Seed Starting in the Classroom

What is a seed?  A seed is a tiny package that contains everything needed to make a new plant. A seed is composed of an embryo, endosperm, and a seed coat.

1. The **embryo** contains all of the parts that are needed to make a new plant: roots, a stem, and leaves. A cotyledon is a part of the embryo within the seed that usually becomes the first, or embryonic, leaf of a seedling. Plants with one cotyledon, such as corn, are called **monocots**. Plants with two cotyledons, such as beans, are called **dicots**.

2. The **endosperm**, or food supply, surrounds the embryo, and is made of protein, starch, and oil. In some seeds there is no endosperm, and the food supply is stored in the embryo.

3. The **seed coat** protects the embryo and food supply and regulates the intake of water and oxygen. A tiny hole in the seed coat, called a **micropyle**, allows water inside.

Seeds form in the flowers of plants when pollen grains (male cells) from the **stamens** of a flower join with ova (female cells) from the **pistil** of a flower. This process is called **pollination**. The pollen travels to the pistil on the bodies of bees, butterflies, or other insects, by floating in the wind, or by humans. The fertilized ova sends a tube through the pistil to the **ovule**, where seeds form. A flower can be **self pollinated**, or **cross pollinated**, which is the transfer of pollen from the stamens of one plant to the ovary of another. Each seed contains genetic information from both the male and female cells.

**Seed dispersal.** Seeds travel to their growing sites in many ways.

1. Seeds travel on the wind, often helped by special seed shapes such as the “wings” on a maple seed or the “parachute” on a dandelion seed.
2. Seeds of plants near streams or rivers can travel by floating on the water.
3. Some seeds have spines that attach them to animal or human skin or clothing, and allow them to travel until they drop off at their new growing site.
4. Animals eat fruits, and help disperse their seeds by discarding them, regurgitating them, or leaving them in their droppings.
5. Humans disperse seeds by planting them in gardens and fields.

**Germination.** Seeds are **dormant**, or inactive, which is much like sleeping. For them to **germinate**, or begin growing, they must have oxygen, moisture, and warmth. Some seeds require special light or temperature conditions to germinate. When the right conditions, or cues, for a particular seed have been met, the seed absorbs water, swells, and breaks the seed coat. The embryo begins to grow. Tiny root hairs spread out, anchoring the plant and pulling in moisture and nutrients from the soil. The embryo straightens and pops out of the soil. The root always bends so it will grow down, sensing the force of gravity. This function occurs in the root tip. If the root tip is cut off, the root would grow in any direction.

Certain seeds, particularly shrubs and trees, require a moist, chilling period in a dark place before they will sprout. Chilling seeds prior to planting to mimic natural conditions is called **stratification**. Some seeds have very hard seed coats, which are cracked or broken in the ground before they germinate. Artificially nicking these seeds with a file or sandpaper is called **scarification**.

**Growing on.** Food stored in the cotyledons, or seed leaves, provides all of the energy that the plant needs for its first burst of growth. Once the plant leafs out and grows its **true leaves**, it is able to make its own food, using a green pigment in its leaves, called **chlorophyll**, and the energy in sunlight. Leaves and roots take in oxygen and water.

**SUCCESSFUL SEED STARTING**

**Supplies:**

1. **Soil.** The potting medium needs to be free from weed seeds, disease, fungus spores, and other pests and pathogens. It needs to be able to absorb and hold moisture and air. It needs to be non-crusting. For these reasons it is best to use soilless mix to start your seeds. Soilless mixes contain vermiculite, perlite, peat
moss, and possibly a wetting agent and nutrients, and are available at most garden centers. The suggested proportion for making your own soil-less mix is 50% fine peat moss, 25% vermiculite, and 25% perlite.

2. **Containers.** Because roots need oxygen, which they get from the air spaces in the soil, **all growing containers must have drainage holes.** Peat pots may be used, but they dry out quickly, and may inhibit roots when planted in the ground. Containers should be new or sterilized with a 10% bleach solution. Plants may be started en masse in a small container, and potted up to larger, individual containers after they have developed their first set of true leaves. The planting containers, with drainage, should be placed on a tray or other container to catch excess water after watering.

3. **Lights.** Plants need full spectrum light to develop. Sunlight is best, but plants may be grown in a bright window. These plants often get “leggy” and bend towards the light, and must be turned often. Incandescent light does not offer a large light spectrum and produces heat. Special incandescent spot grow bulbs can be used, but are quite expensive, as are fluorescent grow bulbs. The greatest success at a moderate price will occur when using a fluorescent light system. A two bulb shop light will suffice. Using one warm fluorescent light bulb and one cool fluorescent light bulb will achieve the right light spectrum for successful plant growing.

4. **Seeds.** Choose seeds that germinate easily and successfully grow in containers. Larger seeds, such as beans and sunflowers, are easily handled. Seeds that germinate easily, such as marigold, tomato, and zinnia foster enthusiasm. Very small seeds are usually more difficult to handle and to germinate.

5. **Labels.** Wooden Popsicle sticks or plastic plant tags and a permanent pen or marker make for good labeling.

6. **Watering can.** Some sort of watering can will be required. A small pouring spout helps prevent damage to tender young seedlings. A Mister or sprayer may be used on seeds and small seedlings.

7. **Closeable plastic bag.** A plastic bag may be used to keep moisture in the seeded pot while the seeds are germinating.

8. **Fertilizer.** A water soluble fertilizer is helpful for weekly feeding as the young plants grow on. Germinating seeds do not require supplemental nutrients.

**Planting steps:**

1. **Read the seed packet.** The seed packet will tell you how deep to plant the seed and if there are any particular conditions required for germination. Some seeds germinate best in a cool location and some require warmth. Some seeds, especially very small ones, require light to germinate, and some must germinate in the dark. Some seeds require a period of chilling (stratification) before they can germinate. The seed packet will tell you how many days there will be from germination to mature fruit. **Read the seed packet.**

2. **Moisten the soilless mix, and put it in your container.** Sometimes it takes several hours for the mix to absorb water. This is most easily done in a bucket or large bowl. When the soilless mix is moist, fill the container to about ¼ inch from the top, unless you are planting seeds that require more space for the soil that will cover them.

3. **Place seeds on the soilless mix and cover as indicated on the seed packet.** Soaking seeds in water overnight before planting softens the seed coat and speeds up germination for most seeds. A general rule of thumb is to plant seeds at a depth two to three times the diameter of the seed. Very small seeds are not covered or covered with very fine soilless mix, vermiculite, or milled sphagnum peat moss.

4. **Tamp down gently, to insure contact between the seed and the soilless mix.** **Label the container using a permanent marker.**

5. **Water gently, using a fine mist or by placing the container in a pan or tray which contains about an inch of warm water.** Do not overwater.

6. **Cover the seeded container with plastic or place it in a plastic bag and close the bag to create a closed environment.** This keeps moisture levels constant.

7. **Place the bag in a warm spot (70 to 80 degrees F) until the seeds germinate.** Some seeds will require a cooler spot to germinate—cool season crops such as lettuce and broccoli and most perennials prefer temperatures of 55 to 65 degrees F for germination. Place the seed container under lights if the seed packet indicates that light is required for germination, or cover with an opaque cover if darkness is required. Do not place the container in direct sunlight—the seedlings will bake from the solar energy collected in the plastic bag. Open the bag and vent it if excessive water has collected on the inside of the bag or mold has developed on the soilless mix surface. Check daily for germination.

8. **After the seeds have germinated, remove the plastic bag and place the seedlings under lights.** Keep seedlings close to the light—one to three inches away. Most seedlings need 14-16 hours of light per day for good development. Light coming from the center of a fluorescent bulb is stronger than that coming from the ends. Rotating plants under these lights ensures even light distribution. An inexpensive appliance timer is a convenient way to maintain a good light schedule. Plants that are exposed to good light will be
stocky and well developed. Most seedlings should be grown at lower temperatures than those required for germination, approximately 50 to 70 degrees F with night temperatures approximately 10 degrees lower.

9. **Water seedlings gently when the soil becomes dry.** This can be tested with the finger method—a finger stuck an inch into the soil notes that it is dry—or by picking up the container and determining that it is light in weight. More plants die because of overwatering (water fills the soil pore spaces and prevents the roots from absorbing oxygen) than under watering. Seedlings are very tender—a small watering can or sprinkling device is a good tool for enthusiastic waterers. Bottom watering, in which the container is placed in water and the water is absorbed up into the soilless mix through capillary action, is an effective method.

10. **Fertilize weekly using a water soluble fertilizer.** An alternative is to use a dilute fertilizer solution with each watering. Overfertilization will result in a leggy, weak plant and salt accumulation in the soil. Underfertilization will result in a stunted or pale green plant.

11. **Thin seedlings as necessary.** Crowded seedlings grow tall and spindly, which creates a weak plant that is more susceptible to disease. The seed packet will usually suggest a desired distance between seedlings. Thin by cutting or pinching off the undesirable seedling at soil level. (Pulling seedlings out of the soil can be disruptive to the root systems of remaining seedlings.) An alternative to thinning is to pot up seedlings to individual containers or cells. Seedlings can be transplanted after they have developed their first set of true leaves. Use care when handling the fragile seedlings. Hold the seedling by the leaves, since damaging the stem disrupts the plant’s life-line. Plant the seedling at the soil depth at which it was previously growing. During the process of transplanting, small root hairs, which take up water and nutrients, are damaged and the plant will grow new ones. Reduce light to the plant immediately after transplanting for a couple of days. This allows the plant to focus its energy on growing new root hairs and recovering from transplant shock.

**Taking plants outdoors:** Before growing your seedlings or plants outdoors, it is necessary to harden them off, or acclimate them to the harsher conditions of the outdoor environment. Sunlight, cold, and wind can kill the pampered indoor plant. Gradually exposing the plant to these conditions helps it transition to the new environment. About a week before moving the plant outdoors, start to slow down growth by watering less, eliminating fertilizer, and keeping temperatures on the cool side. Begin with a few hours of sunlight in a protected spot outside or put the plants in the shade for a half a day. Protect the plants during these first days from wind and cold. Gradually increase the outdoor time during the period of a week.

**Notes:**

- Seeds come in all sizes. The smallest seeds come from an orchid plant and can hardly be seen. One million of them weigh as much as a grape. The largest seeds are coconuts from the coconut palm.
- Some seeds, particularly small ones, need light to germinate. Grand Rapids lettuce will not germinate without light, but if pale red light is shone on the seeds for five minutes they will germinate. This mechanism assures that small seeds with limited energy reserves do not germinate deep in the soil where they would not have the stored energy to send shoots to the surface.
- Seeds that are easy to germinate and grow under lights include beans, lettuce, tomatoes, peppers, sunflowers, marigolds, zinnias, and nasturtiums.
- The parts of a seed are easily observed by soaking bean seeds overnight and then gently splitting the cotyledons apart.
- Scientists who study plants are called botanists.

**Recommended reading for adults:**

*Creative Propagation* by Peter Thompson, Timber Press 2005.


**Recommended reading for children:**


*From Seed to Plant* by Allan Fowler, Children’s Press 2001.


*Seeds Travel* by Elaine Pascoe, Gareth Stevens Publishing 2002.
Cross-section of a Flower

- Pollen
- Stamen
- Stigma
- Pistil
- Sepal
- Petal
- Ovule
- Stem

Parts of a Seed

- Leaves
- Root
- Endosperm
- Two Cotyledons
- Seed Coat