



CHAPTER TWO

# Plant Life

of Colorado National Monument



Photo from *Through the Eyes of the Children*  
by Diane Hirschinger Gallegos and Tope Elementary Students



# Plants of Colorado National Monument



The mesa tops, ridges, cliffs, talus slopes, canyon bottoms, sagebrush flats, riparian corridors, creek beds, and clay soils of Colorado National Monument create diverse and challenging environments for plants. The cold winters and hot, dry summers mean that plants must be sturdy and adaptable in order to survive. Listed below are some of the more common plants, shrubs, and trees that may be seen on a field trip. They are listed in alphabetical order, not in order of their occurrence or quantity. The common name is located in the left column, and the scientific name is shown in italics in the right column.

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## Trees

Box elder	<i>Negundo aceroides</i>
Canyon cottonwood	<i>Populus deltoides ssp. wislizenii</i>
Douglas fir	<i>Pseudotsuga menziesii</i>
Gambel oak	<i>Quercus gambelli</i>
Narrow leaf cottonwood	<i>Populus angustifolia</i>
Pinyon pine	<i>Pinus edulis</i>
Ponderosa pine	<i>Pinus ponderosa</i>
Sandbar willow	<i>Salix exigua</i> or <i>Salix interior</i>
Singleleaf ash	<i>Fraxinus anomala</i>
Tamarisk	<i>Tamarix ramosissima</i>
Utah juniper	<i>Juniperus osteosperma</i>

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## Shrubs

Big sagebrush	<i>Artemesia tridentata</i>
Black sagebrush	<i>Artemesia nova</i>
Cliffrose	<i>Cowania mexicana</i>
Fendlerbush	<i>Fendlera rupicola</i>
Four-winged saltbush	<i>Atriplex canescens</i>
Greasewood	<i>Sarcobatus vermiculatus</i>
Mormon tea	<i>Ephedra torreyana</i> or <i>Ephedra viridis</i>
Mountain mahogany	<i>Cercocarpus ledifolius</i> and hybrids
Rabbitbrush	<i>Chrysothamnus nauseosus</i>
Serviceberry	<i>Amelanchier utahensis</i>
Snowberry	<i>Symphoricarpos oreophilus</i>
Spiny sagebrush	<i>Artemesia spinescens</i>
Wild rose	<i>Rosa woodsii</i>

# Plants of Colorado National Monument



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## Cactus

Barrel cactus	<i>Echinocereus triglochidiatus</i>
Claret cup cactus (hedgehog group)	<i>Sclerocactus parviflorus</i>
Fishhook cactus	<i>Opuntia erinacea</i>
Prickly pear (pads flat)	<i>Opuntia fragilis</i> Grass
Prickly pear (pads potato-like)	<i>Hilaria jamesii</i>
Galleta grass	<i>Oryzopsis hymenoides</i>
Indian ricegrass	<i>Stipa comata</i>
Needle and thread grass	<i>Bromus tectorum</i>
Cheatgrass	

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## Flowering Plants (Pink, Red and Organge)

Annual gilia	<i>Gilia sinuata</i> or <i>Gilia leptomeria</i>
Bull thistle	<i>Cirsium vulgare</i>
Claret cup cactus	<i>Echinocereus triglochidiatus</i>
Copper globemallow	<i>Sphaeralcea coccinea</i> ssp. <i>dissecta</i>
Cranesbill/Wild geranium	<i>Erodium cicutarium</i>
Fishhook cactus	<i>Sclerocactus parviflorus</i>
Indian paintbrush	<i>Castilleja chromosa</i>
Longleaf phlox	<i>Phlox longifolia</i>
Prickly pear cactus	<i>Opuntia</i> sp.
Showy milkweed	<i>Asclepias speciosa</i>
Wallflower	<i>Erysimum capitatum</i>
Wild onion	<i>Allium acuminatum</i>
Wild rose	<i>Rosa woodsii</i>
Wirelettuce	<i>Stephanomeria tenuifolia</i>

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## Flowering Plants (Purple and Blue)

Bilobe larkspur	<i>Delphinium nuttallianum</i>
Bluestem penstemon	<i>Penstemon cyanocaulis</i>
Branching daisy/Fleabane	<i>Erigeron divergens</i>
Colorado four o'clock	<i>Mirabilis multiflora</i>
Common vetch	<i>Vicia americana</i>
Dusty penstemon	<i>Penstemon comarrhenus</i>
Mat verbena	<i>Verbena bracteata</i>
Pacific aster	<i>Aster chilensis</i>
Silvery lupine	<i>Lupinus argentus</i>
Tansy aster	<i>Machaeranthera canescens</i>
Utah daisy	<i>Erigeron utahensis</i>
Wild blue flax	<i>Linum lewissii</i>

# Plants of Colorado National Monument



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## Flowering Plants (White to Cream)

Aster	<i>Aster falcatus</i>
Bindweed	<i>Convolvulus arvensis</i>
Cryptantha or white borage	<i>Cryptantha crassisejala</i>
Datil yucca	<i>Yucca baccata</i>
Desert evening primrose	<i>Oenothera caespitosa</i>
Desert pepperweed	<i>Lepidium densiflorum</i>
Fragrant sandverbena	<i>Abronia fragrans</i>
Hoary townsendia	<i>Townsendia incana</i>
Mountain pepperweed	<i>Lepidium montanum</i>
Rattleweed milkvetch	<i>Astragalus praelongus</i>
Sego lily	<i>Calochortus nuttallii</i>
Spreading fleabane	<i>Erigeron divergens</i>

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## Flowering Plants (Yellow)

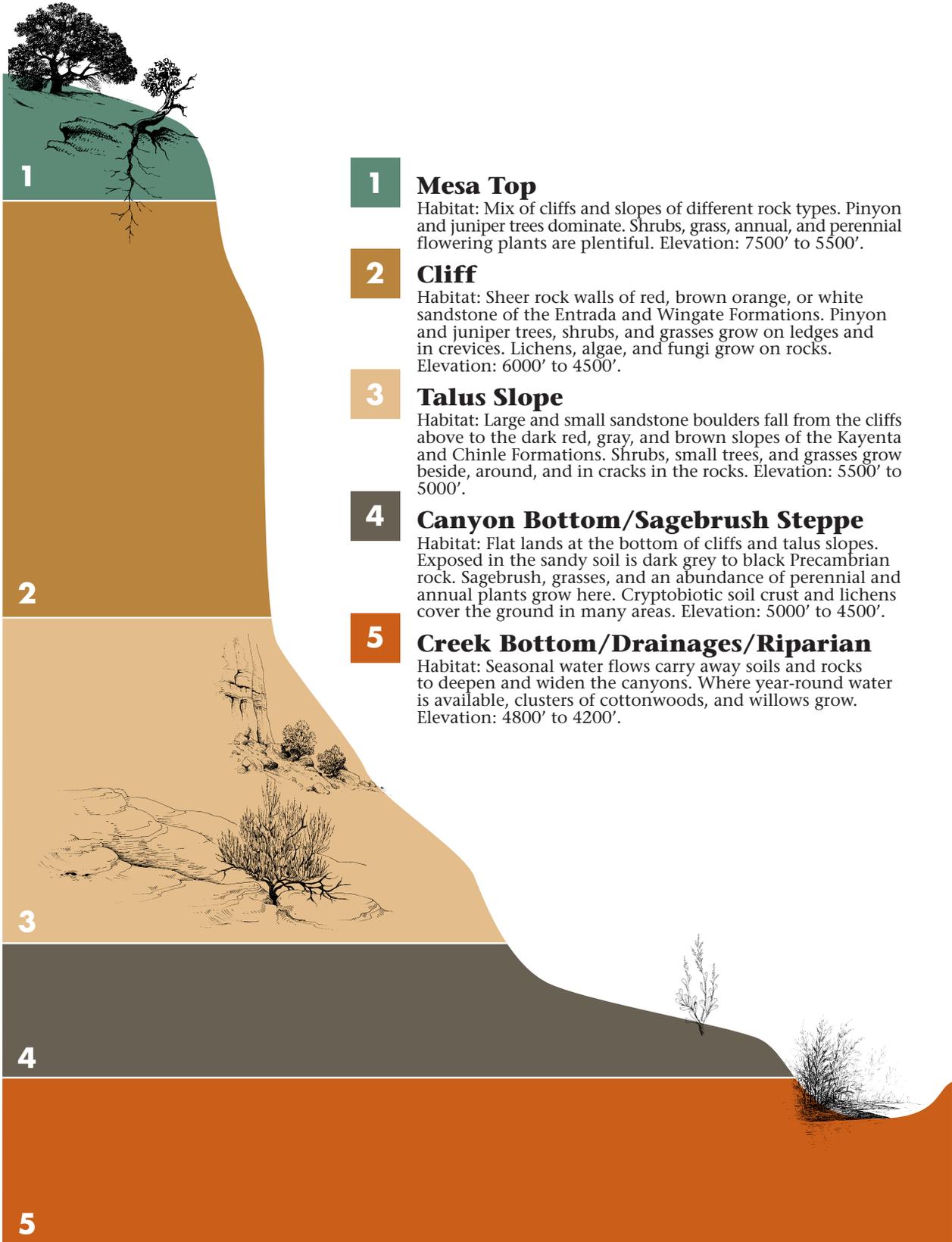
Actinea or Perky Sue	<i>Actinea acanlis</i>
Arrowleaf balsamroot	<i>Balsamorhiza sagittata</i>
Butter and eggs	<i>Linaria vulgaris</i>
Common dandelion	<i>Taraxacum officinale</i>
Common sunflower	<i>Helianthus annuus</i>
Cream tips	<i>Hymenopappus filifolius</i>
Desert trumpet	<i>Eriogonum inflatum</i>
Few flowered goldenrod	<i>Solidago sparsiflora</i>
Gaillardia/Blanket flower	<i>Gaillardia pinnatifida</i>
Golden aster	<i>Heterotheca horrida</i>
Gumweed	<i>Grindellia squarrosa</i>
Mullein	<i>Verbascum thapsus</i>
Prickly pear	<i>Opuntia phaeacantha</i>
Prince's plume	<i>Stanleya pinnata</i>
Puccoon	<i>Lithospermum incisum</i>
Rabbitbrush	<i>Chrysothamnus nauseosus</i>
Senecio or Groundsel	<i>Senecio mulicapitatus</i>
Salsify	<i>Tagopogon dubius</i>
Stonecrop	<i>Sedum lanceolatum</i>
Streptanthus or Jewel flower	<i>Streptanthus cordata</i>
Tansy mustard	<i>Descurainia pinnata</i>
Twin bladder pod	<i>Physaria acutifolia</i>
Yellow borage	<i>Cryptantha flava</i>
Yellow sweet clover	<i>Melilotus officinalis</i>
Wallflower	<i>Erysimum asperum</i>

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## Flowering Plants (Green)

Sagebrush	<i>Artemesia tridentata</i>
Grass family	<i>Gramineae</i>

# Land Forms and Life Zones of Colorado National Monument



## 1 Mesa Top

Habitat: Mix of cliffs and slopes of different rock types. Pinyon and juniper trees dominate. Shrubs, grass, annual, and perennial flowering plants are plentiful. Elevation: 7500' to 5500'.

## 2 Cliff

Habitat: Sheer rock walls of red, brown orange, or white sandstone of the Entrada and Wingate Formations. Pinyon and juniper trees, shrubs, and grasses grow on ledges and in crevices. Lichens, algae, and fungi grow on rocks. Elevation: 6000' to 4500'.

## 3 Talus Slope

Habitat: Large and small sandstone boulders fall from the cliffs above to the dark red, gray, and brown slopes of the Kayenta and Chinle Formations. Shrubs, small trees, and grasses grow beside, around, and in cracks in the rocks. Elevation: 5500' to 5000'.

## 4 Canyon Bottom/Sagebrush Steppe

Habitat: Flat lands at the bottom of cliffs and talus slopes. Exposed in the sandy soil is dark grey to black Precambrian rock. Sagebrush, grasses, and an abundance of perennial and annual plants grow here. Cryptobiotic soil crust and lichens cover the ground in many areas. Elevation: 5000' to 4500'.

## 5 Creek Bottom/Drainages/Riparian

Habitat: Seasonal water flows carry away soils and rocks to deepen and widen the canyons. Where year-round water is available, clusters of cottonwoods, and willows grow. Elevation: 4800' to 4200'.

# Tips for Plant Watchers



**1** Plants can be a source of wonder and amazement for children as well as adults. Yet because we are seldom conscious of them in daily life, our connections to them have dwindled. We live in cities where pavement and buildings rise in place of trees and plants. Our food and clothing comes from stores instead of crops and animals that we grow. A trip to Colorado National Monument offers a memorable opportunity to rediscover our “roots.” The keys to interesting children in plants lie in an adequate amount of time to explore, and in an attitude of appreciation and marvel by the leader. Enthusiasm and curiosity are contagious, no matter what the subject.

**2** The leader should feel comfortable with the subject matter and the setting. Trying to figure out which way to go at the same time as trying to locate interesting plants will cause tension for both the leader and the class. As a result, the students will be more disruptive and hard to handle. Therefore, take time to review background information, make notes, and preview the area.

**3** Visit the trail that will be used for the field trip ahead of time, and as close to the date of the trip as possible. Flowers are ephemeral, and do not last long. Two weeks later, the beautiful cliffrose will no longer be blooming. Nor will the fifteen species that you painstakingly keyed out. Thus, plan your exploration with students as close as possible to your preview of the trail.

**4** Structure the hike to coincide with students’ rhythms. If they are at their most energetic in the morning, have the moving part of the trip early. To ask them to walk slowly and observe, when they are straining to get out and go, will cause trouble for everyone. After lunch and snacks are natural times for reflecting, observing, and conducting quieter activities.

**5** Not all people are inclined towards plants. The interest and enthusiasm of the leader will draw in some students, but many will still need help. If you can anticipate who these children are, pair them with a chaperone who can give them individual attention and encouragement. Planning a few special activities for these students can also make a big difference.

For example, many people like plants but have more active ways of exploring their environment. For them, “jobs” can be created to keep them interested, alert, and involved. These may be given verbally, or a task card with the assignment can be developed. Below is a list of possible jobs.

- ~ Assign students to be “scouts” for certain plants. One looks for cactus, while another lets you know when you pass a Sego lily or Indian paintbrush. You may want to allow these scouts to go at the front of the line, and report back their discoveries.
- ~ A second option is to designate “counters” to keep track of the number of bees and wasps that are located at flowers along the way. “Counters” can keep a list of all the plants that are found, record the number of plants that are in seed, in bloom, or are dead, throughout the trip.

# Tips for Plant Watchers



- ~ A third option for the active learner is the role of “defenders” of the cryptobiotic soil crust. They let you know when it is nearby, and help keep students on the trail.
- ~ Still other students can be “trackers”, finding signs of animals’ use of plants and trees.
- ~ A student who likes field guides can be the “informer”, carrying the guide and looking things up.
- ~ For the most active students, the role of the “litter bug” can be created. This student carries the trash bag and collects litter along the route.

**6** Make linkages between plants and other aspects of the environment. If students learn about how juniper trees are pioneers for growth in new environments, then they may appreciate the junipers in their own yards a bit more. If they see a broken-off cactus pad or a loose cactus fruit, they will think of it as food for a pack rat later that night. Creating an appreciation for and understanding that plants are essential elements in the web of life is a valuable goal for any field trip.

**7** Plant names are important and useful terms for describing, classifying, and recollecting. However, the value of the plant lies not in its identification, but in its function and place in the environment. As the leader, you do not have to be a scholarly botanist. Children’s interest in names is not nearly as great as their curiosity about leaf hairs, cones, flowers, and cactus pads and spines. Encourage them to invent their own plant names based on features of the plants that they observe. Then compare what they give to what scientists have given. If you are familiar with scientific names of plants, you may want to include these too. As the roots of so many plant names derive from Latin or Greek, a follow-up lesson with dictionaries might be of interest.

Several books about the derivations of plant names are also available. See the bibliography section for more information.

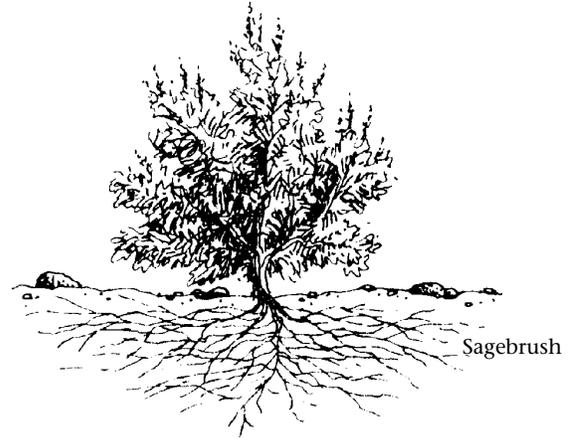
# Plant Adaptations to the Environment



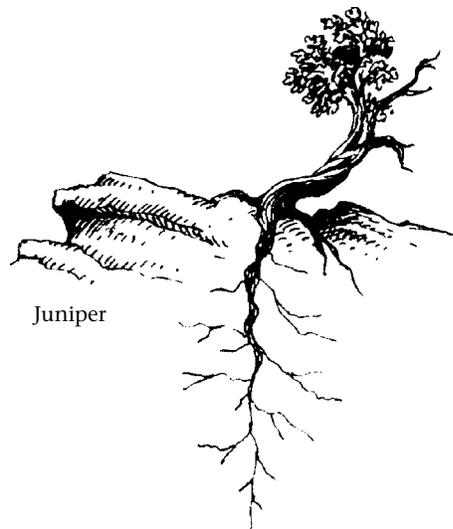
Plants are in a state of continual change. Between the flux of seasons and the resulting periods of growth and dormancy, plants must complete their cycle of life in a short period of time to assure survival. In an environment like that of the Grand Valley, where only 6 to 12 inches of moisture are received each year, plants face additional challenges. The first is to get enough water to survive. The second is to preserve what water they can. The third is to protect themselves against heating up and drying out. To cope with these obstacles, plants have developed many fascinating and unique features.

To appreciate what plants must contend with, look first at what humans carry with them when going on a hike or camping trip. Water, food, shelter, rain gear, jacket, hat, sunscreen, hiking boots are among the essentials that we need. What, then, do plants do in the same setting? Numerous adaptations help each one to prevail. Below are some of the strategies that plants and plant families utilize to assure reproduction and survival.

## How plants get water



**1** Extensive, shallow root systems spread far beyond the plant itself. If only a small amount of rain falls, these widespread roots absorb as much as is available for the plant. *Examples: Sagebrush and cactus.*



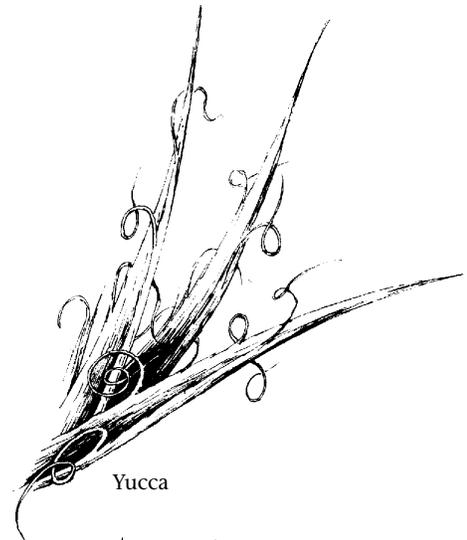
**2** Long tap roots reach deep in the soil to bring underground moisture to the plant. *Example: Juniper.*

# Plant Adaptations to the Environment



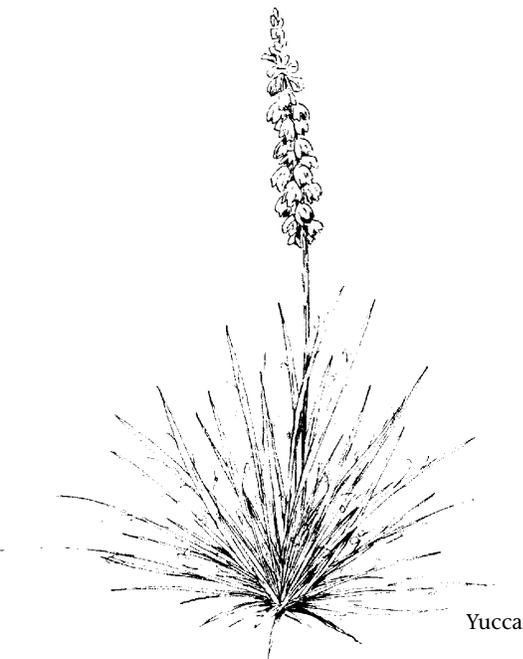
**3** Plants are widely spaced. This reduces competition between plants for water, nutrients, and other scarce resources. Some plants even concentrate resins, minerals, and other compounds in the soil surrounding them to make it difficult for other plants to grow nearby.

*Examples: Sagebrush, pinyon, and juniper.*



Yucca

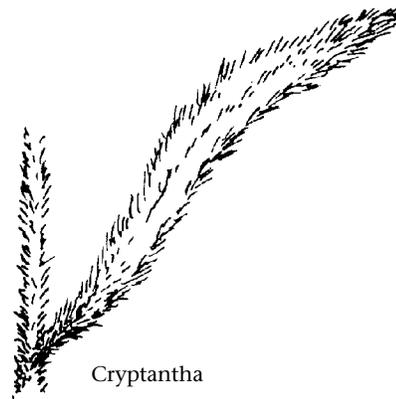
**5** Leaf edges curl up or inward to act as a reservoir for any available moisture.  
*Examples: Yucca, primrose, and grass families.*



Yucca

**4** Leaves grow in a rosette or whorl shape to direct any moisture collected to the center of the plant.

*Examples: Yucca and buckwheat families.*



Cryptantha

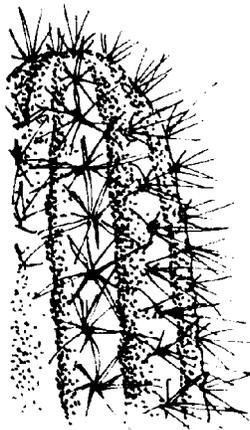
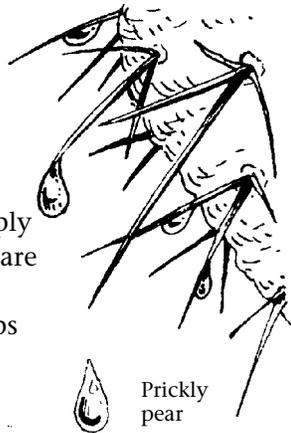
**6** Tiny hairs cover the surface of the leaf and/or stem. This increases surface area from which the plant can capture moisture from the air.

*Examples: Indian paintbrush, globemallow, and borage family.*

# Plant Adaptations to the Environment



**7** Spines and sharply pointed leaf tips are oriented downwards to drain dew and raindrops towards the soil below.  
*Example: Prickly pear cactus.*



Hedgehog

**8** The stem is wavy or fluted so that water and dew can be channeled to the base of the plant.  
*Example: Hedgehog cactus.*



Indian paintbrush

**9** Plants grow as parasites on other plants, getting their moisture and nutrients from the other plant.  
*Examples: Indian paintbrush and mistletoe on juniper trees.*

**10** Plants grow in areas where a black crust grows in the soil. Known as cryptobiotic soil crust, the blackened areas are actually a patchwork of tiny filaments of fungus, algae, lichen, and moss that penetrate the soil to aerate, open up, and increase soil volume. They also aid in retention of water, and decompose into valuable soil nutrients and organic material. Seeds and plants growing in such places benefit from association with the soil crust.  
*Example: Pea Family.*

# Plant Adaptations to the Environment

BACKGROUND FOR  
TEACHERS

## How plants keep water



Rabbitbrush

**1** Surface area of leaves is reduced so less water is lost from transpiration and overheating. Many plants have narrow leaves, such as *rabbitbrush*, *composite*, *buckwheat*, and *mustard families*. Others are deeply dissected leaves: *geranium* and *delphinium families*.



Mountain mahogany

*alderleaf* in fruit



*curleaf* in fruit

**2** Leaves are reduced in size compared to leaves of plants growing in wetter environments: *composite family* and *pine trees*. Leaves roll or curl under to be smaller: *mountain mahogany*. These strategies for survival reduce surface area from which moisture can be lost, thereby conserving precious water.

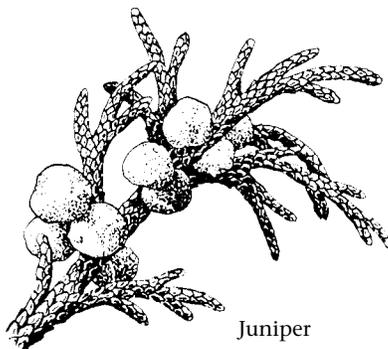
# Plant Adaptations to the Environment

BACKGROUND FOR  
TEACHERS



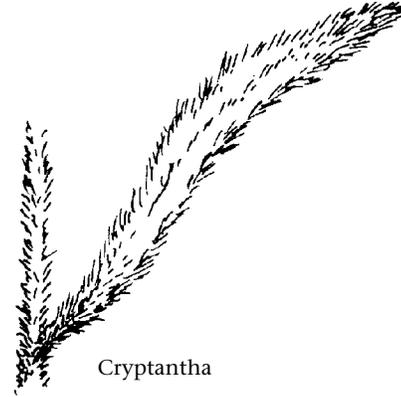
Sagebrush

**3** Leaves drop off and/or the plant goes dormant during especially dry seasons: *sagebrush*, *creosote bush*. The pads drop off during dry seasons, and new ones grow once rains begin again: *prickly pear cactus*.



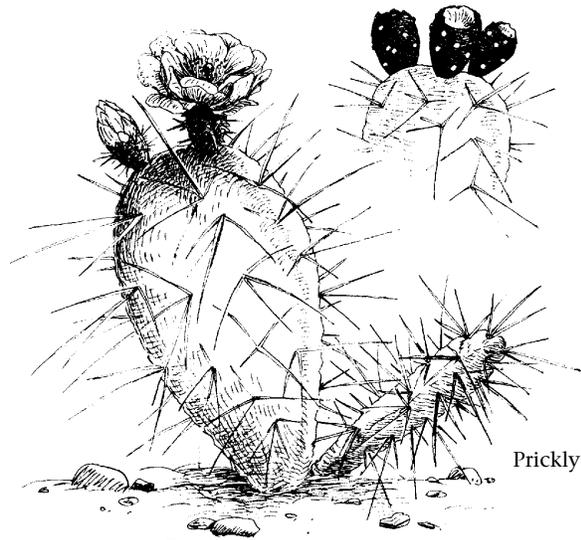
Juniper

**4** Leaves are tiny scales on the branch (*juniper* and *tamarisk*), or dry out soon after appearing (*Mormon tea*). *Prickly pear cactus* also have small scales at the joints that grow only for the first few years.



Cryptantha

**5** Leaves are covered with tiny hairs that reduce heat by reflecting away light, and cool the plant as air passes over them. The result is less water loss and improved survival. *Examples: Indian paintbrush, globe mallow, sagebrush, cliffrose, willow.*



Prickly pear

**6** Leaves are coated with a waxy substance, called cutin, that keeps water in and reflects away heat. *Example: Cactus family.*

# Plant Adaptations to the Environment



**7** The pores on leaves open at night instead of during the day as a way of keeping moisture in the plant. Blossoms open in the evening or early morning, and close up during the heat of the day.

*Examples: Four o' clock family, evening primrose family.*

**8** Leaves or stem are succulent, fleshy and thick, thanks to water storage tissues inside which retain water even when it is dry.

*Examples: Cactus and greasewood families.*

**9** Internal leaf structures enable leaves to dry out entirely, yet recover as soon as rain begin.

*Examples: Lichen and fungus.*

**10** Some plants have physical structures that act as reservoirs to hold water. Many swell up during rains, and wither as water is used up.

*Examples: Desert trumpets, bladderpods, and cactus.*

## How plants protect themselves from heat and harsh conditions

**1** Flowers bloom quickly, or in one day. The blossom happens before, or as, the leaves are coming out. The entire life cycle of the plant takes place during times of moisture, and the plant survives dry seasons as a seed. This leads to cycles of wildflower blooming, where wet years are spectacular, and dry ones are minimal. A second blooming of some species occurs when late summer rains trigger seeds to sprout and flowers to bloom.

*Examples: Many annuals, including the evening primrose, lily and grass families, utilize this strategy for survival.*

**2** Hairs and spines act to shade the plant from the ultraviolet rays and heat of the sun. They also reflect light away. Plants have a greenish-gray to white color on leaves and stem.

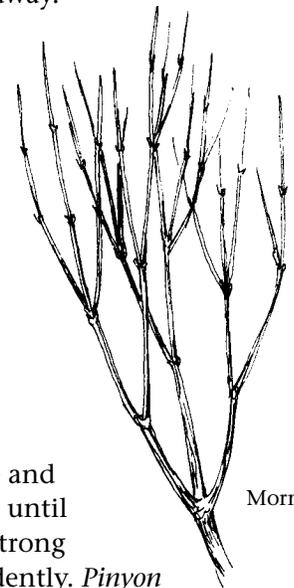
*Examples: Cactus, bladderpods, globemallow.*

**3** Plant has no leaves at all, and instead, photosynthesis takes place in the stem.

*Examples: Mormon tea and cactus.*

**4** Many seedlings and young trees get shade and shelter from something else until they are large enough and strong enough to survive independently. *Pinyon pines* follow pioneering *juniper* trees into new areas. Young trees grow under old ones.

**5** Plants orient leaves to point upward vertically to the sun so that a minimum of surface area is exposed to the heat. *Example: Mountain mahogany.* Plant leaves droop with the same effect. *Example: Willow.*



Mormon tea

# Plant Terminology

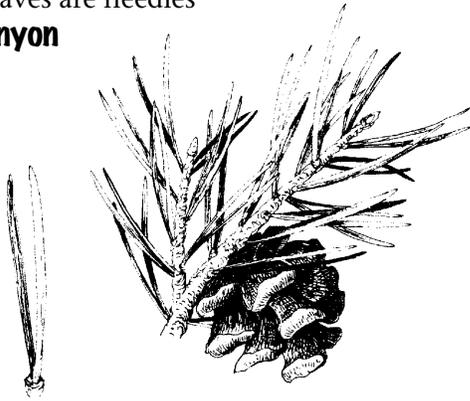


On a field trip, students will ask, “What’s this plant?” You do not have to be a botanist to answer their questions, but some background in plant identification is helpful. While botany is the study of plants, a division within it is known as “taxonomy”. It is the study of how plants (and animals) are classi-

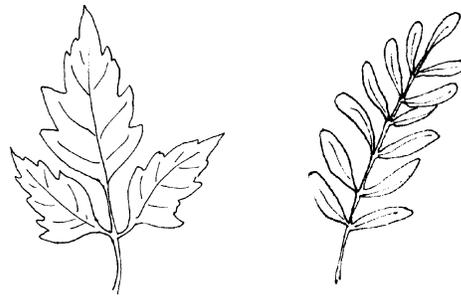
fied, based on a systematic arrangement into categories. Because many details combine to distinguish plant species, attention must be paid to all parts. The following terms will help you match up an unknown plant with information in a field guide to decide “what that plant is.”

## Kinds of Leaves

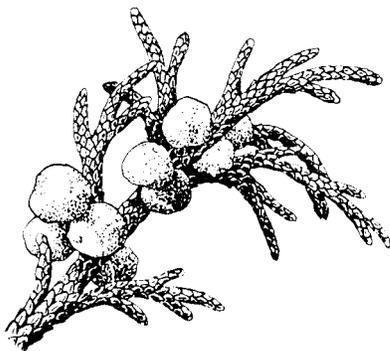
Leaves are needles  
**Pinyon**



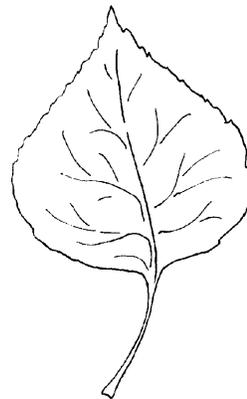
Leaves are compound  
**Legume (Pea) Family**  
(many smaller leaflets come off a single stem)



Leaves are scales  
**Juniper**



Leaves are simple  
**Singleleaf Ash and many other plants**  
(single leaf on a stem, unbranched)



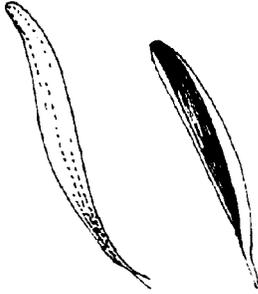
# Plant Terminology



Leaves are linear

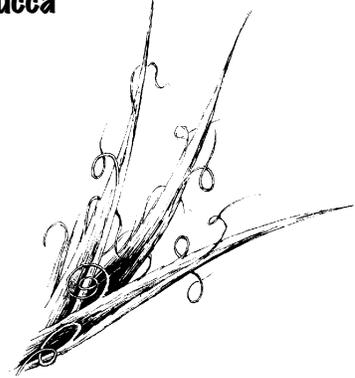
## **Rabbitbrush**

(longer than they are wide)



Leaves are lance-shaped (lanceolate)

## **Yucca**



Leaves are oval to ovate

## **Cottonwood**



Leaves are toothed

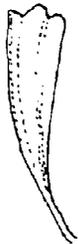
## **Mountain Mahogany**

(small indentations along the leaf edge)



Leaves are wedge-shaped (cuneate)

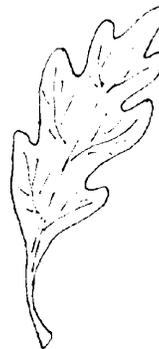
## **Sagebrush**



Leaves are lobed

## **Oak Family**

(edges are indented like scallops)



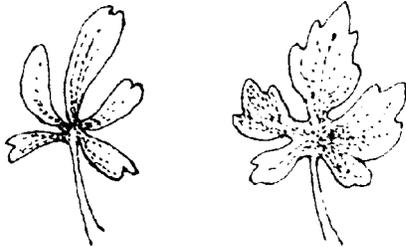
# Plant Terminology



Leaves are dissected

## **Globemallow**

(deeper indentations that may nearly divide the leaf)



Leaves are arranged opposite each other

## **Legume (Pea) Family and many others on the stem**



Leaf veins are parallel

## **Lily Family**

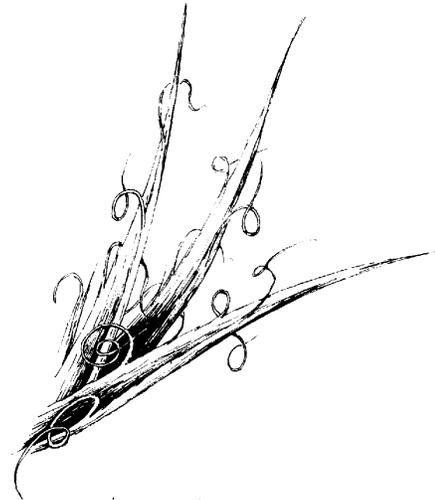
(all veins travel in the same direction)



Leaves are arranged in a whorl

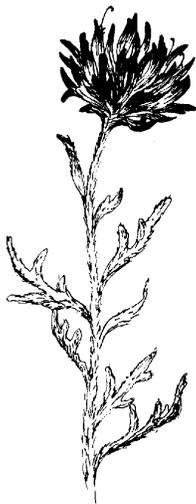
## **Narrowleaf Yucca**

(circular fashion around a single stem)



Leaves are arranged alternately on the stem

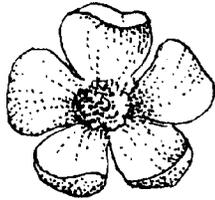
## **Indian Paintbrush and many others**



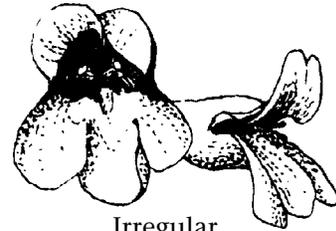
## Flower Terms

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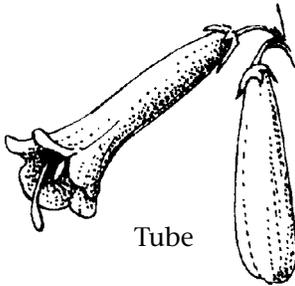
### Flower shape



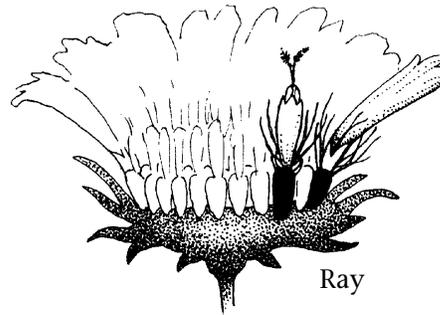
Regular



Irregular



Tube



Ray

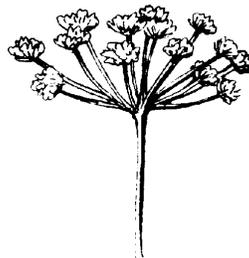
### Arrangement of flowers on stalk



Solitary



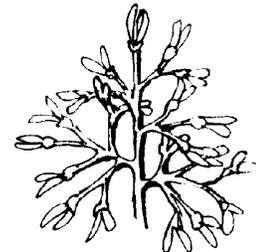
Spike



Umbel



Raceme



Panicle

# Plant Terminology



## Flower Terms

This area is for drawing flower shapes and arrangements of flowers on stalks.



### Flower shape

Regular

Irregular

Tube

Ray



### Arrangement of flowers on stalk

Solitary

Raceme

Spike

Umbel

Panicle

# The Value of Magnification



When studying plants in the field, whether it be the tiny mosses and lichens of cryptobiotic soil crust, the needles of a pinyon tree, or the hairs on the underside of a mountain mahogany leaf, a magnifying glass or hand lens is invaluable. An entirely new world opens up to students when a leaf is enlarged to show waxy epidermis, stomata, and tomentum. The true meaning of composite flower, and the remarkable adaptations of lichens to lack of water, can be appreciated. You do not need the fancy lens loupes of botanists. A five to ten-power magnification works well for students. If the school provides these, take them on your field trip. If not, a purchase may be worthwhile. Local discount stores, art suppliers, even toy stores may carry them. Alternatively, science distributors (NASCO or Carolina Biological Supply) should have them. Lastly, never underestimate the desk drawers, closets, and sewing boxes of your students and parents.

## A word of caution

Every group has at least one of these...the firestarter. They aren't bad children or pyromaniacs. It is just the chemistry of a magnifier in a hand coupled with a natural curiosity. A clear warning to the group when the lenses are passed out should take care of most problems. "These lenses are your responsibility. Thirty were passed out. Thirty must be returned. You will be responsible for replacing any that are lost. If the teacher or chaperone or other student sees anyone using the magnifier in a dangerous manner, no questions will be asked, and the magnifier will be collected immediately. This is dry country, a national treasure. It must be treated as such."

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## Age Level

4th through 8th grades.



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## Purpose of Activity

The purpose of this activity is to explore the fascinating and diverse world of plants with children. In this activity, they will learn how to identify plants by location and physical features. In addition, they will create a “Botanical Journal” as a record of the plants that they found at Colorado National Monument.

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## Amount of Time Needed

One to one and one-half hours.

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## Best Location

The “Journal” can be made at various points along a hike in the Colorado National Monument. Trails like Devils Kitchen, Old Gordon, No Thoroughfare Canyon, Monument Canyon, Black Ridge, Alcove Nature, and Window Rock can all be the focus for the hike. Even on a tour of Rim Rock Drive, this activity works well. However, not all plants listed in this activity will be found on each trail.

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## Materials Needed

Materials needed include:

- “Botanical Journal” (one copy of each page per student).
- Pencil (one each).
- Colored pencils, craypas, or crayons (not markers).  
You will need lots of greens, grays, yellows, and browns.
- Clip board, or hard surface to write on (one each).
- Blank sheets of paper (for extra drawings or records).
- Magnifier (optional for younger students).
- Plant identification book(s).
- Optional: Make the “Botanical Journal” more informative by including copies of “Plant Terminology”, “Plants of Colorado National Monument,” “Life Zones,” and “Plant Adaptations”
- Optional: Camera to record interesting plants, or interesting students with plants.

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## Background Information

This activity works well on a day-long hike or overnight outing. It can be used by itself or mixed with other activities, such as “Territories”, “Who Lives Here?”, and “The Magic of a Drop of Water” and “Floral Investigation”. It serves as an excellent conclusion to a study of plants, and will assist the teacher in assessing how much the class has learned. It also complements and involves Educational Content Standards in science.

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## Review Teacher Information

Before going on a plant hike at Colorado National Monument, review the information given in the Background Information section of this chapter. Many useful concepts about plant survival and adaptation to dryland conditions are outlined. Specifics of plant and flower structure are also shown. Lastly, look through “Tips for Plant Watchers” to assist in planning for students’ needs.

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## Take Time to Explore

Time to inspect and investigate is crucial to the success of the “Botanical Journal”. Be sure to allot plenty of time to explore, observe, and record. Everyone will appreciate being able to get their worksheets done, and the time to really observe “their” plants.

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## No Collecting Policy

Always remember that you are in Colorado National Monument. As a result, NO PLANTS, OR PARTS OF PLANTS, MAY BE COLLECTED. They are an important part of the future of the area. Not only do the plants help to hold and create soil, but they carry in them the seeds of future generations of plants. Taking one, or destroying one, may not seem significant to you. Yet the increasing number of visitors to the area is resulting in a steadily growing impact to the land. One picked flower multiplied hundreds, even thousands, of times means less vegetation — more erosion on the land — less food and shelter for wildlife — more displacement of creatures from their territories — less diversity and beauty for the visitor — more future economic and quality of life deterioration for area residents. It may seem like a little thing to pick a flower, but the consequences extend for a long way.

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## “Botanical Journal” Worksheets

Following this activity are the “Botanical Journal” worksheets. Twelve plants are described in detail. Included is information on plant features such as leaves, stem, blossom, fruit, and root. Adaptations of the plant to live in the desert-like conditions of the region are also shown. When possible, details on the scientific and common name of the plants are given. Drawing is an important way of learning. A line drawing of each plant will help students to identify it, and “close up views” highlight interesting features.

Worksheets also contain an area for personal observation and reflection by students. A section of each page is left blank for them to record in words, or with a sketch, their observations about the plant and its identification. This part of each worksheet can be tailored to meet any special interests of your class. It can also be expanded by the inclusion of extra blank sheets of paper in the “Journal”.

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## Encourage Participation

A word of encouragement: from previous plant activities, the teacher may be acquainted with individuals who are not interested in plants, and can be disruptive for the rest of the group. In anticipation of this situation, the teacher will benefit by reviewing “Tips for Plant Watchers” in the Background Information section. To encourage the participation of wanderers or non-enthusiasts, plan an extra dimension to this exercise: hunting for insects and spiders using plants, or finding signs of bird or animal use of plants or areas around them. These discoveries not only will help the individual student, but all students will become more aware of how crucial vegetation is in the desert web of life.

## How to Do the Activity

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### Before the Field Trip

Before the field trip, the teacher should copy off the “Botanical Journal” sheets that accompany this exercise. Enough should be made for each student to have a copy. All plant profiles may be used, or feel free to focus on only a few. “Botanical Journal” is easily tailored to meet curriculum or site needs. In addition, a blank plant identification sheet, called “Your Own Record,” is included so that students may document a special plant of their own. (See Extensions for more information on this.) Compile “Journal” pages and secure with a paper clip, staple, or on a clipboard.

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### Methods for Identifying Plants

In the classroom before the field trip, the teacher should discuss how to identify a plant with students. Grade appropriate curriculum materials may be incorporated here. Of greatest use to students will be information on leaf size and shape; leaf arrangement on the stem; and flower, fruit, and seed structures. Numerous resources to plants and field guides are listed in the “Resources” chapter at the back of this manual. In addition, the “Background Information” section of this chapter offers useful identification tips in “Plant Terminology”, “Flower Identification”, and “Plant Adaptations”. The activity “Floral Investigation” also makes an excellent warm-up activity for the “Botanical Journal”.

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## Preview the Trail

Just a few days before the trip, the teacher should preview the trail where the field trip will take place. Flowers are ephemeral, fading away within a short time after blooming. What was in full glory over the weekend may well have disappeared by mid-week, and been replaced by something unnoticed before. The leader should locate some of the plants shown in the “Botanical Journal” beforehand, and make good notes about where they are so that the group will find them with ease.

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## Step-by-Step Instructions

- 1 On the field trip, find a quiet place to sit to go over the activity. Begin by passing out the “Botanical Journals”, along with pencils, colored pencils, and a hard surface on which to write.
- 2 Go over each page of the “Journals” with the students. Explain that along the hike they will be looking for many of the trees, shrubs, and flowering plants shown inside. At various stops, they will have opportunities to observe and record in their books about the nearby plants. The purpose of the activity is not to record all plants, but to study a few closely. Plan plenty of time to do the writing on the hike.
- 3 Each page of the journal has a section in which students may make their own sketch, statement, poem etc. about the plant. Botanists study plants by making measurements and observations as well as by making “field notes.” Many times these jottings end up having significant scientific value unknown at the time of record. The students will have a similar option.
- 4 Review National Park Service regulations about collecting with the class. Remind students to stay on the trails when looking for plants to protect the fragile cryptobiotic soil crust.
- 5 After hiking a good distance, stop at a place where there are enough plants along the trail for everyone to observe at least one. Give a set amount of time for students to make an entry in their journal. During the stop, the teacher and chaperones should roam among the students to assure that they are doing all right. Give reminders of the time at five minutes and one minute. See “Tips for Plant Watchers” for ideas of how to engage students in the task.
- 6 Make stops for other recordings. Occasionally, the teacher may want to have students report to the group some of their more interesting discoveries. Bumblebees, spiders camouflaged inside a flower, or signs of pack rats chewing on cactus pads will be of special interest to the class.
- 7 The teacher may want to alert the group to changes of habitat or places where two ecosystems come together. If it can be done safely, students should step off the trail to explore these border areas. Notice how many more plants grow there. Try to answer the question, “Why it is that where communities overlap, there are more plants?” Compare with other areas like slickrock. What factors influence both the type of plant and the number of plants in a certain area? Could it be soil, moisture level, elevation, wind, weather, or exposure?

8 If a plant is found that is not in the “Journal”, use the “Your Own Record” sheets to make a record of it. Be sure to include specific details shown on the sheet, so that a correct identification may be made later using a field guide. Finalizing the plant species can be done back in the classroom, but complete field notes will make identification much easier.

9 If you have a camera along, photograph students making their observations. That way they will have a personal record of both their plant and the place it was found. Often children find far more meaning in photographs of their activities than adults expect. A Polaroid camera where the picture is immediately available, or one where the students can each take their own photographs, will be very successful with students.

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## Conclusion

Making a “Botanical Journal” of plants that students find at Colorado National Monument increases awareness of the diversity and bounty of these seemingly dry lands. Plants colonize the soil, and make it a more habitable place for wildlife as well as people. The ways that plants adapt to the limits of their environment, such as little water and lots of sun, are fascinating and impressive. Taking time to look closely helps students to appreciate the beauties, both large and small, around them. It also introduces and involves them in the scientific process.

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## Extensions

This activity has numerous adaptations and extensions. Foremost, it can be combined with other activities given in this manual. The “Territories,” “Plant Scavenger Hunt,” “Magic of a Drop of Water,” “Crossword Puzzle,” and “Floral Investigation” activities are easily linked with it, either in the field or later in the classroom.

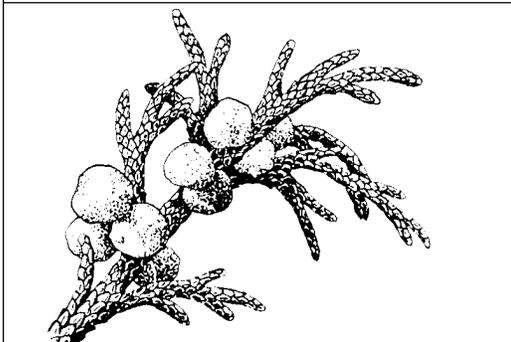
The teacher can also tailor the “Journal” to meet specific curriculum needs. If the class is studying trees, for example, the “Botanical Journal” can be used exclusively for trees. Alternatively, you can mix and match worksheets with other parts of the manual, such as the animal or geology chapters. The animal chapter has a “Wildlife Observation Sheet”, scat and track identification sheets that can all be incorporated in with the plant worksheets for a more broad-based Colorado National Monument discovery packet.

# Utah Juniper

The twisted trunks and deeply lined limbs of the Utah juniper are the centerpiece of many photographs of the western landscape. Stands of junipers, and pinyon pines, which often grow with it, cover thousands of acres of the arid southwestern United States and especially the state of Utah, for which this species is named. Juniper trees are part of the Cypress family, which includes about 70 species worldwide, and 13 species in the U.S. Because these trees have mistakenly been linked with the "cedar" family, they have spawned many place names, such as Cedar City, Cedar Breaks, and Cedar Mountain. These hardy and adaptable trees grow in alkaline soil, desert sands, cracks in rocks, even places where there seems to be no soil at all. In clearcuts and fire scars, they are often the first tree to set root and provide shade for the pinyons that will follow. Part of their

durability comes from their slow growth and long tap roots. Follow the root of a Utah juniper, and you will be amazed how far beyond the tree it stretches. Its small, scale-like needles tightly clasp the twigs to minimize water loss. Instead of cones, it produces round, wax-coated berries that mature over two to three years. As they age, they change from green to reddish-brown inside. Rabbits, jackrabbits, coyotes, and birds eat them, while humans use them for medicinal, herbal, and flavoring purposes. Juniper limbs and trunks have been used for centuries. Puebloan structures in Chaco Canyon have juniper beams, and fence lines across the West are held up by juniper posts. Countless meals have been cooked over juniper fires. The shreddy bark has been collected to make sleeping pads, sandals, rope, even diapers. Utah juniper is marvelously adapted to desert life, making it a better place for all.

## Up Close View



## Your Field Notes/Sketch

A large, empty rectangular box provided for students to write their field notes or draw a sketch of the Utah juniper.



# Pinyon Pine

The pinyon pine, or piñon pine, is one of the best known trees in this region. Its name is Spanish meaning “nut-bearing pine.” Large stands of these trees cover mesa tops, plateaus, and semi-desert lands between 4000’ and 7500’ in elevation, and occasionally higher. They are abundant from west and central Colorado, across Utah and Nevada, to the eastern slope of the Sierras. Their rounded, wide-spreading crowns also extend south into Baja, across central and northern Arizona, and green much of New Mexico. Because pinyons reach only 20 to 40 feet in height, they are often referred to as the “pygmy forest”. Different species are recognized by the number of needles per bundle: singleleaf (1 needle), Parry’s (4 needles) or hybrids (3 or 5 needles). Colorado pinyon, or

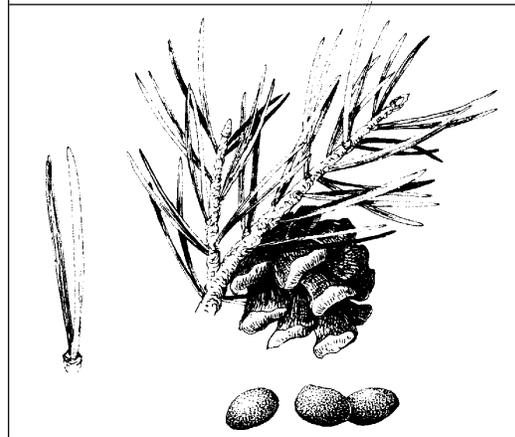
*Pinus edulis*, with two needles per bundle, is found at Colorado National Monument. Every part of this tree has a value in nature. Their trunks supply firewood, charcoal, and support shade shelters and hogans. Porcupines eat the bark, while pack rats and mule deer consume the needles. Resin, or sap, is sought as food by insects, and waterproofs many baskets of the Ancestral Puebloan people. The seeds, or pinyon nuts, are enjoyed most of all. Rich in protein, fat, vitamins and minerals, a multitude of squirrels, chipmunks, rats, mice, bears, voles, insects – and of course, humans – feast on them. Pinyon, Stellar’s, and scrub jays cache the nuts in the soil, thereby assuring that future generations of pinyon pines will grow.



## Your Field Notes/Sketch

Blank space for field notes or sketches.

## Up Close View



# Tamarisk

**T**amarisk is a ten to fifteen foot high shrub or small tree that grows along watercourses of the western United States, including that of the Colorado River. In spite of its abundance, tamarisk is not a native species. Introduced here in the 1800's, it has spread rapidly. Now, this non-native tree, which grows in dense, almost impenetrable thickets, threatens to out-compete willows, cottonwoods, and other water-loving native vegetation. Nevertheless, it is a striking looking tree, with feathery, soft-looking

branches, and clusters of pink flowers in the spring. Its leaves are small, almost scale-like, to minimize water loss. The root system is deep and wide-spreading. These features make it well adapted to arid climates, and contribute to its successful invasion of drainages and riverbeds. The National Park Service is attempting to minimize the impact of its entry into the canyons of Colorado National Monument with programs to remove it.



## Your Field Notes/Sketch

A large empty rectangular box intended for students to write their field notes or draw a sketch of the tamarisk plant.

## Up Close View



# Rabbitbrush

Rabbitbrush, also known as Chamisa, is a two to four foot high shrub that is found in many parts of Colorado National Monument and the western United States. A companion of sagebrush, it grows on dry mesa tops, along roads and trails, and flourishes in moist drainages. Its stems are greenish-white in color, and quite straight as they emerge from a woody trunk. They have been used in basketry, for arrow shafts, and as fuel. The leaves are narrow, 1 1/2 to 3 inches long, with little value as forage for

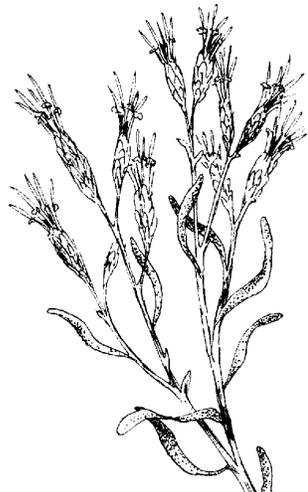
animals. In the fall, rabbitbrush is most striking, because its crown is covered with a profusion of bright gold flowers that emit a pungent smell. Its botanical name, *Chrysothammus nauseosus*, means "golden bush with a strong smell." After the blossoms fade, the seeds provide important winter food for juncos, sparrows, and many other seed-eating birds. Another name for this plant is "rubber rabbitbrush," for the latex-like sap that oozes from broken branches.



## Your Field Notes/Sketch

A large empty rectangular box for students to write their field notes or draw a sketch of the rabbitbrush.

## Up Close View



# Sagebrush

Some people say the smell of the desert after a rain is one of the best imaginable. One reason is a three to six foot tall shrub called big (or tall) sagebrush. Its leaves contain an oil which has a fragrance that is unforgettable. However, it is not used in cooking. The spice, sage, is in the mint family, whereas the sagebrush of the dry lands, deserts, and mesas is in the sunflower (composite) family. The botanical name for sagebrush is *Artemisia tridentata*, from the Greek goddess of nature, Artemis. "Tridentata" refers to the leaves of the sagebrush, which are wedge-shaped with

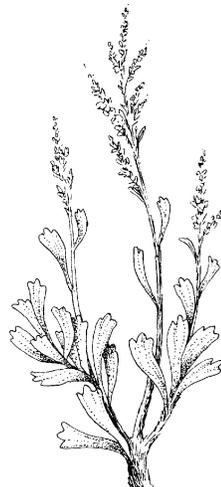
three (tri) teeth (denta) at the end. The green-gray leaves are covered with tiny hairs that both reflect light away, and catch any available moisture. In the late summer and fall, flowers that look like tiny clusters of yellow, and greenish-gray balloons bloom atop the bush. The roots of sagebrush run shallow (to catch any moisture from rain showers) and deep (to reach underground sources of water). In dry seasons, sagebrush can go into a dormant state until the next rains. Because of these adaptations, sagebrush is well-suited to desert life, and covers hundred of miles of the western landscape.



## Your Field Notes/Sketch

A large empty rectangular box provided for students to write their field notes or create a sketch of the sagebrush.

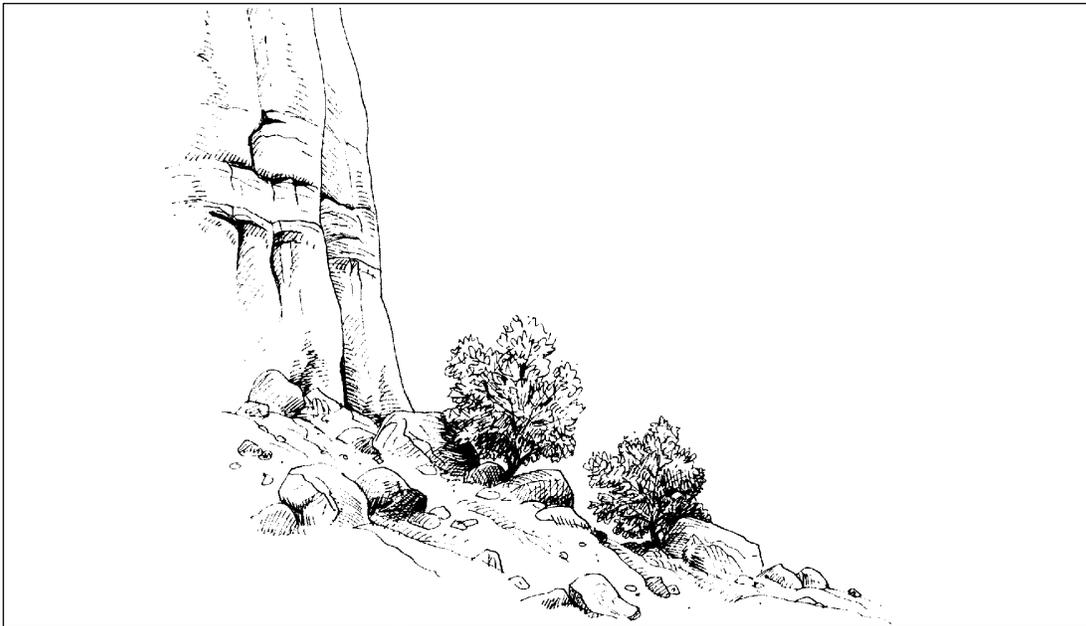
## Up Close View



# Serviceberry

The rocky slopes below the red-orange cliffs of the Wingate Formation are dotted with a three to ten foot tall shrub that lights up the landscape when it blooms. In the spring and summer, serviceberry flowers form clusters of bright, white blossoms at the end of a stem. The five petals are one-half inch long and twisted, so that they look like tiny flags twirled by the wind. These flowers create the effect of snow-in-summer across the canyons of Colorado National Monu-

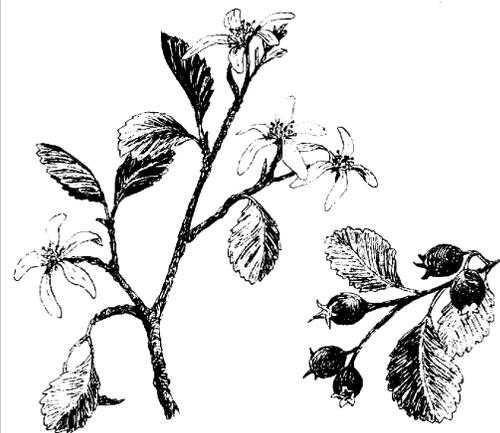
ment. Much of the rest of the year, serviceberry is inconspicuous. Its small, round, toothed leaves provide important shade, shelter, and forage for deer, bighorn sheep, rodents and birds. When its fruit ripen in mid-summer, they look like tiny, dry apples. Many birds and animals, like bears, consume them. As preserves, dried fruit, or mixed into jerky or pemmican, humans too enjoy serviceberries.



## Your Field Notes/Sketch

A large empty rectangular box for students to write their field notes or draw a sketch of the serviceberry.

## Up Close View



# Mormon Tea

Mormon tea, or *Ephedra*, is among the most abundant plants at Colorado National Monument. It grows in canyons, on slopes, rocky areas, even cliffs. Because it looks like a cluster of dead twigs, Mormon tea is easy to recognize. Still, this distant relative of pine trees is very much alive, and superbly adapted to life in the desert. A member of the Joint-fir family, it grows in a skeleton-like arrangement of segmented green branches up to four feet tall. Rather than leaves, it has tiny scales that appear at joints, where the segments come together. This adaptation helps to reduce water loss. With such small leaves, Mormon tea instead photosynthesizes through chlorophyll in its

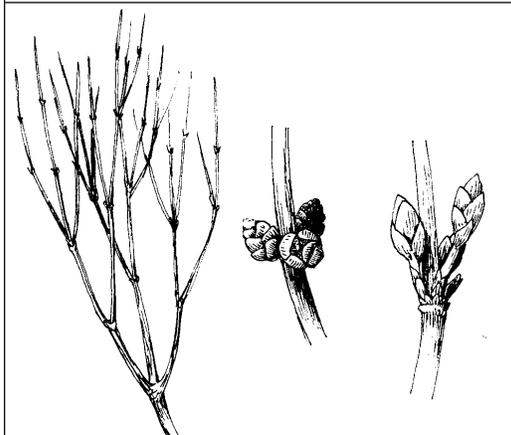
branches. Separate male and female plants grow near to one another, and have cones instead of fruit. By looking closely, you can tell them apart. The male cones grow right next to the joints, whereas female cones have short stems that make them stick out more from the branch. Teas made from the branches of Mormon tea are said to cure many different symptoms and illnesses, and give the plant its common name. Relatives of this plant in Asia are one of the sources of the drug, ephedrine, which is used as a decongestant and for bronchial disorders. Our local plant, often called Ephedra, has minimal quantities of that drug, and simply makes a pleasant tea.



## Your Field Notes/Sketch

Blank space for field notes or sketches.

## Up Close View



# Mountain Mahogany

Three species of mountain mahogany are found at Colorado National Monument: alderleaf, curleaf, and hybrids of the two. All are very drought tolerant, slow growing, and have been found to fix nitrogen in the soil. You can see them on rocky slopes, mixed with pinyon and junipers, and on the sagebrush flats as well. *Cercocarpus*, meaning "tail-fruit", is the Latin name for this group of shrubs. It is most appropriate, given that the seeds are so striking. The small, green and yellow tube flowers have no petals, and develop into seeds with long tails covered with white hairs. Some years, the branches seem to fluff out with decorative plumes. As the seeds dry, the feathery "tails" curl up into corkscrews. When they fall to the ground, they are perfectly poised to dig themselves

into the soil. The tiniest bit of rain or dew releases the coiled up tail, and powers the seed into the earth, thereby planting the next generation of mountain mahogany. In spring and summer, alderleaf is covered with small, oval leaves that resemble tiny rippled potato chips. They roll under on the sides as a way to reduce surface area and water loss. Leaves of curleaf are narrow and pointed at both ends. Dark green on top and white hairy below, they also curl up, hence the name. Deer, elk, and bighorn sheep browse on the leaves and branches of these sturdy shrubs. Since the trunks are hard, strong, and quite straight, they have found many uses as arrow shafts, digging sticks, and in woodworking. Because they polish well, "mahogany" is an especially fitting name.



alderleaf in fruit



curleaf in fruit

## Your Field Notes/Sketch

# Globemallow

Unlike other members of the hollyhock family that grace many gardens, the copper globemallow is found in drylands, rocky or disturbed soils, and road sides. Locally, it grows along Rim Rock Drive, as well as trailside, on plateaus, and in canyons. This widespread perennial plant is very adaptable, in part because its extensive root system penetrates deeply into the soil. Like many desert flowers, it grows quickly during the spring, blooms in May to mid-July, sets seed, dries up, and disappears. Globemallow's pale green leaves are opposite on the stem, and are so deeply dissected (cut) that they

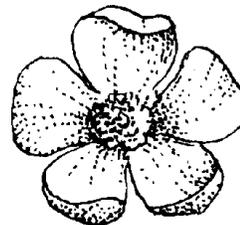
look like tiny fingers. To the touch, both the stem and leaves feel powdery from a coating of tiny white hairs, which help to reflect away light and conserve water. The orange to scarlet colored flowers have five overlapping petals that create a cup-shaped blossom. In the center, bright yellow stamen are fused to the pistil. The botanic name for globemallow comes from the Greek words, *Sphaeralcea munroana*. "Alcea" means "mallow", and "sphae" means "sphere", which describes the fruit, which are little globes (spheres) that divide, like oranges, into five segments.



## Your Field Notes/Sketch

A large empty rectangular box for students to write their field notes or draw a sketch of the plant.

## Up Close View



# Indian Paintbrush



Indian paintbrush is easily recognized and appreciated for its brilliant scarlet, red, rose, yellow and orange colors. Named because it looks like a scraggly artist's brush dipped in paint, it may be found high in alpine meadows, growing out of cracks in slickrock, or tucked under sagebrush across the desert. If you look at it closely, what first appears to be red flowers are not flowers at all. Instead, they are small leaves, called bracts, that grow at the base of the flower. Usually bracts are green, but in the case of paintbrush, they are brilliantly colored. The flower itself is a small tube of dull color, often hard to distinguish within the bracts. Still, hummingbirds and bees

know to find plentiful nectar at the base of this flower. Like many desert plants, the leaves of paintbrush are reduced in size, narrow and lancelike. Their gray-green color comes from tiny hairs covering them. The hairs assist in reflecting away light and conserving water. Perhaps the most unique quality of this plant is its tendency to be a parasite on sagebrush and other plants. By invading the roots of a host plant, paintbrush receives sugars, water, and minerals, in addition to shade from the desert sun. Look for these brilliant flowers from spring until late fall in all of Colorado National Monument's canyons, and along Rim Rock Drive.



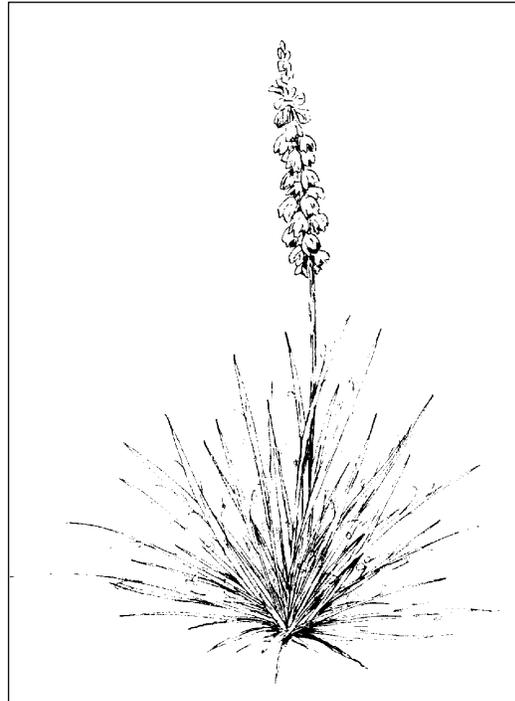
**Your Field Notes/Sketch**

**Up Close View**

# Yucca

**Y**ucca is a common and easily identified plant at Colorado National Monument. Found in the dry soils of mesa tops and canyons, it grows from a central spot outward to form a tight cluster of spike-like leaves. Care should be used around these plants because the ends of the gray-green leaves are sharp and needle-like. Spanish bayonet and dagger plant are nicknames for yucca that derive from the pointed leaves. Another feature of yucca is that the leaves roll up along the sides, creating a channel that extends from the outermost point of the leaf downwards to the middle. Possibly this structure helps to catch and drain any moisture to the central stem. Strong fibers, prized by basket makers, line the leaves, and often curl up along the edges. In the spring, cream-colored yucca flowers bloom on a stalk that rises three to five feet in height. The flowers, which only open at dusk, have a remarkable relationship with a tiny night-flying moth. It places yucca pollen, along with one of its eggs, inside the stigma of the flower, thereby assuring both the pollination of the flower, and the safety of its young. Several weeks later, when a fig-shaped fruit ripens on the stalk, the developing larva eats some of the many seeds, and then chews its way out of the fruit to fly away. Can you find a tiny hole in a yucca fruit that a moth left behind? The roots of the yucca, like those of many desert plants, spread out far

beyond the plant. For centuries, people have gathered them for their high quantity of saponin, a soap-like material that works well as a cleaning agent. Yucca is a fascinating desert plant, for its lovely form, its remarkable natural history, and its many uses.



## Your Field Notes/Sketch

A large, empty rectangular box intended for students to write their field notes or draw a sketch of the yucca plant.

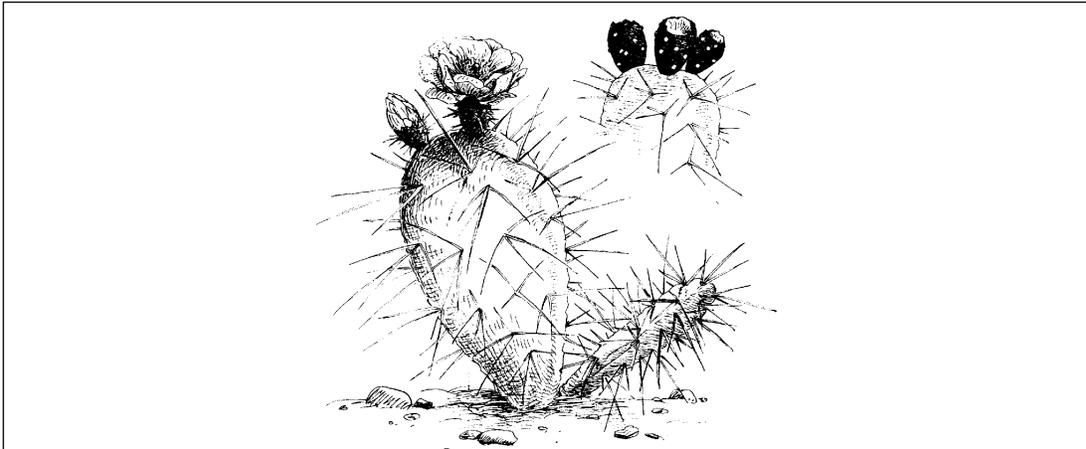
## Up Close View



# Cactus

The cactus is one of the best known desert plants. This spiny succulent has four important adaptations to survive in lands of little rain. First, it has an extensive root system that spreads far beyond the plant itself. Even the smallest amount of moisture is absorbed and put to use. Second, when it rains, the cactus has internal structures that act like reservoirs to store water for the future. Third, cactus has few, if any, leaves, thereby reducing sources of water loss. Instead, the stems, which are covered by a thick waxy coating, carry on the functions of photosynthesis and transpiration. Fourth, cactus has spines which protect it from animals that might eat it, and which help to shade it from the hot sun. Together, these features reduce moisture loss, and keep precious water in the plant. Cactus plants are well known for their beautiful flowers that

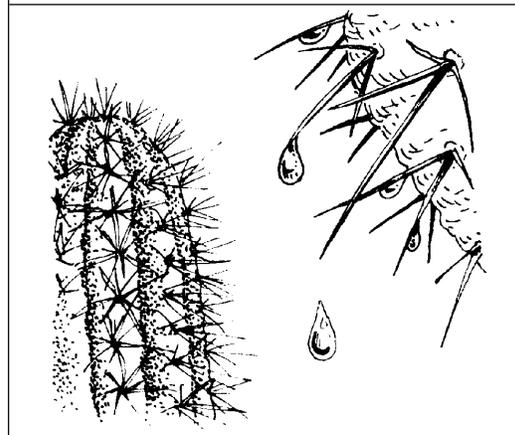
bloom for as little as one day during the late spring and early summer. Their pollination is assured by insects and bees that are attracted to the brightly colored petals and the ample amounts of pollen. The fruit that follows is enjoyed by many creatures, most notably the pack rat. Of the 2000 species of cactus found in our hemisphere, eight are found along Colorado National Monument's canyons, mesa tops, slickrock, and trails. Prickly pear cactus, which looks like a rambling collection of flat, oval-shaped pads, one atop the other, grows low to the ground, and can cover large areas in the canyon bottoms. Its flowers are yellow to pink, and its fruit reddish. Claret-cup cactus is small, with a ridged stem and brilliant red flowers. Because of their unique beauty, and desirability for dry-land landscaping, many species of cactus are becoming threatened or endangered.



## Your Field Notes/Sketch

A large empty rectangular box for students to write their field notes or draw a sketch of the cactus.

## Up Close View



# Find Your Own Plant



Name of plant, if known: \_\_\_\_\_

**D**escribe your plant. Begin at ground level, and estimate its height. What are the size and shape of the leaves? Are the leaves arranged opposite each other, or alternating on the branch or stem? Are leaves/stem hairy, smooth, or powdery? Are leaves curled under or up? Are they narrow, wide, cut up, wavy, or smooth? Do they seem waxy, shiny, or succulent? If flowers are visible, count the number of petals, stamen, and comment on their colors and arrangement. If fruit are visible, what are their shapes, sizes, and colors? Are there spines or other interesting features? Do you see any signs of insect, spider, bird or mammal use of the plant? Where is your plant located? Is it near water, on slickrock, in a canyon, along the road, trail, etc. After you have recorded your discoveries in the space below, compare your plant with the plants described in the "Botanical Journal". Does it match any of them? If so, write its name in the space above. If not, try using a field guide to plants, or ask your teacher to help you identify what kind of plant you have found.

**S**ketch your plant. Include its stem, leaves, flowers, fruit or other interesting features. This is to help you remember it, and does not have to be a great artistic creation.

# The Magic of a Drop of Water

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## Age Level

4th through 8th grades —  
as well as ages younger and older.



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## Purpose of the Activity

This activity is an investigation of the effects of water on cryptobiotic soil crust (formerly known as cryptogamic soil). After a cup of water is poured on the cryptobiotic soil crust, students watch a remarkable transformation of the organisms from a hard, wizened, dry crust to a soft garden of diverse plant life. The adaptability and resilience of plants in a desert environment is dramatically underscored in this short project.

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## Best Location

Perhaps the most easily accessible area for this activity is along Old Gordon Trail after the split of Old Gordon and No Thoroughfare/Devils Kitchen Trails. However, many other trails, including Monument Canyon, Otto's, Liberty Cap, and Coke Ovens also have extensive areas of cryptobiotic soil crust. This activity can be done at any point that suits the needs of the group, but works very well as an introduction to desert from the trail. It must be located in such a way that everyone in the group can reach it without walking off the trail. This soil crust is very fragile, and damage to it can last for many years. Therefore, students must have easy access so that little impact from their presence will occur.

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## Materials Needed

In addition to a large area of cryptobiotic soil crust, the materials that you will need are:

- Hand lens. Preferably one for each student or pair of students.
- Water. Enough for one cup per student.
- 5 ounce or larger paper cups. One per student.
- Stop watches or watches with second hands on them.  
(Extension for grades 6 through 8.)

# The Magic of a Drop of Water

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## Background Information

Cryptobiotic soil crust has received increasing attention over the past few years as more visitors come to explore the national parks and monuments of the Four Corners Region. In truth, this type of soil crust has existed for multitudes of years without much recognition. Now, because more people hike trails, ride bikes, camp, raft, adventure, and use off-road vehicles in the desert, damage to this fragile environment has been occurring at a faster and faster rate.

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## What is Cryptobiotic Soil Crust?

Previously known as cryptogamic soil, cryptobiotic soil crust derives its name from the Greek words, *kryptos*, meaning “hidden” or “covered”, and *-biotic* meaning “having a mode of life.” A hidden life it is indeed!

This soil crust is composed of many of the simplest plants in the plant kingdom. Tiny filaments of blue-green algae (known as cyanobacteria), as well as other algae, intermingle with mosses, lichens, and fungi to create a miniature community that is scarcely two inches high. Many of the elements of cryptobiotic soil crust, the Thallophytes, or algae and fungi, have no roots, stems, leaves, or flowers. The Bryophytes, which include mosses, have stems and leaves, but no roots or flowers. Without the glamour of size and colorful flowers, the members of this plant community are easily overlooked, and unappreciated.

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## The Contributions of This Soil Crust

The contributions of these simple plants to the desert environment are nonetheless important. First, they grow slowly, both above and below the soil, to form a complex of organisms that help hold soil in place. They act like a net, trapping soil particles so that they will not blow or wash away. Second, they add valuable nutrients, such as nitrogen, to the soil. Third, as they decompose, they add critical organic matter to the soil. As a result of these contributions, the desert soils are richer, better able to hold water, and more hospitable for other plants. In all of these “hidden” ways, cryptobiotic soils perform a life-giving role in the desert.

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## Impact of Their Destruction

The destruction of these soils by people unfamiliar with the desert, and unaware of the impact of their vehicles, bicycles, even footsteps, has serious consequences. Without the protective cover and nutrient benefit of cryptobiotic soil crusts, plants do not have a foundation, and soils rapidly erode. Damage this significant is not easily repaired. Scientists estimate that from 50 to 250 years are needed for these soils to recover. In some areas, no recovery will occur. What took years to develop can be undone in a few seconds of careless walking or biking. As much as we profess to care about the lands around us, we need to take care of all parts of them, even the tiniest of communities of cryptobiotic soil crust.

# The Magic of a Drop of Water

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## How to Recognize These Crusts – Color – Texture

How do you recognize cryptobiotic soil crusts? Color is one indicator. If you see an area where the earth is black, gray, brown, reddish, even beige, look more closely and you may find it to be cryptobiotic soil crust. Variations may occur depending on local soils, amount of water, composition of organisms in the soil, and age of the crust. Older crusts tend to be darker, while ones newly forming may be nearly invisible.

Texture is a second way to recognize cryptobiotic soil crust. Have you ever poured water on sand and let it dry? When you touch it afterwards, it may look solid, but crumbles in your hand. So it is with this soil too. Filaments of the algae penetrate down into the soil, and help to stabilize the grains of earth into a solid layer. Because many other tiny organisms such as fungi, lichen, moss, and other types of algae also grow in this crust-like layer of soil, it is not smooth. You may notice bumps, lumps, heaves, even knobby areas within it. Using a hand lens, you may distinguish the different kinds of tiny plants forming a patchwork of plant life across the earth.

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## Adaptability of Soil Crust

A remarkable feature of cryptobiotic soil crust is that it survives in places where temperatures are high, there is lots of sun, and very little water through part of the year. This adaptability occurs in part because the lichen, fungi, moss, and algal components exist in a dormant state in dry periods. They further protect themselves from water loss with leathery surfaces; reduced to minimal leaf size; and wide-spreading rootlets, rhizomes, and algal threads to absorb any moisture that becomes available. Much the way a kitchen sponge dries up, contracts, and hardens between uses, so it is with cryptobiotic soil crust.

When it rains, however, a magical transformation occurs. The lichens soften and become more brightly colored. The mosses, which have looked like black lumps in the soil, turn green, and their tiny leaf-like appendages expand outwards. Also shriveled and dry, the fungi soak up water and swell up. Distinct plants and plant parts become visible across the soil crust. There is a magical quality to this transformation, almost as if the wand of a fairy godmother were waved...

All this is visible for students through the “Magic of a Drop of Water” activity.

# The Magic of a Drop of Water

## How to Do the Activity

### Before the Field Trip

Before the field trip, gather materials and plan to carry plenty of extra water with you. The experience of the swelling, expanding, and unfolding of the soil crust is very compelling and intriguing for students. Often they want to repeat the activity over and over. As water is a precious commodity in the desert for people, bring extra water along so the students will not deplete their own supplies in the experiment.

As always, preview the trail to choose the perfect area for this activity. Remember each student will want to do this for themselves, so that plenty of cryptobiotic soil crust is needed.

### Step-By-Step Instructions

Review the material above on cryptobiotic soil crust, as well as other information on plant adaptations in the Background Information section.

**1** Before you get to the destination for this exercise, stop and explain what you will be doing. Encourage students to take a drink of their water as you discuss how plants and animals adapt to survive in a place with so little moisture.

Pass out hand lenses and explain how to use them. Be sure to mention that if anyone is seen using them in dangerous ways (such as magnifying the sun on the ground, or on a person) they will be taken away.

**2** Using information from the section above, discuss what cryptobiotic soil crust is, and how it is extremely fragile. While the experiment of pouring water on it will not damage it, a misplaced backpack, or inattentive step, could indeed impact it. Great care should be taken by students as they work so that none is destroyed.

**3** At the site, spread students out so that each person has a bit of crust before them. Ask them to investigate it in its dry form using a hand lens. What do they notice? Can they recognize individual plants? Touch the crust. How does it feel? After some discussion, pass out a cup to everyone. Designate a teacher's aide or chaperone to go along the line filling cups with the same amount of water for everyone.

**4** Have everyone pour their water at the same time on their dry section of cryptobiotic soil crust. This must be done slowly, in small amounts, or much of water will run off and be lost.

Now the observing begins. What happens to the water? What happens to the soil crust? Inspect it with the hand lens. What is different now? Ask students what they notice about colors, sizes, and shapes of the plants in the soil. Can they recognize any? How is the crust different after the water is absorbed?

# The Magic of a Drop of Water

**5** All students should have noticed on their site, or on that of their neighbors, a dramatic change in the way the soil crust looks. After talking about the changes in the soil crust that they observe, use the Plant Adaptations information sheet to assist the class in observations of how the algae, mosses, fungi, and lichens could survive without water. Make a list of the different strategies that they could use to survive without water. (Dry out; go dormant; have thick, waxy coating; grow widespreading and shallow roots; have a fast life cycle are some of the many answers to look for from students.)

If these are ways that this tiny community of plant organisms survive, how could larger plants, like those around you, survive?

What methods could larger plants use to protect themselves in the desert?

**6** In conclusion, ask for words, images, or phrases that students think of having seen the effect of water on the cryptobiotic soil crust. What ways can they think of to help preserve this delicate environment?

With older students, grades 6 to 8, the following extensions can be added to make the activity more challenging and to incorporate it with the curriculum needs.

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## Conclusion

Cryptobiotic soil crust is a fascinating assemblage of plants, algae, fungi, and lichens that are marvelously adapted to survive under harsh conditions with little water. It makes one drop of water seem like an amazing life-giving substance. It daily pioneers the creation of soils, growing, aerating, penetrating, and improving dry desert sands for the benefit of other plants. To continue its vital role, this fragile habitat needs our protection. Not only must hikers, joggers, cyclists, horseback riders, and campers be careful where they step, but they must remember that they are only visitors to these soils. Their passage through this environment should benefit it, not destroy it.

# The Magic of a Drop of Water

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## Extensions

### Grades 4 and 5

**1** Write a story or poem that describes what you saw take place when you poured the water on the cryptobiotic soil crust. Describe what the soils looked and felt like beforehand. Discuss what happened when you poured on the water. What happened to the soil crust after the water was absorbed? Draw pictures to illustrate your story.

**2** Imagine that Colorado National Monument has hired you to prepare an education campaign about cryptobiotic soil crust. Create a sign that will help to educate visitors about fragile area soils. What should and shouldn't they do when hiking, biking, camping, or cycling? Can you invent a slogan that will help protect these soils? Use crayons, paints, or markers to color your sign.

### Grades 6 through 8

**1** Find out which students have watches with a second hand, or stop watches built in to their watches. Ask one person to be the timekeeper in this next segment of the experiment. Their job is to notify everyone of one, two, five and ten minute intervals.

Have students pick a new site of cryptobiotic soil crust to use. It should be several inches to a foot away from the one where the water was originally poured. At this new site, students should measure out an area of 3 inches by 3 inches. This is approximately the length of one of their fingers. The corners of the plot should be gently marked with pebbles.

Once the plot is established, ask students to make note of the plant size in the dry soil crust. Have them use hand, fingers, and fingernails for comparison. Ask them to make a count of all the plant organisms they can see in the crust. Remember these numbers, or write them down on a piece of paper.

Then, at a signal from the timekeeper, have students pour a new cup of water on the plants that were measured. After one minute passes, get students to remeasure their plants. After two, and again after five minutes, remeasure. Discuss the results. After ten minutes, do a final measurement. What happened? Compare results at this second plot with those at the first area where water was poured.

# The Magic of a Drop of Water



## Math Content Standards

2 Another extension of this activity is to incorporate math content standards involving measuring, projecting, percentages, and word problems.

Math calculations: Measure off an area of cryptobiotic soil crust that is three inches by three inches in size. Mark off the corners of the area with pebbles. Get down close and count how many different tiny plants, lichens, and fungi you can find within the area. Write these figures down on a piece of paper. Can you determine where the algae is? If so, what percentage of the area is covered by it? 10%, 25%, 50%, 75%, 90%, or 100%? Can you do the same with lichens, moss, and fungi?

## Projections

Your 3 x 3 inch plot (9 square inches) has \_\_\_ number of lichens in it. Assuming the number of lichens remains constant, how many lichens would be in 12 x 12 inch plot? 36 x 36 inch plot?

Compare the number of lichens with the total number of plants counted in the plot. Calculate what percent of plants are lichens.

Repeat with the other plants. What percent are fungi? moss? algae? other? Many other calculations and projections from the information gathered can be made to coordinate with the math curriculum that is being covered by the class.

# Plant Scavenger Hunt



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## Age Level

4th through 8th grades. Study of plants, plant parts, plant identification, and adaptations prior to field trip will make this easier.



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## Purpose of the Activity

This scavenger hunt is intended to get students to look closely at plants, trees, and shrubs in order to find the answers on their worksheet. See Extensions for numerous ways to adapt this activity.

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## Amount of Time Needed

30 - 45 minutes if students have a familiarity with plants, and longer if not. Older students will complete it sooner than younger students.

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## Best Location

Devils Kitchen Trail, No Thoroughfare Canyon Trail, Old Gordon Trail, Monument Canyon Trail, or Lower Monument Canyon Trail. You could also use Canyon Rim Trail or Alcove Nature Trails, but they may not be long enough in the fall to find all items. See Extensions for ways to adapt the scavenger hunt for different seasons, ages, time frames, and trails.

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## Materials

One copy of the scavenger hunt per student, and pencils, are all that is needed to do this activity. A clipboard or something to write on is helpful. Prizes or rewards work as good incentives, and are an optional addition to the activity.

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## Background Information

Scavenger hunts play a useful role in both the short field trip and the day long or overnight experience. Not only do they give a focus and structure to the students, but they teach valuable observation skills and information as well. Their flexibility is another asset. They may be done as teams or individually. They can be done as a whole, or in part. Substitutions for seasons and conditions are easily made. Finally, scavenger hunts may be handled cooperatively or as a competitive game.

This plant scavenger hunt is not easy. Time must be taken with it in order to discover the plants and the features that are listed. Students must slow down and LOOK! Fourth and fifth graders may be more comfortable working on the hunt as teams. Older students may prefer to work alone. Feel free to choose the structure that is best for the students, or the teacher.

# Plant Scavenger Hunt



Plan a minimum of 30 minutes for this activity. The more time for exploration, the more discoveries will be made.

The teacher should review the Background Information section of this chapter to feel more at ease with questions that might come up. Material in Plant Terminology, Plant Adaptations, and Plant List of Colorado National Monument will be especially helpful. Because numerous plants are discussed in the Botanical Journal activity, a review of it is worthwhile. Finally, Tips for Plant Watchers is also recommended to assist with students who may not be interested in the topic.

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## Before the Field Trip

Before the field trip, copy the worksheets, and any other information that you want to take with you in the field. Gather pencils and clipboards for students. As always, it is recommended that several days before the trip, the teacher preview the trail, so that good areas for the activity can be predetermined and planned.

Decide if you want to have the scavenger hunt be played competitively or cooperatively. The benefit of it being a race is that the students who are not as interested in plants might get caught up in the game aspect of the hunt. The drawback is that students may not be as careful, or observant, if they are trying to get done first.

Lastly, decide if you want to give prizes or not. Fun (and easy) prizes related to plants are a carrot, an apple, a bag of peanuts, handful of sunflower seeds, a squirt from a water bottle (rain).

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## Step-by-Step Instructions

**1** Decide beforehand if the class will do this activity as individuals or as teams. If teams are chosen, then have students pick their team members before passing out the scavenger hunt sheets. Each person should have their own sheet whether working as a team or individually.

**2** Give directions (from the worksheet). Go over the scavenger hunt worksheets with students to answer any questions that students have.

**3** Establish some clear rules and boundaries before starting out. Recommendations include:

- ~ NO COLLECTING OF PLANTS OR PLANT PARTS.
- ~ No pushing or shoving.
- ~ No exclusivity of observations. More than one person or group can make the same observation.
- ~ Stay on the trail due to cryptobiotic soil.
- ~ No running on trail.
- ~ Stay with the group.

At this age, the students can make up their own rules and regulations for the activity. Often they are more strict than those the teacher might impose.

**4** Have chaperones and aides spread out among the group to be available to assist with questions or observations.

# Plant Scavenger Hunt



5 Set a time limit, and let them know when they are half way through it, when ten, five, and two minutes are left.

6 Gather everyone together to hand in their sheets. While one person compiles information about who found the most answers, have students share some of their most interesting observations.

Ask them what they learned by doing the hunt as a way of getting feedback.

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## Conclusion

Scavenger hunts help students to focus and observe numerous details about a subject such as plants.

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## Extensions

### Seasonal Studies

1 This scavenger hunt can be adapted to seasonal variations and curriculum needs. For example, if the class is studying flowers, and it is spring, substitute flower types, stamen counts, pollen colors, and petal counts to customize the hunt. Alternatively, if trees are a focus, include observations of bark, leaf arrangement (alternate or opposite), leaf shape, needle length, venation, and other comparisons. In the fall, seeds, fruit, berries, and nuts are plentiful for adding to the hunt.

### Plant Adaptations

2 Plant adaptations for survival can also be an effective focus for the scavenger hunt. Finding waxy coating, evergreen leaves, curled leaf margins, spines and scales instead of leaves, small leaf size, hair on leaf undersides, hair on stems and leaves, powder on leaves, parasitic plants, etc. can be added to the worksheet.

This is a good fall activity, after flowers and many fruit have gone.

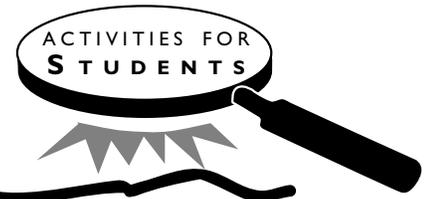
### Bingo

3 If time or attention span are factors, have students just complete one row of the hunt, like the board game "Bingo."

### Interpretive Writing

4 Older groups can use the last square, the "find your own," to make up a riddle, poem, or story about one of the discoveries that they made. This type of interpretive writing can be inspired by the teacher's reading of poetry by writers such as A. R. Ammons, Carl Sandburg, Wendell Berry, e. e. cummings, Robert Bly; or the haiku of Basho or Wang Wei. *Once There Was a Tree*, by Natalia Romanova (Dial Books, 1985.) is a children's book about the cycle of life of a tree. Many similar and marvelous accountings of life are available in the library or bookstores. Several other options include: Ruth Heller's *The Reasons for a Flower*. Grosset & Dunlap. Anne Dowden's *The Clover and the Bee, A Book About Pollination*. Thomas Crowell.

# Plant Scavenger Hunt



**Directions:** Working alone or with a partner, look along the trail for the plant features listed below. When you locate one of the answers, fill in the blanks (if needed), and then cross the item off by making a line across the box. Do not expect to get this done quickly. You will have to look carefully along your path to find everything. **GOOD LUCK!!**  
**Remember you must stay on the trail, and you may not pick or collect anything!!**

## Find

A flower in bloom or bud.	What color is the outside shell of the pinyon nut?	A dead flower.
A blade of grass.	The veins of a leaf.	What kind of leaves does a juniper tree have?
A berry.  (Hint: Look for a juniper tree.)	The flower, fruit, or pad of a cactus.	What sign of an animal or bird can you find? (Clues: Scratch marks, chewings, holes, diggings, droppings.)
What color are the stems of the Mormon tea plant?	A hairy leaf or stem.	Find a fruit or seed. What value does it have to the plant?
How many needles does a pinyon pine have?	What value is there in a dead tree or plant?	A plant that smells.
A plant growing on, or from, the roots or branches of an-other plant. (Clue: Look for mistletoe or Indian paintbrush.)	Roots of a tree or plant.	Name a way that a plant or tree can conserve water in this land of little rain.
Sagebrush.	An insect or spider on (or in) a plant.	Fill in the blank with your own discovery!
Cryptobiotic soil crust.	New growth on a plant, shrub or tree. OR A new plant sprouting out of the ground.	Fill in the blank with your own discovery!

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## Age Level

4th through 6th grades.



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## Purpose of the Activity

In this activity, students take apart a flower in order to identify its features. In the process, they learn about the functions of all the different flower parts, and how they work together to assure the future of the plant.

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## Amount of Time Needed

15 - 30 minutes.

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## Best Location

Classroom or school yard.

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## Materials

- Flowers from a florist or local gardener. (One per student, plus 5 to 7 extras for demonstration.)
- Magnifier. (One per student.)
- Blank paper. (One sheet per student.)
- Colored pencils or markers. (One set per student.)
- Floral Map worksheet. (One per student.)
- Bag of peanuts in the shell. (Enough for everyone to have a handful.)
- Copies of "Plant Terminology" and "Flower Identification" sheets from Background Information section. (For leader.)

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## Background Information

### The Reasons for a Flower

Flowers appeal to us, to our emotions, aesthetics, and, of course, our senses. They are associated with music, art, poetry, romance, beauty, and sentiment. We grow them in our gardens. We buy them for our mothers, friends, and even ourselves. We send them in remembrance and in celebration. Our children carry their names, Rose, Daisy, Violet, Lily, even Ginger. The names we give to flowers reflect our tenderness for them: forget-me-not, baby's breath, sweet pea, morning glory, buttercup, bleeding heart, jewel weed.

Such emotions extend far back in our history. In Iraq, a cave was discovered where Neanderthal people were buried. Pollen grains were found all over the cave, and it appears the people were covered with flowers at the time of their burial. Similar traditions may be found in many cultures, including our own modern style of commemorative wreaths, laying flowers on the casket, and bringing flowers to the grave site.

## Descriptions of the Parts of a Flower

For all the meanings with which humans imbue flowers, their real function is much more pragmatic: reproduction and survival of the species. The parts of the flower, from the bud, to the blooming, to the fruit, to the seed, are designed to assure that the next generation of plants gets started. All that beauty, all that fragrance, all that color and shape are part of a strategy to bring about seeds. From the inside out, the organization of a flower is to that end. It is a fascinating and complex story, with one chapter being about the flower, and the next about the seed.

As the reproductive organs of plants, flowers contain both male and female cells. Still, most plants do not fertilize themselves. Instead, they get male cells from another plant of the same species to cross-fertilize their female cells. In order to accomplish this feat, plants utilize remarkable and ingenious methods to get the next generation started. While some plants get help from the wind, others entice bats, birds, bees, flies, ants, beetles, and spiders to be their “transfer agents.” While pollination cannot be assured in all cases, plants are amazingly successful in accomplishing this drama of bringing male and female cells together.

Botanists refer to flowers as plant shoots designed for reproduction. The base for a flower is an enlargement of the stem known as the receptacle. Arranged in circles on the receptacle are two important parts of the flower, the calyx and the corolla. The calyx is made up of sepals, green, leaf-like appendages which protect the flower as a bud, while its tissues develop. The calyx also shelters the ovary, where the seeds will grow. Inside the calyx is the corolla, better known as the petals. Usually the number of sepals and petals is the same within a flower. Together these parts form the perianth, the outer tissues of the flower called the “floral envelope.”

## Why Petals?

Flower petals grow in many shapes and arrangements. They may be separate, united, fused, symmetrical, regular or irregular. For students, these terms are not nearly so important to know as the real purpose of petals which is to attract insects, birds, and bats to pollinate the flower. In essence, petals act as advertisements to call in helpers from the outside world. Once a bee or moth is attracted, the petals operate as a place for the insect to land. Many have tiny lines from the tip of the petal to the inside. Known as nectar guides, these lines direct the insect down into the central part of the flower, where both the “food” is, and where the transfer of pollen can take place. Additionally, the petals act to shelter the inner parts of the flower from the elements.

## Male Flower Parts

Tucked inside the corolla are the male and female parts of the flower. Usually, the male parts surround the female part, and are known as the stamens. Every species of flower has a specific number of stamens, which is a key to its identification. Each stamen is composed of a filament and an anther. The filament is a sturdy stalk whose function is to assure the anther gets as much exposure as possible. The anther is a small pouch(es) that contains pollen. Pollen hold the male sperm nuclei. They are like the fingerprint of the flower, with each species having its own uniquely shaped granule. Amazingly sturdy, pollen grains can exist for hundreds of years, as is witnessed by their discovery in amber, in the ashes of Pompeii, and in the caves in Iraq referred to earlier.

## Female Flower Parts

At the very center of the corolla is the pistil, or female part of the flower. Ringed by the numerous, feathery stamens, it, too, has a distinct shape. It looks like a balloon that has not been blown up, or a goldfish with a very long tail that is standing on its head. The pistil may be single or made up of several parts. Another term for the pistil is carpel. A flower may have a single or compound carpel.

Each pistil is made up of three elements, the stigma, the style, and the ovary. The stigma is the landing area for the pollen. As a result, it is often enlarged like a little ball, a sponge, a star, or a feathery square. Each plant species has a uniquely shaped stigma. Often the stigma carries a sticky substance on it to help hold onto the pollen that reaches it. Under a hand lens, one may be able to see tiny structures that resemble velcro that also assist in holding onto pollen.

Attached to the stigma is a tube-like structure, the style, which connects to the ovary. The style functions like the tube on a balloon. Just as air passes down the tube and into the sac at the end of a balloon, so the style helps to convey the male pollen down to the female ovary at its base. When a pollen grain lands on the stigma, it germinates, and grows a tube. The tube extends down the style until it reaches the ovary. The ovary is a swelling at the base of the style which contains the ovules, or female cells.

## The Fruit and Seed

Once the male sperm cells have been “delivered” to the ovary, they fertilize the ovules. The next generation of plants is held within the resulting embryo. The ovules develop a cover, or seed coat, to surround and protect the embryo. The calyx and ovary grow into a fruit, a variously shaped and colored package that further shelters the embryo plant, now a seed, inside.

To imagine what this really looks like, think of a peanut. When you open a peanut and look inside, frequently you see a tiny embryo plant tucked inside. The meat of the peanut protects and nourishes the tiny plant while it awaits the proper conditions for growth.

Covering the peanut is its skin, and around that is the shell, both of which afford further safekeeping for the tiny plant hidden deep inside.

The first chapter in the story of plants is complete: pollination and fertilization are accomplished. Therefore, the petals wither and die. The next chapter of the story unfolds as the fruit develops and ripens with the purpose of getting the seeds dispersed. Since it is most favorable to move away from the parent plant, the fruit helps in that process: poppies and locoweeds explode; milkweeds cradle the seeds until they split open and are carried away by the wind; cherries get eaten, and the seeds released with a pile of droppings to act as fertilizer. The mechanisms for dispersal are as diverse and unusual as the mechanisms for attracting pollinators.

In chapter three, the seed functions to give the embryo plant inside as good a start as possible. It contains a reserve of food inside, to nourish and shelter the young plant during the time before sprouting and photosynthesis. A tough outer coat, the testa, protects the plant inside from drying out. Inside this sturdy shelter, the young plant can survive for long periods of time, awaiting the proper conditions to germinate and begin the cycle of life once more.

## How to Do the Activity

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### Getting Ready

Before the activity, contact local flower stores or gardeners to find out what types of flowers they have available. Find out if they would be willing to donate flowers for the activity. As flowers have a short shelf life, and regular shipments come in, flower stores are often happy to help you out. In turn, this activity can be scheduled to coincide with delivery days.

You will need flowers that are in bloom, not buds. Preferred flowers are: tulips, lilies, gladiola, or alstroemeria. The latter three flowers work especially well because they have numerous blossoms on a single stalk. You do not want to get daisies, asters, roses, or carnations, or other flowers with stamen and pistils that are difficult to see. Plan for one flower per student. Try to have all students working with the same species if possible. A few extra flowers of other species can be useful to demonstrate the wide range of shapes, sizes, colors and structures of flowers. These can also be used as challenges to see if the students can find all the parts.

Copy the “Floral Map” worksheet for each person. It will be a helpful guide to locations as well as terms. A magnifying glass or hand lens for each student is also useful.

Practice on a flower yourself. As the instructor, it is helpful to recognize all the features readily.

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## Step-by-Step Instructions

**1** As you pass out the worksheet, hand lenses and flowers, explain that students will be investigating a flower to learn its parts, and how they work together. Each person will take apart a flower. To assure that everyone sees all the elements, follow directions carefully. **DO NOT TAKE OFF PARTS OF THE FLOWER UNTIL YOU ARE TOLD TO DO SO.**

**2** Begin the floral investigation by inspecting the stem or stalk of the flower. Notice where it widens out into the flower itself, called the receptacle. Can you find the sepals, small green leaves that are at the base of the flower? How many are there? Write down this number on the worksheet. Pull off a sepal and look at it. How does it compare to a leaf on the plant? The ring of sepals around the base of the blossom is called the calyx. See Background Information for details on function. Pull off all sepals and set aside.

**3** Next, look at the petals. Note their color, shape, and size. Count how many there are and compare with the number of sepals. Write the number of petals down. Pull off a petal and look at where it connects into the receptacle. This ring of petals is called a corolla. See Background Information for details on function.

**4** Can you find any lines that run the length of the petal? They will go from the tip of the petal towards the central part. These are called nectar guides. The function of the petal is as a landing pad for insects and birds, and the nectar guides help direct them into the center of the plant. They are like the lines on a road that keep the cars going to where they are supposed to be. Use magnifiers to look closely at a petal. Pull off all the petals and set them aside.

**5** What remains after the petals are taken off are the central elements of the flower: the male and female parts. The reason for a flower is to assure that pollen from the male stamen gets over to the female pistil, thereby fertilizing the eggs held down within the ovary. Look at the next ring of the flower. It is made up of the male parts called the stamens. Count how many stamens there are in this ring. Different species of flowers have different numbers of these. Record the number on your worksheet. Afterwards, take off ONE stamen and look at it carefully.

**6** Can you find a pouch (anther) sitting atop what looks like a tiny drinking straw (filament)? The pouch is the sac that contains the pollen, or male cell of the flower. Gently shake the pouch over the palm of your hand. What happens? Some students will get a handful of tiny specks, called pollen granules. Other students will not, either because their flower is not yet ready to release the pollen, or because it is sterile. Have these students try removing a second stamen, and shake its anther. If need be, let students borrow a little pollen from a neighbor. Everyone should look at the pollen with their hand lens.

The purpose of the filament is to hold up and display the anther. This gives the pollen grains inside an optimal chance for dispersal. Because pollen is highly nutritious to insects, they are attracted to flowers to eat it. In the course of eating their fill, they knock into the stamens, which drop pollen onto them. As the pollen-covered insects move on to other flowers, they inadvertently transfer the pollen from flower #1 to flower #2. Anthers have an amazingly high amount of pollen to assure that some portion of it will survive long enough to be introduced into the female part of a neighboring flower. Remove yet another anther, shake it in your hand, then guess how many pollen granules are released. Multiply this by the number of stamens in the flower. An impressive number will result!

Some trees and flowers produce higher amounts of pollen than others. Most of these plants do not depend on insects, birds and bats to transfer pollen: they take their chances with the wind. These flowers have long pistils with plenty of sticky material on them to catch any male pollen flying by on the breeze. Many humans do not appreciate this reproductive effort by plants, such as junipers and blue spruce, because the huge amounts of pollen released into the air cause them allergies.

**7** At this point, remove any remaining stamens and set them aside. Can students tell how many stamens there were in their flower? Botanists standardly use petal number, stamen number, and pistil number in plant identification. The number of stamen is the same within a plant species, and therefore useful in distinguishing plant species.

**8** By this point, all that should remain of the original flower is a tall, funny looking tube in the middle of the receptacle. (Some students will have accidentally pulled off this part too. Have them look back through their stamens for it, or they can look on with a neighbor.)

The remaining element in the receptacle is the female part of the flower, known as the pistil. It has several parts. First, use a hand lens to look at the top of the pistil. Can any pollen be seen sticking to the top? This feathery or enlarged area at the top of the pistil is known as the stigma. Its role is to catch pollen, and hold onto them until they can fertilize the ovules inside. Often the stigma has a sticky substance on the top, or little hooks (like velcro) to hold onto the pollen.

9 After the pollen lands on the stigma, or is brought there by a roving insect, the pollen granule develops a long tube, which grows down the neck of the pistil, to a sac at its base. VERY CAREFULLY have students remove the stigma and pistil (tube).

In what remains of the original flower is an enlargement, a ball, or a sac, that is the ovary of the plant. Most likely it is green in color. This is the place where the female part of the plant, the egg cells called ovules, await delivery of the male sperm cells in order to be fertilized. Once those cells meet up, the ovules develop a hard coating around them, called a testa. This protects the tiny embryo plant that is now developing inside. The fertilized ovule is better known as the seed of the plant. Meanwhile, the ovary that covers the seed develops into the fruit of the plant. Now the true purpose for fruit is revealed: they are to protect the seeds inside until they can get established as the next generation of plants. Ask students to open up the ovary to see how many ovules or seeds are inside. A hand lens will be needed to count the ovules.

10 As a final part of the activity, pass around the peanuts, and ask everyone to open up the shell. Can they make the connection as to what part of the plant they are holding? Before they eat both peanuts inside, ask them to carefully break one peanut open. Use a hand lens to see the inside. What is tucked inside the peanut? Most students should be able to identify the tiny plant nestled in the base of the peanut seed. If the students cannot find one in their first peanut, have them continue to sample them until they do find one.

11 Review the parts of the plant that the class has learned about. Now they are ready to sketch the arrangement of their flower onto the “Floral Map”, and answer the questions about each flower part they found. When this is complete, ask students what they think about flowers now that they have investigated one. What do they find are the most interesting features of flowers? How do they feel about picking flowers, about bees and other insects, about the fruit that they eat? The class could even write a story or a poem describing their attitudes and feelings about the processes of pollination and seed dispersal.

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## Conclusion

“Floral Investigations” gives students an opportunity to observe and get acquainted with parts of a flower. By looking at it piece by piece, they see how the different elements work together to assure the plant’s pollination and seed production.



## Extensions

Extensions to this activity could include the following:

**1** This activity coordinates well school curricula about plants, as well as with the “Plant Scavenger Hunt,” “Botanical Journal,” and “Territories” activities in this chapter. The “Crossword Puzzle” is another fun complement to this activity.

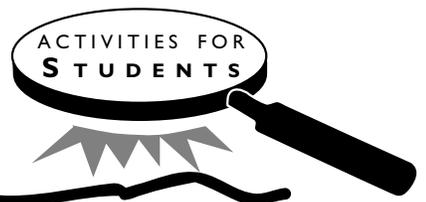
**2** In the classroom, ask students to write and illustrate a short story or poem about how a bee, fly, spider, hummingbird, butterfly, moth, or bat helped to pollinate a flower. Another angle on this topic is to describe how a bird, insect, or mammal helped to disperse the seeds from this flower by eating the fruit, or by storing the seeds.

**3** In the classroom, older students can explore the origin of plant names. Several good books on this subject are available through libraries and bookstores. By learning why scientists give a plant a particular name, students may better appreciate why a plant is so unique, or so common.

Many plants have scientific names whose origin is Latin or Greek. Students can use dictionaries, encyclopedias, and some botany books to look up the names for insight into the ways that plants function or are classified. The sunflower that grows alongside roads in mid to late summer, for example, has the scientific name of *Helianthus annuus*. These words are Greek: *Helios* meaning “sun”; *anthus* meaning “flower”; and *annuus* meaning “year.”

This plant, whose flower turns to follow the path of the sun across the sky, and which comes back every year, seems very aptly named. In contrast, other plants are given names from the person or place where they were found. They may want to make a list of several local plant names and their origins in conjunction with the plants that they saw (or will see) on their field trip to Colorado National Monument.

# Floral Investigations Worksheet



Sketch/Diagram a flower and all its parts.  
Examples for reference are in *Botany for Beginners* and *Botany for All Ages*.

## Answer these questions about your flower.

- 1) How many sepals does it have? \_\_\_\_\_
- 2) How many petals does it have? \_\_\_\_\_
- 3) What color and shape are the petals? \_\_\_\_\_
- 4) Can you see nectar guides on the petals? \_\_\_\_\_  
What color are the nectar guides? \_\_\_\_\_
- 5) How many stamens (the male part of the flower) are there? \_\_\_\_\_
- 6) Did the anthers have pollen on them? \_\_\_\_\_  
If yes, what color/shape/texture is it? \_\_\_\_\_
- 7) How many pistils (female part of the flower) does your flower have? \_\_\_\_\_
- 8) What shape is the stigma? \_\_\_\_\_  
Does it have any pollen on it? \_\_\_\_\_
- 9) Could you count how many ovules were in the ovary? \_\_\_\_\_



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## Age Level

5th through 8th grades.



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## Purpose of the Activity

The purpose of this activity is to create the opportunity for students to make a personal connection to the land. Spread out a short distance from one another along a trail, they each have a “territory” to observe silently. Next, they use a small notebook to make inventories of the plants, animals, birds, and insects that live in or pass through their land.

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## Amount of Time Needed

45 minutes.

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## Best Location

Any trail is possible for this activity, but Lower Monument Canyon, No Thoroughfare Canyon, or Black Ridge Trails may be best. On them, the group can spread out and have adequate room to “claim a territory” for themselves without being too disturbed by other park visitors. Devils Kitchen and Old Gordon Trails can also be used. The sections after the wash are recommended, so that the group will be away from other foot traffic.

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## Materials Needed

- “My Territory Notebook” for each student.
- Colored pencils or markers for each student.
- Clipboard for each student.
- Hand lens for each student.
- Camera and film.
- Binoculars (optional).
- Thermometers (optional).



## Background Information

In our busy, urban lives, children know their neighborhoods, but also travel regularly far from home. Connections to a piece of land with trees, grasses, shrubs, wildflowers and all the associated webs of life are becoming more rare. As people are less dependent on the land for their survival, their roots to it are cut or dwindle. This activity creates a space and a time for children to slow down and get acquainted with a small plot of earth. Once they have become familiar with their spot, they will always be able to return to revisit it.

The structure for this exploration is provided by a notebook of worksheets. Each page focuses on a different subject: trees, plants, birds, animals, insects and spiders, and weather. Students are asked to inventory their “territories”, and record their findings with words and drawings.

The role of the teacher and chaperone is to rove among the students making sure that everyone feels comfortable. By taking a photo of each person on their plot of land, the teacher is able to make a permanent record of each student and their “territory”. As nothing may be collected in Colorado National Monument, having a photo remembrance has extra meaning for the student.

“Territories” is an activity that is very compatible with a long day hike, or an overnight trip in Colorado National Monument. It stands alone, easily expanding to fill several hours of time. Alternatively, it may be incorporated with other exercises about plants, wildlife watching, or geology. On an overnight trip, students’ “territories” can be visited in full sun, at dusk, and even at night. An ideal way to use this exercise is to visit the “territories” in the fall, and again in the winter or spring to observe changes over time.

## How to Do the Activity

Before the field trip, copy the worksheets that follow and assemble them into a notebook type of format. Gather up colored markers for each student to use, or have them bring them from home.

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### Assembling the “Territory Notebook”

The Notebook is designed to be folded in half. It is also intended for each page to be copied onto the back of another, or “back-to-back”. Thus, if the numbering seems off as you first look at it, wait until you actually compile a notebook to decide. The notebook must be used as a whole, or the numbering and arrangement of pages will get out of kilter.

Some tips for assembly:

- ~ Remember that the cover has a front and a back (pages 1 + 12).
- ~ Pages 2 + 11 should be copied onto the cover (pages 1 + 12).
- ~ Copy pages 10 + 3 onto pages 4 + 9.
- ~ Copy pages 6 + 7 onto pages 8 + 5.

If this organization is used, then the notebook assembly is easy.

Practice on one if you need to. Run off the copies separately, then lay them down as if they were back to back, and you will soon see how they fit together.

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### Preview the Trail

Be sure to preview the trail to choose the right spot for the activity.

Preferable locations are as follows:

- ~ A place with little or no cryptobiotic soil crust.
- ~ A section of trail that is not going to be bustling with other hikers.
- ~ An area with a mix of trees, shrubs, plants, rock, and good views.
- ~ A spot that is safe for the children to wander without hazards of cliffs, rockfalls, or other dangers.
- ~ A location where, as students are dropped off at their “territories”, they will feel alone without being so. This is best achieved by a winding or curving section of trail, or one with lots of trees.

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## The Value of a Camera

Locate a camera to use. Polaroid cameras are ideal because a picture is immediately available to accompany the activity. However, other types of cameras work very well, and the photos can be incorporated into the notebooks after development. Either the teacher or the chaperone can be the photographer. With a large group, two cameras make the job get done more quickly. Remember to check the camera's battery beforehand, and pack some extra film, just in case!

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## Step-by-Step Instructions

**1** Pass out notebooks, markers, and clipboards at the start of the hike so that the teacher does not have to carry them for the entire trip.

**2** When the area for "Territories" is reached, give directions to the students before entering the area. Get out notebooks and go over them page by page so that no one has any questions before they start.

**3** Directions for students:

- ~ Each person will be dropped off from the group along the trail. The area where you are left will be your "territory," your private spot here in the monument.
- ~ Other students will be nearby, but out of sight, so that each person can have a feeling of the land for themselves. The teacher and chaperones will roam amongst the "territories" so that someone will be checking on you regularly.
- ~ You will have \_\_\_ minutes to explore your "territory." (20 minutes is recommended for younger students, 30 - 40 minutes for older groups.)
- ~ While you are on your land, first explore it, then find a place to settle in. Take some time to observe what lives on your land. Imagine what it would be like here if this really were your home.
- ~ Notice any places that you especially like on your land. Can you find birds, animals, signs of animals, insects, and of course, plants and trees? Notice what happens around you as you sit quietly. Be peaceful, and enjoy your "territory".
- ~ After a while, get out your notebook and make a record of what you see, using the questions on each page as a guide. Several blank pages are also included in case you want to make your own notes. Feel free to draw or write or both.
- ~ While you are out, a parent will come by and take a picture of you on your "territory". This will become part of your notebook.
- ~ Have fun, and enjoy this opportunity to get close to a piece of land.

**4** After all preparations have been made with students, and all questions answered, have students line up single file behind the leader. Intersperse parents or chaperones if available; otherwise, the teacher should be at the head of the line, and another adult at the end of the line. Ask everyone to be quiet on the walk in. Head up the trail a ways and leave off the student immediately behind the leader. The rest of the group should pass by that person so that if there is a problem, others will be near to deal with it right away.

**5** Drop off the next person in line after the first person is out of sight. A large distance between students is not necessary. The space between is so that they do not interfere with one another.

Drop off the rest of the students one by one in a similar fashion. When the leader has come to the last student, she or he should turn back down the path to check how everyone else is doing. When the first “territory” is reached, the teacher should return once more through the students to the last “territory.” The other adult should move through the group taking photos. A minimum of contact should be given by both adults, leaving the students to explore their “territories” in their own ways.

**6** If a student is shy or uncomfortable with this activity, try pairing them with another student, or with one of the adults.

**7** After the allotted time has passed, the group should gather at a given point, such as half-way along the trail, or at the last “territory”. Remind students to leave no sign of their passage on their special spot, other than their footprints.

**8** Make sure all materials from this activity, especially photographs, are safely stored in backpacks. Keep water bottles and lunch boxes away from the notebooks to preserve them better.

**9** Students will have many things to share and comment upon from this activity. Plan a time for each person to share their story.

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## Conclusion

This activity helps students to develop their skills of observation, identification, inventorying, and documentation while also making a personal connection to Colorado National Monument that can last a lifetime. Additionally, students have the opportunity to gain self-confidence in a controlled setting by spending time alone on their “territory.”



## Extensions

Back in the classroom, “Territories” may be extended into other areas of the curriculum. In math, graphs of plant numbers within plots may be made. Pie charts, percentages, and fractions can all be introduced or interwoven with discussions about what was found on the land. Comparisons between students’ plots can be explored. Why would there have been 25% trees on Chris’ “territory” while Pat’s had 2%? Could it be there was more slickrock on Chris’ plot?

Language arts may be incorporated with stories and poems written about their experiences while out by themselves. Research about different animals, birds, or plants could be assigned so that students learn more about specific topics.

Art projects could be developed based on the notebooks. Students could create a painting or sculpture from their sketches made in the field. A mural of the trail could be put together, highlighted by each student rendering a diagram or map of their territory.

Finally, science curriculum alternatives abound in conjunction with this activity. Regular visits to the area could be scheduled so that students could watch their plot of land change over the seasons.

Discussions of erosion, geology, soil building, decomposition, adaptation, and ecology easily interconnect with discoveries made on “territories”.

# My Territory Notebook

.....

**Name**

.....

**Date**

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Imagine that this is your piece of land.

You will be living here from now on.

This is your "territory."

You want to find out what else is here: trees, plants, animals, birds, insects...

Look around. Up and down. In the air.

On the ground. In the trees, the grass, by the rocks. Look for big things, and little ones too. Where would you get water?

Find a good place to sit where you can see your land in all directions. Be very still. Listen for sounds. A twitter in the pinyon tree. A scurrying by the rock.

A buzzing near the flower...What else is out there, besides you?

The pages that follow are for you to make observations and records about your "territory". Some have questions for you to answer. Others are left open for you to fill with your own words or pictures. Discover as much as you can on your "territory."

This page is for you to record your own observations.

## Personal Observations

This page is open for you to record in words or with sketches your observations or feelings on your "territory."

## Weather

How would you describe the temperature on your "territory"?

Hot!  Pleasant  Cool  Freezing!

Is the wind blowing?  Yes  No

If yes, is it blowing  all the time

in gusts

softly

Do you see any clouds?  Yes  No

If yes, what do they look like?

Thin, wispy — cirrus

Puffy, white — cumulus

Thick, flat, grayish — stratus

Puffy, dark bottom — nimbus

Very puffy, dark — thunderhead

Feel your skin. Is it  dry  moist?

Next, look at some plants. Are they

Droopy?  Wilted?  Shriveled?

Do they seem fresh and upright?

Yes  No

Do they have dew or raindrops on them?

Yes  No

Touch the soil under a plant.

How does it feel?

Hot  Cool  Moist  Dry

Dig down a little bit under the plant.

How does the soil feel there?

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Touch different plants, trees, rocks, and soil in your "territory". Can you find the coolest or the hottest place? Where is it?

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## Trees

Count how many trees over 5 feet in height are on your "territory". \_\_\_\_\_

Count them a second time, and this time notice how many different kinds of trees there are. Record how many different types of trees you find. (Ex: 4 types of trees found.) \_\_\_\_\_

Can you identify any of the trees or shrubs?

Yes.  No. If so, list two of them here. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

How many tall trees do you see? \_\_\_\_\_

How many short trees? \_\_\_\_\_

How many dead trees? \_\_\_\_\_

How many young trees? \_\_\_\_\_

How many shrubs (bushes) are on your land? \_\_\_\_\_

\_\_\_\_\_

Can you find any signs of animals, birds, or insects using a tree or shrub? Describe them below with words or a sketch.

**Draw a map of your territory.** This is to help you remember what it looks like. Imagine that you are a golden eagle hovering high above this place. What will you see as you look down? Where is the trail? Where are the rocks? The trees? The shrubs? The animal scat? The ant hill? Use different symbols, numbers, or letters to designate where the different places are. At the bottom of your map, list what the different symbols mean.

# Animals

Sit quietly for a time. Be as still as you can. Do you see or hear any animals on your "territory"? \_\_\_\_\_

Can you tell what kind of animals they are? \_\_\_\_\_

\_\_\_\_\_

Many animals come out only at night, when it is quiet, or when they need food, water, sun, or company. You may not see them, but they are still there. Looking around your land, what kinds of animals do you think might live nearby? \_\_\_\_\_

\_\_\_\_\_

Often you will only find signs of an animal's passage. Can you find any of these signs on your land?

- burrows / dens
- diggings / scratchings
- scat (droppings)
- fur/ hair/ bones
- tracks
- leaves / twigs chewed
- bark peeled off
- other (you describe) \_\_\_\_\_

\_\_\_\_\_

# Plants

Count how many flowers that you see blooming in your "territory". Are there?

- more than 50.
- more than 15, but less than 50.
- less than 15.
- no flowers are blooming.

What colors are the flowers? \_\_\_\_\_

Is there any sagebrush near you? \_\_\_\_\_

Are there any cactus on your "territory"? \_\_\_\_\_

Is there any grass growing on your land? \_\_\_\_\_

Is there cryptobiotic soil crust near you? \_\_\_\_\_

Can you find any lichens on the rocks? \_\_\_\_\_

Check if you can find the following plants:

- Plant smaller than your hand.
- Plant with tiny leaves.
- Plant with hair on the leaves / stem.
- Plant with no leaves but still alive.
- Plant growing in the shade of another plant.
- Plant growing in a crack in a rock.
- Dead plant.
- Plant with fruit, berries or seeds.
- Plant with a swelling /growth on the leaf or stem called a gall.
- Plant with insect(s) on it.
- Plant that has been chewed or bitten by an animal or insect.

## Birds

Listen for a while. Do you hear any birds?

- Yes     No

Count how many different bird sounds and songs you can hear. \_\_\_\_\_

Look around your "territory". Look up in the air, in trees, and on the ground. Do you see any birds

- flying?
- soaring?
- cleaning themselves (preening)?
- building a nest?
- perched?
- feeding?
- walking?
- other?

What colors are the birds that you see? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Where do the most birds seem to be?

- In the air.
- In the bushes.
- In the trees.
- On the rocks.
- On the ground.

## Insects

Do you see any insects in your "territory"?

- Yes     No

Are they...

- crawling?
- flying?
- eating?
- resting?
- burrowing?
- hiding?
- swarming?
- biting you?
- other? (you describe) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Can you identify any of the insects?  
(Flies, ants, bees, caterpillars, butterflies, mosquitoes, etc.) \_\_\_\_\_

\_\_\_\_\_

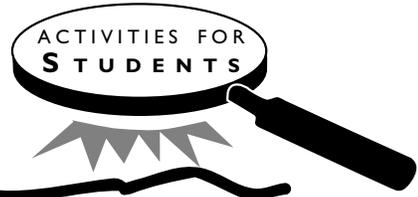
Are there any spiders or spider webs that you can spot? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Where do most of the insects/spiders seem to be located? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

# Plant Crossword Puzzle



## Clues

.....  
**Down**

2. What is green and grows on a tree?
4. What is inside the ovary of a flower?
5. What do you call a plant that has lots of tiny fuzz-like growths on its leaves and stems to reflect away sun?
7. What oozes out if you break off the branch of a plant or tree?
8. What do you have to shovel in the winter?
9. What parasitic plant often grows on and amongst sagebrush?
11. What do some people get from the roots of yucca plants?
13. What is the name of the cousin/creature on the Addams Family?
15. What comes off the trunk and limbs of trees?
17. What don't you want to get bitten by in the desert?
19. What has eight legs and might be living in a flower?
21. What bush has yellow flowers in the fall and rabbits like to sit under on hot summer days?
23. What is sharp and pointed on pine trees, and is also used in sewing?
26. What is a favorite landing, eating, and hiding place for bees and insects?
31. Name the tube that goes down to the ovary in a flower. Or "He doesn't dress like anyone else. He has his own \_\_\_\_\_ of dressing."
33. Cactus have these to give them shade and to poke you with.
36. A pinyon tree has this inside its cone.

.....  
**Across**

1. A flower has these to attract insects and help them land.
3. Bees often get yellow with this on their legs and heads.
6. A short but useful verb: She \_ \_ a funny person.
10. This plant has no leaves and swells up when it rains.
12. In the desert, every drop of this is used by plants.
14. A leaf with several rounded or scalloped edges, as an oak leaf, is known as \_ \_ \_ \_.
16. A dark crust growing on the surface of the earth made up of lichens, mosses, and fungi.
18. You smell with your nose, not your \_ \_ \_!
19. Plants have these to hold up their leaves and flowers.
20. This rodent stores seeds, nuts, even cactus pads in its home in the rocks.
22. The place where the bark lives; or a word and memory game: " My Grandmother's \_ \_ \_ \_ \_."
24. The pad where pollen sits, above the filament.
25. Found in flowers, this creature has six legs and three body parts.
27. A good \_ \_ \_ \_ for hiking in the desert is to carry plenty of water. This word rhymes with MULE.
28. These insects buzz and sting!
29. This is where plants get moisture, nutrients, and a place to anchor themselves.
30. This plant part extends outward underground, far beyond the base of the tree.
32. Yucca plants are pollinated by these night-flying insects.
33. A tree gives this to birds and animals on a hot day.
34. The nuts from this tree are a favorite of the scrub and Stellar's jays, chipmunks, and squirrels.
35. This tree has scales instead of leaves or needles.
37. A fruit is the second half of the this shrub's name: Service\_ \_ \_ \_ \_.
38. Leaves have hair and waxy coatings to reflect away the \_ \_ \_ and conserve water.
39. A misspelling of the word, "the".

# Plant Crossword Puzzle



A crossword puzzle grid with 39 numbered starting points for words. The grid is set against a light gray background with some cells shaded gray to indicate non-letter positions. The numbered starting points are:

- 1: 5-letter horizontal word, top-left.
- 2: 1-letter vertical word, top-left.
- 3: 5-letter horizontal word, top-left.
- 4: 1-letter vertical word, top-left.
- 5: 5-letter vertical word, top-right.
- 6: 2-letter horizontal word, top-right.
- 7: 2-letter horizontal word, top-right.
- 8: 1-letter vertical word, top-right.
- 9: 4-letter vertical word, top-right.
- 10: 4-letter horizontal word, middle-left.
- 11: 1-letter vertical word, middle-left.
- 12: 2-letter horizontal word, middle-right.
- 13: 2-letter horizontal word, middle-right.
- 14: 4-letter horizontal word, middle.
- 15: 1-letter vertical word, middle.
- 16: 10-letter horizontal word, middle-right.
- 17: 1-letter vertical word, middle-right.
- 18: 2-letter horizontal word, middle.
- 19: 5-letter horizontal word, middle-left.
- 20: 4-letter horizontal word, middle.
- 21: 3-letter horizontal word, middle.
- 22: 4-letter horizontal word, middle-right.
- 23: 1-letter vertical word, middle-right.
- 24: 5-letter horizontal word, middle.
- 25: 6-letter horizontal word, middle-left.
- 26: 1-letter vertical word, middle-right.
- 27: 3-letter horizontal word, middle-right.
- 28: 4-letter horizontal word, middle.
- 29: 3-letter horizontal word, middle-right.
- 30: 4-letter horizontal word, middle-left.
- 31: 1-letter vertical word, middle-left.
- 32: 4-letter horizontal word, middle.
- 33: 5-letter horizontal word, middle.
- 34: 5-letter horizontal word, bottom-left.
- 35: 1-letter vertical word, bottom.
- 36: 4-letter horizontal word, bottom.
- 37: 5-letter horizontal word, bottom-left.
- 38: 2-letter horizontal word, bottom.
- 39: 1-letter vertical word, bottom.





CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<p><b>Language</b></p> <p><b>Arts</b></p> 	<p><b>Standard 1</b> Reference Obj. 4.26 4.04 4.07 Thinking Obj. 4.06 4.07</p> <p><b>Standard 2</b> 4.11 4.13</p> <p><b>Standard 3</b> 4.04 4.05 4.08 4.10 4.21</p> <p><b>Standard 4</b> 4.09 4.10</p> <p>Listening Obj. 4.01 4.02 4.05 4.06 4.08</p> <p>Thinking Obj. 4.03 4.14 4.16 4.07 4.08</p> <p><b>Standard 5</b> 5.23</p>	<p><b>Standard 1</b> Writing Obj. 5.07 Reference Obj. 5.04 Thinking Obj. 5.18</p> <p><b>Standard 2</b> Writing Obj. 5.04 5.05 5.11 5.12 5.13</p> <p><b>Standard 3</b> Reading Obj. 5.05 5.096 5.09 5.12</p> <p>Thinking Obj. 5.12</p> <p><b>Standard 4</b> Listening Obj. 5.02 5.05 5.08 Thinking Obj. 3-5.01 3-5.04</p> <p><b>Standard 5</b> 5.23</p>	<p><b>Standard 1</b> 6.16 6.20 6.22 6.25 6.37</p> <p><b>Standard 2</b> 6.17 6.18 6.19</p> <p><b>Standard 3</b> 6.01 6.06 6.07 6.09</p> <p><b>Standard 4</b> 6.01 6.04 6.09 6.22 6.25 6.34 6.47</p> <p><b>Standard 5</b> 6.01 6.05 6.06</p>	<p><b>Standard 1</b> 7.15 7.19 7.22 7.26</p> <p><b>Standard 2</b> 7.15 7.16 7.17 7.18 7.19 7.23</p> <p><b>Standard 3</b> 7.04 7.05 7.06 7.08</p> <p><b>Standard 4</b> 7.08 7.12 7.19 7.22 7.24 7.26 7.28</p> <p><b>Standard 5</b> 7.08</p> <p><b>Standard 6</b> 7.12 7.24</p>	<p><b>Standard 1</b> 8.14 8.33</p> <p><b>Standard 2</b> 8.12 8.13 8.18</p> <p><b>Standard 3</b> 8.01</p>
<p><b>Science</b></p> 	<p><b>Standard 1</b> 1.01 1.02 1.03 1.04</p> <p><b>Standard 2</b> <b>2.1</b> 2.11 2.12</p> <p><b>Standard 3</b> <b>3.1</b> 3.12 <b>3.4</b> 3.43</p>	<p><b>Standard 1</b> 1.03 1.04 1.07</p> <p><b>Standard 2</b> <b>2.1</b> 2.11</p> <p><b>Standard 7</b> 7.05 7.06</p>	<p><b>Standard 1</b> 6.1.03 6.1.05 6.1.06 6.1.07 6.1.08 6.1.10</p> <p><b>Standard 2</b> <b>2.1</b> 6.2.01</p> <p><b>Standard 3</b> 3.1</p>	<p><b>Standard 1</b> 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08</p> <p><b>Standard 2</b> <b>2.1</b> 7.2.01</p> <p><b>Standard 3</b> <b>3.1</b> 7.3.01 7.3.03</p>	<p><b>Standard 1</b> 8.1.05 8.1.07 8.1.10</p> <p><b>Standard 2</b> <b>2.1</b> 8.2.01</p> <p><b>Standard 3</b> <b>3.1</b> 8.3.01 8.3.02 8.3.03</p>

# Botanical Journal



CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<p><b>Science (cont.)</b></p> 	<p><u>Standard 5</u> 5.05</p> <p><u>Standard 6</u> 6.03</p> <p><u>Standard 7</u> 7.04</p>		<p><u>Standard 4</u> <u>4.2</u> 6.4.07</p> <p><u>Standard 5</u> 6.5.03</p> <p><u>Standard 7</u> 6.7.05</p>	<p><u>Standard 4</u> <u>4.2</u> 7.4.01</p> <p><u>Standard 5</u> 7.5.03</p> <p><u>Standard 7</u> 7.7.05</p>	<p><u>Standard 5</u> 8.5.03</p> <p><u>Standard 7</u> 8.7.05 8.7.06</p>
<p><b>Social Studies</b></p> 	<p><u>Standard 2</u> 4.44 4.46</p>		<p><u>Standard 4</u> <u>4.1</u> 6.35 6.36</p> <p><u>4.2</u> 6.38</p>		<p><u>Standard 2</u> <u>2.1</u> 8.18 8.19</p> <p><u>Standard 4</u> <u>4.1</u> 8.40 8.41</p> <p><u>4.2</u> 8.43</p>
<p><b>Art</b></p> 	<p><u>Standard 1</u> <u>Standard 3</u></p>	<p><u>Standard 1</u> <u>Standard 3</u></p>		<p><u>Standard 1</u> Art .03</p>	<p><u>Standard 1</u> Art .03</p>

# Magic of a Drop of Water



CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<p><b>Language</b></p> <p><b>Arts</b></p> 	<p><b>Standard 1</b> 4.06 4.07</p> <p><b>Standard 3</b> 4.21</p> <p><b>Standard 4</b> 4.01 4.02 4.05 4.06 4.08</p> <p><b>Standard 5</b> 4.06</p>	<p><b>Standard 4</b> 5.02 5.05 5.06 5.08</p> <p><b>Standard 5</b> 5.5.2</p>	<p><b>Standard 1</b> 6.1.03 6.1.05 6.1.06 6.1.08</p> <p><b>Standard 2</b> <b>2.1</b> 6.2.01 6.2.02 <b>2.3</b> 6.2.04</p> <p><b>Standard 3</b> <b>3.1</b> 6.3.01 <b>3.2</b> 6.3.02</p> <p><b>Standard 5</b> <b>Standard 6</b> <b>Standard 7</b> 6.7.02</p>	<p><b>Standard 4</b> 7.24</p>	<p><b>Standard 4</b> 8.23</p>
<p><b>Math</b></p> 	<p><b>Standard 1</b> 4.1.3</p> <p><b>Standard 3</b> 4.3.1</p> <p><b>Standard 5</b> 4.5.1 4.5.2 4.5.3b</p>		<p><b>Standard 2</b> 2.1 2.3</p> <p><b>Standard 3</b> 3.1 3.5 3.6</p> <p><b>Standard 5</b> 5.1 5.2 5.5 5.6</p>	<p><b>Standard 2</b> 2.1 2.3</p> <p><b>Standard 3</b> 3.1 3.4 3.5 3.6 3.7</p> <p><b>Standard 4</b> 4.4</p> <p><b>Standard 5</b> 5.1 5.2 5.3 5.5 5.6</p>	<p><b>Standard 2</b> 2.3</p> <p><b>Standard 3</b> 3.1 3.4 3.5 3.6 3.7</p> <p><b>Standard 4</b> 4.4</p> <p><b>Standard 5</b> 5.2 5.5 5.6</p>
<p><b>Science</b></p> 	<p><b>Standard 1</b> 1.01 1.02 1.03 1.04</p>	<p><b>Standard 1</b> 1.03 1.05 1.06 1.07 1.08</p>	<p><b>Standard 1</b> 6.1.03 6.1.05 6.1.06 6.1.08</p>	<p><b>Standard 1</b> 7.1.02 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08</p>	<p><b>Standard 1</b> 8.1.05 8.1.06 8.1.09</p>

# Magic of a Drop of Water



CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<p><b>Science</b> <b>(cont.)</b></p> 	<p><b>Standard 2</b> 2.1 2.11 2.12 <b>Standard 3</b> 3.1 3.12 3.14 3.4 3.43 <b>Standard 6</b> 6.01 6.02 6.03</p>	<p><b>Standard 2</b> 2.11 <b>Standard 3</b> 3.1 3.12 3.14 3.15 3.2 3.22 3.24 <b>Standard 6</b> 6.01 6.02 <b>Standard 7</b> 7.01 7.02 7.03 7.06</p>	<p><b>Standard 2</b> 2.1 6.2.01 6.2.02 6.2.04 <b>Standard 3</b> 3.1 3.2 6.3.01 6.3.02 <b>Standard 5</b> <b>Standard 6</b> <b>Standard 7</b> 6.7.02</p>	<p><b>Standard 2</b> 2.1 7.2.01 7.2.04 7.2.04 7.2.05 <b>Standard 3</b> 3.1 7.3.01 7.3.03 7.3.04 7.3.05 <b>Standard 4</b> 4.2 7.4.01 <b>Standard 6</b> 7.6.01 <b>Standard 7</b> 7.7.01 7.7.02 7.7.03</p>	<p><b>Standard 2</b> 2.1 8.2.01 8.2.03 8.2.05 8.2.06 8.2.07 <b>Standard 3</b> 3.1 8.3.02 8.3.03 3.2 8.3.04 8.3.05 <b>Standard 4</b> 4.2 8.4.03 4.3 8.4.04 <b>Standard 5</b> 8.5.02 <b>Standard 7</b> 8.7.03 8.7.05</p>
<p><b>Social Studies</b></p> 		<p><b>Geography</b> <b>Standard 4</b> 5.18 5.38</p>	<p><b>Geography</b> <b>Standard 2</b> 2.1 <b>Standard 4</b> 4.1 6.35 6.36 4.2 6.38</p>	<p><b>Geography</b> <b>Standard 2</b> 2.1 7.3.5 7.3.6 <b>Standard 4</b> 4.1 7.59 7.60 4.2 7.62 7.63</p>	<p><b>Standard 2</b> 2.1 8.18 8.19 <b>Standard 4</b> 4.1 8.40 8.41</p>
<p><b>Extensions of this activity meet Content Standards in Language Arts, Math, and Science for all age groups.</b></p>					

# Plant Scavenger Hunt



CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<p><b>Language</b></p> <p><b>Arts</b></p> 	<p><b>Standard 1</b> Reference Obj. 4.26 Thinking Obj. 4.06 4.07 4.17</p> <p><b>Standard 3</b> Reading Obj. 4.04 4.05</p> <p><b>Standard 4</b> Thinking Obj. 4.03 4.07</p> <p><b>Standard 5</b> Thinking Obj. 4.04 4.06</p>	<p><b>Standard 1</b> Reference Obj. 5.04 5.06</p> <p><b>Standard 3</b> Reading Obj. 5.05 5.06</p> <p><b>Standard 4</b> Thinking Obj. 3-5.01 3-5.04 3-5.17</p> <p><b>Standard 5</b> Reading Obj. 5.01 5.23</p>	<p><b>Standard 1</b> 6.20</p> <p><b>Standard 4</b> 6.01 6.06 6.22 6.25 6.34</p>	<p><b>Standard 1</b> 7.19</p> <p><b>Standard 4</b> 7.01</p> <p><b>Standard 6</b> 7.24</p>	<p><b>Standard 1</b> 8.14</p> <p><b>Standard 4</b> 8.01</p> <p><b>Standard 5</b> 8.02</p> <p><b>Standard 6</b> 8.04</p>
<p><b>Math</b></p> 	<p><b>Standard 1</b> 4.1.3 4.1.5</p> <p><b>Standard 2</b> 4.2.1</p> <p><b>Standard 3</b> 4.3.1 4.3.2</p> <p><b>Standard 5</b> 4.5.3b</p>	<p><b>Standard 2</b> 5.2.1</p> <p><b>Standard 3</b> 5.3.1 5.3.7</p> <p><b>Standard 5</b> 5.5.2</p>	<p><b>Standard 2</b> 2.1</p> <p><b>Standard 3</b> 3.7</p> <p><b>Standard 5</b> 5.2</p>	<p><b>Standard 2</b> 2.1</p> <p><b>Standard 3</b> 3.7</p> <p><b>Standard 5</b> 5.2</p>	<p><b>Standard 2</b> 2.1</p> <p><b>Standard 3</b> 3.7</p> <p><b>Standard 5</b> 5.2</p>
<p><b>Science</b></p> 	<p><b>Standard 1</b> 1.02 1.04</p> <p><b>Standard 2</b> <b>2.1</b> 2.11</p> <p><b>2.3</b> 2.31</p> <p><b>Standard 3</b> <b>3.1</b> 3.12 3.14</p> <p><b>Standard 7</b> 7.02 7.04</p>	<p><b>Standard 1</b> 1.05 1.07</p> <p><b>Standard 2</b> <b>2.1</b> 2.11</p> <p><b>Standard 3</b> <b>3.1</b> 3.11</p> <p><b>Standard 7</b> 7.05</p>	<p><b>Standard 1</b> 6.1.03 6.1.05 6.1.06 6.1.07</p> <p><b>Standard 2</b> <b>2.1</b> 6.2.01</p> <p><b>Standard 3</b> <b>3.1</b></p> <p><b>Standard 7</b> 6.7.05</p>	<p><b>Standard 1</b> 7.1.03 7.1.05 7.1.06 7.1.07 7.1.08</p> <p><b>Standard 2</b> <b>2.1</b> 6.2.01</p> <p><b>Standard 3</b> <b>3.1</b> 7.3.03</p> <p><b>Standard 7</b> 7.7.05</p>	<p><b>Standard 1</b> 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08</p> <p><b>Standard 2</b> <b>2.1</b> 8.2.01</p> <p><b>Standard 3</b> <b>3.1</b> 8.3.01 8.3.02</p> <p><b>Standard 7</b> 8.7.05</p>

# Plant Scavenger Hunt



CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<p><b>Science</b> <b>(cont.)</b></p> 	<p><b>Standard 5</b> 5.01</p> <p><b>Standard 6</b> 6.03</p> <p><b>Standard 7</b> 7.02 7.04 7.05</p>		<p><b>Standard 7</b> 7.7.02 7.7.05 7.7.06</p>	<p><b>Standard 7</b> 7.7.02 7.7.05 7.7.06</p>	<p><b>Standard 7</b> 8.7.02 8.7.05 8.7.06</p>
<p><b>Social Studies</b></p> 	<p><b>Geography Standard 2</b> 4.44 4.45 4.46</p>		<p><b>Geography Standard 1</b> <b>1.2</b> 7.27</p> <p><b>Standard 2</b> <b>2.1</b> 7.35</p>	<p><b>Geography Standard 1</b> <b>1.2</b> 7.27</p> <p><b>Standard 2</b> <b>2.1</b> 7.35</p>	<p><b>Geography Standard 2</b> <b>2.1</b> 8.18</p>

# Floral Investigations



CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<p><b>Language</b></p> <p><b>Arts</b></p> 	<p><b>Standard 1</b> <u>Writing Obj.</u> 4.01 4.08 4.05 4.12 4.07</p> <p><u>Thinking Obj.</u> 4.07</p> <p><b>Standard 2</b> 4.05 4.10 4.11 4.13</p> <p><b>Standard 3</b> 4.03 4.04 4.06 4.08 4.21</p> <p><b>Standard 4</b> 4.10</p> <p><u>Listening Obj.</u> 4.01 4.02 4.05 4.08 4.03 4.07</p> <p><b>Standard 5</b> 4.06</p>	<p><b>Standard 1</b> <u>Writing Obj.</u> 5.01 5.05 5.07</p> <p><b>Standard 2</b> 5.04 5.05 5.10 5.11 5.12 5.13</p> <p><b>Standard 3</b> 5.3.7</p> <p><b>Standard 4</b> 5.4.1</p> <p><b>Standard 5</b> 5.5.2</p>	<p><b>Standard 1</b> 6.20 6.22 6.25</p> <p><b>Standard 2</b> 6.17 6.18 6.19 6.24</p> <p><b>Standard 3</b> 6.01 6.06 6.07</p> <p><b>Standard 4</b> 6.22 6.34 6.37</p>	<p><b>Standard 1</b> 7.19 7.26 7.43</p> <p><b>Standard 2</b> 7.15 7.16 7.17 7.18 7.23</p> <p><b>Standard 3</b> 7.01</p>	<p><b>Standard 1</b> 8.14 8.34</p> <p><b>Standard 2</b> 8.11 8.12 8.13 8.21</p> <p><b>Standard 3</b> 8.01</p> <p><b>Standard 4</b> 8.20</p> <p><b>Standard 5</b> 8.33</p>
<p><b>Math</b></p> 	<p><b>Standard 1</b> 4.1.3</p> <p><b>Standard 2</b> 4.2.3</p> <p><b>Standard 3</b> 4.3.1</p> <p><b>Standard 4</b> 4.4.1a 4.4.4 4.4.5</p> <p><b>Standard 5</b> 4.5.3a 4.5.3b</p>	<p><b>Standard 2</b> 5.2.1 5.2.2 5.2.3</p> <p><b>Standard 3</b> 5.3.7</p> <p><b>Standard 4</b> 5.4.1</p> <p><b>Standard 5</b> 5.5.2</p>	<p><b>Standard 2</b> 2.1 2.3</p> <p><b>Standard 3</b> 3.1 3.7</p> <p><b>Standard 4</b> 4.1 4.2</p> <p><b>Standard 5</b> 5.2 5.6</p> <p><b>Standard 6</b> 6.2 6.3</p>	<p><b>Standard 2</b> 2.1</p> <p><b>Standard 3</b> 3.1 3.3 3.7</p> <p><b>Standard 4</b> 4.1</p> <p><b>Standard 5</b> 5.2 5.3 5.6</p> <p><b>Standard 6</b> 6.2 6.3</p>	<p><b>Standard 2</b> 2.2</p> <p><b>Standard 3</b> 3.1 3.3 3.7</p> <p><b>Standard 4</b> 4.1</p> <p><b>Standard 5</b> 5.2 5.3 5.6</p> <p><b>Standard 6</b> 6.2 6.3</p>

# Floral Investigations



CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<p><b>Science</b></p> 	<p><b>Standard 1</b> 1.01 1.02 1.03 1.04 <b>Standard 2</b> <b>2.1</b> 2.11 2.12 <b>Standard 3</b> <b>3.1</b> 3.12 <b>3.2</b> 3.22 <b>3.3</b> 3.33 <b>3.4</b> 3.43 <b>Standard 5</b> 5.05 <b>Standard 6</b> 6.01 6.02 6.03 <b>Standard 7</b> 7.02 7.03</p>	<p><b>Standard 1</b> 1.02 1.03 1.05 1.06 1.07 1.08 <b>Standard 2</b> 2.11 2.11 <b>Standard 3</b> <b>3.1</b> 3.11 3.12 <b>Standard 5</b> 5.04 <b>Standard 7</b> 7.05 7.06</p>	<p><b>Standard 1</b> 6.1.02 6.2.03 6.1.05 6.1.06 6.1.07 <b>Standard 2</b> <b>2.1</b> 6.2.01 <b>2.2</b> 6.2.03 <b>Standard 3</b> 3.4 <b>Standard 5</b> 6.5.03 <b>Standard 7</b> 6.7.04 6.7.03 6.7.02</p>	<p><b>Standard 1</b> 7.1.03 7.1.05 7.1.06 7.1.07 <b>Standard 2</b> <b>2.1</b> 7.2.01 7.2.03 <b>2.2</b> 7.2.04 <b>Standard 3</b> <b>3.1</b> 7.3.01 7.3.03 <b>3.2</b> 7.3.04 <b>3.4</b> 7.3.09 <b>Standard 5</b> 7.5.03 <b>Standard 7</b> 7.7.02 7.7.03 7.7.04 7.7.05</p>	<p><b>Standard 1</b> 8.1.03 8.1.05 8.1.06 8.1.07 <b>Standard 2</b> <b>2.1</b> 8.2.01 <b>2.2</b> 8.2.03 <b>Standard 3</b> <b>3.1</b> 8.3.01 8.3.02 8.3.03 <b>3.2</b> 8.3.05 <b>3.3</b> 8.3.06 <b>Standard 5</b> 8.5.03 <b>Standard 7</b> 8.7.02 8.7.03 8.7.04 8.7.05</p>
<p><b>Art</b></p> 	<p><b>Standard 1</b> <b>Standard 2</b> <b>Standard 3</b></p>	<p><b>Standard 1</b> <b>Standard 2</b> <b>Standard 3</b></p>	<p><b>Standard 2</b> Art. 04 Art .09 Art .10 Art .11</p>	<p><b>Standard 2</b> Art. 04 Art .09 Art .10 Art .11</p>	<p><b>Standard 2</b> Art. 04 Art .09 Art .10 Art .11</p>

# Territories



CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<p><b>Language Arts</b></p> 		<p><b>Standard 1</b>  <u>Writing Obj.</u>                      5.07  <u>Listening Obj.</u>                      5.03  <u>Speaking Obj.</u>                      5.10  <u>Reference &amp; Study Skills</u>                      5.06  <u>Thinking Obj.</u>                      3 - 5.18  <b>Standard 2</b>  <u>Writing Obj.</u>                      5.05                      5.10                      5.11                      5.12                      5.13  <u>Speaking Obj.</u>                      5.01                      5.08  <b>Standard 3</b>                      5.05                      5.06                      5.11                      5.12  <b>Standard 4</b>                      5.11                      5.02                      5.05                      5.08                      5.10                      5.11  <b>Standard 5</b>                      5.23</p>	<p><b>Standard 1</b>                      6.20                      6.22                      6.25  <b>Standard 2</b>                      6.17                      6.18                      6.19                      6.24  <b>Standard 3</b>                      6.01  <b>Standard 4</b>                      6.06                      6.09                      6.20                      6.22                      6.25  <b>Standard 5</b>                      6.01  <b>Standard 6</b>                      6.06                      6.25</p>	<p><b>Standard 1</b>                      7.15                      7.19                      7.22  <b>Standard 2</b>                      7.16                      7.17                      7.18                      7.23  <b>Standard 4</b>                      7.01                      7.12                      7.19                      7.14  <b>Standard 6</b>                      7.24</p>	<p><b>Standard 1</b>                      8.14                      8.17                      8.32                      8.33  <b>Standard 2</b>                      8.12                      8.13                      8.18                      8.21  <b>Standard 4</b>                      8.01                      8.17                      8.23</p>
<p><b>Math</b></p> 		<p><b>Standard 3</b>                      5.3.1                      5.3.7  <b>Standard 5</b>                      5.5.2</p>	<p><b>Standard 2</b>                      2.1  <b>Standard 3</b>                      3.6                      3.7  <b>Standard 5</b>                      5.2                      5.6</p>	<p><b>Standard 2</b>                      2.1  <b>Standard 3</b>                      3.6                      3.7  <b>Standard 5</b>                      5.2                      5.6</p>	<p><b>Standard 3</b>                      3.6                      3.7  <b>Standard 5</b>                      5.2                      5.6</p>

# Territories



CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<p><b>Science</b></p> 		<p><b>Standard 1</b> 1.05 1.07 1.08</p> <p><b>Standard 2</b> <b>2.1</b> 2.11</p> <p><b>Standard 3</b> <b>3.1</b> 3.11 3.12 3.13 3.14 3.15</p> <p><b>3.2</b> 3.24</p> <p><b>3.4</b> 3.43</p> <p><b>Standard 4</b> <b>4.2</b> 4.22 4.25</p> <p><b>Standard 5</b> 5.04</p> <p><b>Standard 7</b> 7.05 7.06</p>	<p><b>Standard 1</b> 6.1.03 6.1.05 6.1.06 6.1.07</p> <p><b>Standard 2</b> <b>2.1</b> 6.2.01</p> <p><b>Standard 3</b> <b>3.1</b> <b>3.2</b> 6.3.01 6.3.02</p> <p><b>Standard 4</b> <b>4.2</b> 6.4.04 6.4.07</p> <p><b>Standard 5</b> 6.5.03</p> <p><b>Standard 7</b> 6.7.02 6.7.05 6.7.06</p>	<p><b>Standard 1</b> 7.1.03 7.1.05 7.1.06 7.1.07</p> <p><b>Standard 2</b> <b>2.1</b> 7.2.01 <b>2.2</b> 7.2.04</p> <p><b>Standard 3</b> <b>3.1</b> 7.3.01 7.3.02 7.3.03</p> <p><b>3.2</b> 7.3.04 7.3.06</p> <p><b>Standard 4</b> <b>4.2</b> 7.4.01</p> <p><b>Standard 5</b> 7.5.03</p> <p><b>Standard 7</b> 7.7.02 7.7.05 7.7.06</p>	<p><b>Standard 1</b> 8.1.03 8.1.05 8.1.06 8.1.07 8.1.08</p> <p><b>Standard 2</b> <b>2.1</b> 8.2.01</p> <p><b>Standard 3</b> <b>3.1</b> 8.3.01 8.3.02 8.3.03</p> <p><b>3.3</b> 8.3.06</p> <p><b>Standard 4</b> <b>4.2</b> 8.4.03</p> <p><b>Standard 5</b> 8.5.03</p> <p><b>Standard 7</b> 8.7.02 8.7.05 8.7.06</p>
<p><b>Social Studies</b></p> 		<p><b>Geography Standard 4</b> 5.18 5.38</p>	<p><b>Geography Standard 4</b> <b>4.1</b> 6.35 6.36</p> <p><b>4.2</b> 6.38</p>	<p><b>Geography Standard 2</b> <b>2.1</b> 7.35 7.36</p> <p><b>2.3</b> 7.41</p> <p><b>Standard 4</b> <b>4.1</b> 7.59 7.60</p> <p><b>4.2</b> 7.62 7.63</p>	<p><b>Geography Standard 2</b> <b>2.1</b> 8.18 8.19</p> <p><b>Standard 4</b> <b>4.1</b> 8.40 8.41 8.42</p>

# Plant Crossword Puzzle



CONTENT STANDARDS	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
<b>Language Arts</b> 	<u>Standard 1</u> Writing Obj. 4.12 Study Skill 4.26 Thinking Obj. 4.06 4.07 <u>Standard 2</u> 4.11 <u>Standard 3</u> 4.01 4.03 4.04 4.05 4.06 4.08 4.21 <u>Standard 4</u> 4.07 4.09 4.10 4.11 4.16 <u>Standard 5</u> 4.10	<u>Standard 1</u> Reading Obj. 5.13 Writing Obj. 5.01 5.05 <u>Standard 2</u> 5.03 Writing Obj. 5.04 5.05 <u>Standard 3</u> 5.11 5.12 <u>Standard 4</u> 5.02 Thinking Obj. 3-5.01 3-5.04 3-5.15 <u>Standard 5</u> 5.01 5.23 5.06 5.07	<u>Standard 1</u> 6.20 <u>Standard 3</u> 6.01 6.06 6.07 <u>Standard 4</u> 6.01 6.06 6.20 6.22 6.34 6.35 6.37	<u>Standard 1</u> 7.19 7.22 <u>Standard 2</u> 7.23 <u>Standard 3</u> 7.01 7.08 <u>Standard 4</u> 7.42	<u>Standard 1</u> 8.14 8.17 <u>Standard 3</u> 8.01 8.02
<b>Math</b> 	<u>Standard 2</u> 4.2.1 4.2.2 4.2.3	<u>Standard 2</u> 5.2.1 5.2.4	<u>Standard 2</u> 2.1	<u>Standard 2</u> 2.1	
<b>Science</b> 	<u>Standard 1</u> 1.04 <u>Standard 2</u> <u>2.1</u> 2.11 <u>Standard 3</u> 3.1 <u>Standard 5</u> 5.01	<u>Standard 1</u> 1.03 1.05 1.08 <u>Standard 2</u> <u>2.1</u> 2.11 2.12 <u>Standard 7</u> 7.05 7.06	<u>Standard 1</u> 6.1.03 6.1.05 6.1.08 <u>Standard 2</u> <u>2.1</u> 6.2.01 <u>Standard 3</u> <u>3.1</u> 6.7.05 6.7.06	<u>Standard 3</u> <u>3.1</u> 7.3.01 7.3.02 <u>3.2</u> 7.3.04 <u>Standard 5</u> 7.5.03 <u>Standard 7</u> 7.7.05 7.7.06	<u>Standard 3</u> <u>3.1</u> 8.3.01 8.3.02 <u>Standard 5</u> 8.5.03 <u>Standard 7</u> 8.7.05 8.7.06

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