Seeds to Seedlings: Propagating Seeds in the Classroom

Activity Overview
Students explore methods of propagation and investigate dormancy in seeds while relating those methods to natural processes.

Objectives
- Investigate seed dormancy
- Explore seed dispersal mechanisms and animal interactions
- Explore the phenology of seedling germination, cotyledon stage, first true leaves
- Use observation skills and plant identification skills

Subjects Covered
Science, Math, and Art

Grades
K through 12

Activity Time
Activity A - Classroom/Lab: 15-30 minutes This activity needs to be done one (1) month before the planting activity

Activity B - Classroom/Lab: 30-45 minutes

Season
Late summer to late fall

Materials
Potting soil, planting containers or trays (egg cartons and paper tubes work well), trays, water, and seeds

State Standards
Science:

Math:

*Adapted to California by Return of the Natives•CSU Monterey Bay

Background
Seeds generally require warmth, moisture and eventually light for good germination. Moisture tends to be the limiting factor for good germination. However, other factors can play a role in how well seeds germinate, if they germinate at all. A seed contains an embryo, an endosperm, and a seed coat. Water must penetrate the seed coat for the seed to imbibe water, swell, and germinate. Although some spring blooming species have seeds that germinate the same year they fall, other seeds must first break dormancy to allow enough water to saturate the seed coat. Dormancy provides a safety net for the seed to not germinate when habitat conditions are unfavorable to the survival of the seedlings. It is important to think of what ecosystem the seeds came from when considering the type of treatment that is required for breaking dormancy. Seed treatment for breaking dormancy is used when propagating seeds. Seed treatments mimic natural processes for breaking dormancy and eliminate the barrier to germination. There are four general treatments (and many variations) for breaking this dormancy; 1) dry-cold stratification; 2) moist-cold stratification; 3) scarification; 4) other treatments such as chemical (inhibitor), morphological, physiological, and embryo (deep). Some seeds have double dormancy and require combinations of treatments.

Dry-cold stratification
Dry-cold stratification is exactly what it sounds like. The seed is stored in a dry condition while being exposed to native habitat temperature conditions – commonly called winter.

Dry-cold stratification requires only cool temperatures of 32 degrees Fahrenheit for 1-2 months. Most commercial seed has undergone this treatment already. Plants like Lavender Hyssop, Lead Plant, Aster, and Blazingstar require dry-cold stratification.

Moist-cold stratification
Moist-cold stratification requires moist sand, peat, or vermiculite to be used with cool temperatures of 32 degrees Fahrenheit. The moisture level should be like a moist sponge. The potential for seed rot can be reduced by first sterilizing the inert material in a 400 degree oven for one hour prior to wetting. Many species need a 30 day period of moist-cold stratification, although some may need as little as 10 and others 90 days. Lupine is a species that needs only 10 days while Wild Quinine and Bottle Gentian need 30 days.

Scarification
Scarification is the act of breaking through the seed coat by rubbing sandpaper across the seed coat, or by pouring hot water onto the seeds, or using an acid to break through the seed coat. Different scarification techniques are used depending on the permeability and thickness of the seed coat. More of-

ten than not, scarification is an easy process of gently scratching the seed coat between two pieces of sandpaper. Acid scarification is used for seeds with tough, thick seed coats. Many of these larger seeds are food source for birds and other animals. The acid scarification acts as a mimic of the conditions the seed encounters when passing through an animal's digestive tract. Soaking seed in near-boiling water apparently breaks down the waxy cuticle associated with some species.

Other treatments

Other treatments include heat, harvesting immature fruits, and an application of plant hormones (regulators). Complete information on these methods is in the book Plant Propagation: Principles and Practices (see Additional Resources).

If seed is planted in the field in the fall, the physical and biological processes encountered on the soil will naturally break dormancy to allow the germination process the following spring. Some seed may take two to three years in the field to break dormancy.

Activity Description

(A) Seed Treatment

1. Verify seed treatment method. Proceed with following steps unless different techniques are recommended for your seeds. Seeds that do not need pretreatment can be planted right away.
2. Scarify seeds lightly with sandpaper or hot water.
3. For moist-cold stratified seed -

- Fill ziplock bag with sterilized sand, vermiculite or peat and moisten.
- Place seeds that need moist-cold stratification into ziplock bag.

For dry-cold stratified seed -

- Place dry seed in ziplock bag.

4. Label bags.
5. Refrigerate bags for at least 30 days.
6. Compare how seeds look after 30 days with those in dry-cold stratification. Plant seed using directions below.

Questions to consider

- What natural process are we imitating by using an abrasive or acid to penetrate the seed coat?
- What is the link to the food web in this process?
- Which seeds require moist-cold stratification and which do not? What is the shortest length of time required and what is the longest? How long can you keep seeds in cold-moist storage?
- Why might a particular species need hot, moist conditions to germinate?

(B) Seed Planting

1. Fill containers with soil and moisten very well; let sit to absorb water.
2. Remove seeds from refrigeration (see activity A above).
3. Plant seeds as deep as the seed is large; tiny seed can remain on the surface.

4. Water seeds well.
5. Place seeds in a south facing window and under florescent lights for best results. Florescent lights need to remain on 24 hours per day unless you have very large windows, then turn florescent lights off during the day and back on for the evening.
6. Continue to water daily as needed. Look for signs of germination. You will first observe the hypocotyl or stem of the seedling below the cotyledons. The cotyledons appear next: they are the leaves of the embryo and source of food for the young plant. Next the true leaves appear.
7. Once germinated and after the seedlings have grown their first true leaves, transplant the seedlings into growing trays or pots. If interested, see additional resources for a source for deep groove tube trays.

Questions to consider

- Compare how species germinate with treatment to those that do not require treatment.
- How densely can you plant seeds before they are negatively influenced by their seedling neighbors?
- Which species germinate the fastest? Some species, called pioneers, are the first to colonize a disturbed area. Do any of your species seem to be pioneers?

Extensions

- Chart the growth of your plants and monitor the phenology: when do they germinate, get their first true leaves, flower, and go to seed?
- Explore germination rates by counting out a specific amount of seed for each species. How many germinated? X number of seeds germinated out of 100 seeds will give you the percent germination. What trends do you see: do some germinate faster than others?

Assessments

- Look at different seeds and identify stratification techniques based on characteristics and/or species name.
- Describe the processes of plant growth from a dormant seed to a mature plant. Include drawings of each stage.
- Tell a story about a seed using terminology learned in this activity such as dormancy, stratification, seed coat, germination, cotyledons, and true leaves.