

Whiskeytown Environmental School

Clear Creek Field Lab Experience - Second Grade

Plant Life Cycles

Revised Fall 08

Unit Overview:

In this unit, students will be introduced to elements of the scientific method as they explore germination and seed dispersal in plants. The first three lessons will prepare the students for the field experience and the last lesson will serve as an assessment for the unit. An optional lesson for growing plants from has been included for the teacher's convenience.

Optional Plant Growth Lesson: *The Needs of Seeds*

It is not necessary to do this lesson before the field lab

Students will plant two different types of seeds to observe germination and the development of important structures. They will record the growth of their plants in their journals. Options for expanding this lesson into an experiment are included.

Classroom Lesson 1: *Seeds*

Students will examine the inside of a seed and identify the parts. They will record their observations in their journals.

Classroom Lesson 2: *Temperature*

Students will learn to use thermometers and become familiar with the Fahrenheit scale.

Classroom Lesson 3: *Seed Dispersal - Mix and Match /Seed Scavenger Hunt*

The students begin thinking about where some familiar seeds come from and how they are dispersed. They will also discover what seeds can be found outside on their own campus. This activity will help the students develop the desired behaviors and skills for the field trip.

Field Lab Lesson 4: (Taught by WES Staff)

Activity One: Seed Scavenger Hunt

Activity Two: Role of Plant in the Aquatic Ecosystem (Story)

Activity Three: Temperature Investigation

a) Clear water in shade and sun

b) Muddy and clear water

Activity Four: Seed Races

Activity Five: Seed Necklaces

Classroom Lesson 5: *Seed Dispersal - Assessment*

Students will modify seeds so that various natural forces may disperse them.

Science Content Standard – Second Grade

State of California, State Board of Education

Life Sciences

2. Plants and animals have predictable life cycles. As a basis for understanding this concept, students know:

- a. organisms reproduce offspring of their own kind. The offspring resemble their parents and each other.
- b. many characteristics of an organism are inherited from the parents. Some characteristics are caused by, or influence by, the environment.
- d. there is variation among individuals of one kind within a population.
- e. the germination, growth and development of plants can be affected by light, gravity, touch, or environmental stress.
- f. in plants, flowers and fruits are associated with reproduction.

Investigation and Experimentation

4. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept, and to address the content of the other three strands, students should develop their own questions and perform investigation. Students will:

- a. make predictions based on patterns of observation rather than random guessing.
- b. measure length, weight, temperature, and liquid volume with appropriate tools and express measurements in standard and non-standard units.
- e. construct bar graphs to record data using appropriately labeled axes.
- f. write or draw descriptions of a sequence of steps, events, and observations, and include the use of magnifiers or microscopes to extend the senses.
- g. follow verbal instructions for a scientific investigation.

Optional Plant Growth Lesson: *The Needs of Seeds*

It is not necessary to do this lesson before the field lab. It is provided for those teachers who would like to have a convenient lesson to integrate the field lab into a larger plant unit.

Objective

Students will germinate seeds in a plastic bag so that they may observe the development of important structures.

Ca Science Standards – 2a, 2d, optional 2c, 2e, 4a, 4b, 4d, 4e, 4f, and 4g

Time/Setting

First Lesson: 30 to 45 minutes; inside

Follow up lessons/observations: 3 observations with 15 to 30 minutes each session; inside

Materials

Large dry seeds - beans and corn

Large plastic resealable bags - 9" x 12"

Paper towels

Hand lenses

Dilute bleach solution

Water

Stapler

Journal Pages (will depend on which activities are chosen)

Subjects

Science, math

Vocabulary

Germination, primary root, root hairs, geotropism, phototropism

Background Information

The first structure to emerge from a germinating bean seed is the primary root, which grows downward seeking moisture. At the tip of the root is a hardened root cap that protects the end of the growing root from being torn as it pushes through the soil. Along the sides of the primary root, a soft fuzz appears. Seen through a hand lens, the fuzz is made up of tiny root hairs that increase the surface area of the root and its ability to absorb water. Next, the new plant stem and leaves emerge and grows upward, pushing the cotyledons out of the soil.

A corn seedling grows in a slightly different manner. As the root emerges and grows downwards, another structure, the coleoptile, grows upward. The coleoptile forms a hollow protective cover over the shoot of the corn plant. The corn cotyledon is left below the soil line.

The tendency for roots to grow downward independent of the direction in which a seed is oriented is called geotropism or gravetropism. The tendency for stems to grow upward toward light is called phototropism.

Advanced Preparation

Gather materials. Soak seeds in a dilute bleach solution (see step one).

Procedure

1. Soak the seeds in a diluted bleach solution for 15 minutes before beginning the activity. This will sterilize the seed coats and prevent mold growth. Rinse the bleached seeds with fresh water before distributing them to students.
2. Tell each student to fold a paper towel to fit neatly into a resealable plastic bag. Place a line of staples across each plastic bag parallel to and about three inches from the top. Leave a space of about 3/4" between the staples. The staples should perforate two layers of plastic and the paper towel.
3. Have one student pour about a half cup of water into each bag while another student holds it upright. The water will collect in the bottom and be picked up by the paper towel. A small amount may dribble out through the staple holes.
4. Have students place six soaked seeds (3 bean, 3 corn) inside the bag above the line of staples. This will allow them to observe the differences between the two types of plants and it can be used to support standard 2a. These seeds should be put between the front layer of plastic and the paper towel. Seal the bags and hang them on a bulletin board or window
5. Students will be able to watch the seeds germinate through the plastic. Once the seeds have germinated, have students open the tops of the bags and add more water when the level in the bottom of each bag gets low.
6. Have students use hand lenses to observe the formation of root hairs. They'll be able to see evidence of geotropism and phototropism where seeds were placed in the bags in different orientations (the stems will go up and the roots will go down no matter how the beans were placed in the bag). Notice what happens to the seedlings' cotyledons over time. As stored food is depleted, they will wrinkle and shrink. To support standard 2d, have them look for differences among the corn plants. Though they are raised in the same conditions, they are not identical. They can also look for differences among the bean plants.

7. Observation/ Investigation/ Data Recording Options:

- Measure the growth and record it on a chart in their journal on at least three different days (ex.- when it germinates, 2/3 days later, 4/5 days later). Using the information they collect, they can create simple bar graphs based on the length of the root, stem, or entire plant. They can put the day on the x-axis and put the length on the y-axis. The bar graphs will make it easier to see trends or changes in growth rates. This graphing practice will help them understand that graphs make data easier to read and analyze. This supports standards 4b and 4e.
- To develop this into an experiment or science fair project, try different variables: place one plastic bag garden in a lighted area and another in the dark; feed fertilizer to one garden and plain water to the other; place one in a cool place and the other in a warm place; put staples in the top or the middle. Ask students to measure their growth each day (or every 2/3 days), record the results in their journals, and make conclusions about the different variables that were tested. These options can be used to support standards 2c, 2d, 2e, as well as 4a, 4b, 4d, 4e, 4f, and 4g.
- To expand the phototropism/ geotropism component of the lesson, rotate the bags 90° and record what happens. If the students show a great deal of interest in this particular aspect of plant growth, continue rotating the bag 90° in the same direction every few days. The stem and root will eventually form a double spiral. This supports standards 4c and 4e. If this is developed into an experiment or science fair project, it can be used to support standards 4a, 4b, 4d, 4f, and 4g.

My Plant Growth Record

Name _____

Date _____

Observation 1st 2nd 3rd

Bean

Length of Stem _____

Length of Root _____

Draw your BEAN plant

Corn

Length of Stem _____

Length of Root _____

Draw your CORN plant

Classroom Lesson 1: Seeds

Objective

Students will examine the inside of a seed and identify the parts.

CA Science Standard – 2a

Time/Setting

First session 15 to 30 minutes, second session 30 to 40 minutes; inside

Materials

Dry lima bean seeds or peanuts in the shell

Water

Hand lenses

Pencils

Journal page

Subjects

Science, art

Vocabulary

Seed coat

Advanced Preparation

Gather materials.

Background Information

Seeds are well adapted to house the plant's next generation because they provide both nourishment and protection for the infant plant. An inner layer, surrounding the embryo, stores enough food to nourish the tiny plant when it first sprouts until its roots can take nutrients from the soil and its leaves can produce their own food.

The outer seed coat protects the embryo from drying out, freezing, and being destroyed by some animals. An apple seed is apt to be eaten, but its seed coat is relatively smooth and hard, so it passes through an animal's digestive system intact. Each kind of seed, no matter how tiny, has its own distinctive seed coat. A hand lens will reveal the ridges, indentations, and sometimes tiny hairs that give a seed its characteristic markings.

Procedure

1. Have students examine a dry seed closely using a hand lens. Make sure students notice the waxy coat that covers and protects the seed from injury, loss of water, and insects.
2. Have the students put the seeds in a jar of water and soak them overnight.
3. The next day, pass out the seeds and have the students carefully split them open.
4. Tell the students to observe the tiny stem and leaves of the new plant. Point out the stored food underneath the seed coat. This part of the activity can be used to reinforce standard 2a.
5. Tell students to draw the seed in their journal and label 3 parts: the seed coat, the stored food, and the new plant. A journal page is provided in this packet for your convenience.

My Science Journal

Name _____

My Seed

Draw a picture of your seed. Label the seed coat, stored food, and new plant.

Classroom Lesson 2: *Temperature*

Use whatever lesson you normally use for introducing thermometers and the procedure for taking temperatures. We will use Fahrenheit in the field lab, but we can add Celsius if you think your students are ready.

Suggestions for temperature investigations:

Their own body temperature

Air (indoors, out in sun on blacktop, out in sun over grass, shade on blacktop, shade on grass, etc)

Water, milk, juice (drink first from clean container then take temp to attach # to physical sensation)

Vinegar before and after adding baking soda (temp will decrease – endothermic rxn)

Classroom Lesson 3: *Mix and Match/ Seed Scavenger Hunt*

Objective

Mix and Match

Students are encouraged to think about where some familiar seeds come from and how they are dispersed.

Seed Scavenger Hunt

Students will discover what seeds can be found outside and how they are dispersed.

CA Science Standards – 2f, 4f

Time/Setting

Mix and Match

20 to 30 minutes; inside

Seed Scavenger Hunt

50 to 60 minutes; outside

Materials

Mix and Match

Sets of cards – each with a seed taped on it (ex.- apple seed, burdock seed, red bud seed, etc.) See advanced preparation for details

Parent fruit/seed head to match seeds (ex. Apple, burdock seed head, red bud seed pod, etc.) See advanced preparation for details

Seed Scavenger Hunt

Seed Hunt cards - 1 set for each team – a copy is included in this lesson

Bags for collecting – one per group

Old wool socks – one per group

White paper – large enough to display seeds

Hand lenses

Subjects

Science

Vocabulary

Seed dispersal

Background Information

Anyone who has blown the fluffy seeds from a ripe dandelion or tossed an apple core onto the ground has unwittingly contributed to one of the most important missions in the plant world - seed dispersal.

For without the dispersal of seeds to new locations, young seedlings would be competing with their parent plants, often unsuccessfully, for sunlight, soil, water, and nutrients, and the plant's success as a species could well be endangered.

Seed production and dispersal may not seem especially significant to those of us whose favorite part of a plant's life cycle is the flowering stage, but for the plant it is the ultimate goal. Flowers are just one step in the process; they are the plant's way of conceiving, fertilizing, and nurturing the tiny plant embryos as they develop into seeds.

Seeds are well adapted to house the plant's next generation because they provide both nourishment and protection for the infant plant. An inner layer, surrounding the embryo, stores enough food to nourish the tiny plant when it first sprouts until its roots can take nutrients from the soil and its leaves can produce their own food.

The outer seed coat protects the embryo from drying out, freezing, and being destroyed by some animals. An apple seed is apt to be eaten, but its seed coat is relatively smooth and hard, so it passes through an animal's digestive system intact. Each kind of seed, no matter how tiny, has its own distinctive seed coat. A hand lens will reveal the ridges, indentations, and sometimes tiny hairs that give a seed its characteristic markings.

The formation of viable seeds is a plant's primary goal: their dispersal to a favorable location is the next assignment. Plants don't move, so how can seeds travel? Among flowering plants, it is at this stage that the seed container plays a vital role, whether it be an apple, an acorn, or a coconut. Plants package their seeds in whatever way best guarantees dispersal. Biologically, the seed is a fertilized, ripened ovule and its container, the ripened ovary. The technical name for flowering plants is *angiosperm*, which translates to "seed in a vessel".

Some seed containers serve as foods for humans or animals who eat them and either discard the seeds or, in storing them, carelessly leave some behind. Squirrels hide acorns and forget to retrieve them all. Cherry seeds pass unharmed through the birds that eat them. Since the time when humans began tilling the soil and traveling to all corners of the earth, we have become the primary dispensers of many seeds.

There are ingenious seed containers. Some have wings or blades to propel them through the air whichever way the wind takes them. Maple, ash, elm, and basswood trees have such seeds. Some grow parachutes or fluffy hairs, which enables the wind to sweep their seeds aloft. Airborne dandelion and poplar tree seeds can travel long distances. Other seeds have sharp hooks or barbs that attach to passerby. Burdocks are well-known hitch-hikers. There are even seed containers with seams that burst open with such force the seeds explode from the parent plant. Jewelweed gets its nickname touch-me-not from the sudden expulsion of seeds that follows touching a ripened pod. A few seed containers are buoyant and carry their seeds on the water to new destinations. Coconuts are perhaps best known for this, although the seeds of many plants that grow along waterways are at least in part dispersed by water.

Thus dispersal of seeds is accomplished in a variety of ways, but they all attempt to achieve a common objective – distribution of the ripened seeds far enough away from the parent plant to reduce competition.

Advance Preparation

Mix and Match – Create seed cards by finding a fruit/seed head with seeds still in it. Remove the seeds and tape them to cards. 5 seed cards for each fruit would allow the class to be split into five groups for this activity. A single parent fruit/seed head for each seed type could be placed in the front of the class or each group can have their own. The season will usually determine what parent fruits are available, but try to find 3 from the kitchen or garden and 3 from outside.

Seed Scavenger Cards

Create the *Seed Hunt* cards using the master provided in this lesson.

Procedure

Mix and Match

1. Have the children match seeds to their parent fruits, looking closely at the shapes and designs of both. Briefly discuss how each type of seed might be dispersed.

Seed Scavenger Hunt

1. **SPECIAL NOTE** *Allow the students to collect only if you are in a very large area with many seed-producing plants. If this is not the case, the students can draw pictures of the seeds and seed heads they find and leave them on the plants.* Divide the class into teams of 3 to 4 students. Before passing out the bags and the socks, go over the rules for collecting. They should damage the plant as little as possible and only pick from plants that are abundant in the area.
2. Distribute the *Seed Hunt* cards. There are five different tasks listed. Each team can be given all five tasks if there is plenty of room and time. If time or space is limited, let each team do the sock card and one other task.
3. At the end of the hunt, have each group place their items on a piece of white paper. Pass out the hand lens and let the students look at some different seeds. Ask them to describe what they see.
4. Read the each task card and have the students point to or hold up the plant they collected for that description. Allow each group to introduce a seed they found interesting. Discuss its means of dispersal.
5. Have the students draw a picture of one of the seeds they found in their journal.

Source of Activity

Hands-On Nature: Information and Activities for Exploring the Environment with Children. 1986.
Jenepher Lingelbach, Editor
Vermont Institutes of Natural Science
Woodstock, VT 05091
1-(802)-457-2779

Seed Scavenger Hunt Cards

Make copies of this page and cut apart the sections to create the seed hunt cards.

Find two different seed containers that look good enough to eat. (Don't eat them yourself!)

Find two different seeds that travel a distance of three feet when you blow on them.

Find two different seeds that have hooks to stick to fur. (Put a wool sock on over one shoe and periodically check to see what seeds are hitch hiking a ride.)

Find two seed heads that have more than 20 seeds on them. Which one has the most?

If there are trees nearby, look for two different seeds that are carried by the wind; two seeds that animals might eat.

Seed Scavenger Hunt

Draw a picture of a seed your team found. Describe how it travels.

Field Lab Lesson 4 – (Taught by WES Staff)

Special Note – Activities made be modified due to weather, season, size of group, time, etc.

We will do at least four of the five activities.

CA Science Standards – 2a,2c, 2e, 2f, 4a, 4b, 4e, 4f, 4g

Materials

#1-6 dishpans

2 liter measure

10 - 15 thermometers (one per pair of students)

Seed collecting bags

Seed Examples

Seed Necklace Kit

Book: Salmon Stream by, Carol Reed - Jones

Data Sheets/ Pencils

Advance Preparation

When you arrive at the site, fill six dishpans (two liters in each) with clear creek or pond water. Add dirt to two dishpans. Place two clear water in the shade and put the other four next to each other in the sun.

Students Arrive:

- Meet buses, Introductions, (Quite Coyote)
- Respect and Safety talk.
- Does the group need a snack break?
- Use bathrooms.

Activity One: Seed Scavenger Hunt

- Lead the students to an open area (the field near the naturalist cabin) and form a circle.
- Review with the students, “What do all plants need to grow?” (Sun, soil, water and air).
- Ask the students how do plants reproduce? (seeds)
- Share some seed container examples. (pine cones, acorn, cattail) and ask, “Where are the seeds?” “How do the seeds travel to there new home?” (float, glide, hitch hike, and get eaten).
- Divide the students into small groups with a parent leader. Have them search for seed examples. Tell them that when they come back they will sort the seeds by how they travel using the activity card. Let them search for 10 minutes or more and circulate around to point out examples of seeds.
- Have the students return with their seed examples and sort them. Go around to each group and have them share and interesting seed and explain how it might travel.
- Have the students draw one of the seed examples they found.
- Then ask the students to save a seed that they think might be a floater to be used for the seed races later.

Activity Two: Role of Plants in the Aquatic Ecosystem

- Discuss the importance of plants in an aquatic ecosystem. Ask the students: “Why are plants important in the ecosystem?” (Plans provide food, shelter, shade and prevent erosion).

Use the following lessons as guides for relating the importance of riparian plants to salmon:

- "These Sheltering Trees", from Creek Watchers by, California Aquatic Science Education Consortium.
- "Why Do Salmon Need Trees", from The Pacific Salmon and Steelhead Coloring Book by, U.S. Fish and Wildlife Service,

- Read the story: Salmon Stream by, Carol Reed – Jones

Teach the students the repeating line in the story that goes, "this is the water clear and cool, that flows in the stream in the forest", so they can participate in the story.

- At the end of the story review the salmon life cycle.
- Ask the students "How did the water stay clear and cool for the salmon?" (Plants provide shade and prevent erosion by holding on to the soil with their roots).
- Ask the students "Why would dirty water be bad for the salmon?" (Sediment may suffocate the salmon eggs or make it difficult for the salmon to breath). You can make the analogy of smoke in the air makes it difficult for humans to breath.

Activity Three: Temperature Investigation

- The students will measure the temperature of water in three sites: shade, sun, and muddy water in the sun.
- Ask the students to predict which tub will have the warmest and coolest water. Explain that scientists always make a prediction or form a hypothesis before doing an experiment or collecting data. Students can record their prediction on their data sheet.
- Show the students how to use a thermometer. Explain the difference between Celsius and Fahrenheit degrees.
- After they have measured the tubs of water, they can also measure the pond and creek water.
- Bring the group together and ask them if their prediction was right.
 - A) Clear water in shade and sun – Which tub is cooler? How do plants (trees) affect the temperature of a stream? Which is better for salmon – a stream with trees or without trees?
 - B) Clear and muddy water in sun – Which tub is cooler? Which would be better for young salmon? How can plants (trees) make a difference between muddy and clear water?
 - Ask, "Why was the muddy water the warmest?" (Dark colors absorb light).

Activity Four: Seed Races

- Take the students to the creek and let them try to float/ race their seed.
- Do a comparison of an acorn, a pine seed, and a fluffy seed, such as a dandelion. Since most of the seeds will not be ones that are specifically designed to float, ask the students to guess which way the seed is designed to travel.
- Ask the students to predict which seed will float faster. Set up a start and finish line in a shallow riffle and have them race the seeds (use a 10 ft rope to mark the course). Ask the students, "Why was the winner was so fast?"
- Discuss why it might be to their advantage to move quickly (get farther away from the parent plant). "What else is necessary for a good floater?" (buoyancy).
- If it is very cold, this can be done with a fan on land. If there is time, use both methods for the same three seeds and compare the results.

Activity Five: Seed Necklaces

- Review what plants need to grow, (sun, soil, water, air).
- Have the students take their own body temperature.

- Show the example necklace to the students and explain how the warmth of your body will be like the warmth of the sun and help the seed germinate. The cotton ball will hold water for the seed. The seed has food stored inside to help it start growing. (Ask parents to help pass out supplies).
- Students can wear the necklace and compare germination time to a seeding started in a bag that is kept at room temperature.

Activity Six: (Optional) Mini Field Guides

- If the students brought their mini field guides with them, you can take them on a walk by the creek and identify the common trees. Student could even make leaf rubbings of willow and alder tree leaves.

Activity Seven: (Optional) Succession Game or Salmon Evolution

Temperature Investigation

Record the results of your temperature investigation in the spaces below.

Names _____

My Prediction:

I think that the _____ will be the warmest water.

I think that the _____ will be the coolest water.

Sun - Clear Water #1 ___°F ___°C

Sun- Muddy Water #2 ___°F ___°C

Shade- Clear Water #3 ___°F ___°C

Shade- Muddy Water #4 ___°F ___°C

Conclusion:

Which site had the warmest water? _____

Which site had the coolest water? _____

Seed Scavenger Hunt

Draw a picture of a seed your team found.
Describe how it travels.

Name _____

How does it travel? _____

Seed Scavenger Hunt

Draw a picture of a seed your team found.
Describe how it travels.

Name _____

How does it travel? _____

Seed Scavenger Hunt

Draw a picture of a seed your team found.
Describe how it travels.

Name _____

How does it travel? _____

Seed Scavenger Hunt

Draw a picture of a seed your team found.
Describe how it travels.

Name _____

How does it travel? _____

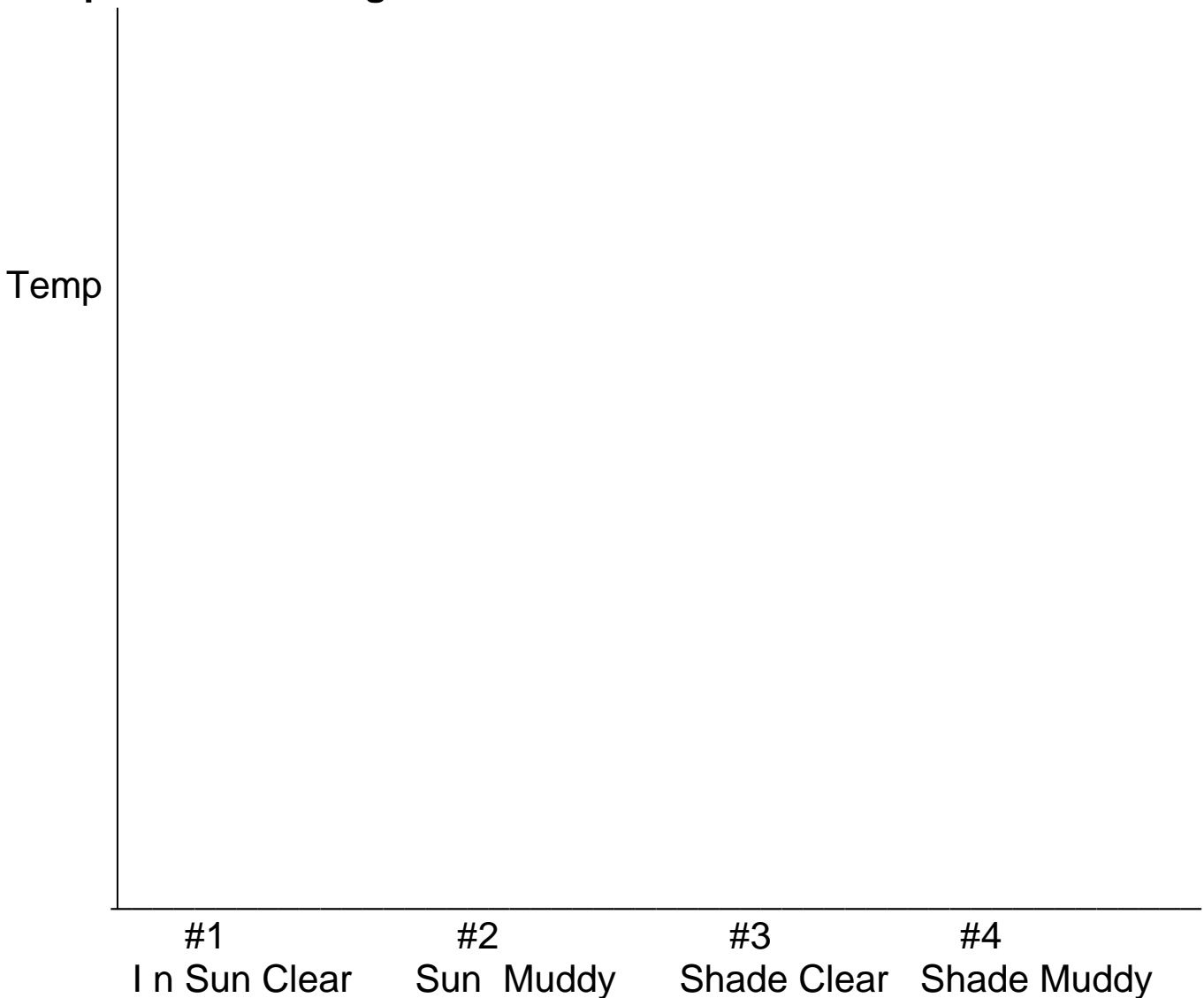
Data Sheet for Teachers

Floating Seeds

(Data is in seconds it takes to float 10 ft. If you would like to convert this into velocity or speed, just divide the number of seconds by 10 ft. to get number of seconds per 1 ft. ex. $15 \text{ sec}/10 \text{ ft} = 1.5 \text{ sec/ft}$)

Seed #1 _____ Seed #2 _____
Seed #3 _____ Seed #4 _____
Seed #5 _____ Seed #6 _____

Temperature Investigation



Classroom Lesson 5 – Seed Dispersal

Objective

The students will modify dried peas or beans so that they could be dispersed

CA Science Standards – 4f

Time/ Setting

30 to 50 minutes; inside or outside

Materials

Dried pea or bean seeds

Items for modifying seeds; colored paper, tape, glue, rubber bands, cotton balls, balloons, pipe cleaners, string, paper clips, etc.

Scissors

Markers

Tub of water

Seed modification cards

Subjects

Science, art

Vocabulary

Seed dispersal

Advance Preparation - Gather the materials together.

Procedure

1. Ask to students to review all the mechanisms of seed dispersal that they have observed during this unit (ex. Float, glide, explode, eaten, hitch-hike, rolled, etc.) Explain to the class that they will now have the chance to change peas or beans so that they can be dispersed in different ways.
2. Show the students the materials they will be able to use to modify their seeds. If the activity is done outside, let them know which natural materials are appropriate (twigs, dead leaves, small rocks, etc.)
3. Pass out a seed and one *Seed Modification* card to each group (included at the end of this lesson). Allow time for making the modifications.
4. When they are finished, let each group read their card and demonstrate their seeds' dispersal mechanism.
5. Discussion Questions:
 - Can you think of plants that actually have features like the seed dispersal mechanisms you constructed? What might happen if plants did not have seed dispersal mechanisms?

Source of Activity

The California State Environmental Education Guide

Carolie Sly, Coordinator

Alameda County Office of Education

313 West Winton Avenue

Hayward, CA 94544-01198

Adapted from *Outdoor Biological Instructional Strategies (OBIS)*, "Seed Dispersal." Developed by Lawrence Hall of Science, University of California. Nashua, NH: Delta Education, 1979.

Seed Modification Cards

Make copies of this page and cut apart the sections to create the seed modification cards.

Modify your seed to float on water at least five minutes.

Hint: air bubble, raft

Modify your seed with a mechanism that will throw the seed two feet away from the parent plant.

Hint: burst, split

Modify your seed to attract a bird or other animal.

Hint: bright, tasty fruits with seeds inside

Modify your seed to hitchhike on an animal or man for twenty feet.

Modify your seed to fly at least three feet.