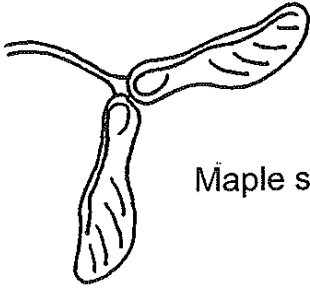
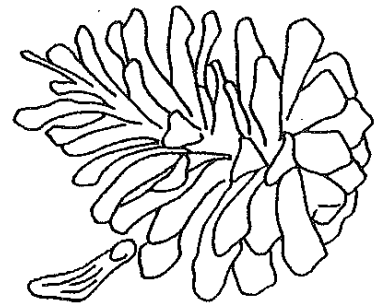


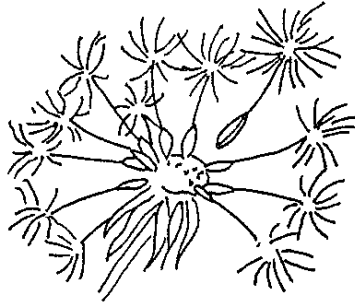
Teacher Packet
PLANT TRAVELERS



Maple seed



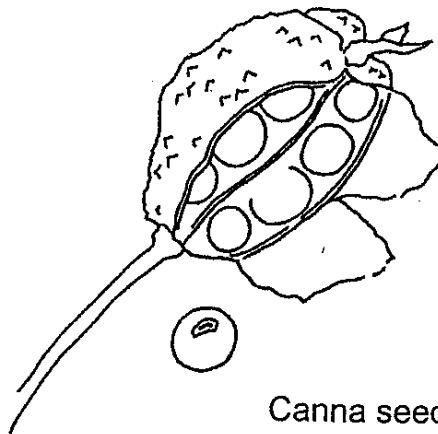
Pine cone



Dandelion



Acorn



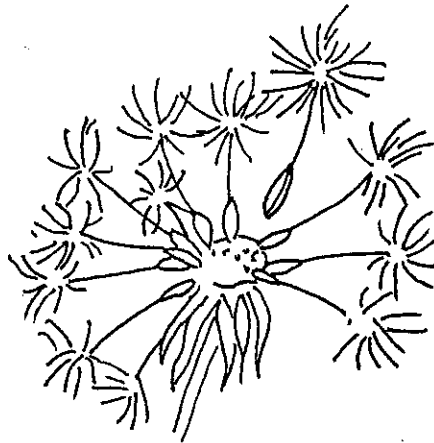
Canna seed



Blackberry

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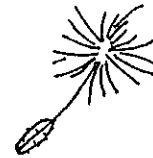
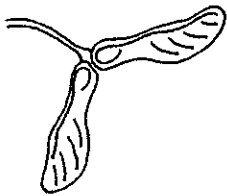


Produced by the Youth Education Program, San Francisco Botanical Garden Society in conjunction with the Children's Walk Committee of the Docent Council, Fall 1999.
Illustrations by Linda Seabrooks Campbell.

Plant Travelers Walk

The San Francisco Botanical Garden (SFBG) in Golden Gate Park contains over seven thousand different kinds of plants from around the world. During the fall, many of these plants bear fruit and produce seeds, which display a wonderful variety of mechanisms for dispersing themselves. We look forward to guiding your class on an exploration of these plant travelers.

This teacher's guide is designed to help you and your students make the most of your visit. It includes some general background information for you to share with your class before your visit, activities to help prepare for the walk, other activities to extend the experience back in the classroom, and an annotated bibliography of useful materials. We strongly encourage you to prepare your class by making use of these materials, especially if you are just beginning your exploration of these concepts.



Basic concepts

The walk is designed to illustrate four key concepts:

- 1. Most plants produce seeds in order to reproduce themselves.**
- 2. A seed contains a baby plant and a supply of food wrapped in a seed coat, ready to grow when conditions are right.**
- 3. Seeds need specific things to grow well – sun, air, water, and space.**
- 4. Different seeds have different shapes and features that help them travel away from their parent plant and to a new place to grow.**

The story of seeds

For most flowering plants, seeds are the most important way to reproduce. The flowers of a plant are designed for the purpose of making seeds. If a flower is pollinated, then a seed can develop in the ovary at the base of the flower. As this seed ripens, the ovary swells and helps produce the fruit that encloses the seed.

The seed of a flowering plant contains three basic parts:

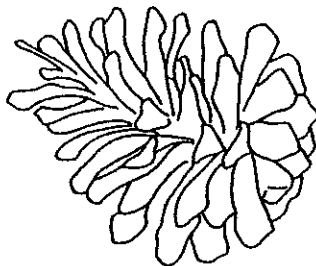
Embryo – the tiny baby plant, which already has leaves, a stem and a root tip

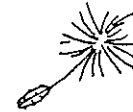
Endosperm – a food supply for the embryo

Seed coat – a covering that protects the embryo and endosperm

Not all plants have flowers! The seeds of cone-bearing plants are formed inside of cones. The female cones are pollinated by the smaller male cones, and the seeds grow in the female cones.

In order to grow, a seed needs to have a certain amount of water, sun, air and space. Sometimes the best place to grow is right near the parent plant, where the environment may be good for that kind of plant. Often, though, a seed needs to move away from the parent plant to grow well. Sometimes the leaves of the parent may cast too much shade, or its roots may take up all the available water, or it may simply take up too much space. In this case, seeds can have interesting adaptations that help them to travel away from the parent.





How seeds travel

There are many different ways that seeds can travel. Sometimes we can tell how a seed can travel just by looking at it or experimenting with it. Sometimes we have to see the seed travel to be sure how it works. Sometimes one seed can travel in several different ways! Following is a description of how some seeds travel.

Seeds can travel by forces of nature

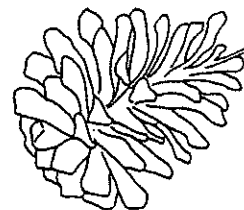


Wind - Some plants have seed pods which become dry and split open, becoming **shakers** which sprinkle out their seeds when the wind blows (*poppy, columbine*). Other seeds have **wings**, which act like helicopters or gliders (*maple, ash, linden*). Some seeds have tufts of **hair**, which help them float like parachutes (*dandelion, willow*).

Gravity – Some seeds **fall** straight to the ground (*eucalyptus, iris*), while others, especially large round seeds, **roll** downhill (*buckeye, bladderpod, canna*).

Water – Some seeds can **float** along in the water for long distances (*coconut, pussy willow*).

Fire – Some seeds are found inside hard, closed containers and need the heat of a **fire** to open the nut or cone (*fire pines*).



Seeds can travel with the help of the parent plant

Exploders– Some seed pods open violently, shooting their seeds in all directions (*squirting cucumber, cranesbill*).

Self-planting – Sometimes the stem of the parent plant bends over and the seed grows right into the ground (*peanut, cyclamen*).

Seeds can travel with the help of animals

Hitchhikers – Seeds with barbs like velcro can grab onto fur, feathers, and clothing (*foxtail grass, forget-me-nots*).



Edible seeds and fruits – Nuts and cones are gathered and stored by squirrels, jays and other animals, and can sprout if the animal forgets about them (*hazelnuts, acorns*). Fruit such as berries get eaten by various animals, and the seeds pass through the animal's system and are excreted, along with some fertilizer! (*huckleberry, crabapple*) Sometimes only the outside of the fruit is eaten, and the seed is thrown away (*wild ginger, trillium*).



Plant explorers and collectors – Sometimes people collect seeds from all over the world and bring them to new places to grow. That's what has happened at the SFBG!

Vocabulary

We will use these words during your visit to the gardens. You may wish to share these definitions with your students, or have them use their dictionaries to find other definitions.

botanical garden – a place where different kinds of plants are grown to be studied and enjoyed

disperse – to spread into a new area

embryo – the part of a seed that will become a new plant

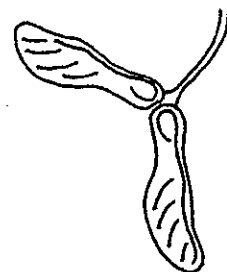
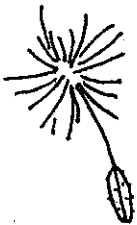
flower – the part of a plant that can make a seed

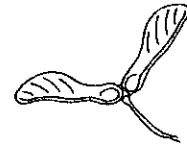
fruit – the part of a plant that holds and protects the seeds, usually formed from the ovary

ovary – the part of the flower where seeds are formed

pod – a tough container which holds one or more seeds

seed – a tiny plant and its food source, tucked in a seed coat, waiting for good growing conditions





Pre-visit activities

Becoming a nature detective

A visit to the SFBG is a chance for students to become nature detectives, exploring and discovering the wonders of the natural world around them. Help your students get ready to make the most of their trip with the following activity.

Introduce the concept of a "nature detective" to your students – a nature detective is someone who explores the natural world by observing closely, thinking about what they observe, and coming up with ideas about what they discover. Every one of us can be a nature detective – we all have special tools that can help us investigate the natural world.

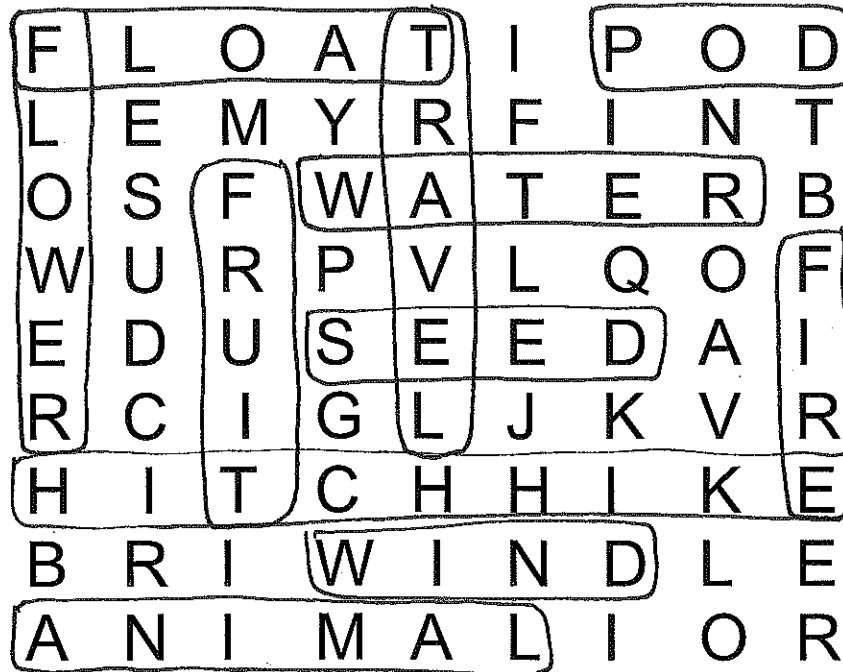
Divide children into small groups. Ask them to think about what tools we have *in or on our bodies* that we can use to explore the world around us. Each group can make a list of the tools they think of, or can draw pictures illustrating their ideas. Have each group share their results with the class, and compile their ideas in a large list or drawing.

Here are some suggestions – you and your class may think of others!

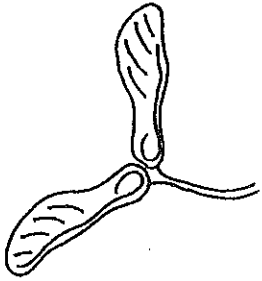
eyes - counters, cameras
noses – scent detectors
fingers – tweezers, feelers
hands- rulers, cups
hair – wind detector
memories – notebooks and pencils
ears – tape recorders
feet – transportation
skin – thermometer

Plant Travelers Word Seek

Use this scramble to help familiarize your students with some of the terms we will use on our walk! Student version is on the reverse.

**Hidden word list**

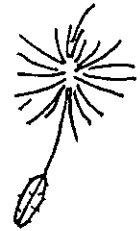
	seed
animal	hitchhike
fire	pod
float	travel
flower	water
fruit	wind



Plant Travelers Word Seek

Can you find all of the hidden words?

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



Hidden word list

seed

- | | |
|--------|-----------|
| animal | hitchhike |
| fire | pod |
| float | travel |
| flower | water |
| fruit | wind |



Seeds – the inside story

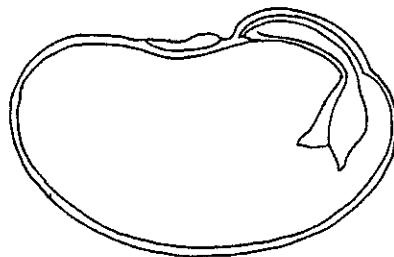
Seeds range in size from tiny dust-like orchid seeds to enormous forty pound double coconut seeds. Some have spikes, some have hairs, some have sweet fruit around them. They come in all colors of the rainbow. No matter how different they may be, they all have one purpose, which is to produce a new plant. The following activity will introduce your students to the parts of a seed by looking closely at one or two common seeds.

The day before you wish to do this activity, soak enough large dried lima beans in water to have at least one per child. You will also need a toothpick for each and hand lenses, which can be shared by smaller groups. You may also wish to have one peanut in the shell for each child.

Give each student, or group of students, lima beans, toothpicks, and hand lenses. Have students carefully examine and describe the outside of their bean. If you wish, you may have students sketch what they see. Explain that what they see and feel is the seed coat, which is protecting the contents of the seed.

Use toothpicks and fingers to peel off the seed coat and split the bean in half lengthwise. Students should closely examine the inside of the seed. The endosperm, which is the large fleshy part, provides food for the small plant in the seed. The small plant, or embryo, is ready to grow, with small leaves, a stem, and a root tip. Again, students may sketch what they see.

If you wish, have children perform the same exploration with a peanut. The peanut shell is the fruit surrounding the seeds, the papery covering is the seed coat, the seed itself can be split in two to reveal the tiny plant nestled against its food source.



Post-visit Activities

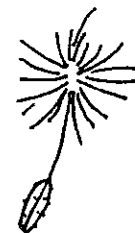
Seed sorting

We know that seeds come in many different shapes and sizes, and travel in a number of different ways. In this activity, students will examine a variety of seeds and sort them into categories which they will define themselves.

Divide students into small teams and give each team an assortment of seeds. These can include seeds collected on their visit to the SFBG, seeds they have collected in the course of a scavenger hunt near the school, and seeds found at home in the pantry and spice rack.

For ease of sorting, put seeds on a large piece of white paper. Have students closely observe their seeds, with hand lenses if available. Encourage them to write down some of their observations. After they have observed for several minutes, ask them to divide the seeds into different categories on their piece of paper.

Ask students to share their categories with the class. If you wish, have students circulate to each other's tables and guess what their seed categories are. Ask students to return to their seats and to organize their seeds in a new way. Students may enjoy being challenged to produce the fewest possible categories, or the most, or exactly four, or categories that you can recognize with your eyes shut. If they have not yet done so, ask them to sort the seeds by the way that they think the seeds travel.





Seed Scavenger Hunt

Now that your students have some ideas about where to look for seeds, send them on a seed scavenger hunt around the school grounds!

Have students work in pairs or small teams. Give each group a copy of the card below. You can either ask them to draw or describe what they find, or to collect it if there is enough plant material available. Be sure to set clear boundaries and a reasonable time limit.

When students are finished, ask them to share their results. What was easy to find? Why? What was hard to find? Why? Where else do you think you might look to find some of these things? Did you have any surprises while you were looking?

SEARCHING FOR SEEDS !!!

A seed smaller than this



A smooth seed

A seed that can fly

A seed that a bird might eat

Something that MIGHT be a seed (but you are not sure!)

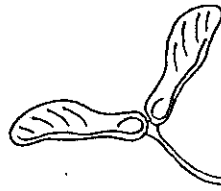
A seed still growing on a plant

A seed that might stick to you

A seed bigger than this

An empty seed container





Create a Traveling Seed

After visiting the garden, your students will have many ideas about the different ways in which seeds can travel. In this activity, they can try out some of their ideas by modifying a simple seed so that it can travel in a new way.

Divide students into pairs or small teams. Ask each group to make up a list of ways that seeds can travel, based on their experiences in the garden. After they have finished their lists, have them share their ideas with the class.

Now offer students a challenge. Tell them that you will give them a seed which needs to travel. Their job will be to make it possible for that seed to travel in one of these ways:

The seed will **float** on water for at least five minutes

The seed will **fly** at least three feet in the air

The seed will **roll** at least 10 feet across the floor

The seed will **stick** to an animal or person and travel at least 20 feet

The seed will **shoot** at least two feet from its plant

You may wish to write these descriptions on the board and allow each group to make its own decision. Alternatively, make up slips with one seed description on each and have student groups pick randomly.

Now distribute the following materials to each group:

several large seeds - fava beans, lima beans, peas, pumpkin seeds, etc.
assorted construction materials - colored paper, rubber bands, toothpicks, popsicle sticks, string, cotton, feathers, balloons, pipe cleaners, plastic bags, cloth scraps, glue, tape, paste and scissors.

Give students enough time to design, build, and test their seed systems. When students are all ready, have them share and demonstrate their dispersal inventions. As each group displays its invention, other students can predict how they think each seed will be dispersed.

Bibliography and Resources

If these books are not available in your library, you can find them at the Helen Crocker Russell Library at the SFBG.

The Dandelion Seed. Paula Z. Hogan. Austin TX: Raintree Steck Vaughn, 1991.

A nicely illustrated and well written book for young readers (K-3).

How Seeds Travel. Cynthia Overbeck. Minneapolis MN: Lerner Publications Co., 1982.

Beautifully photographed, text appropriate for older readers (gr.3 and up).

The Tiny Seed. Eric Carle. Saxonville MA: Picture Book Studies, 1987.

Colorful and entertaining, a boldly illustrated story of the journey of a single seed (K-3).

Seeds and Weeds. Rena R. Kirkpatrick. Austin TX: Raintree Steck Vaughn, 1991.

Includes simple activities, intended for younger readers (K-3).

Seeds Pop, Stick, Glide. Patricia Lauber. New York NY: Crown Publishers, 1981.

Simple clear text and photographic illustrations introduce readers to the clever ways plants disperse their seeds (K and up).

From Flower to Fruit. Anne Ophelia Dowden. New York NY: Thomas Y. Crowell, 1984.

An all-encompassing primer for beginning naturalists and botanists; beautiful illustrations and informative text for educators and older students.

The Visual Dictionary of Plants. Eyewitness Visual Dictionaries. New York NY: Doris Kindersley, Inc. 1992.

Full color photographs labeled in great detail; text appropriate for older students and adults, photos for all ages.

