2. Survivor Seedlings

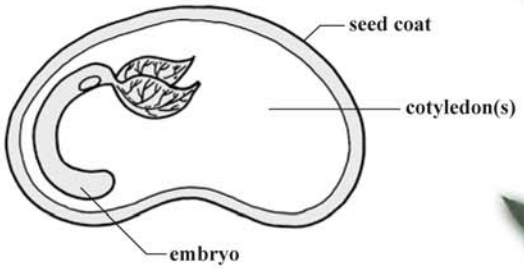
Objective: To create three-dimensional models of seeds and seedlings to survive extreme environmental conditions

Time: Two 45-minute sessions

Materials: Coconut, avocado seed, at least four additional seeds (see note below regarding various seed coat types), "Survivor Seedlings Specifics" page (following this lesson, on page 63)

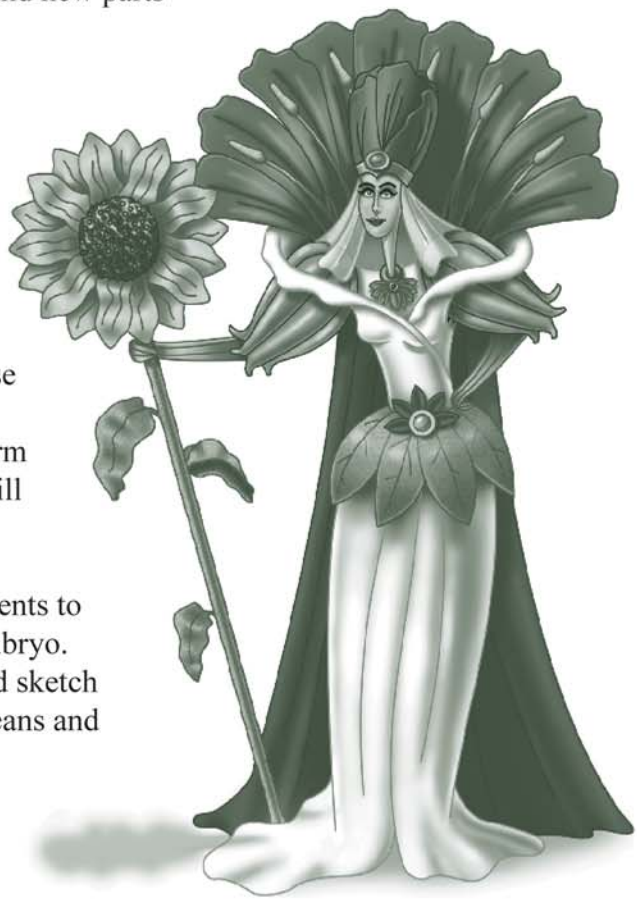
Note: *Before this activity, you will need different types of seeds available for gardeners to examine, including seed specimens with fleshy fruit. Seeds that would work well with this activity are peanuts (in-shell), fresh green beans, pecans, walnuts and coconuts (if possible with yellow-green husk). Examples of seed specimens with fleshy fruit would be peaches, mangos and apples. Cut or break open to expose seeds and seed parts, and if possible, have at least two seed types available for each gardener to examine individually.*

Remind gardeners of the three main parts of the seed and their function:



seed coat: protects the seed and may help provide means of dispersal for seed
cotyledons: provides energy for the seed to germinate and helps produce the *true leaves*
embryo: the young plant itself

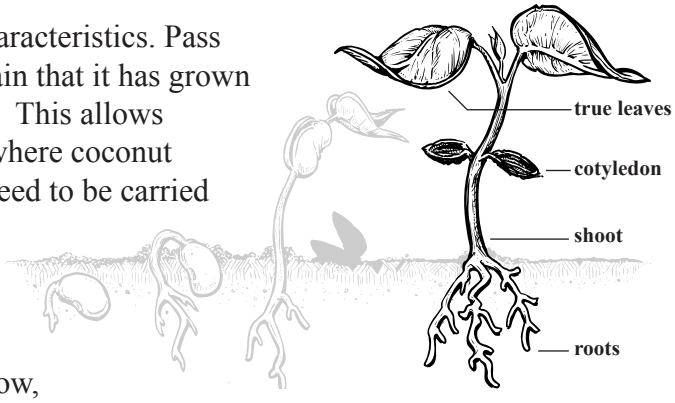
Explain that as a seed germinates to become a young plant, called a **seedling**, the parts begin to change and new parts begin to grow:



seed coat: splits and falls away from the plant as it grows
roots: grow into the soil to absorb moisture for the young seedling
shoot: grows from the embryo through the soil to become the stem
cotyledons: provides energy for the seed to germinate and produces the first leaves. These initially grow at the top of the stem and are mistaken for leaves before the true leaves form
true leaves: the first set of real leaves that will begin to absorb light to sustain the plant

Using the available seeds, challenge the students to identify the seed coat, cotyledons and the embryo. Have students choose two different seeds and sketch and label the parts. In some seeds, such as beans and

peanuts, it is easy to see the small embryo. In other seeds, such as pecans and walnuts, the embryo is not easy to see and may just appear as a small, raised bump on the cotyledon.



Point out that many seeds have special characteristics. Pass around the sample coconut seed and explain that it has grown so that there is a hollow space in the seed. This allows the coconut to float. In the environment where coconut trees grow, the ability to float allows the seed to be carried away from the parent plant. Pass around the avocado seed and explain that some seeds, like this of the avocado, have especially large cotyledons. In the environment where avocados naturally grow, large cotyledons are needed to provide a sufficient energy source for the seedling to grow among dense foliage until it can reach sunlight and begin making its own food. Point out that over time, seeds have adapted to grow in their special environments.

Explain that a seedling is a seed that has germinated out of the seed coat to produce roots and grow a **shoot**. On the shoot are cotyledons and from this stem will grow the first set of **true leaves**. There are also examples of seedlings that have adapted to grow in their special environments such as seedlings that grow in tundra areas may mature and produce seed especially fast to be able to survive the short growing season. In addition, leaves of desert plants often have a grayish, lighter coloring to reflect more of the harsh sunlight so the plants do not absorb as much heat.

Assign the gardeners the task of building two models. They will create a three-dimensional model of a seed and three-dimensional model of a seedling. Tell the gardeners that their models will not be of an ordinary seed and seedling but will be models of a very unique seed and seedling that is especially equipped to survive a very extreme environment. Explain that you will assign them an environment for which they will create their model. Pass out the "Survivor Seedlings Specifics" page to each student. Allow partners time to study the adaptations listed for each part of a seed or seedling.

Have students work in pairs to create the ideal seed and seedling to survive an extreme environment of the world. Assign one of the extreme environments on the following page to each pair of gardeners. Tell the gardeners the model can be made from any available materials but must include the listed parts of the seed and a seedling and each of these parts should have an attached label.

Make craft materials available and allow partners to bring any other desired materials from home the next day. Items may include:

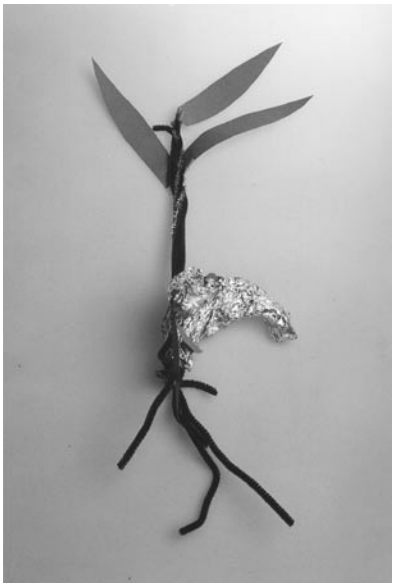
natural seed parts	cloth	string
sticks and leaves	plaster	confetti
styrofoam	modeling clay	scissors
paper mache	drinking straws	staplers
rubber bands	egg cartons	yarn
construction paper	glue	etc.

As models are being constructed, have the students think about the following questions:

- What size is the seed?
- What characteristics describe the seed coats?
- Did your survivor seedling use a seed dispersal strategy to find better growing conditions?
- How fast did your seed germinate and the seedling grow?
- Did this give your seedling an advantage in the extreme environment?
- How big are the cotyledon(s)? Why?
- What size are the first true leaves? What is the color of the leaves?

When models are complete, have the gardeners make oral presentations responding to the questions and describing the three-dimensional models of their survivor seedlings.

Student-created survivor seed



Student-created survivor seedling

Survivor Seedlings Specifics

Seed size—some seeds are huge to avoid being eaten by animals; sometimes seeds are tiny to hide from pests that might eat them.

Seed coats—some seed coats are very thick to protect the seed from extreme conditions such as hot or freezing temperatures or dry or wet conditions. Seed coats may contain poison or taste bitter which discourages animals and people from eating them (i.e., castor beans); sometimes seed coats are camouflaged to hide from pests that might eat them.

Seed dispersal—some seeds are surrounded by fleshy seed coats (called fruit, such as mangos and peaches) which taste good to animals who may carry the fruit away from the mother plant and drop the seed in an area with better conditions for the seed(s) to germinate. Some seeds have seed coats which help the seed drift through the wind (maple), some seeds are sticky (cocklebur) and hitchhike on animals to a new location, some cotyledons are food (acorns) for animals and are stored underground for a future meal and some, like the coconut, float to allow seed to drift away from the mother plant.

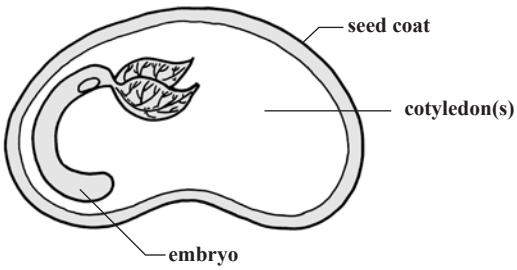
Speed of seed germination and seedling growth—some seeds germinate and seedlings grow fast to survive a short growing seasons. Some seeds lie dormant (during bad conditions such as drought or freezing weather) waiting for good growing conditions.

Cotyledon size—when soil nutrients are scarce or limited sunlight reaches the growing area, cotyledon size may increase to provide much needed nutrients for the tender seedling.

Leaf size—leaves of desert plants are generally very small to reduce the amount of the plant hit by the blazing sun. Leaves in rainforests are often large to capture as much sunlight as possible under the shady forest canopy. Leaves in areas with short growing seasons, but long days, grow very large to create energy for the plant as fast as possible.

Leaf color and texture—leaves of desert plants are often light green or even gray to reflect the harsh sunlight; leaves of rainforest plants are often dark green with tons of green-pigmented (colored) chlorophyll cells to receive as much of the scarce sunlight as possible. Leaves growing in areas of burning sun and low rainfall may also have a waxy coating or can even possess a hairy texture to prevent water loss.

Circle your extreme environment

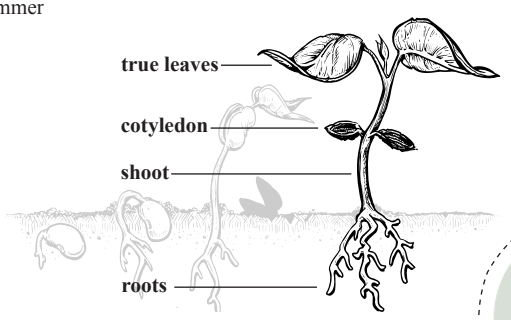


Desert

Soil—very sandy, no nutrients
Rainfall—four inches per year with most falling in spring
Temperature extremes—110˚ F. in summer, 10˚ F. in winter
Growing season—200 days; however, drought (no rain) occurs for 150 days
Sunlight—lots of baking sun all year long
Pest problems—lizards and birds are always looking for edible seeds

Tundra

Soil—loamy soil which is high in nutrients and great for seedling growth
Rainfall—30 inches of precipitation per year with most falling in the winter as snow and in the spring as rain
Temperature extremes—65˚ F. in summer, -15˚ F. in winter
Growing season—only 100 days
Sunlight—little to no sunlight in winter, 20 hours each day in summer
Pest problem—rabbits are everywhere and eat any edible seed



Rainforest

Soil—very rocky but lots of nutrients from decaying leaves
Rainfall—200 inches evenly dispersed throughout the year
Temperature extremes—90˚ F. in summer, 70˚ F. in winter
Growing season—365 days
Sunlight—very shaded due to dense canopy of foliage (leaves)
Pest problems—birds abound and eat big, good looking, edible seeds