

## Grow More Vegetables Citywide

Bronx Green-Up's *Grow More Vegetables Certificate Series* is a free edible gardening course designed to teach the best organic techniques for growing vegetables safely and effectively, particularly in urban settings. This development of this online course material (outlines 1-5 and course handouts available online at [http://www.nybg.org/green\\_up/tips.php](http://www.nybg.org/green_up/tips.php)) was made possible by The New York Community Trust.

<b>Grow More Vegetables Certificate Series</b>	<div style="border: 2px solid black; padding: 5px; text-align: center;"> <h3>2: Seed Starting for Vegetable Production</h3> </div>
<b>Total Time:</b>	<b>2 hours</b>  <i>Show: To prepare for this workshop, start a variety of seeds under the grow light or in a sunny window to help demonstrate proper techniques. The more variety you have in type of seedling and stage of development, the more helpful the demonstration will be.</i>
<div style="border: 2px solid black; padding: 5px; text-align: center;"> <b>Learning Objectives</b> </div>	<p>In this class, students will:</p> <ul style="list-style-type: none"> <li>• define what a seed is, and understand how the types of seed differ</li> <li>• learn the process of seed-starting indoors, then practice sowing a tray of seeds</li> <li>• become acquainted with some of the global issues surrounding seeds</li> </ul>
<div style="border: 2px solid black; padding: 5px; text-align: center;"> <b>Materials</b> </div>	<p>Seeds  Seed-starting Mix  Seed-starting Tray or Containers with holes in the bottom for drainage  Tags or Labels  Watering Can  Spray Bottle  Handouts: <i>Sowing Seeds Indoors; Planting Seeds Outdoors; Types of Seed; Seed Germination Table; Planting Guide for the NYC Area<sup>1</sup>; Seed Viability Chart<sup>2</sup></i></p>
2 minutes	<p><b>Ask students: Why Grow Plants Indoors From Seed?</b></p> <ul style="list-style-type: none"> <li>• Seed is inexpensive</li> <li>• You get to grow varieties you are interested in</li> <li>• You get a jump start on the season</li> <li>• You can plan ahead</li> <li>• You have a controlled environment</li> <li>• You get the satisfaction of growing plants from infancy to maturity</li> </ul>

Bronx Green-Up, the community gardening outreach program of The New York Botanical Garden, provides horticultural advice, technical assistance, and training to local gardeners, urban farmers, school groups, and other organizations interested in improving neighborhoods through greening projects. At the heart of Bronx Green-Up are the community gardens, school gardens, and urban farms of the Bronx. For additional information, contact Bronx Green-Up at 718.817.8026 or [bronxgreenuip@nybg.org](mailto:bronxgreenuip@nybg.org), or visit [www.nybg.org/green\\_up](http://www.nybg.org/green_up)

5 minutes	<p><b>Seed Vocabulary Review</b></p> <p><b>Seeds</b> are fertilized and ripened ovules (“small egg” or, structure containing reproductive cells) of a seed-producing plant (AKA the mother plant). Seeds contain a plant embryo capable of germinating and producing a new plant.</p> <p>Seeds contain enough stored food around them to last until they can make their own food. As soon as a plant has a root and green leaves, it can begin to make its own food, a process of usually 10-30 days.</p> <p><b>Propagation</b> is the reproduction of plants. There are 2 types of propagation:</p> <ol style="list-style-type: none"> <li>1. <b>Sexual</b> – By seed</li> <li>2. <b>Asexual</b> – By vegetative parts of plants, such as roots, bulbs, tubers and stems <i>Show:</i> Root a raspberry cane or rose cutting, or place a spider plant (<i>Chlorophytum comosum</i>) baby’s roots in water until it produces new roots.</li> </ol> <p><b>Germination</b> is the sprouting and development of a seed. When a seed comes in contact with soil and moisture, it begins to absorb water and oxygen. The water and oxygen activate enzymes that stimulate the seed to grow.</p>
7 minutes	<p><b>Types of seed</b></p> <ul style="list-style-type: none"> <li>• <b>Conventional</b> – Seeds may be treated with a product, usually a pesticide or fungicide, to protect against pests and disease. Peas and corn are two examples of commonly treated seeds.</li> <li>• <b>Genetically-modified (GM)</b> – Some conventional seeds are GM; these seeds have been altered at the gene level using genetic engineering. Some reasons for creating a GM crop are: <ol style="list-style-type: none"> <li>1) resistance to pests, herbicides or harsh environmental conditions</li> <li>2) improved product shelf-life</li> <li>3) increased nutritional value</li> </ol> <p>Qualities like these can be achieved without GM. For example, you can choose to grow seed varieties that are suited to a specific region or growing condition. Varieties bred for drought-resistance, for example, may have been created using traditional breeding methods.</p> <p><i>While this course focuses on organic growing methods, some proponents of GM seed argue that GM crops will be important in adapting agriculture to climate change or in producing enough food to feed the world’s poor. Here is a take-home article on GM cotton in India:</i>  <a href="http://www.nature.com/news/genetically-modified-cotton-gets-high-marks-in-india-1.10927">http://www.nature.com/news/genetically-modified-cotton-gets-high-marks-in-india-1.10927</a></p> </li> <li>• <b>Certified organic</b> – Seeds grown according to rules and regulations specified by the USDA’s National Organic Program; use of synthetic fertilizers, pesticides, sewage</li> </ul>

sludge, irradiation and genetic engineering are prohibited.

- **Hybrid** – Seed obtained by cross-fertilizing two different parent varieties, for certain desirable characteristics.
  - The cross is made by traditional breeding techniques, like brushing a flower of one variety with the pollen from another.
  - The plants you get from hybrid seeds are very uniform and predictable, which is why farmers use them.
  - However, the next generation is not so predictable because it is not a stabilized variety and may not have desirable characteristics.
  - The problem is not how they are made, but that each cross is a “trade secret” that belongs to a company or breeder. Since we can’t predict the next generation, gardeners become dependent on the companies, needing to buy new seed each season.
  - Hybrids must be labeled “hybrid” or “F1” and are usually more expensive than open-pollinated varieties.
- **Open-pollinated** – Seeds produced from plants where pollination is by wind, birds, insects or other natural mechanisms
  - Open-pollinated seeds will produce plants with the same characteristics as the parent plant (as long as they were not cross-pollinated with another variety).
  - If you are saving seed, you will want to use open-pollinated seeds.
  - Because their genetic make-up is more diverse than hybrid seeds, there is more diversity in its characteristics and it is less likely to be totally wiped out by disease. In contrast, hybrids tend to be very uniform in physical characteristics and bearing times. Think about natural selection.
- **Heirloom:** Seeds from plant varieties that were commonly grown during earlier periods of human history, but were never used in modern large-scale agriculture. Heirlooms are **open-pollinated plants** **varieties** that resulted from natural selection instead of a controlled hybridization process.
  - Seeds from heirloom varieties produce plants with the same characteristics as the parent plant.
  - Many gardeners consider 1951 the latest date to call a variety an heirloom (since hybrids started to be grown after that period).
  - Many varieties of heirloom plants are lost every year.

### **Why grow heirlooms?**

- 1) For historical interest
- 2) To preserve the gene pool for future generations
- 3) Many heirloom varieties are also grown organically
- 4) Many varieties taste better
- 5) Heirlooms have adapted over time through evolution to their local climate and soil, so they are often better suited to grow in local conditions (resistant to local pests, diseases and extreme weather)

5 minutes	<p><b>Loss of crop diversity</b></p> <ul style="list-style-type: none"> <li>• In large-scale farming, fewer and fewer varieties of food crops are being grown. This translates to a loss of biodiversity, as well as neglect for food plants that are culturally important and/or environmentally adaptable.</li> <li>• The majority of humans rely on only 12 plant species, according to the Food and Agriculture Organization of the United Nations.<sup>3</sup> <ul style="list-style-type: none"> <li>- Historically, humans utilized more than 7,000 plant species to meet their basic food needs<sup>4</sup>.</li> <li>- Only 150 plant species are under large-scale cultivation today. This is due to the increased mechanization of food production. For example, a mechanical harvester for corn will need to fit down specifically-sized rows and is not suited to harvest other crops.</li> <li>- Varieties are chosen based on factors like being able to withstand drought, tolerate pesticides, and being shipped long distances without spoiling.</li> <li>- Nutrition and flavor are no longer the main concerns for growing specific crops.</li> </ul> </li> <li>• To counteract this loss of diversity, source local seed from companies like Hudson Valley Seed Library. There are also organizations like Seed Savers Exchange, where members are active in the process of saving and planting hundreds of thousands of heirloom and open pollinated garden seeds.</li> <li>• Seed banks and seed libraries, like the Hudson Valley Seed Library and Navdanya in India, exist to preserve our genetic resources for the future.</li> </ul>
5 minutes	<p><b>Corporate Control and Consolidation<sup>5</sup></b></p> <ul style="list-style-type: none"> <li>- The seed industry has transformed in recent years from one comprised of small-family owned firms to an industry dominated by a small number of transnational corporations with roots in pharmaceutical and chemical companies.</li> <li>- Consolidation (centralization): large competitors have acquired smaller seed and related companies and “refashioned agriculture toward a factory model” mostly through the sale of agricultural inputs (seed, chemicals, equipment, often as a package geared at each farm).</li> <li>- There has been a shift in public and private research toward most profitable crops (began with hybrids, then GM crops).</li> <li>- Technological treadmill: There is the tendency to spend constantly, increasing the amounts of money to operate a farm, even if net revenues decline. Only the most competitive farms can survive.</li> </ul> <p><i>For an example of corporate priorities changing the way we eat, recommend this article as a take-home:</i>  <a href="http://www.nytimes.com/2012/06/29/science/flavor-is-the-price-of-tomatoes-scarlet-hue-geneticists-say.html">http://www.nytimes.com/2012/06/29/science/flavor-is-the-price-of-tomatoes-scarlet-hue-geneticists-say.html</a></p> <p><b>Steps For Starting Seeds</b></p> <p>■ <b><u>Planning</u></b></p>

7 minutes	<ol style="list-style-type: none"> <li>1. Get a notebook to make notes about your seedlings. Keep these notes and refer to them year after year.</li> <li>2. Find out when your last frost date is. NYC's last frost is usually around mid-April. Do not start seeds too early; this is a mistake many gardeners make.</li> <li>3. Count backward from your last frost date and find out when the time is you should start your seeds. The seed package should have the information on how many weeks before your last frost you should start your seeds. Write this information in your notebook and use it every year. <b>For example</b>, tomato seeds should be started 6 to 8 weeks before setting them outdoors. If your last frost is April 15, you count backwards 6 to 8 weeks and find your starting time. In NYC tomato seeds should be started around March 1.</li> </ol> <p><b>Activity:</b> Take a seed packet, <i>Planting Guide for NYC Area</i> and blank <i>Germination Table</i>, and fill in the information for the crop you have chosen.</p>
10-15 minutes	<p>■ <b>Materials</b></p> <ol style="list-style-type: none"> <li>1. <b>Seeds</b> Fresh, viable non-treated seed is best. They should be stored in a dry cool area. (Note: some seeds perform better if planted directly in the ground, consult seed packet for information on sowing recommendations).</li> <li>2. <b>Germination Mix (or other sterile planting medium)</b> The role of the germination mix in seed-starting is to provide the ideal environment for healthy growth of seedlings. Therefore, you will want a mix that contains the proper texture and structure to support and anchor seedlings. The mix for seedlings should be light and loose so that small, delicate roots can grow freely. <ul style="list-style-type: none"> <li>- Soil tends to harbor weeds and fungus; soil is also too heavy and clumping for tender seedlings (if using soil in your mix it is a good idea to pasteurize it). Soilless potting mix is light, holds water, and is weed free.</li> </ul> <p><i>What's wrong with using peat moss, a common ingredient in soil mixes?</i></p> <p>Peat is made up of the decaying remains of sphagnum mosses which grow in bogs. Almost all peat is extracted from lowland bogs, home to a variety of species, many found in no other environment. In North America, the majority of peat comes from Canada. Demand for peat has resulted in the destruction, degradation and fragmentation of lowland peat bogs and their wildlife. The UK lost 94% of its lowland peat bogs since the beginning of the 19th century.<sup>6</sup></p> <ul style="list-style-type: none"> <li>- Finely screened compost makes a good, cheap alternative to peat moss. Any diseases that might be harmful to seedlings would die if the temperature in your compost bin has reached sustained temperatures of 120-150 °F.</li> <li>- Coconut coir is a waste product of the coconut industry and can be used in place of peat moss.</li> <li>- Soil mix recipe for seedlings: 1-2 parts pasteurized garden soil, 1-2 parts fine compost, 1 part vermiculite or sand, a little steamed bone meal (for phosphorus).<sup>7</sup> (See how to make your own seed germination mix at end of outline).</li> <li>- For a good alternative to store-bought potting mix, you may also use equal parts compost, gritty sand and good garden soil. Remember to mix it</li> </ul> </li> </ol>

<p>5 minutes</p> <p>40 minutes</p>	<p>thoroughly and keep it evenly moist.</p> <p>Handout: Appendix 7: Sample Soil Mix Recipes (from <i>Teaching Organic Farming &amp; Gardening: Resources for Instructors</i>, UC Santa Cruz: <a href="http://casfs.ucsc.edu/documents/Teaching%20Organic%20Farming/1.3_Propagation.pdf">http://casfs.ucsc.edu/documents/Teaching%20Organic%20Farming/1.3_Propagation.pdf</a>)</p> <p><b>3. Light</b></p> <p>Artificial light works best for indoor seed-starting. Florescent light is good, with two bulbs being ideal. One bulb should be a cold white, and the other a warm white. If a fluorescent light source is unavailable, place your seed trays in a south facing window for the most exposure to light. Another option is to place seedlings in a sunny window, preferably south-facing. Grow light systems can be purchased through hardware stores for about \$50-75.</p> <p><b>4. Containers</b></p> <p>You can use any kind of container that is at least 3” deep with drainage holes. For example, you can use recycled milk cartons. Best are planting trays (flats). If you are re-using old containers, make sure to sterilize them. To do so, you can sink the container into a bucket filled with 1 part bleach /10 parts water solution, or, if the container is not too dirty, just clean with soapy water and vinegar.</p> <p><b>5. Tags for Labels</b></p> <p>Always label after seeding. Include the name of plant, date and how many days to germination.</p> <p><b>6. Watering Can and Spray Bottle</b></p> <p>Break</p> <p><i>The instructor will demonstrate how to start seeds indoors while explaining the steps required and other considerations. Students will then have the chance to start a tray of seeds for themselves.</i></p> <p>■ <b><u>Sowing Seeds</u></b></p> <ol style="list-style-type: none"> <li>1. Prepare and moisten seed starting mix. It should be moist like a damp sponge.</li> <li>2. Fill containers with mix. Make sure you have filled each cell completely, so the seedlings will have as deep a space as possible to grow in. Using another clean cell pack or your fingers press down the mix without packing it too tightly.</li> <li>3. Take a pencil or a ruler and run it over the top of the seed-starting tray so that the medium is leveled with the tray.</li> <li>4. Prepare seed if necessary. Follow the directions that are listed in the seed package. Some seeds need to be scarified or stratified.  <b>Scarification</b> is when you scratch the seed coat so it can better take up water.  <b>Stratification</b> is when you take the seed and provide it with either a cold or hot period for the specified amount of time that the seed package recommends.</li> </ol>
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10 minutes	<ol style="list-style-type: none"> <li>5. Using your fingers, make holes in each cell to the correct planting depth. If there are no recommendations on the back of the package then the recommended depth of the hole is at least 2 to 3 times the width of the seed. Author and farmer John Jeavons gives us this easy advice: “Plant seeds at a depth that is equal to or greater than its thickness.”<sup>8</sup></li> <li>6. Put your seed into the holes. Then cover it with the appropriate amount of soil.</li> <li>7. Label your trays. On the tag should be the name of the seed, the date you planted, and the expected days to germination.</li> <li>8. After everything is labeled put the seed-starting tray into the bottom-watering tray. Fill the bottom tray with water. The tray will absorb the water. When you think that the tray has absorbed all the water and seems saturated, dump out the excess water.</li> <li>9. Place the humidity cover over the seed-starting tray. Then either place newspaper over the top of the humidity cover or place the entire tray in a dark place. Seeds need to be in the dark till they germinate, with a few exceptions, like lettuce. <b>Remove the cover after they germinate</b>, because the seedlings will need both light and air circulation.</li> <li>10. Light. Once the seeds have germinated, move them into the light. If using florescent light, the bulbs should be kept 2-3” above the plants and moved upwards as the plant grows. Alternatively, you can place seedlings in a sunny window, preferably south-facing.</li> <li>11. Wind. In order to produce strong seedlings, you may want to expose them to a fan for a few hours per day. This will help them to adapt to outdoor conditions and grow a stronger structure. This also helps prevent disease, especially damping off.</li> <li>12. Temperature. It is best to start seeds in a greenhouse or cold frame, but many gardeners have success growing seedlings indoors. Most vegetables germinate best between 65-85°F. If possible, at night, turn down the heat between 50° and 55°F. The plants will grow slower, but stronger.</li> </ol> <p>■ <b><u>Watering</u></b> Water plants from the bottom. Use your watering can to put water in the bottom tray. You should also mist seedlings from the top with a spray bottle. <b>Use water at room temperature.</b> Cold water can retard germination and growth. Keep seeds moist but not sopping wet.</p> <p>■ <b><u>Transplanting indoors</u></b> Transplant seedlings to a larger container when they start to get crowded. Crowded seedlings are weaker, more susceptible to disease, and not uniform in size. Seedlings should have at least a 2<sup>nd</sup> full set of leaves and good root development before they are transplanted. The day before transplanting, water seedlings well. This helps limit the shock of transplanting and ensures seedlings are turgid (sturdy).</p> <p>Transplanting your seedlings has several advantages in a small garden space.</p>
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- Seeds can take from 5 days to 12 weeks to reach transplanting size. You can grow something else in your garden bed, while you wait for your transplants to grow to the proper size.
- You can be pretty sure that each transplant will grow into a healthy plant. Not all seeds germinate, so you may end up with gaps between plants.
- Plants grow better if they are evenly spaced. Plants that are too close together compete with each other for light, water and nutrients. Plants that are too far apart leave wasted space, more water may evaporate, and soil around the plants may become compacted.
- Transplanting stimulates growth. When you transplant your seedlings, you give them a second dose of nutrients, air and moisture, after their first dose in the flat or container in which you grew them.

#### ■ **Fertilizing**

Do not fertilize your seedlings until after they develop their first true leaves. When fertilizing use only half of the recommended dose.

#### ■ **Hardening Off**

After danger of frost has passed you can start thinking about putting your seedlings out in the garden. Remember that they have been sheltered inside with warm temperatures. So when you are ready to put your seedlings outside you first need to accustom them to outdoor temperatures. Start by putting plants outside 2 hours per day and increase the time to a full day over the course of a week or so. This process is called **hardening off**. Pay attention to the weather conditions during the period of hardening off.

Here is a good timetable for hardening off seedlings, from the *Book of Garden Secrets*<sup>9</sup>.

	1 <sup>st</sup> day	2 <sup>nd</sup> day	3 <sup>rd</sup> day	4 <sup>th</sup> day	5 <sup>th</sup> day	6 <sup>th</sup> day
<b>In full sunlight</b>						
If plant is spindly	½ hour	¾ hour	1 hour	1.5 hours	2 ¼ hours	3.5 hours
If plant is sturdy	1.5	2.5	3.5	5	6	7
<b>In light shade</b>						
If plant is spindly	1	1.5	2 ¼	3.5	5	3 hours in sun
If plant is sturdy	2.5	3.5	5	6	7	7 hours in sun

#### ■ **Transplanting into the Garden**

The best environmental conditions for transplanting from indoors to out in the garden are low wind, part shade, mild temperatures (don't put your seedlings out in full sun until they are adapted to full sun conditions), and good soil moisture. Here are some techniques:

- When transplanting your seedlings into the garden bed, fill the hole with the same potting mix you used to grow them in, or finely sifted compost. This





HOMEWORK	<p><b>Planting seeds outside</b>  Some plants don't do well as transplants, so it's better to plant them directly into the ground, outside. We will be demonstrating how to <b>direct seed</b> when we work out in the field.  Handout: <i>Planting Seeds Outdoors</i></p> <p><b>These are the simplest plants to grow from seed:</b>  beans  marigolds  radish  sunflowers</p> <p><b>These are easy-to-grow plants from seed:</b>  basil  beets  bunching onions  chives  cucumbers  gourds  kale</p> <p><i>Students should come to Class 3 with a soil sample from their gardens. Include instructions on how to take the sample.</i></p> <p><b>Making your own seed germination mix</b></p> <ul style="list-style-type: none"> <li>• Use equal parts finely sifted compost, soil (garden loam) and gritty sand.</li> <li>• Mix in a wheelbarrow and add water to desired wetness.</li> </ul> <p>To pasteurize your soil mix, there are several home methods. Here is one, the oven method:</p> <ul style="list-style-type: none"> <li>• Set the oven between 180° and 200° F.</li> <li>• Spread soil not more than four inches deep in non-plastic containers, such as seed flats, clay pots and glass or metal baking pans.</li> <li>• Cover each container tightly with aluminum foil.</li> <li>• Insert a meat or candy thermometer through the foil into the center of the soil.</li> <li>• Heat the soil to at least 180° F*; keep at this temperature for 30 minutes. Do not allow the temperature to go above 200° F. High temperatures may produce plant toxins.</li> <li>• After heating, cool, remove containers from the oven and leave aluminum foil in place until ready to use. The heated soil will give off an odor.</li> </ul> <p>*140° for 30 minutes will kill damping-off spores and other diseases but will not harm beneficial organisms<sup>10</sup></p>
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- <sup>1</sup> Ameroso, John. Cornell Cooperative Extension NYC. *Planting Guide for the NYC Area Handout*.
- <sup>2</sup> Center for Agroecology and Food Systems. Appendix 1: Seed Viability Chart (Unit1.3). *Teaching Organic Farming & Gardening: Resources for Instructors*. University of California at Santa Cruz. Available at: <http://casfs.ucsc.edu/education/instructional-resources/downloadable-pdf-files>
- <sup>3</sup> International Development Research Centre (IDRC). Facts and Figures on Food and Biodiversity. IDRC Communications. Available at: <http://www.idrc.ca/EN/Resources/Publications/Pages/ArticleDetails.aspx?PublicationID=565>
- <sup>4</sup> <http://www.fao.org/biodiversity/components/plants/en/>
- <sup>5</sup> Howard, P.H. (2009). Visualizing Consolidation in the Global Seed Industry: 1996-2008. *Sustainability* 2009, 1, 1266-1287.
- <sup>6</sup> Wendy Priesnitz. Ask Natural Life: Does Peat Moss Have a Place In the Ecological Garden? Available at: <http://www.naturallifemagazine.com/0712/asknlpeat.html>
- <sup>7</sup> Dorothy Hinshaw Patent and Diane E. Bilderback. *Book of Garden Secrets*. Firefly Books Ltd., 1997.
- <sup>8</sup> John Jeavons. *How to Grow More Vegetables, Eighth Edition: (and Fruits, Nuts, Berries, Grains, and Other Crops) Than You Ever Thought Possible* (8th Edition). Ten Speed Press.
- <sup>9</sup> Dorothy Hinshaw Patent and Diane E. Bilderback. *Book of Garden Secrets*. Firefly Books Ltd., 1997.
- <sup>10</sup> Dorothy Hinshaw Patent and Diane E. Bilderback. *Book of Garden Secrets*. Firefly Books Ltd., 1997.