Starting an Indoor Container Garden from Seed
Written by GEF Staff

Grades: Middle
Subject: Science, Language Arts, Math
Time: Initial lesson- 30 minutes, Planting- 30 minutes, observation on-going

*** Standards: Students will...**

Science Standard 1: Understand atmospheric processes and the water cycle.
Benchmark # 3: Know that the Sun is the principle energy source for phenomena on the Earth's surface (e.g., plant growth).

Science Standard 5: Understand the structure and function of cells and organisms.
Benchmark # 2: Know that cells convert energy obtained from food to carry on the many functions needed to sustain life (e.g., cell growth and division, production of materials that the cell or organism needs).
Benchmark # 4: Know that multi-cellular organisms have a variety of specialized cells, tissues, organs, and organ systems that perform specialized functions (e.g., respirations, circulations, excretion, movement) and that the function of these systems affects one another.
Benchmark # 6: Know how an organism's ability to regulate its internal environment enables the organism to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.
Benchmark # 7: Know that organisms can react to internal and environmental stimuli through behavioural responses (e.g., plants have tissues and organs that react to light, water, gravity and other stimuli).
Benchmark # 9: Know that cells use inorganic compounds (e.g., minerals, water) to make materials that the cells or organism needs.

Science Standard 12: Understand the nature of scientific inquiry.
Benchmark # 3: Design and conduct a scientific investigation (e.g., formulate hypotheses, design and execute investigations, interpret data, synthesize evidence into explanations).
Benchmark # 6: Use tools and techniques to gather, analyze and interpret scientific data.

Language Arts Standard 1: Use the general skills and strategies of the writing process.
Benchmark # 14: Write technical text (e.g., identifies essential steps in a logical sequence; list materials equipment needed; describe all factors and variables that need to be considered; use appropriate formatting).

Mathematics Standard 4: Understand and apply the basic and advanced properties of the concepts of measurement.
Benchmark # 6: Select and use real units and tools, depending on the degree of accuracy required, to find measurements for real-world problems.

Objectives: Students will be able to...
- Describe the process of the germination.
- Explain the need for edible seeds in regards to food production and world populations.

153 Washington Street | Fourth Floor | Walpole | MA | 02032 | 1.888.668.2298

- Identify and describe the basic necessities and specific nutrients that plants need for growth and development.
- Collect, record and organize data using a variety of graphic and written representations.

Materials:
- Seeds: bush beans, pumpkins, sunflowers, corn,…
- Paper towels
- Water
- Hand lenses
- Rulers
- Petri dishes, one per group
- Coarse gravel
- 2 to 5 gallon pots with drainage holes for container gardens
- Potting Soil
- Fertilizer
- Science journal

Overview: Edible seeds are a staple in the human diet and have been since the time of early man. Edible seeds include the seeds from: a) grasses, such as wheat, corn, oats and rice, b) legumes, such as beans and peas, c) nuts, such as hazelnuts, hickory nuts and chestnuts and d) flowers and fruits, such as sunflowers and pumpkins. While many of these seeds are not edible in their raw state, once cooked they are both a healthy and nutritious source of food. The continued growth and cultivation of edible seeds is essential if we are to feed the ever-increasing world populations.

A seed that is not destined to be eaten as food can be used to grow more food. In this case the seed transitions from its dormant stage into the germination stage, the beginning of the growing process for the plant embryo. There are three major factors needed for germination: a) water, b) oxygen, and c) the appropriate temperature. For germination to begin, a seed must first absorb water. This absorption causes the seed to swell and activates a growth enzyme. Respiration increases and cells of the embryo begin to multiply. The embryo grows larger and soon splits open the seed coat (the protective outer layer of the seed). This allows the embryo to absorb oxygen.

The amounts of absorbed moisture and oxygen differ by seed species. Temperature requirements also vary with different seeds, and there can be a wide range of temperatures in which seeds will germinate. Light is another factor for germination, and while many seeds require light, others do not. Planting depth is yet another concern. Seeds that are too close to the surface may not absorb enough moisture to germinate fully, and those that are planted too deep may use all the food tissue stored in the interior of the seed before they break through the soil and find sufficient light.

When the root of the embryo breaks through the seed coat and the root tip emerges the process of germination is complete, but the young seedling must still rely on the food stored in the seed until it is established and able to support itself. These are the two most crucial stages in the life cycle of the plant, as it is during these stages that the plant is at its most vulnerable.

153 Washington Street | Fourth Floor | Walpole | MA | 02032 | 1.888.668.2298

Kid's Speak: There are many different kinds of seeds that people eat, such as corn, wheat, oats, rice, beans, peas, sunflower, pumpkin and nuts. Some seeds are safe to eat raw, while other seeds must be cooked in some way before they can be eaten. Seeds are an excellent source of food for people all over the world.

Seeds need to germinate before they can grow into plants. Seeds need water, oxygen, the right temperature, and in many cases, light to germinate. When conditions are favorable the embryo inside the seed begins to grow until it is so large that the seed coat cracks and the root tip pokes out. This ends the germination process and begins plant growth. As the plant grows and develops it produces more seed. Some of the seed is used as food and some is reserved to start the growing cycle all over again.

Eco-Fact: Nuts are edible seeds. Examples of nuts include hazelnuts, hickory nuts and chestnuts. Most edible seeds that are called nuts actually are not nuts. For example peanuts are legumes, like peas or beans, and coconuts are drupes, like olives or peaches.

Procedures:
Before Starting the Seeds:
- Explain to students that they will be planting an indoor container garden. Also explain that if these plants reach maturity and produce fruit, more seeds will result. These seeds will be edible and may be used as food or to grow more edible seed plants. Edible seeds are a staple in man's diet and important in feeding the world's growing populations.

Procedure for Germinating Seeds:
1. Divide the students into small groups of two, three or four. Provide each group with a plastic Petri dish, half a paper towel and a seed. (If Petri dishes are not available, substitute with clean, clear plastic lunch bags.)
2. Students will soak the paper towel in water and wring it out to remove the excess water.
3. Students will place the moist paper towel in the Petri dish. They will place a seed on the paper towel.
4. Students will cover the Petri dish and tape it closed. Students will label the dish with the date, type of seed and group designation.
5. Students will place the seeds in an area of the classroom where they will receive sunlight.
6. Students will observe seeds throughout the germination process, noting changes, taking measurements and making labeled diagrams. Observations may be recorded in a Science Journal. They may observe their own seed and those of their classmates as well.

After Seed Germination:
Students will observe seedlings and record observations regarding:
- How seedlings react to light
- How seedlings react when the Petri dish is inverted for several days

Instructions for Planting Seedlings:
Seedlings should be transferred to pots when they have their first two or three true leaves.
1. Student will wash out and dry pots, add 1 inch of coarse gravel to the bottom, and fill the pots two thirds of the way with moist potting soil.
2. Students will transfer seedlings carefully to the container. Fill in around the seedling with additional potting soil and place container in a spot that receives full sunlight.
3. Students will water and fertilize daily, being careful not to overwater.

153 Washington Street | Fourth Floor | Walpole | MA | 02032 | 1.888.668.2298

After Planting Seedlings:
- Students will research and identify any specific needs their plant has and as the plant grows, students will tend to its needs (e.g., pumpkins will need space for vines to trail, pole beans will need some type of support, corn plants will need to be pollinated, etc.).
- Students will record their observations for different stages of plant growth and compare them with those grown by other members of the class.
- After plant growth is complete, students will create a visual presentation that will describe the growth and development of their plant and share their conclusions with the class.

Adaptations:
- For a larger garden design, use in a child's small plastic swimming pool as a container. Set the pool on a table under a window or on the floor under grow lamps. Fill the pool two inches deep with stones to allow for drainage. Then add soil and seeds. Space the seeds as you would in an outdoor garden. Consider companion planting corn, beans and squash as in the *Three Sisters* lesson found elsewhere on the GEF site.

Extensions:
- Harvest any seeds that grew, prepare them as needed, and share with the class as a snack or part of a meal.
- Explore the Green Thumb Challenge section for instructions on how to build your own compost heap, which you can use to nourish your indoor plants.
- For tips on dietary guidelines and healthy eating habits visit the USDA Food Pyramid.

GEF Community: Introduce yourself to the Green Education Foundation Community online! First, add your school, class or group to the Community section. If you can, display the screen for the class to see. In just a minute, they can learn about social networking and be connected to other classes across the country. Once inside the community, decorate your page with your projects, ideas, photos, and more! By joining the Green Thumb Challenge, you can share your gardening lessons and tips with classrooms and groups around the nation. Post pictures of your indoor gardens and share fresh garden recipes with other GEF classrooms.

* All lessons listed on the GEF website have been aligned with the McREL Compendium of Standards and Benchmarks for K-12 Education. GEF curriculum has been developed in accordance with the McREL standards in order to reflect nationwide guidelines for learning, teaching, and assessment, and to provide continuity in the integrity of GEF curricular content from state to state. The decision to utilize McRel's standards was based upon their rigorous and extensive research, as well as their review of standards documents from a variety of professional subject matter organizations in fourteen content areas. Their result is a comprehensive database that represents what many educational institutions and departments believe to be the best standards research accomplished to date. To access the McREL standards database, or for additional information regarding the supporting documentation used in its development, please visit http://www.mcrel.org.

153 Washington Street | Fourth Floor | Walpole | MA | 02032 | 1.888.668.2298