Mifflin Company) is a good reference book.



SNOW CRYSTALS

The study of snow crystals has fascinated scientists for a long time. The scientists on the ground can learn a great deal about the condition of the cloud high above where the snow crystals were formed and the process of falling to the ground, by carefully looking at the shapes of the snow crystals.

Snow crystals have numerous beautiful shapes and artists have used the designs as inspiration for cut-out works and art works.

It is easy to begin the study of snow crystals. On a snowy day, go out and catch a snowflake on a piece of black paper. Then, examine it with a magnifying glass.

Sketch each crystal in your notebook. It is also a good idea to write down the date of the observation and temperature.

You have to do this all outside. Otherwise, the snow crystals will melt quickly before you can sketch them.

Compare your sketch with your friends, and you will notice that there are many different shapes of snow crystals.

Snow crystals are formed when the molecules of water vapor are attracted to dust particles or some other small particles in the super-cooled clouds.

The basic shape of a snow crystal is determined by the temperature at which it was formed and the availability of water vapor in the cloud.

A snowflake grows by sweeping up snow crystals while falling through a cloud. Each snowflake is a collection of thousands of snow crystals. Maximum snowflake size occurs near the freezing point. Above this temperature, snowflakes start to melt. Generally, the lower the temperature, the dryer the snow.

Wet snow is sticky and heavy. Dry snow is fluffy because of all of the air spaces between the snow crystals.



SNOW SCULPTURE

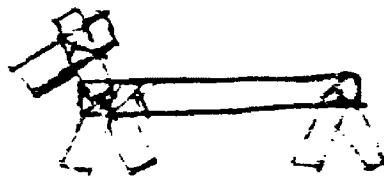
Attention artists!!

When the snow is deep and weather forecast predicts that the below-freezing temperature will continue for a few days, that is the best time for you to dress warmly, go outside, and construct a snow sculpture. Don't forget to put on your mittens.

To do this, you need;

1. Snow.
2. Water.
3. Water sprayer for indoor plants or ironing.
4. Boards, boxes, or sticks.
5. Wire.
6. Spoon.
7. Knife.

Unless you want to make something very small, it is best to make a framework first. The framework can be constructed from boards, sticks, or boxes and securely held together by wire.



The framework can be constructed indoors, but once it is finished, you need to take it outside and freeze it. You can do so by spraying water and leaving it outside for a few hours.

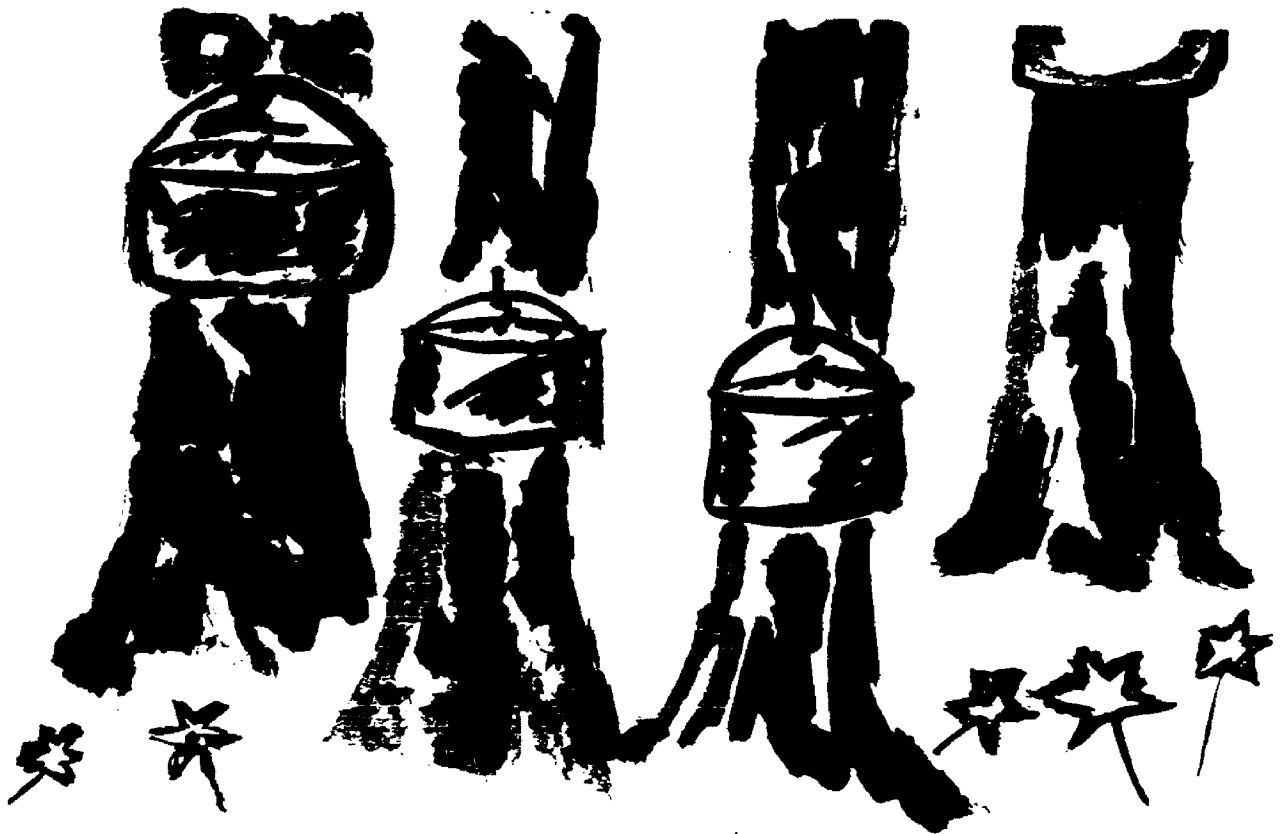
After the framework has been frozen, snow slush has to be made. It can be made in a depression on the ground or in pails. Mix snow and water until an icy slush is formed.

Snow slush is easy to work with, but it freezes quickly, so the work has to be done before it hardens. Pour the slush around the framework, and shape the slush roughly before it sets and freezes.

You can add the final touch by carving the

sculpture with a spoon and knife.

After the carving is finished, it is best to spray with water. It helps to prevent the sculpture from melting too quickly.



MAPLE SYRUP, MAPLE SUGAR

True maple syrup on pancakes! What a nice flavor.

Native American people have been making syrup and sugar from the sap of certain trees for a long, long time. When the first English colonists learned from the Native Americans how to make them, it was long before commercial sugar became available. So, even the famous English scientist Robert Boyle (have you heard about the Boyle's law? It was he who found the relationship among pressure, temperature, and density of gas) was very much impressed when he learned about

the method from people who had returned from the New World. He even made an announcement to the scholars of Europe about maple syrup making as a major " scientific discovery".

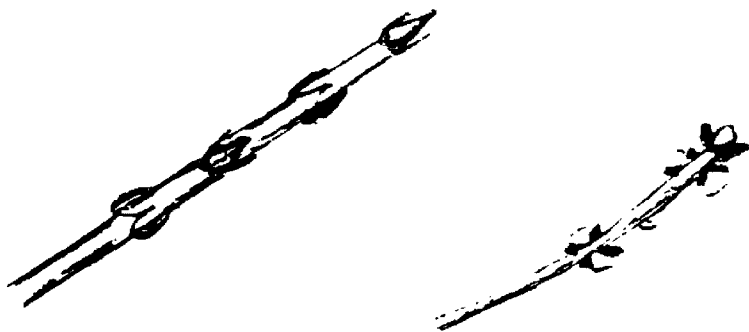
Maple syrup and sugar are made by tapping the trees in late winter before the buds begin to swell. The sap is collected and boiled until it reaches the proper consistency.

Native American people have been making maple syrup and sugar since long before they began using metallic pots and pans. Then, how could they boil down the sap? Well, after collecting the sap in buckets made of birch bark, they poured it into a trough made from the hollowed-out section of a tree trunk, and boiled it down by putting heated rocks into the trough. Another method they used was to let the sap freeze overnight and throw away the ice which was separated from the syrup.

Sugar maple (Acer Saccharum Marsh.) is the kind of maple tree whose sap is used for the maple syrup you buy at stores. Silver maple (Acer saccharinum L.)----- the maple trees on Sussex campus----- has sap which yields a good quality of syrup and sugar, but has a lower sugar content than the sugar maple. Sugar maple and silver maple have very similar Latin names. "Acer" means maple in Latin. "saccharum" means sugar and

"saccharinum" means sugary or sweet.

Box elder (Acer negundo L.) is also a maple tree. It does not have leaves shaped like hands, but if you see their V-shaped fruits with wings, they do look similar to fruits of silver maple. There are many box elder trees in the Sussex backyard. Native American people of eastern Montana as well as pioneers tapped a sweet syrup from box elder trees. Box elder is a native plant of eastern part of the United States all the way to the eastern Montana.

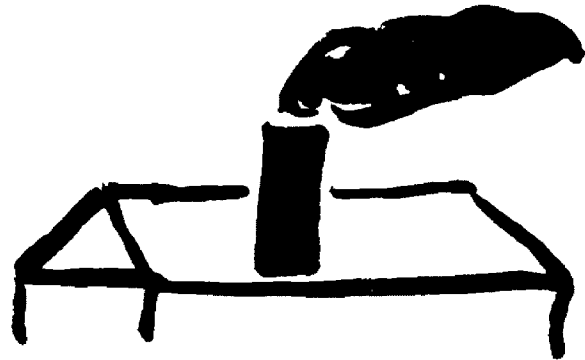


TREES IN WINTER

After the leaves have all fallen off the trees, you can see the basic structure of the trees very well. Different kinds of trees have different ways of extending their branches.

During winter, most of trees on the Sussex campus are "dormant", meaning that they are not active. But being dormant does not mean that they are just standing there without doing anything. Trees are preparing for the spring to come.

As early as late January or early February, if you go close to one of the silver maple trees on the campus, you will see their buds on the twigs. You will see both flower buds and leaf buds. Flower buds are slightly reddish and turn greenish-yellow later in the season. Leaf buds are paired on opposite sides of stems. All of the buds stay hard until spring arrives.



AIR POLLUTION

Winter life in the Missoula Valley could be much more enjoyable if there were no air pollution.

Unfortunately, the air quality in Missoula area on a cold winter morning is often so bad that the amount of small particulate in the air is considered unhealthy.

Why is the air pollution problem in the Missoula Valley so serious during winter?

One reason is the residential wood burning. Over 50 percent of winter time air pollution in the Missoula Valley, according to the Missoula City-County Health Department, is caused by the use of fireplaces and wood stoves. Wood smoke contains very small particulate matter which can be directly taken into the lungs.

Another reason is the temperature inversion.

During nights in the winter, the ground becomes very cold and the air near the ground surface becomes colder than the air at higher elevations. The temperature inversion is a layer of air of increasing temperature with height. When it is created in the Missoula Valley, pollution caused near the ground level stays near the ground where people live, until the ground warms up and the air near the ground also warms up, and then moves upward. Strong winds also can move the polluted air away, but during the winter in the Missoula Valley, the strong inversions are common and the strong winds are not.

The residential wood burning is the number one cause of the air pollution during winter. Please remember; the less you burn wood, the better air quality you will have.

During the winter and also rest of the year, driving less, using the buses, and car pooling help reduce the air pollution.

For the observation, dust samples can be collected by placing outside a filter paper with vasoline coating on it.

Spring





Dandelion (Taraxacum officinale Weber)

Some people cannot stand having dandelions in their gardens and lawns. They work hard pulling them out, or, spraying them with chemical herbicides (weed-killer).

Dandelion is one of the typical plants called "weeds". It grows rapidly, produces a lot of seeds, and crowds out other plants.

Weeds are uninvited guests in the human habitat. Once Ralph Waldo Emerson said that " a weed is a plant whose virtues have not yet been discovered".

Dandelion may not have been invited to lawns and gardens of people today, however, its virtues have been known for hundreds of years. In fact, the botanical name (Latin name) of dandelion, Taraxacum officinale means the officially recognized medicinal plant.

Before the greenhouse was invented and the transportation system developed, unless you lived in the tropic region, fresh vegetables and fruits were not available in winter. Back in those days, many people became ill during late winter and early spring. So, oldtime herb doctors gave their patients the juice from freshly dug dandelion roots. They also told the patients to eat dandelion leaves as soon as they were out.

Dandelion is extremely rich in vitamins and minerals. All parts of dandelion, including the flowers and roots, are edible. The leaves are somewhat bitter, the flowers sweet, and roots make the famous "dandelion coffee". There are many dandelion recipes you can experiment with. When you try, PLEASE BE SURE TO PICK DANDELIONS WHERE NOBODY HAS SPRAYED WITH HERBICIDES.

Dandelion is also one of the best food sources for wildlife. The flowers and leaves are a favorite spring and summer food of Canada geese, elk, deer, black and grizzly bears, porcupines and many others.

Here are some recipes: Again, PLEASE MAKE SURE NOBODY HAS SPRAYED WITH HERBICIDES BEFORE YOU PICK ANY WILD PLANTS TO EAT.

Dandelion pancakes

- * Pancake mix of your choice
- * Dandelion flowers, washed with stems removed (flowers are sweet, but stems are bitter).

Follow the directions of your pancake mix.

Drop one flower on top of each pancake as it is cooking on the griddle. Once you have tried and liked them, you can add more flowers to each pancake.

Dandelion sandwich

- * Dandelion leaves gathered before the flowers open (older leaves are very bitter!)
- * Bread
- * Butter

Put butter on a piece of bread. Place washed dandelion leaves on the buttered piece of bread and cover with another bread also with butter on it.

Dandelion fritters

- * 2 eggs, well beaten
- * 1 teaspoon baking powder
- * 1 cup flour
- * 2/3 cup milk
- * Oil for deep frying
- * 4 cups dandelion flower heads

Beat eggs and add milk. In a separate bowl, mix flour and baking powder. Slowly add dry ingredients to eggs and milk. Heat oil in a saucepan until batter sizzles when dripped in. Drop dandelion flowers in batter and fry until golden brown.

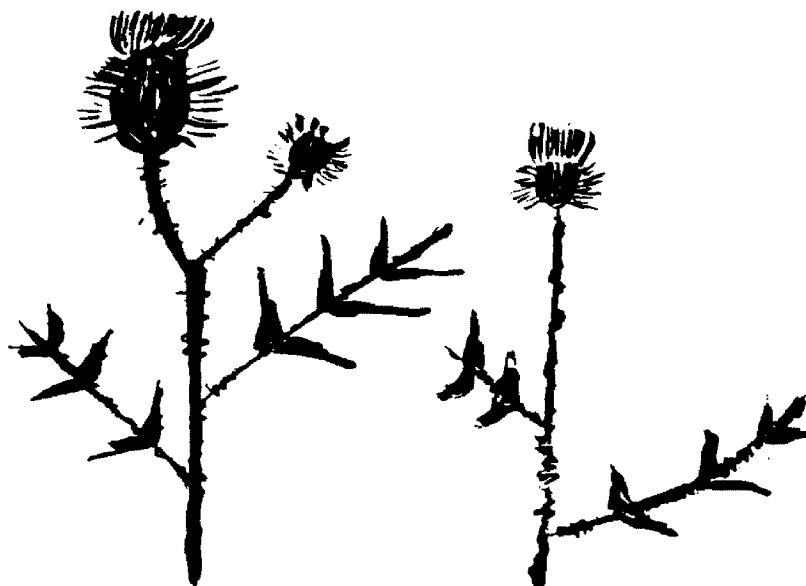
Dandelion root coffee

- * Dandelion roots (5 or more)
 - * cream
 - * sugar
1. Scrape off as much outer skin as possible from the dandelion roots.
 2. Place roots on a cookie sheet and dry in a

low oven (200 to 300F) until brown and brittle (about 2 hours).

3. Grind the dry roots in a coffee-bean grinder or food chopper.
4. Bring 3 cups of water to a boil.
5. Add 2 teaspoons ground dandelion roots and boil for 10 minutes.
6. Strain into cup.
7. Lace with cream and sugar.

This is a healthy drink without caffeine.



Bull Thistle (Cirsium vulgare (Savi) Tenore)

Bull thistle, also called common thistle, is another weedy plant you can easily find on the Sussex campus. If you have not noticed, it may be because the purple flowers of the thistles usually do not appear until summer.

Thistles are easy to identify because the leaves and stems are spiny all over. There are many different thistles besides the bull thistle, but they all have spiny leaves and stems.

It is helpful to remember that thistles are edible. Some thistles are tasty and some are not, but none are poisonous. If you ever get lost in wilderness, there is a good chance that you will find some thistles to eat. Although the bull thistle is an introduced

plant from Eurasia, there are about 20 different kinds of native thistles in Rocky Mountains.

Easy way to prepare thistles is to peel and chop the stems and make a salad. Kim Williams recommended it as a camp food to replace your usual celery.

The Native American people used to eat elk thistle (Cirsium foliosum (Hook.) DC.). They ate both roots and stems, cooked or uncooked. Peeled stems of the elk thistle are said to be tender and sweet. Roots of elk thistle are so nutritious that Truman Everts, a member of an expedition team in 1870, survived in area of Yellowstone National Park by eating only the roots of the elk thistle for a month. After he was lost and his glasses were broken, he was too nearsighted to look for food, but luckily, elk thistle was around and he had kept eating the roots until he was rescued.

Being spiny and aggressive, thistles are uninvited guests in most gardens and farms. But their flowers are very attractive and produce large amounts of nectar and pollen, food for a variety of insects such as butterflies and bees. Because thistles bloom in middle to late summer when the flowers of most plants have withered away, butterflies and bees gladly come to thistle flowers to have dinner and help with pollination.



Pineapple Weed

Pineapple weed (Matricaria matricarioides (Less.)
Porter)

If you find small, cone-shaped, yellow-green flowers with a very nice sweet fragrance on Sussex campus, most likely, it is pineapple weed. Pineapple weed has delicate and fern-like leaves.

This plant is called pineapple "weed", but unlike many other plants called a "weed", this plant is a native of the Northwestern part of North America (including western Montana). It has an unusual ability to grow after being repeatedly trampled and is often seen along hiking trails.

Some people think it smells more like a pineapple. Some other people think it smells like an apple.

Anyway, Native Americans liked the fragrance very much and used it as a perfume. Kutenai Indians dried the leaves and placed them in a little pouch to concentrate the aroma. Some other Indians stuffed their pillows with it. Flathead Indians made tea from pineapple weed and drank it for cold, upset stomach and diarrhea.

Pineapple weed has also been known to work as a natural food preservative. Flathead Indians dried and powdered the leaves, then sprinkled it over dried meat or berries in alternative layers. Before the refrigerator and freezer were invented, protecting food from spoilage was difficult work. Sun-drying alone did not always protect the food from spoilage.

If you like herb tea, pineapple weed is an excellent substitute for chamomile.

Sun tea

- * 1 cup dried pineapple weed flowers
- * Honey

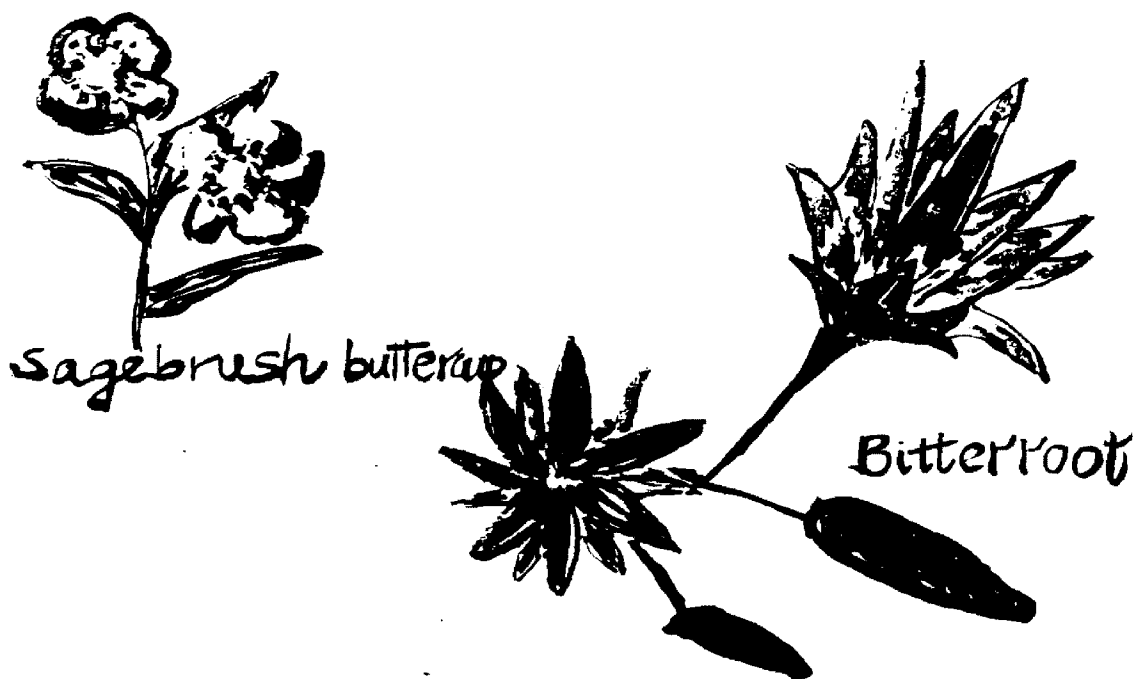
Place dried pineapple weed flowers in 1 gallon clear glass jar.

Fill the jar with cold water.

Cover jar and set in sun for 8 hours.

Cool.

Sweeten with honey.



SPRING EPHEMERALS

As early as the latter part of March, the sagebrush buttercup (Ranunculus glaberrimus Hook) blooms in the Missoula Valley bottomland. This is the first showy wildflower to greet you and let you know that spring has come. The sagebrush buttercup has bright shiny yellow petals and often found in the meadows, sagebrush flats and stream banks.

In April, May and June, there are a variety of beautiful spring ephemerals blooming in this valley. Spring ephemerals are the plants that grow only when the temperature is mild and the soil is moist. These plants produce seeds well before the arrival of the hot and dry summer.

Bitterroot (Lewisia rediviva Pursh) is the state flower of Montana. The white to pinkish flowers are very showy and about 5 centimeters (2 inches) across. The stem is very short and the leaves wither before the flowers bloom. The Bitterroot River, Bitterroot Valley, and Bitterroot Mountains were named after this plant.

Captain Meriwether Lewis of the Lewis and Clark expedition collected the bitterroot in 1806 under the instructions of the President Jefferson to collect information about Indian food plants. The bitterroot collected near Missoula was sent to the east coast by horseback, boat, and stagecoach. Frederich Pursh, a famous British botanist, examined and scientifically named it as Lewisia rediviva, in honor of the Captain Lewis. Rediviva means brought to life.

The starchy root of the bitterroot was a very important food source for the Flathead Indians. They boiled bitterroots in watertight baskets by dropping very hot rocks into the water. Missoula had been historically one of the best places for Flathead Indians to gather the bitterroot. Because the number of people living in the area had increased and extensive areas of the bottomland had been developed, today, you have to look carefully on sunny slopes, ridges, and mountain summits to find the bitterroot.



Glacier
lily



Shootingstar

Glacier lily (Erythronium grandiflorum Pursh) is a small yellow lily that is often found along river banks, on mountain slopes and in meadows. Near the town of Missoula, nodding flowers bloom in April and May. But if you climb up mountain slopes, you may find them blooming in June and July. The green pods of the glacier lily are eaten by deer, elk and bighorn sheep.

Shootingstar (Dodecatheon pauciflorum (Dur.) Greene) has rose-purple backward-flaring petals and forward-projecting stamens. Its "shooting star" like appearance is very noticeable if you happen to walk by. The flowers bloom from late April through July. This plant also is a favorite food source of elk and deer, especially in early spring when green forage is still not abundant.



BIRD WATCHING

Spring is the best time to start bird watching, because many birds that had flown away to avoid the cold weather migrate back to Missoula in the spring.

Everyone has seen birds. The birds are the most familiar wildlife to most of us. Probably everyone can identify the common crow, that is completely black, and has a loud voice of "caw, cah, cahr". The reason why everyone knows the crow is because repeated observation of the same bird give you a familiarity with it.

Increasing the number of the birds that are

familiar to you is like making new friends. It is strange but true that if you learn the name of a particular bird, you develop an intimacy with it. Once a bird becomes familiar to you, you do not have to scrutinize closely to name it.

The easiest way to learn the names of the birds is to accompany someone who already knows. The best way to learn from an expert is to observe the significant characteristics of the birds together and go through a field guidebook with the expert.

Color and markings are the easiest characteristics to observe. The color of different part of a bird such as head, throat, breast, and wing are important. Markings such as lines on heads, rings around the eyes, stripes and spots are described in the field guidebook.

Remember that male and female birds of the same kind often differ in appearances.

The size and shape of the bird and where you normally find it is also important.

Each kind of bird has distinctive songs or calls. Especially the birds that are difficult to identify from the color are often easier to distinguish by the songs and calls.

From the early spring to the fall, the robin is probably the most easily identified bird in the Missoula Valley. The bird is often seen on the Sussex

campus. The robin is also found in residential areas, farmland, open forest, streamsides, and the university campus. It is recognized by its gray back and orange breast with clear singing voice of rising and falling.

It is not as abundant as the robin, but if you pay attention, you may see the western bluebird on the Sussex campus or near your home in spring and summer. It is a little larger than the house sparrow, but smaller than the robin. Its head, wings and tail are blue and breast and back are rusty red. Its voice is a short "pew" or "mew".

The smaller birds, if their color and markings are not conspicuous, are harder to identify. You need to look carefully and hear their voices.

The black-capped chickadee is often observed throughout the year in Missoula. It is smaller than the house sparrow and patterned with the solid black cap, black bib, white cheeks, and gray back. In spring, the voice is a clear whistle of "fee-bee". Rest of the year, the voice is clearly heard as "chick-a-dee-dee-dee".

The house finch is near the size of the house sparrow. It is also observed throughout the year in Missoula. It is brownish with bright red breast, forehead, and rump. It sings lengthy musical songs.

All the birds described so far are the common

birds around Sussex campus. If you live on a farm or a ranch, you may see some other birds, such as the black-billed magpie more often. Meadow lark, the state bird of Montana, also lives where there are open fields. If you go to the Maclay Flat or Lee Metcalf National Wildlife Refuge with the field guidebook, you will be able to identify a variety of birds that are not found around the town.

There are several different field guidebooks that describe the birds of this area. Probably the most popular one is "A Field Guide to Western Birds", Peterson field guide series, Houghton Mifflin Company, by Roger Troy Peterson.



Silver maples (Acer saccharinum L.) in spring

In the middle or late April, flowers of the silver maple trees on the Sussex campus bloom in clusters. Soon after that, young leaves come out.

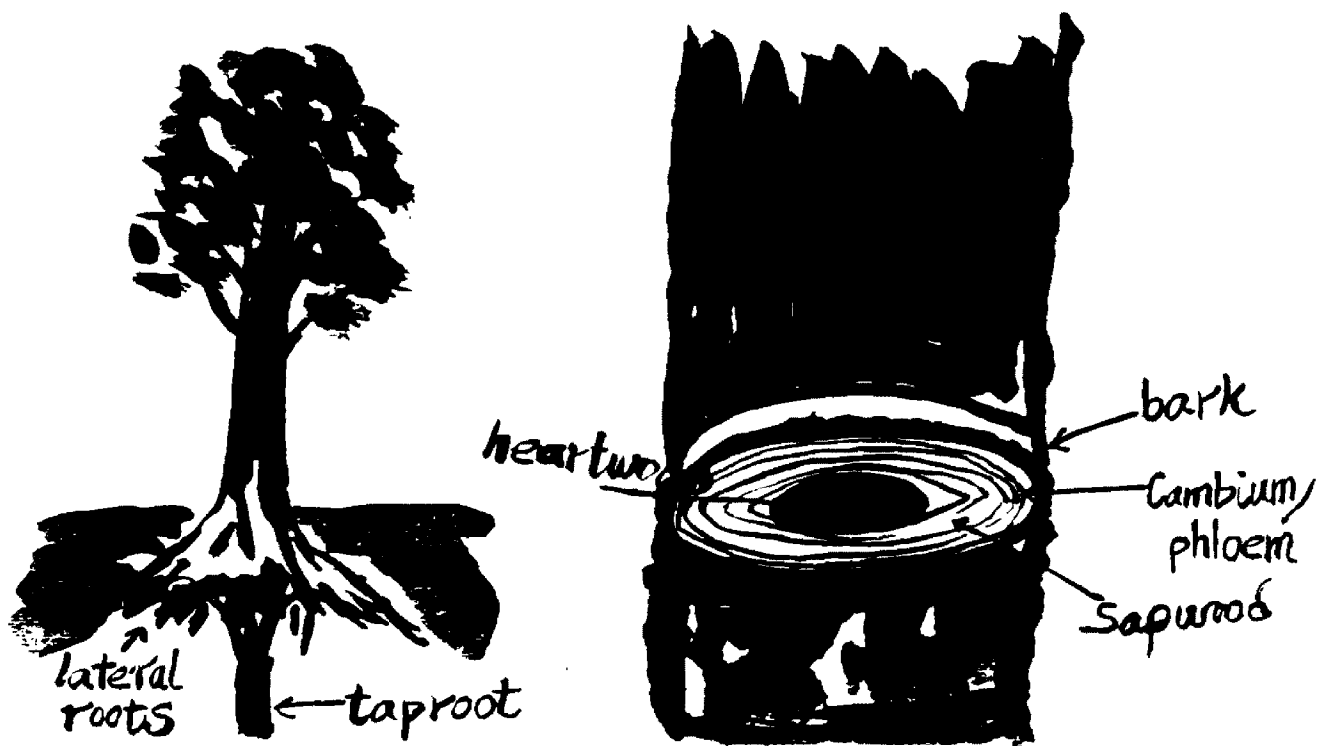
The fruits of the silver maples also mature in the spring. Because the silver maples produce abundant fruits, you will easily notice when they have fallen on the ground. The fruits of any kind of maple tree are borne in pairs. The seed-bearing portions at the base are connected and each one is tipped with a long wing. These fruits are called "keys". Fox squirrels love to eat the seeds out of the keys.

Have you ever wondered the reason why people planted the silver maple trees around the edge of the property? Today's Sussex school was a farmhouse and

built in the late nineteenth century. Probably those trees are about one hundred years. It may sound old to be one hundred years old, but if you compare the size with some pine trees of similar age in Montana, these maple trees are truly large. Because the silver maple grows rapidly and becomes large, it has been popular as the shade tree. People planted silver maples to have shade during hot summer. Although it is a native plant of the eastern North America, it has been cultivated in the West for a long time to serve this purpose.

Along the streets in Missoula and many other cities, Norway maple (Acer platanoides L.) trees have been planted extensively. The Norway maple, another kind of tree in the maple family, is a native of Europe from Norway to Caucasus and Turkey. It also grows rapidly and has been used as a shade tree, but is much more famous as a street tree. Norway maple is remarkably tolerant of road dust and city smoke.

Mountain maple (Acer glabrum Torr.) is the native maple tree of western Montana. It is a slender tree and has reddish-brown twigs. You will find them in nearby forests. The leaves and young shoots of the mountain maple are eaten by deer and elk.



BUILD A TREE

This game is from the book called "Sharing the joy of nature" by Joseph Cornell. It had been a popular game for both children and adults and used by many nature centers around the world.

In this game, people act out the various parts of a tree: the taproot, lateral roots, heartwood, sapwood, phloem/cambium, and bark. So, you need at least 6 people to play. It is more fun to play this game with many people.

Heartwood: inner core of the tree. It is not active anymore. Its job is to stand tall and strong. Players of the heartwood stand in the center.

Taproot: long vertical root. It enables the tree to get water from deep in the earth and also anchor the tree firmly to the ground. Players should sit down at the base of the heartwood (not all trees have the taproot, but let's imagine that this one does!).

Lateral roots: laterally growing roots that are covered with root hairs. They also hold the tree upright. Players lie on their backs with their bodies extending away from the tree.

*** When being asked to slurp, both taproot and lateral roots players make a loud slurping noise.

Sapwood: water pump of the tree. It draws water up from the roots and lifts it to the top of the tree. Players form a complete circle around the heartwood, facing inward and holding hands.

*** When being asked to bring the water up, the players of the sapwood make a noise "wheeeee!" and throw arms up into the air. Be careful not to step on any roots!!

Cambium/Phloem: The cambium is the growing part of the tree and the phloem carries food made by the leaves to the rest of the tree. Players form a circle around the sapwood, facing inward and holding hands. Toward the inside of the circle is the cambium. Toward the outside is the phloem.

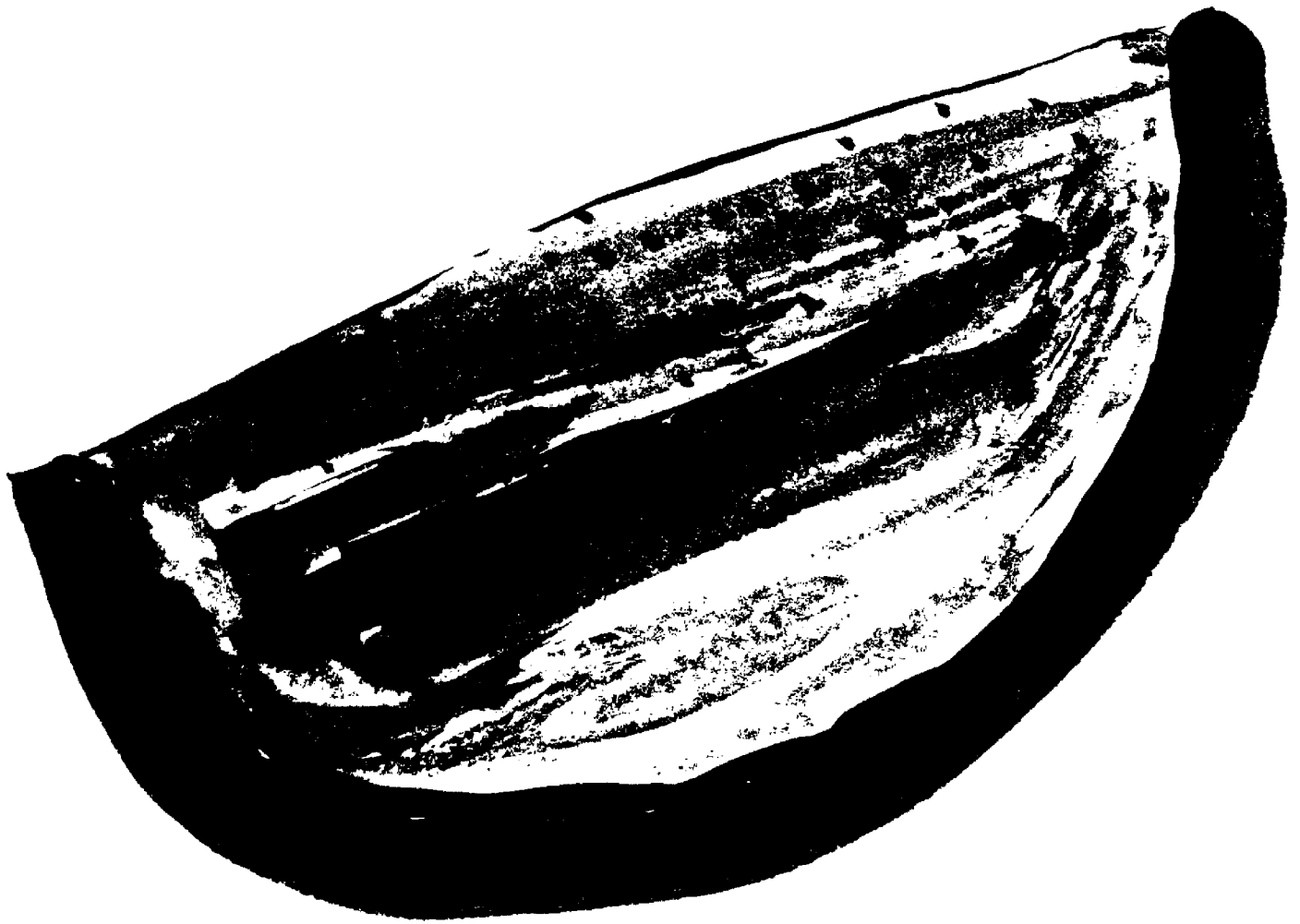
*** When being asked to make food, players raise their arms, flutter the hands (supposedly leaves), absorb the

energy from the sun and make food.

Bark: outer surface of the tree. It protects the tree from fire, insects, and extreme change of temperature. Players form a circle around the tree, facing outward.

Observer of the game (teachers or parents) will say "stand tall and strong, heartwood", "get tough, bark", "let's slurp, roots", "let's make food, leaves", "bring the water up, roots", Phloem, bring the food down", etc. Players have to respond correctly.

Summer





MICROENVIRONMENT

The word "micro" means small. So, the microenvironment is the small environment. It is the environment that directly influences the life of a plant or an animal.

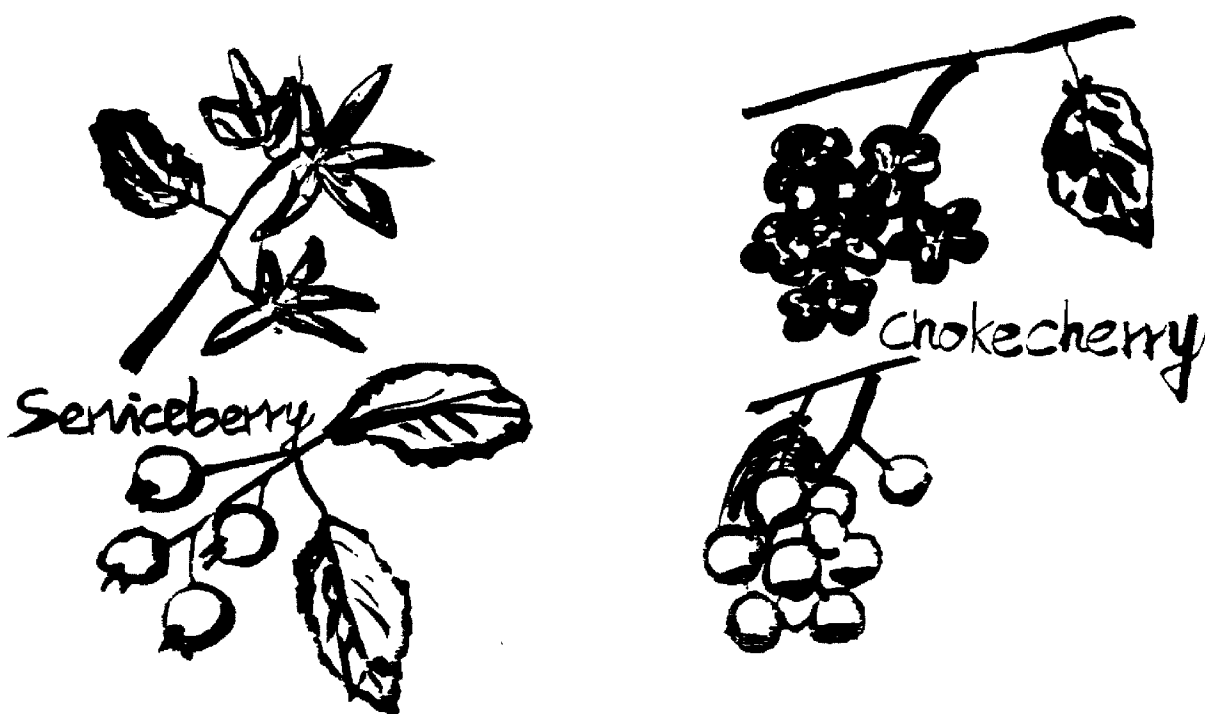
Some plants are very choosy about their microenvironment and some other plants tolerate a wide range of it. But every plant has its own range of tolerable microenvironments.

Certainly not all plants can tolerate the microenvironment under the reading tree on the Sussex campus. The leaves of the big tree make such good shade that the intensity of light under the tree is very low during summer. Snowberries and wild roses grow in very shaded areas and so does burdocks. But it seems too shady for such common weeds in Missoula such as spotted knapweed (Centaurea maculosa lam.) and tansy (Tanacetum vulgare L.) to move in and start growing.

The microenvironment can change greatly within a short distance. For example, south and west of the

auditorium on the Sussex campus are much sunnier than north of the auditorium. Plants growing in those places are fairly different from those of the shaded areas.

When you compare the plants on the western and northern slopes of the Mt. Sentinel, the difference is even more noticeable. The western slope (the slope with the "M" sign on it) receives long hours of direct sun light while the northern slope (the slope facing East Missoula) doesn't. In the spring, snow melts slowly and the ground stays moist on the northern slope while the ground of the western slope becomes fairly dry in summer. The result of the difference in the microenvironment is the coniferous forest and moss-covered ground on the northern slope and the grassland with sparse shrubs on the western slope.



SERVICEBERRY AND CHOKECHERRY

Serviceberry (Amelanchier alnifolia Nutt.) and chokecherry (Prunus virginiana L.) are very common shrubs in Missoula and the rest of the western Montana. Serviceberry flowers are white, have five narrow petals, and beautiful. They bloom in April or early May. Chokecherry flowers are also white and bloom right after serviceberry. Some gullies on Mt. Sentinel in early spring are full of fragrant serviceberry flowers.

For the Native Americans in the Northwest, fruits of serviceberry and chokecherry had been the most important berry crops. They gathered and sun-dried the

berries in summer and stored them for winter use. Both serviceberry and chokecherry were used as the basic ingredients for pemmican. In order to make a pemmican, they pounded the berries with dried buffalo meat and mixed them with fat to form little cakes. The pemmican was a staple food for the Native Americans of the Northwest.

The fruits of the serviceberry are ripe in July and can be eaten fresh. The fruits of the chokecherry are ripe in August and unlike serviceberry fruits, fresh chokecherry fruits have severe taste to humans, as its name suggests, and mildly poisonous. Cooking or sun-drying make the toxic substance harmless.

Today, the fruits of both serviceberry and chokecherry are used to make pies, puddings, jams, jellies, and wines. They are also favorite food source for birds, bears, and chipmunks. The young stems and leaves of the serviceberry are eaten by elk, deer, moose and mountain sheep. Chokecherry twigs and leaves are also eaten by wildlife; however, eating large quantities of the young leaves, which are poisonous, have killed livestock.



SPOTTED KNAPWEED AND TANSY

Spotted knapweed (*Centaurea maculosa* Lam.) and tansy (*Tanacetum vulgare* L.) are very common weeds in the open spaces around Missoula and the rest of western Montana. Although the Sussex campus has not been invaded by these plants, you will see them along roadsides and trailsides (even in Wilderness) and in fields, grasslands and pastures. The spotted knapweed has lavender-purple knob-like flowers, and tansy has numerous flat-topped small yellow flowers.

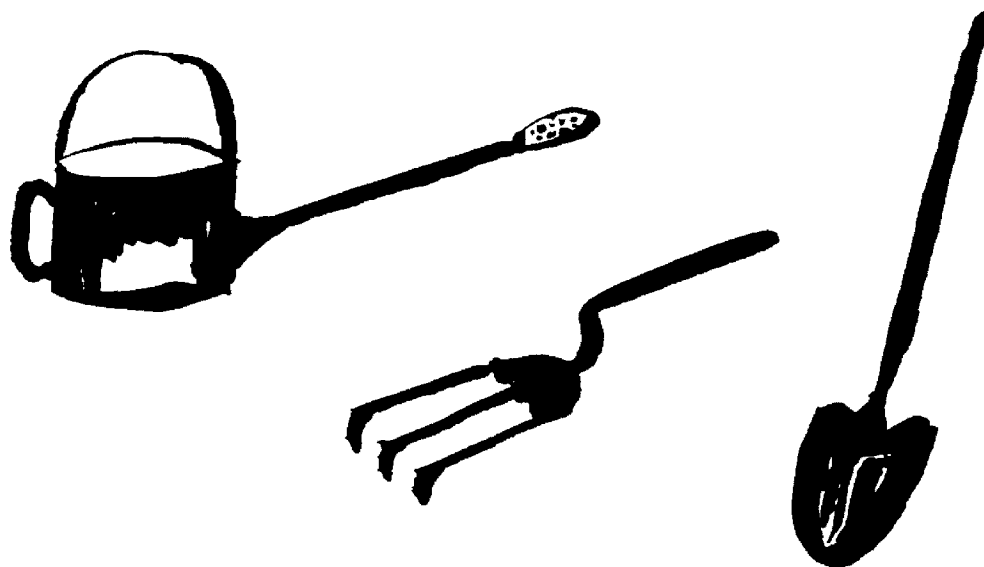
These two plants have something in common. Both of them came from Europe. Neither of them make a good food source for livestock and wildlife of this region.

Both of them have rather attractive flowers.

Once the seeds of the spotted knapweed are brought into a place and the plant starts growing, often it takes over and dominates the place. It is because the basal leaves of the spotted knapweed produce special chemicals that make it difficult for other plants to grow. This is especially troublesome for wild animals that depend on native plants as their food source.

Tansy has long been used in Europe as a medicinal plant to treat rheumatism. However, this plant is mildly poisonous and an overdose can be even fatal. So, it is safe to avoid eating any parts of this plant.

Because neither livestock nor wildlife prefer eating the spotted knapweed and tansy, overgrazing of palatable plants only help these plants to spread.



LET'S MAKE YOUR OWN GARDEN!

The summer, when you are away from Sussex, is most of plants' growing season.

It's fun to see plants grow. So, let's ask your parents to make a portion of yard into your own garden. If it is not possible, you might ask them to rent a plot in a community garden near your home for you.

Vegetable gardens are fun to have because you can grow your own good food. But you can also plant flower seeds, herb seeds, shrub seedlings or even tree seedlings. When you decide what to plant, you need to consider the soil type (drains water well, rich in organic matter, etc.) and shade (very sunny all day long, sunny for a few hours of a day, shady all day

long, etc.) available in your garden. Your choice of plants needs to be suitable to your site. You also need to make sure that you have an easy access to water.

If you gather and eat the vegetables, nutrients are taken out of the soil. It is a good idea to start composting of kitchen scraps and give the nutrients back to the soil.

Here in Missoula, the frost-free season is relatively short. Seeds produced in California may not grow well in Missoula. You may want to obtain seeds adapted to our growing conditions in the Northern Rockies. You can buy such seeds in many stores in town.

Watering and pulling weeds are major efforts on your part. Sun and soil will do the rest. Isn't it fun to grow your own garden? Best of all, home-grown vegetables and fruits are the freshest and safest as long as you do not apply any chemicals.

Healthy plants on healthy soil usually repel bugs and you do not need to worry much about pest control. Choosing the plants that are insect and disease resistant is important.

Finally, if you do not wish to share your vegetables with deer, a high fence is the best defense.

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