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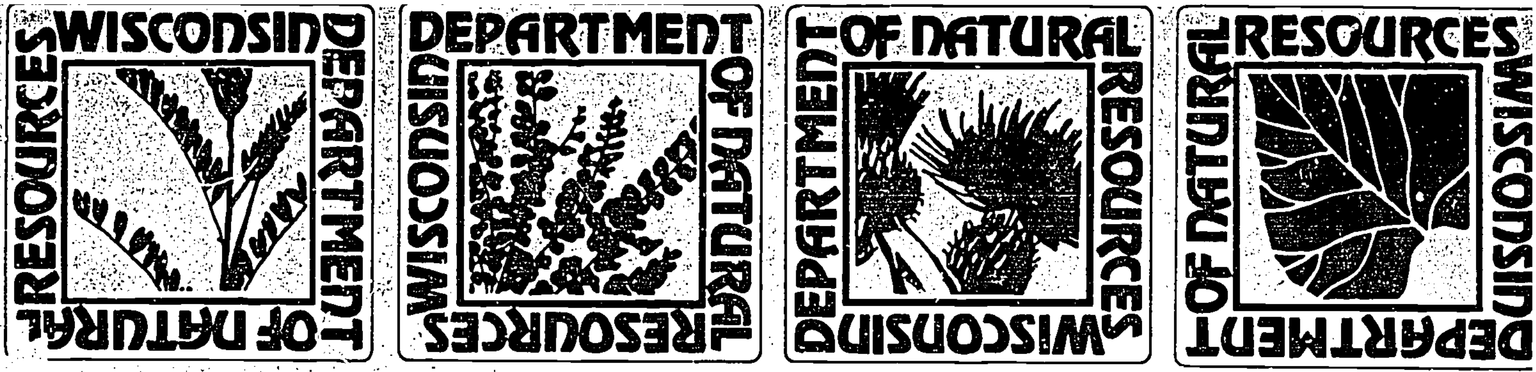
ABSTRACT

This study guide is intended to provide students with information about the types and functions of plants, along with some individual learning activities. The guide contains sections about: (1) the contributions of plants to life on earth and the benefits they afford to humanity; (2) the processes of photosynthesis and respiration; (3) the flow of energy through food chains; (4) plants that do not make their own food (such as saprophytic, parasitic, and carnivorous plants); (5) adaptations of different plant species; (6) the processes of plant reproduction; and (7) the benefit of stability which comes from diverse plant and animal communities. A glossary is included, along with a list of eighteen individual or group learning projects which deal with plants. Information is provided about how to collect plants and a caution is issued about collecting rare and endangered species of plants. A bibliography of field guides and keys, general plant references, plant communities, and natural history is included. (TW)



PLANTS STUDY GUIDE

Pub. 5-1520(83)

Basics

Plants are basic to life on Earth. So, what's basic to plant life is at the root of all our lives. There's much to learn about plants. What goes on inside of a leaf? What do plants have to do with the air you breathe? Your personal study of plants could be an endless and fascinating quest. This study guide is a beginning.

Grasses of the Field

Green plants are the oxygen-makers of the planet. Fifty percent of Earth's atmospheric oxygen is manufactured by oceanic phytoplankton — plants so minute you need a microscope or powerful hand-lens to see them. Land plants produce the other half of the oxygen we breathe.

Worldwide, people eat plants for 95 percent of our food calories. Meat, like steak and fried chicken, is also derived from plant energy, one or more links removed on the food chain. Plants feed all animals on earth, directly or indirectly.

Plants heal us. Herbs can be curative or balming. Plants are sources for hormones, vitamins and valuable ingredients in medicine. Wonder drugs like Quinine for malaria and the heart medicine Digitalis are plant products. Moreover, the lowliest flower can heal a troubled soul.

Plants provide raw materials for industry and manufacturing. Many dyes and fibers, and of course wood are plant products. Even the paper and ink which you are reading are plant derivitives.

Plants work the soil with countless root fibers, keeping it aerated and tillable. Plants enrich the soil and play a part in the natural rotting process reducing dead tissue to its reusable parts — nutrients, minerals, energy. Plants, with weather and water, break down rock to form new soil.

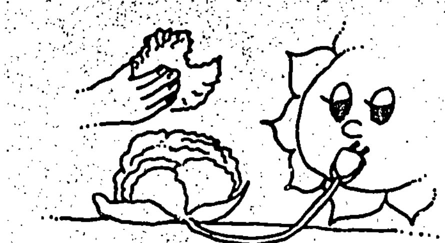
Plants are the true pioneers of the Earth, having evolved some two billion years before animals. Plants first evolved in water and moved onto land. Now the land is known by its vegetative or plant cover — boreal forest, deciduous forest, tall-grass prairie, desert, tundra, etc. Each conjures up a vivid image of the plants that inhabit it. The animals of these habitats are closely adapted to the plant communities. In turn, plants have adapted to animals.

Plants beautify the Earth. Urban planners design "greenery" into concrete cityscapes. Studies indicate that natural areas or green belts are calming, absorb urban noise and help purify the air.

Plants collectively are the storehouse of a good share of life's genetic potential. Genetic variability is the raw material for genetic engineering, a technology we're just getting our hands on. New plant uses, crop varieties and products depend upon genetic preservation or in other words, plant preservation — best practiced by preserving natural plant communities.

Despite the many life-lines connecting human survival to plants, western culture pays little notice. In fact, some human activities threaten to sever those life lines: plant life is poisoned by chemical contaminants in polluted air and water, erosion, urban sprawl, and off-road-vehicles uproot wild plants from fragile habitats. The problem is that these lifelines extend to plants growing outside cities. Day-in-day-out city life can blur vision of the living green plant connecting the lifelines. Plants in the city are mostly ornamental. They accent our houses and decorate our lawns. This encourages a view of plants as luxury rather than necessity. Wisconsin ecologist Aldo Leopold warned ". . . one is the danger of supposing that breakfast comes from the grocery and the other that heat comes from the furnace." Leopold's fine prose caution us to keep sight of our human dependence on the Earth. The purpose of this study guide is to serve as a first step to inspire recognition of the important roles of plants in our daily lives.

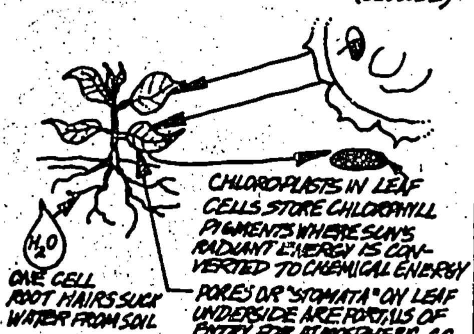
Plant names in parentheses are examples of plants discussed in "Wisconsin's Endangered Flora" booklet cited in the Bibliography.



GREEN PLANTS PLUG IN ANIMAL LIFE TO THE SUN'S ENERGY

PHOTOSYNTHESIS-(PHOTO=LIGHT) =(THE PROCESS OF CONVERTING RADIANT ENERGY TO CHEMICAL ENERGY)

CARBON DIOXIDE + WATER YIELDS (SUNLIGHT) OXYGEN + SUGAR (GLUCOSE)

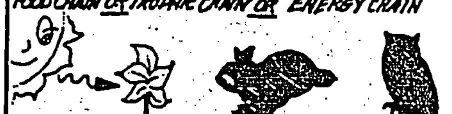


THE PLANT USES SOME OXYGEN FOR RESPIRATION AND ROOT GROWTH AND DISCHARGES THE REST TO THE ATMOSPHERE

RESPIRATION EQUATION:

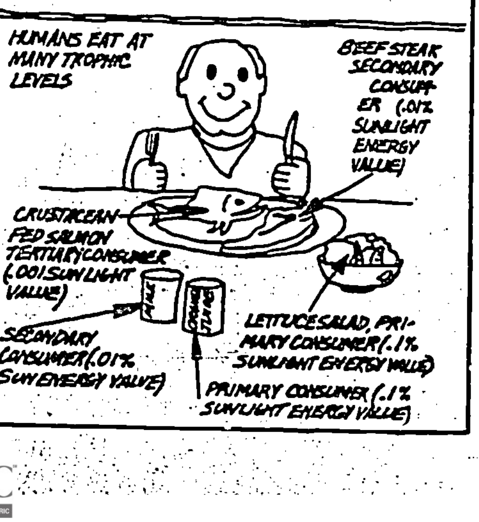
SUGAR + OXYGEN YIELD CARBON DIOXIDE + WATER + ENERGY (HEAT)

FOOD CHAIN OR TROPHIC CHAIN OR ENERGY CHAIN



SUN · RADIANT ENERGY — 1% → CHEMICAL ENERGY PRIMARY PRODUCER → 10% → PRIMARY CONSUMER → 10% SECONDARY CONSUMER

FOR EXAMPLE: 1500 CALORIES LIGHT — 1% → 15 CALORIES — 10% → 1.5 CALORIES — 10% → .015 CALORIES ORIGINAL RADIANT ENERGY VALUE



What's in a Name

Familiarity is a prerequisite of appreciation. Put simply: "Before we care, we must be aware." A crowd of people can be a crowd of strangers. But if you know just one person, that crowd gains dimension and identity, and interactions and dynamics become apparent. In the same way, plants along a forest path, streambank or even along your sidewalk can be just a green haze unless your eye can recognize one plant from another. Getting to know "Mother Nature" on a first name basis is a good way to become familiar. Once you know the name of one plant, you'll start recognizing others that commonly associate with it. You'll notice common traits about its growing places and even learn where to look for the plant. These are really the basic skills of botanists — plant identification, observation of ecological relationships and investigation of geographical distribution.

Botanical field guides or "keys" include glossaries of plant terms and logical systems based on flower color, plant parts or plant appearance to help you "key out" a plant's identity. See the Bibliography for a list of books to help you get started.

First Light

Plants are said to be autotrophic or "self-feeders." But, "feed" and "eat" are merely ways to say "ingest energy." Actually, the staple in a plant's diet is sunlight. Water and soil nutrients are also on the menu. Plants feed on sunbeams by mixing atmospheric carbon dioxide with water in a life-giving recipe called "photosynthesis." This yields a heaping serving of sugar for plants and a by-product of oxygen for the atmosphere. Photosynthesis is the most essential chemical reaction for life on Earth. The sun's radiant energy is converted into stored chemical energy usable by the plants and by the animals which feed on the plants. Photosynthesis occurs in special organelles called "chloroplasts" stored in plant cells. Chloroplasts house chlorophyll, the pigment which colors plants green and which holds the secret of photosynthesis. The chlorophyll molecule is very similar to the hemoglobin molecule in human blood.

The plant equivalent of digestion is called "respiration." Technically, respiration is the oxidation or "controlled burning" of sugar (such as glucose produced by photosynthesis) into carbon dioxide and water. Respiration is the process through which food energy is made available to the plant. Some energy escapes as heat.

Chain Gang

Basic to understanding life on Earth is understanding the flow of energy. Energy is a primary life requirement. Through photosynthesis green leaves act as the solar collectors and converters of the sun's energy to chemical energy. This special talent puts plants in the lead role as "producers" of food energy available to life.

The Greek word "trophos" means "feeder." "Auto" means "self". Plants which manufacture their own food are autotrophic. The Greek meaning of the prefix "hetero" is "other." Thus, "heterotrophs" feed on others. Nearly all animals are heterotrophic. Some plants are heterotrophic (see: Alternative Lifestyles; saprophytes, parasites and carnivores). Heterotrophs which feed on autotrophs are further called "primary consumers." Animals such as deer, milkweed bugs and rabbits which eat plants are primary consumers. Plant-eating animals are also called herbivores. People who eat nothing but plants are called "vegetarians," but they could just as well be called herbivores or primary consumers. Animals that feed on animals that feed on plants are called "secondary consumers." Predatory birds, like an owl that eats a rabbit is a secondary consumer. Humans that eat beef steak are secondary consumers and so it goes. This sort of who-eats-who trophic chain seldom is longer than three or four links because the energy pay-off gets cut by about 90 percent with each trophic level. Plants synthesize only about 1 percent of the sunlight which strikes them. In turn, primary consumers convert only about 10 percent of the plant's food energy, and so on.

Alternative Life Styles

Not all plants make a living by harvesting sunbeams through photosynthesis. Here are some alternative plant life styles:

Saprophytic

Plants that feed on dead plant and animal tissue are called saprophytes. "Sapro-" means "dead or decaying." The ending, "-phyte" refers to "a plant growing in a way or place." Thus, saprophytes are plants that derive nourishment from dead organic matter in the soil. Unlike photosynthetic plants, saprophytes can't synthesize organic compounds (food) from inorganic substances. Mushrooms are recognizable saprophytes. Generally, saprophytes lack chlorophyll and aren't green. Saprophytes play the role of "decomposer" at the recycling end of nature's energy flow. Saprophytic plants along with animal decomposers recycle nutrients, chemicals and energy stored in plant and animal carcasses. (see: Pine-drops)

Parasitic

Plants which feed by breaking down and absorbing organic material still incorporated into the bodies of living organisms are called "parasites." Some parasites are "pathogenic" or disease-causing. Many parasites, however, do little or no damage to the host plant. Dodder vines, which cling to some agricultural crops (e.g. oats, barley, rye, corn, soybeans, millet, alfalfa, peas, rhubarb, tomatoes), attach little pumps to the host plant to suck nutrients. Once attached, the Dodder vine detaches from the soil and lives entirely on the life of the host. Dwarf Mistletoe, found in northern Wisconsin, is parasitic on spruce trees, especially Black Spruce. Some fungi parasitize insects. Parasitic plants have worked out many sophisticated schemes to embezzle nourishment from animals and photosynthetic plants. (see: Clustered Broomrape and Northern Comandra)

Carnivorous

In Wisconsin, flesh-eating plants are most common in nutrient-poor habitats like acid bogs and rocky cliffs. Carnivorous plants utilize many insect-catching strategies. Pitcher Plants have deep, vase-shaped water traps laced with digestive enzymes to feed on fallen insects. The popular Venus Flytrap* uses a color attractant (a blush of red) and touch-triggered jaws which envelop passing insects. Some carnivorous plants like the Butterwort discussed in "Wisconsin's Endangered Flora" secrete sticky enzymes to make their leaves act like flypaper to ensnare food. Studies suggest that Butterwort may really be "omnivorous" feeding on both plant and animal matter. (see: Butterwort, English Sundew and Linear-leaved Sundew)

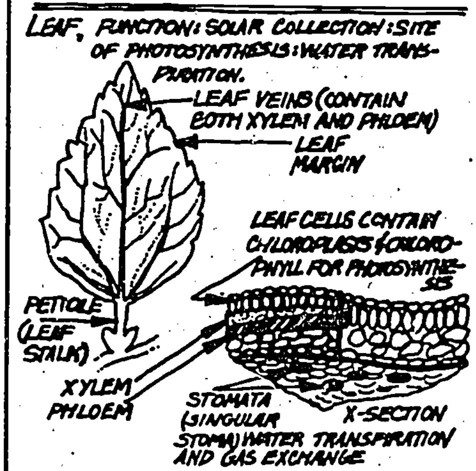
**Not found in Wisconsin*

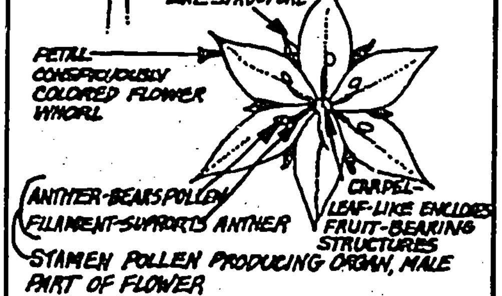
Handiwork

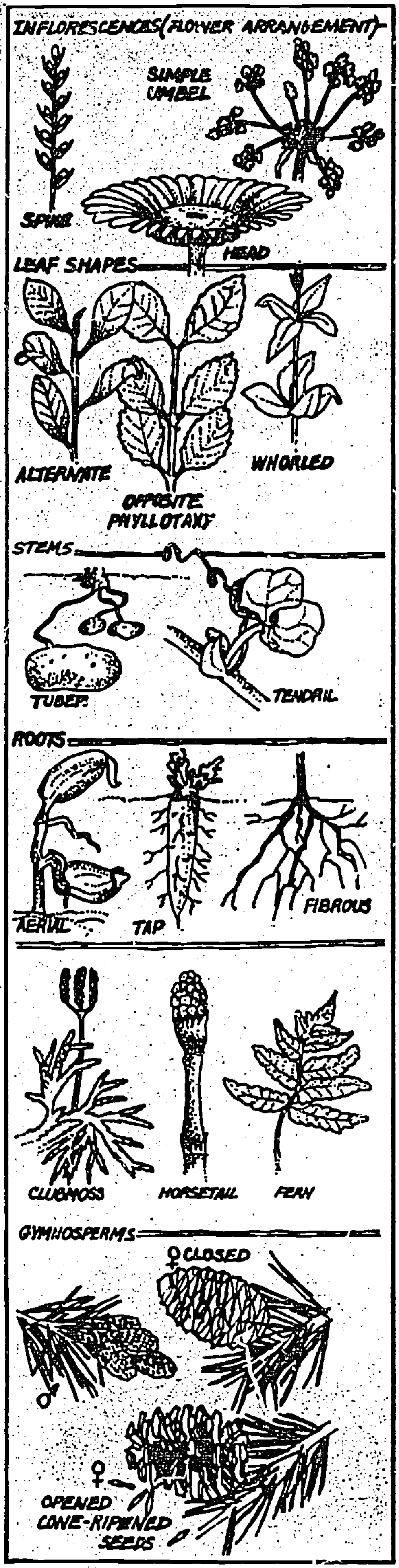
Nature is said to be the "grand designer." According to evolutionary theory, the millions of life forms Earth-wide are the fittest designs for survival within the laws of nature and chance. Water plants have a different set of environmental conditions to deal with than do land plants. Land plants need an anchor; rigidity against gravity; and a pipeline to transport water, nutrients, and carbohydrates. The vascular plant has become the most successful design for land plants. Vascular plants have an organized pipeline for internal circulation which also provides structural support.

ENERGY FLOW IS MORE ACCURATELY DIAGRAMED AS "ENERGY WEBS," WITH MANY SPECIES OF PLANTS AND ANIMALS AT EACH TROPHIC LEVEL.

IT'S EASY TO SEE HOW MANY-STRANDED WEBS CAN BECOME







Variations on a Theme

Most plant species are adapted to specific habitats and to specific pollinators. Often by just looking at a plant, you can tell what its native habitat is or what pollinates it. Desert plants, like a cactus, have adaptations to conserve water. Examples of these are: leaf surfaces reduced to needles which also protect the succulent fleshy stems (which are themselves water storers); far-spreading fiberous roots to catch scarce water; and leathery, waxy or fuzzy leaf surfaces to curb evaporation. In contrast, some tropical plants have large, broad leaves to encourage transpiration to compensate for an over-abundance of water and to absorb sunlight in shady forests. Tubular flowers are best adapted to pollinators like hummingbirds, bats, and long-tongued moths and butterflies (Smooth Phlox). Flat-topped, shallow flowers are more likely to attract flies, beetles and crawling insects (see: Hemlock-Parsley, Prairie Parsley). The individuals of a species best adapted to the existing environmental conditions survive to reproduce and pass on their advantage to offspring.

Consider the following variations of plant parts. In what habitat or environmental conditions are each best suited? Can you think of plants which exhibit each of the variations shown? Look at your houseplants. For what sort of natural habitats might each be adapted?

Seeds

One of the primary drives of life is to continue itself, or to bear offspring. This is nature's reward for survival. Plants utilize both sexual and asexual reproduction. Asexual or "vegetative" reproduction occurs when part of an existing plant breaks off or spreads to form a new plant. Strawberry runners, willow and blackberry bush sprouts are examples (see: Lake Cress). If you have ever taken a "cutting" from a garden or house plant to generate a new plant you have made use of the plant's ability to vegetatively reproduce. Not all plants have this ability.

Plants reproduce sexually through a diversity of schemes. In evolutionarily primitive plants like club mosses (*Lycopodium*), horsetails (*Equisetum*), and ferns, spores from adult plants form an intermediate generation called the "gametophyte" which bears male and female (sperm and egg-producing) structures. Upon fertilization, the gametophyte disintegrates as the immature plant forms. Water is the necessary vehicle for fertilization in this type of life cycle, transporting sperm to the egg.

Gymnosperms and angiosperms are among the most abundant forms of vascular plants. A gymnosperm is a plant with "naked seeds." Cone-bearing conifers like pine and spruce trees are gymnosperms. Conifers bear both male and female cones. The male pollen-bearing cones are small and look like buds or berries and usually grow in clusters. The female cones are the familiar woody "pine cones." Fertilization or pollination occurs in spring, thanks to wind and water. Many years may pass before the female cones open and release the winged seeds to the wind.

Angiosperms are plants with seeds encased in a matured ovary or "fruit." Angiosperms are also known as "flowering plants" and are considered to have the most highly evolved sexual reproduction. There is little fat or excess in nature. Beautiful flowers with alluring fragrances are really show pieces to attract pollinators. Pollinators spread the pollen borne on the anthers to a receptacle called a "stigma" through which the pollen travels to the ovary. Pollinators may be wind, water, bees, flies, moths, crawling insects, birds or bats. When you walk through a summer field you may serve as pollinator. The ripened ovary is called the fruit, which bears the seed(s) and takes on many forms.

Seed Packaging

The seed contains the embryo plant. Much evolutionary craft has gone into distributing the ripened seeds.

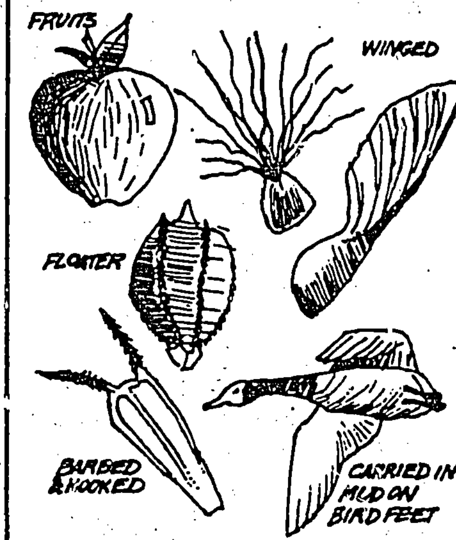
Fruits: encasing seeds in an edible package like a peach, apple or berry is one way plants get animals to distribute seeds. Seeds are carried "en-gullet" by birds, mammals, turtles and many other animals and deposited elsewhere (see: Squashberry, Dwarf Bilberry, Hawthorn-leaved Gooseberry)

Barbed and Hooked Seeds: stickers or prickly seeds are mechanisms to attach seeds to passing animals for dispersal (see: Brittle Prickly Pear Cactus)

Winged Seeds: wind is a ready means of transport for aerodynamically designed seeds (see: Dune Thistle and Prairie Milkweed)

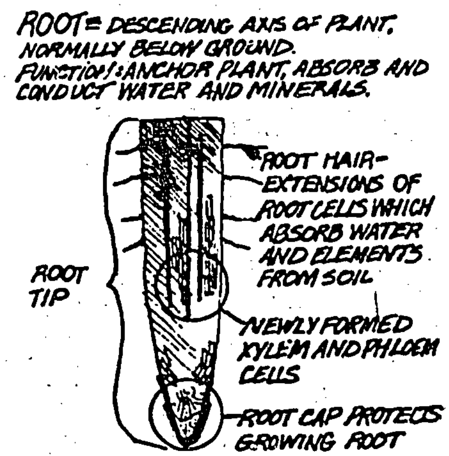
Floaters: "Light and corky" is a good design for seeds of wetland or aquatic plants which float on the water surface (see: Bald Rush)

Seeds are also carried in mud on bird feet (see: Umbrella Sedge)



Diversity

Plants define the lan[illegible]scape community, yet the land and climate environment deter[illegible]aracter of the plants which inhabit it. Plants have changed the atmo[illegible]rough photosynthesis and all life is dependent on that changed atmosphere. Food webs trace how energy flows in an ecosystem and nearly always begin with the green plant which plugs life into the radiant energy of the sun. Plants with other life forms live in communities. The more diverse life is in a community, the more able that community is to cope with change. "Diversity is the key to stability." An entire field sowed to a single crop is a shaky "monoculture," prone to disease infestation and spread. A woodlot planted solely to pine is another example of monoculture. A forest community with many species with varying tolerances is naturally buffered against catastrophe. Some plants thrive in disturbed conditions — they're called pioneer plants. In an ecological scheme known as "succession," pioneers are fast growing and prepare the soil for other plants to grow. The plants of the successional stage which can grow in their own soil and shade are called "climax" species. (For a better understanding of Wisconsin's native plant communities see No. 21 or 29 in the Bibliography).



Words

annual: a plant which completes its life cycle from seed to seed within a single growing season

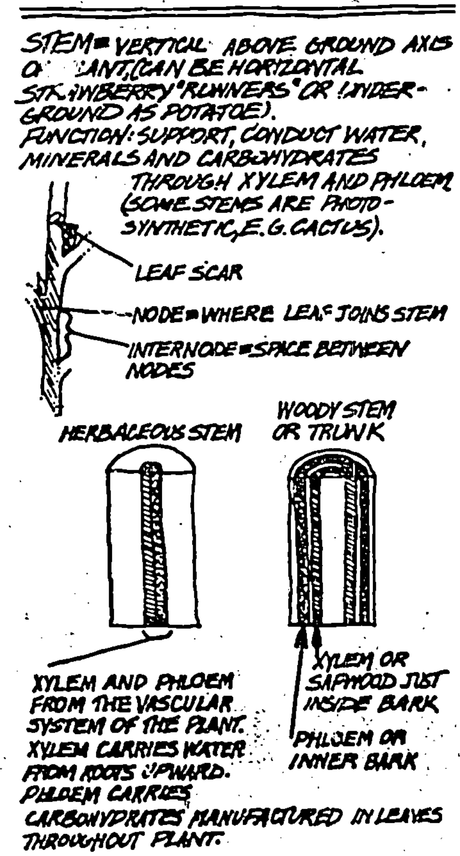
perennial: a plant which persists year after year, flowering and fruiting in cycles

geotropism: growth movement induced by gravity; the tendency for plant roots to grow downward

phototropism: growth movement induced by a light source (sun); the tendency for plant shoots to grow toward the sun

dicotyledon: (abbrv: dicot) angiosperms or flowering plants with typically two cotyledons, net venation, and flowering parts in fours or fives or multiples (e.g., oak trees, buttercups, roses, elderberry)

monocotyledons: (abbrv: monocot) angiosperms or flowering plants with typically a single cotyledon, parallel venation, and flowering parts in threes or multiples (e.g., grasses, corn, orchids, sedges, lilies)



Plant Projects

Here are some things to do on your own or with a class to help you learn about plants:

Cut a piece of celery and place it in food-colored water. Watch the dye move up the stalk. What is the name of the tissue conducting the water? Slice the celery cross-wise very thinly. Examine the cells under a microscope or hand-lens.

Plant projects continued on next page . . .

BIBLIOGRAPHY

Field Guides and Keys

1. **Weeds in Winter.** 1977. L. Brown. Houghton Mifflin Co. Boston, MA.
2. **A Field Guide to the Ferns and Related Families.** 1963. B. Cobb. Houghton Mifflin Co. Boston, MA.
3. **Wildflowers and Weeds.** 1972. B. E. Courtenay and J. H. Zimmerman. Van Nostrand Reinhold Co. New York, N.Y.
4. **How to Know the Wildflowers.** 1963. W. S. Dana. Dover Pubs., Inc. New York, N.Y.
5. **A Manual of Aquatic Plants.** 1940. N. C. Fassett. Univ. of Wis. Press. Madison, WI.
6. **Grasses of Wisconsin.** 1951. N. C. Fassett. Univ. of Wis. Press. Madison, WI.
7. **Spring Flora of Wisconsin.** 1976. N. C. Fassett. Univ. of Wis. Press. Madison, WI.
8. **Trees of the E. and Cen. U.S. and Canada.** 1957. W. Harlow. Dover Pubs., Inc. New York, N.Y.
9. **Identify Trees and Shrubs by Their Leaves:** A Guide to Trees and Shrubs. 1972. E. Knobel. Dover Pubs., Inc. New York, N.Y.
10. **How to Know the Ferns.** 1961. F. Parsons. Dover Pubs., Inc. New York, N.Y.
11. **A Field Guide to Wildflowers of NE and NC N. Am.** 1968. R. T. Peterson and M. McKenny. Houghton Mifflin Co. Boston, MA.
12. **A Field Guide to Edible Plants of E. and Cen. N. Am.** 1977. L. Peterson. Houghton Mifflin Co. Boston, MA.
13. **A Field Guide to Trees and Shrubs.** 1972. C. Petrides. Houghton Mifflin Co. Boston, MA.
14. **Winter Botany: and Identification Guide to Native Trees and Shrubs.** 1967. W. Trelease. Dover Pubs., Inc. New York, N.Y.

Continued next page . . .

Plant projects continued . . .

- Plant several different kinds of flower or vegetable seeds in a clear glass container. Watch and record the seed and plant development from day to day. Repeat the experiment with the container in darkness.
- Start a seed collection. Design a mural using seeds showing various modes of seed transport.
- Start a "phenological calendar." Mark the dates of the "firsts" of any natural events you observe (e.g., first Pasque Flower to bloom; first visible leaves on white oaks.) You could also do this for your "last" seasonal observations of natural events.

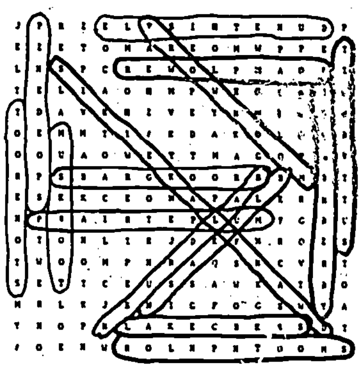
Invite a local artist who uses natural plant dyes to come to your class and demonstrate the use of plants to make dye.

- Invite a local herbalist or health food store manager to talk about edible wild plants or Indian folk medicine and lore. Other guests could be: horticulturist (UW-Extension); garden club representative.
- Older groups (5th grade and up) may want to obtain a copy of Frances Lappe's book "Diet for a Small Planet." Discuss Ms. Lappe's argument that the Earth could feed more people if people ate more plants and less animal matter.
- Obtain a copy of "Vegetation of Wisconsin" (see Bibliography). What was the natural vegetation of the area where you live? Are any of the trees or plants in your home or school yard survivors from the past natural community? How has the vegetation changed? (The Wis. Geological and Natural History Survey, 1815 University Avenue, Madison, WI 53706, sells maps of presettlement vegetation.)
- Record the trophic levels you eat at during an average day or week. Are you most often a primary, secondary or tertiary consumer? Does this vary with the meal you are eating — breakfast, lunch and dinner?
- Look up magazine, newspaper or book articles discussing why leaves change color in autumn. Why do evergreens keep their leaves in winter? What environmental condition do evergreen forests have in common with deserts that would cause the plants in each to have spiney or needle-like leaves instead of broad leaves?
- Make a leaf collection. Organize the leaves in a book entitled, "Trees and Shrubs of Our School Woods" or ". . . of My Neighborhood."
- Make bark rubbings by placing thin paper on a tree trunk and rubbing with the bare side of a crayon. Compare the bark patterns from different tree species or different age trees of the same species.
- Visit a maple "sugar bush" in early spring when the sap begins to run. (If you're lucky, you may get a free sample!)
- Plant a wild flower garden in place of a cultivated flower garden. First, be sure to investigate the growing needs of the plants you select and choose compatible plants. Consult books or a local wildflower nursery.
- Study the "introduced" plants or weeds on roadsides, lawns and nearby wild areas. Where did these exotic plants come from? How did they get here? (e.g., Dandelion, Queen Anne's Lace, Blue Chicory)
- (teachers and parents) Buy a copy of "Sharing Nature With Children" by Joseph Bharat Cornell. 1979. (Check bookstores or write: Ananda Publications, 14618 Tyler Foote Road, Nevada City, CA 95959. $4.95.) See plant activities on pgs. 22, 53, 56, 60, 70 and 74.
- Create a plant. Where would it live? What special adaptations have you included in your plant design to suit its habitat? How would your plant reproduce? What would pollinate it? How would the seeds (if any) be dispersed?
- Watch a "tree stump drama." Study how snow, ice, water, wind, sun and organisms decompose a fallen log.
- Write a slogan and design a poster or a button to make people more appreciative of plants.
- Here's a word scramble using names of some of Wisconsin's endangered and threatened plants. (Read about these plants, in "Wisconsin's Endangered Flora.")

Word search: Wisconsin's endangered flora

Bald Rush	Dwarf Lake Iris	Pinedrops
Blue Ash	Foamflower	Prairie Plum
Brook Grass	Lake Cress	Smooth Phlox
Butterwort	Moonwort	Squashberry
Dune Thistle	Muskroot	Stone Root

J	P	R	I	E	L	T	S	I	H	T	E	N	U	D	P
E	I	E	T	O	N	A	R	E	O	H	W	F	P	E	T
L	N	S	P	C	R	E	W	O	L	F	M	A	O	F	R
T	E	L	I	A	O	H	M	P	[illegible]	F	G	R	E	S	O
T	D	A	V	R	N	I	V	X	Y	N	N	H	L	Q	W
O	R	H	M	T	I	F	E	D	A	K	O	L	S	U	R
O	O	U	A	O	W	E	Y	T	M	A	G	O	P	A	E
R	P	S	S	A	R	G	K	O	C	R	R	B	H	S	T
E	S	K	K	C	E	D	N	A	P	A	L	E	R	H	T
N	P	R	A	I	R	I	E	P	L	U	M	F	G	B	U
O	T	O	N	L	I	K	J	D	E	F	N	K	O	E	B
T	W	O	O	H	P	H	R	A	C	S	R	U	V	R	T
S	E	T	T	C	E	U	S	B	A	W	X	A	Y	R	O
M	R	L	K	J	S	H	I	G	F	D	C	B	W	Y	A
Y	N	O	P	H	L	A	K	E	C	R	E	S	S	D	T
F	O	X	N	W	X	O	L	H	P	H	T	O	O	M	S



Make a crossword puzzle using the following information:

Plant parts we eat

Flower: cauliflower, artichoke, broccoli
Nectar/Pollen: honey, saffron
Sap: maple syrup, sorghum, cane syrup
Stem: potato, celery
Bark: cinnamon sticks, some teas
Leaf: lettuce, spinach, parsley, water cress
Root: carrot, radish
Seed or Fruit: corn, nuts, coffee beans, soybeans, pea, avocado, chocolate, vanilla
Immature or Young Plant: sprouts, asparagus
Fungus: mushrooms

Collecting Plants

Collecting plants no doubt can help you learn, especially if you key out each plant to species. However with the growing number of people, more restricted land use and less open wild lands, it is more advisable to make a joint plant collection for an entire class. Each student could report on one or two plants in the collection. In this way, the class would receive in-depth information about each plant and conserve plants as well. Or, if students have cameras, you could make a class plant photo collection. Art classes could sketch plants in the wild or in school. If you do plan to dig up plants, make sure you ask landowner permission. Even the roadsides along some highways are owned by the adjoining landowner. Check with your school district to see what regulations exist regarding digging plants in your school woods or forest. Most are off limits to digging. Be sure to identify a plant before you dig it up to avoid destroying rare or endangered plants. It is illegal to dig plants on DNR-managed lands (including state parks).

Bibliography continued . . .

15. **Flower Finder: A Guide to Identification of Spring Wildflowers and Flower Families.** 1955. M. T. Watts. Nature Study Guide Publishers. Berkeley, CA.
16. **Master Tree Finder: A Manual for the Identification of Trees By Their Leaves.** 1963. M. T. Watts. Nature Study Guide Publishers. Berkeley, CA.
17. **Winter Tree Finder: For Identifying Deciduous Trees in Winter.** 1970. M.T. Watts and T. Watts. Nature Study Guide Publishers. Berkeley, CA.
18. **Trees: A Guide to Familiar Am. Trees.** 1956. H. Zim and A. Martin. Golden Press, Inc. New York, N.Y.

General Plant References

19. **Plant Classification.** 2nd Ed. 1979. L. Benson. D. C. Heath and Co. Lexington, MA.
20. **An Illustrated Flora of the N. U.S. and Canada.** (3 vols.) 1970. N. Britton and A. Brown. Dover Pubs., Inc. New York, N.Y.
21. **Wisconsin's Endangered Flora.** 1982. I. Brynildson and W. Alverson. Wis. DNR. Box 7921, Madison, WI 53707. ($2.95 prepaid; make check payable to title of booklet)
22. **Manual of Vascular Plants of NE U.S. and Canada.** 1973. H. A. Gleason and A. Cronquist. Van Nostrand Reinhold Co. New York, N.Y.
23. **Flowering Plants of the World.** 1978. V. H. Heywood. Mayflower Books. New York, N.Y.
24. **Biology of Plants.** 1970. P. H. Raven and H. Curtis. Worth Pub., Inc. New York, N.Y.
25. **Edible and Useful Wild Plants of the U.S. and Canada.** 1976. C. Saunders. Dover Pubs., Inc. New York, N.Y.

Continued next page . . .

Bibliography continued . . .

26. **Vascular Plant Families.** 1977. J. P. Smith, Jr. Mad River Press, Inc. Eureka, CA.
27. **A Student's Atlas of Flowering Plants:** Some Dicotyledons of E. N. Am. 1974. C. E. Wood, Jr. Harper and Row. New York, N.Y.

Plant Communities

28. **Reading the Woods.** 1969. V. Brown. Collier Books; MacMillian Pub. Co., Inc. New York, N.Y.
29. **Vegetation of Wisconsin.** 1959. J. T. Curtis. Univ. of Wis. Press. Madison, WI.
30. **North Woods of Mich., Wis. and Minn.** 1981. G. Daniel and J. Sullivan. Sierra Club Books. San Francisco, CA.
31. **Wisconsin's Amazing Woods:** Then and Now. 1973. T. Kouba. Wis. House, Ltd. Madison, WI.
32. **Woodlands of Wisconsin.** 1977. Univ. of Wis.-Extension. Madison, WI. (G2780)

Natural History

33. **Plants, Man and Life.** 1971. E. Anderson. Univ. of Calif. Press. Berkeley and Los Angeles, CA.
34. **How Plants Get Their Names.** 1933. L. H. Bailey. Dover Pubs., Inc. New York, N.Y.
35. **The Life of Plants.** Reprint 1981. E. J. H. Corner. Univ. of Chicago Press.
36. **How Indians Use Wild Plants for Food, Medicine and Crafts.** 1974. F. Densmore. Dover Pubs., Inc. New York, N.Y.
37. **A Natural History of Trees of E. and Cen. N. Am.** 1965. D. Peattie. Houghton Mifflin Co. New York, N.Y.
38. **The Natural History of Wild Shrubs and Vines:** E. and Cen. N. Am. 1981. D. Stokes. Harper and Row Publishers. New York, N.Y.

Plant Places

Here are some suggestions of places to take field trips to observe plants:

- arboretum
- botanical garden
- plant nursery (especially a wild plant nursery)
- wildlife refuge
- greenhouse
- school forest
- nature preserve
- shopping mall (some have exotic plant gardens)
- state, county or municipal park
- home garden
- city street tree tour
- farm (sod, mint, cranberry, orchard, vegetable, Christmas tree farms)
- pulp and paper mill
- U.S. Forest Products Lab (Madison)
- DNR nursery (Boscobel, Wisconsin Rapids or Hayward)

Write

American Forest Institute,
1619 Massachusetts Ave. N.W.,
Washington, D.C. 20036

Botanical Club of Wisconsin:
c/o Dr. Rudy Koch,
Biology Dept. Univ. of Wis.,
La Crosse, Wis. 54601. ($5 for yearly membership and newsletter)

Garden Club of America,
598 Madison Ave.,
New York, NY 10022

National Audubon Society,
950 Third Ave.,
New York, NY 10022

Natural Resources Defense Council, Inc.,
122 East 42nd St.,
New York, NY 10168

Nature Conservancy, The,
1800 North Kent St.,
Suite 800, Arlington, VA 22209
(also Wisconsin Chapter:
923 Williamson St.,
Madison, WI 53703)

National Wildlife Federation,
1412 16th St., N.W.,
Washington, D.C. 20036

U.S. Dept. of Agriculture,
Forest Service, P.O. Box 2417,
Wash. D.C., 20013. (also Eastern Region U.S.F.S. Clark Bldg.,
633 W. Wisconsin Ave.
Milwaukee, WI 53205)

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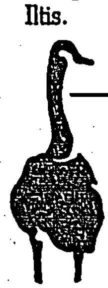

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