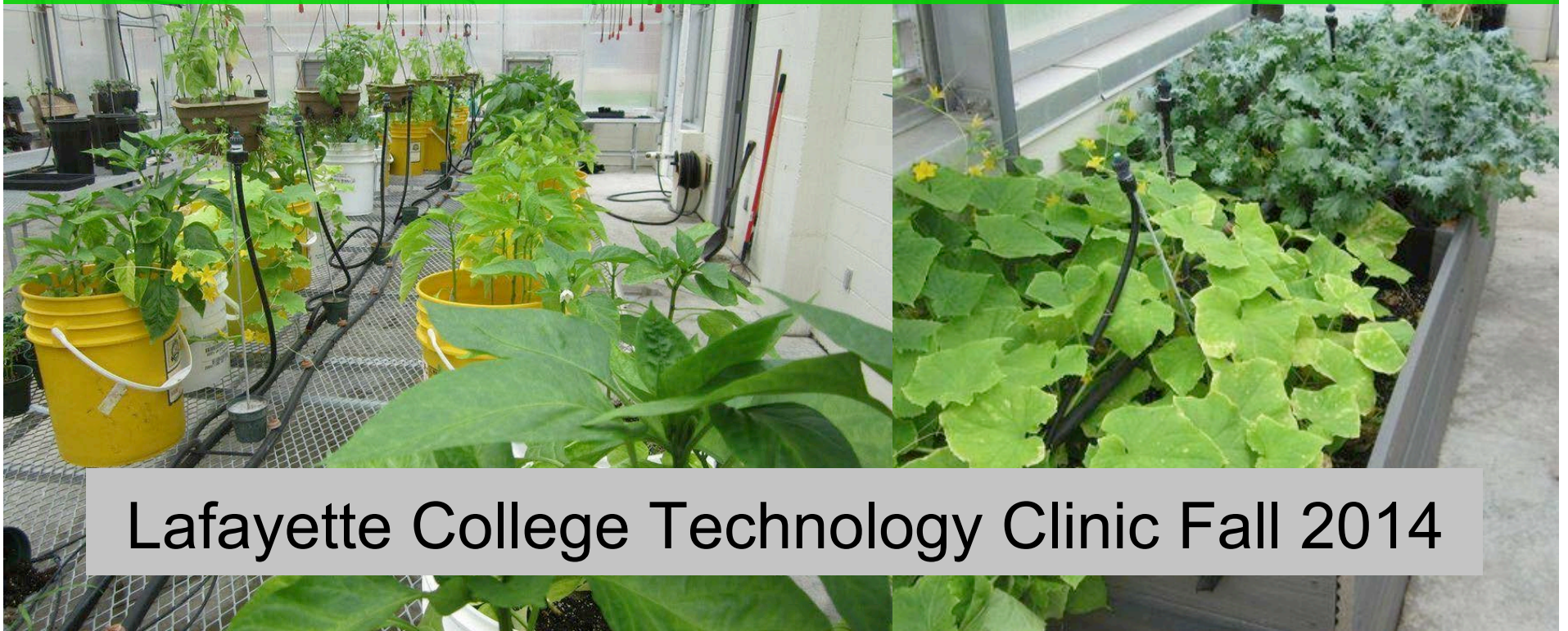


Greenhouse Projects and Curriculum Manual



Lafayette College Technology Clinic Fall 2014





The Lafayette College Technology Clinic has been working with the Bangor Area High School to develop programming that will encourage use of the greenhouses. As a result, we have developed projects and ideas for greenhouse programming to promote student involvement. This is a manual of possible projects including detailed instructions and supplies needed for each project.



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Greenhouse Upkeep

General Greenhouse Maintenance

General maintenance of the greenhouse during each class or program session should include the following main tasks:

1. Watering all plants / checking dryness of soil/hydroponics trays
2. Feeding fish in aquaponics system (as needed)
3. Keeping the greenhouse clean - includes sweeping loose soil from the floor
4. Organizing and cleaning up materials or tools used. This should include stacking and putting away any empty pots or seedlings trays, putting all plants back on tables
5. Make sure the automatic watering cycle is on
6. Generally cleaning up the facility.
7. Keeping logs of various measurements (i.e. air, soil, & water temperature; nutrient levels in soil, hydroponics, and systems).

Greenhouse Finances

- ❖ An important lesson can involve tracking expenditures associated with greenhouse operations
- ❖ In the classroom, we suggest electing treasurers for each elective period so that students have the opportunity to be involved in the finances of running and maintaining the greenhouse.
- ❖ It's important that we keep track of expenditures in order to effectively document/quantify the success of the semesters' harvest and sales, and to evaluate the benefits and costs of the greenhouse program.
- ❖ Documenting expenditures also allows classes to work toward making the greenhouse programming self-sustaining and potentially profitable in order to fund future semesters.

General Greenhouse Finances - Examples

Type of Item	Cost	Number of Items	Total
Planting Soil	\$35	6	\$210
Potting Soil	\$13	2	\$26
Educational Supplies	\$34	2	\$68
Seeds	\$2	30	\$60
Shade Cloth	\$13	1	\$13
Root Grow	\$6	1	\$6
Seedling Tray Labels	\$15	1	\$15
			Total \$398

Hydroponic Expenses

Type of Item	Cost	Number of Items	Total
1 in. x 10 ft. PVC Schedule 40 Plain-End Pipe	\$3.71	1	\$3.71
Pumps	\$30	1	\$30
45L Expanded Clay Bags	\$46.95	1	\$46.95
3 R-6 1 in. x 4 ft. x 8 ft. Polyiso Rigid Foam Insulation Board	\$20.67	1	\$20.67
2" Diameter net pots	\$0.67	6 per raft	\$4.02
Uniseal ½"ID fittings	\$1.46	1	\$1.46

Continued on next slide...

Hydroponic Expenses Continued

Type of Item	Cost	Number of Items	Total
Total Pond 1/2 in. x 20 ft. Vinyl Tubing	\$8.97	1	\$8.97
NIBCO 1/2 in. CPVC CTS 90-Degree Slip x Slip Elbow (10-Pack)	\$2.77	2	\$5.54
JM eagle 3 in. x 10 ft. PVC Schedule 40 DWV Plain-End Pipe	\$15.88	1	\$15.88
1/2 in. x 10 ft. PVC Sch. 40 Plain-End Pipe	\$2.05	1	\$2.05
			Total \$139.25

Greenhouse Supplies and Systems Organization

Part of our commitment to helping the BAHS Greenhouse Elective classes has been to have supplies ready and available for each class. Most of the remaining supplies will be in the storage room in the greenhouse or on the shelves, labeled. Here are some of the general supplies used throughout various projects and where they are located in the greenhouse:

- | | |
|---------------------------------|---|
| ❖ Soil | -shelves/floor in storage room |
| ❖ Seeds (various) | -shelves in storage room |
| ❖ Pots (varying sizes) | -shelves in storage room (boxed by size) |
| ❖ Hanging Baskets | -shelves in storage room |
| ❖ Bucket Gardens | -table lined along right side of greenhouse |
| ❖ Seedling Trays (cells/trays) | -shelves in storage room |
| ❖ Brooms/Dustpans | -leaning in corner of storage room |
| ❖ Watering Cans | -will probably float around greenhouse |
| ❖ Hand Shovels/ Trowels | -shelves in storage room |
| ❖ Full Sized Shovels | -leaning in corner of storage room |
| ❖ Watering System Controls | -left/back wall of storage room |
| ❖ Raised Beds | -far left/back wall of first greenhouse room |
| ❖ Hose | -on wall between entrance and storage room door |
| ❖ Fish Food | -shelves in storage room |
| ❖ Water Quality Testing Kit | -shelves in storage |
| ❖ Flora Series Nutrition System | -shelves in storage |
| ❖ Worm Farm Bins (2) | -floor of storage room |



Projects

Blogging

- Blogging in the classroom, especially throughout project work, is a great way for students to document their work and experiments.
- The blog serves as a platform upon which to post written editorials, videos, photos, how-to instructions, recipes, and more.
- This would be a great way for students to take initiative, get involved, and share their stories with others.
- This type of documentation is recommended in the greenhouse classroom.
- A blog has been started for the greenhouses it is accessed at: bahsgreenhouse.blogspot.com
- Initial login information:
 - bahsgreenhouse@gmail.com, [kale4ever](#)



Bucket Gardens

❖ About:

- Made of recycled containers primarily five gallon buckets.
- A convenient way to grow fresh produce in any living space - especially homes that don't have the access to or space for a garden.
- Require minimal maintenance. The water collected from the drain can be poured back on the plant to water it and recycle leached nutrients.
- Buckets can be easily transported and supplies are easily accessible - can be found local bakeries or perhaps the High School cafeteria.
- The buckets can be re-planted year after year and are great for growing tomatoes, kale, basil, and other staple vegetables.



Bucket Gardens: Supplies

Making the Bucket:

- ❖ 5 gallon bucket
- ❖ 5 gallon bucket lid
- ❖ $\frac{3}{8}$ - $\frac{1}{2}$ " tubing
- ❖ 3 2 $\frac{1}{2}$ " corrugated plastic drain pipe

Planting and Assembly:

- ❖ Seedling Trays
- ❖ Potting Soil
- ❖ Vegetable Seeds
 - Tomatoes, cucumbers, kale, peppers etc. are recommended.
 - Avoid root veggies or plants that require deep root growth.

Tools needed to create bucket garden:

- ❖ Saber Saw/ Reciprocating Saw (lid and spacers)
- ❖ Jig Saw (lid)
- ❖ Drill (with match sized drain-cut as diagonal)

Bucket Gardens: Bucket Instructions

Constructing the Bucket Garden:

1. Drill about 15 holes in middle area of bucket lid using a 5/16" drill bit (upper left photo).
2. Use a jig saw to saw around the inner edge of the lid, cutting off the outer lip so that the lid fits inside the interior of the bucket.
3. Cut three 3" pieces drain pipe with a Saber Saw (middle right photo)
4. Cut one 6" piece of vinyl tubing/drain hose at a diagonal with a Saber Saw.
5. Drill hole in the side of the 5 gal. bucket 2-3" from the bottom with the same size drill bit as the vinyl tubing is wide, $\frac{3}{8}$ - $\frac{1}{2}$ " (bottom photo). The hole should match diameter of outside of tubing.

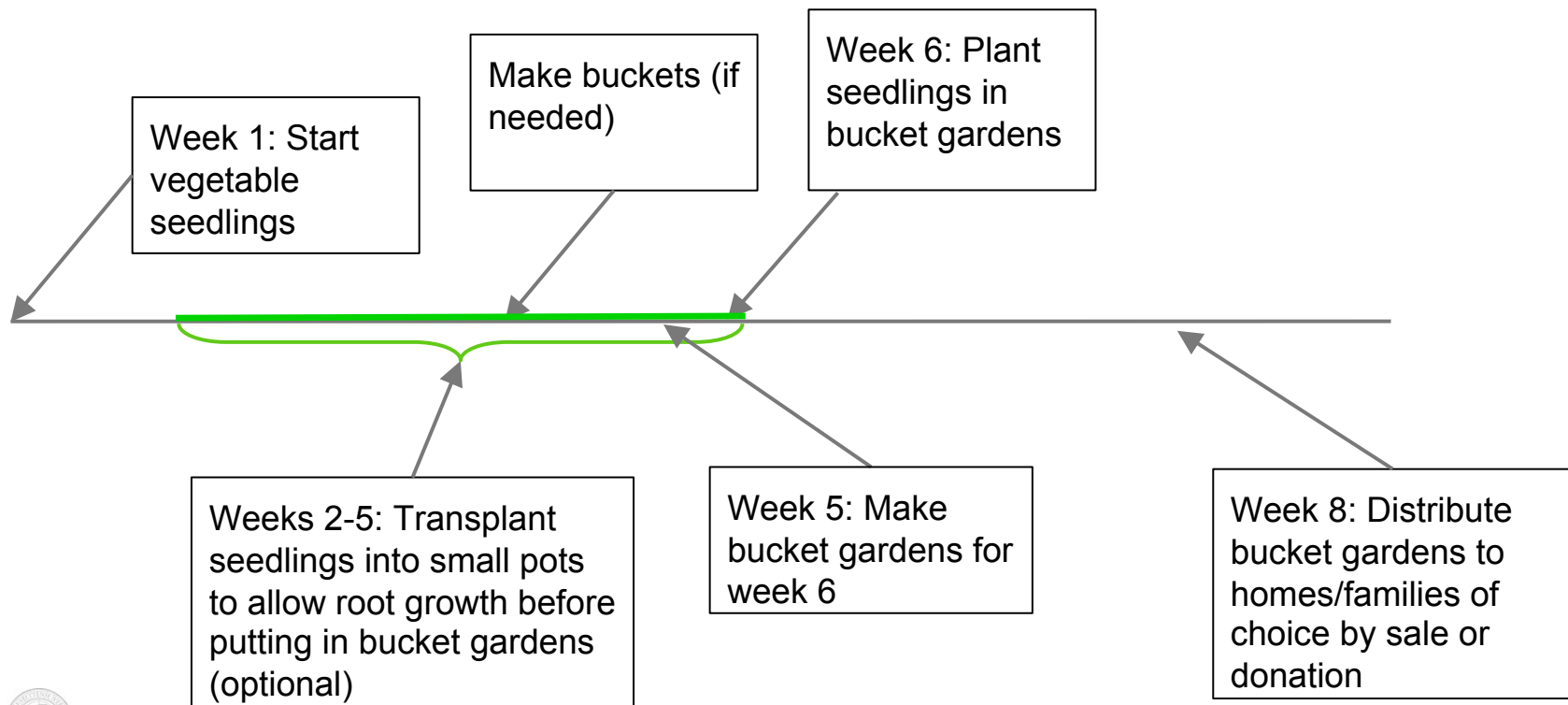


Bucket Gardens: Assembly Instructions

Starting the Bucket Garden (video available at: <http://bahsgreenhouse.blogspot.com/>)

1. Start Seedlings 4-6 weeks before starting bucket gardens (see Starting Seedlings Instructions pg 6).
 2. Put cut plastic tubing in hole on side of bucket to provide drainage.
 3. Set three corrugated plastic drain pipes in bottom of bucket and set the circular cut lid on top of them.
 4. Above the lid, fill the bucket with soil up to 5" from the top.
 - a. The amount of soil can depend on the contents the bucket.
 5. Transplant seedlings (1-2 plants) into the buckets (see Transplanting Instructions pg. 7).
- ❖ Optional: You can place a receptacle (such as an empty milk jug) for the water beneath the drainage pipe to recycle the water draining from the bucket garden. Many nutrients drain with the excess water that can be put back into the soil with this method.

General Bucket Garden Timeline



Bucket Gardens: Follow Up

Maintenance of started bucket gardens is simple. They just need water and sunlight. They can grow indoors by a window or out on a porch. The water that drains out of the plastic spout, if collected, can be recycled. Buckets should be lightly fertilized to provide extra nutrients.

Bucket gardens are a great way to get fresh herbs and produce growing in homes that would not otherwise have easy access to them. Once the bucket gardens have been started and are growing, here are a few ideas for what the class or group can do with them:

- ❖ Donate them to a local food shelf.
- ❖ Donate them to a local assisted living center.
- ❖ Donate to the school for classroom use.
- ❖ Allow each student to take their bucket home with them.

This project promotes nutrition and access to fresh produce. It's a great way to get students involved in growing vegetables and, in addition, it helps reinforce the importance of agriculture, gardening, and healthy living in the lives of students. Bucket gardens also create the opportunity for an activity to pair with a lesson on nutrition, as well as expanding on the importance of fresh produce and healthy food in daily life.

Hanging Baskets



& Plant Propagation

http://4.bp.blogspot.com/-SxZtjemqvhc/UbSv9nvvZ2I/AAAAAAAAATfg/y7WimbwWJPg/s1600/DSC_0993.JPG

Hanging Baskets and Plant Propagation

- ❖ Hanging baskets are a great and fun way to display both flowers and herbs.
- ❖ Both decorative and efficient, they do not take up valuable ground space in the greenhouse.
- ❖ They have the potential to be sold to the community for profit, providing funding for future greenhouse programs.

- ❖ Plant propagation is another great way to involve students in various methods of growing plants. Many flowers require plant propagation to reach the flowering stage.



Hanging Baskets: Instructions

- ❖ There are two types of hanging baskets in the greenhouse:
 - Plastic green pots (12"-18") that have one opening at the top.
 - Brown recyclable material pots that have one opening at the top and 6 around the sides.
- ❖ Flowers/herbs to put in the green plastic pots:
 - Lobelia
 - Million Bells
 - Petunia
 - Sweet Asylum
 - Mums
 - Pansies
 - Spider Plants
 - Basil
- ❖ Herbs to put in brown baskets:
 - Basil can be paired with Coleus (inedible) in the middle of the basket (Note: basil does not grow well with the cabbage family, and the two should not be planted together).
 - Cilantro, Parsley or Thyme on sides coming out of the smaller holes.



tastefulgarden.com/

Hanging Baskets: Instructions cont.

- ❖ Start herb seedlings 4-6 weeks in advance (see Starting Seedlings pg 62).
- ❖ When starting your hanging basket, make sure your seedlings are mature enough. Approximately (5 weeks) after germination.
 - ❖ Once plants have a mature root system, you may transplant them into the hanging baskets.
- ❖ Plastic baskets can be labeled by taping labeled pictures to the bucket, and brown baskets by making small signs with pictures or words to put in the soil.
- ❖ For the brown baskets:
 - Put soil into the bottom until it reaches the level of the side holes.
 - Plant Parsley, Cilantro and Thyme on the sides.
 - Put more soil in to cover roots.
 - Plant the bigger plants, Coleus and Basil, in the middle.
- ❖ For plastic baskets:
 - Transplant flowers and herbs as explained in Appendix 2.

Plant Propagation: Coleus

Plant propagation is a cost-effective way to grow new plants and is a great learning opportunity. Some plants that can be propagated include a variety of Succulents, Poinsettias, Coleus, and Mums. While most plants can be rooted directly into potting soil, others, like Coleus, can be rooted in water.

In order to propagate Coleus:

1. Take a small trimming, about 5 inches long from the top of the plant.
2. Give the cutting a smooth stalk about 2 inches in length by removing any leaves near its new base.
3. Put plants in water. Optional: Add a small amount of rooting hormone to the tip. Roots for coleus will start to show in about two weeks. Make sure to replenish water as needed while the plant is rooting.
4. Once there is a stable root system, the plants can be potted. To increase and encourage root growth, keep the soil damp for the first few weeks.



<http://www.jenniferrizzo.com/2011/01/overwintering.html>

Coleus Plant Propagation: In 3 Steps



Take a trimming about 5" long from the top of the plant. Try to take from the outer perimeter of the plant.



Remove leaves from base, giving the cutting a new stalk from which roots will grow.



Place cutting in a water filled cup. Refill water as needed.

Plant Propagation : Follow Up

- ❖ Propagation is a fun way to learn about gardening. We recommend using Coleus in particular because they are hearty plants that propagate well. Additionally, they are extremely versatile. They can be:
 - Added to hanging baskets for a fundraiser.
 - Incorporated into a hydroponics system.
 - Sold on their own in pots for a fundraiser.
 - Incorporated into a drip irrigation system.
 - Planted outside the greenhouse or around the school grounds.

Keep in mind - Coleus need to be pinched at flowers or seed shoots to create branches and fill in as a foliage plant. Once coleus plants mature, they can be used for more propagation activities!

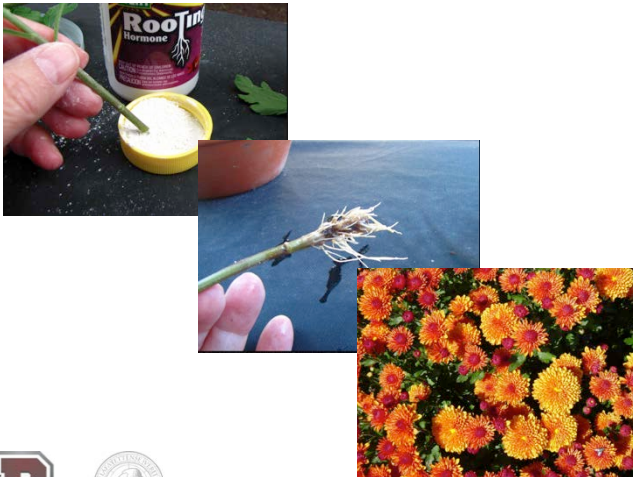
Mum Propagation

Supplies

- ❖ Root stimulant
- ❖ Sharp, sterile knife
- ❖ Nutrient rich, loose soil

Procedure

1. Water Mums to a depth of 4 inches the day before propagation.
2. Using sterile knife, make a 2-3 inch cutting of new growth from end of stem without buds or flowers.
3. Pull the leaves from the bottom 1 inch to reveal growth nodes.
4. Dip end (and potentially exposed nodes) into root growing stimulant.
5. Place clippings in perlite or perlite/peat moss mixture.
6. Keep in bright but indirect sunlight, and damp (not soaking!).
7. Roots should form in 2-4 weeks.
8. Cuttings can be placed in soil when roots have reached ½ inch in length.



Poinsettia Propagation

- Poinsettias can be propagated in soil. (Refer to page 65)
- Once propagated, Poinsettias require a dark space (12 hour nights for the first 6 weeks) so that their leaves can turn red. Poinsettias can benefit from rooting hormone, to speed up the rooting process.
- Poinsettias were once grown for a fundraiser at Bangor Area High School that was very successful,
 - contact Gary Oiler (717)-860-6097 (retired teacher who is generally willing to help) for more information.
 - 500 rooted cuttings were purchased for growth and sale.
 - Cuttings planted the first week of school.



More information on Poinsettia propagation:

<https://www.extension.purdue.edu/extmedia/HO/HO-235-W.pdf>

<http://www.fumcfairfield.org/>

Optional Activity 3: Succulent Propagation

A variety of succulents can form new growth through their leaves, bases, and stems. Succulents require plenty of light, but only need to be watered when their soil is dry (about once a week). Water the soil of the plants until it drains from the bottom. Additionally, soil for succulents should be more rocky, and hold less water. You can find palm/cactus mix from your local Home Depot. Succulents can be added to vertical gardens, hanging baskets, or be sold in a plant sale.

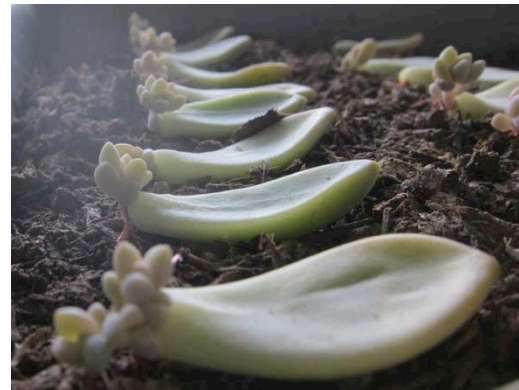


1. Remove the lower leaves from the stem. Wiggle gently from side-to-side until you hear a snap.

2. Cut the top of the plant, leaving a small stalk.



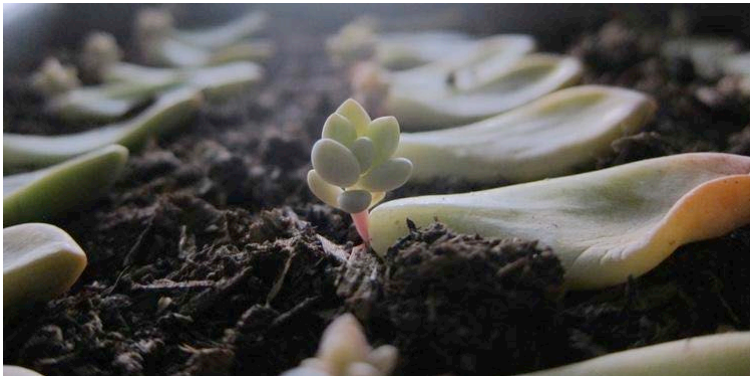
3. Allow all of the cuttings 2-7 days in open air to callous. This is essential in order to spark new root growth.



4. Once leaves are dry enough, line them up on well drained succulent soil. Allot one leaf per seedling cell. Water infrequently until you see little plants emerge. Then water once a week.

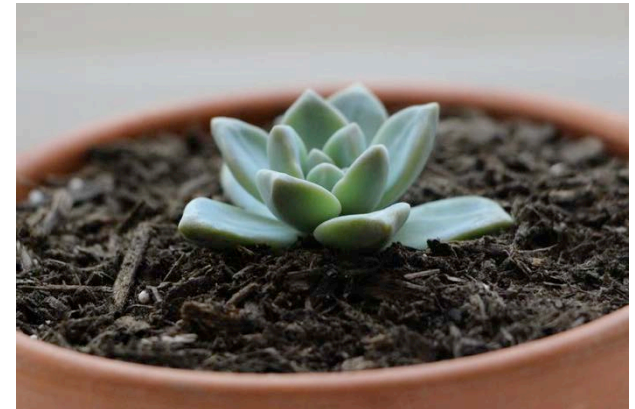
Optional Activity 3: Succulent Propagation

5. After a few weeks, baby plants will start to form with pink roots, and the “mother leaf” will start to wither. Eventually the mother leaf will break off from the roots, and can be composted.



6. Put the original pot with the stump aside and eventually it will begin to sprout new plants from each place you removed a leaf!

7. Repot the original top to the plant and it too will eventually grow roots!



All images and instructions from this online resource: please take advantage of it!
<https://needlesandleaves.squarespace.com/blog/2013/5/31/propagating-leggy-succulents>

Flower Sale



This picture is an example of Conway High School preparing trays of flowers for a spring flower sale.

The BAHS greenhouse has the potential to do the same thing, as has been done with remarkable success in the past.

Flower Sale: Supplies

- ❖ Potting Soil
- ❖ Chrysanthemum, Marigolds and Profusion seeds
- ❖ Watering Can
- ❖ Seedling Trays
- ❖ Flower Pots



Profusions

http://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&ved=0CAQQjBw&url=http%3A%2F%2Fwww.fleuroselect.com%2Fornamental-plants%2Fprofusion-double-hot-cherry%2Fgetlargeimage%3Fid%3D1505&ei=ut5jVNaFBKtIsASJ-oLgAQ&bvm=bv.79189006,d.cWc&psig=AFQjCNHrYXTfNc2-5B5VT_HOt1z8knr5Qw&ust=1415917546340949

Flower Sale: Plant Instructions

Profusions and Marigolds

1. Fill planting flat cells $\frac{3}{4}$ full with seedling soil.
2. Water the soil until damp.
3. Place 1-2 seeds in each cell.
4. Fill each cell to the top with additional soil.
5. Water seedlings daily.
6. Typical Germination: 5-14 days

Chrysanthemums

1. Fill planting flat cells $\frac{3}{4}$ full with seedling soil.
2. Water the soil until damp.
3. Place 1-2 seeds in each cell.
4. Do not add additional soil!
 - a. Light is needed for germination.
5. Typical germination rate: 7-14 days

Note: also see “How to Plant Seedlings” in Appendix 2 for more on planting seedlings.

Flower Sale: Sale Instructions

1. Establish a goal and sale prices through class discussion. Determine cost of materials, how much someone would pay for the product, and how much of a profit is desired (discuss concept of “breaking even”).
2. Create order forms and make available to students to distribute to their peers, parents, faculty, and the community.
3. Establish date, time, and location of sale.
4. Make signs for the sale and hang them around school to promote and advertise...possibly in local newspaper.
5. Decorate flower pots and make the plants presentable.
6. Designate student jobs during the sale to help sale run smoothly.
7. Have a class discussion on the assessment of funds raised and profit margins.

General Flower Sale Timeline

Wk 1- Greenhouse orientation, group establishment, financial goals and price setting; plant poinsettia clippings

Wk 2- Mum/coleus propagation, distribution of request forms

Wk 3- Plant Profusion/marigolds

Wk 4- Plant Profusion/marigolds

Wk 5- Mum/Coleus Propagation

Wk 6- Mum transplant

Wk 7- Profusion/Marigold transplant

Wk 8- Mum/Coleus transplant

Wk 9- Sale Organization and Prep

Wk 10- Plant Sale (around Thanksgiving or Halloween for holiday sale)

Wk 11- Profit Assessment

Wk 12- Student/customer assessment of the semester and cleanup

Followup: along with each sale, include a method for customer feedback on quality, value, color and assortment, etc.

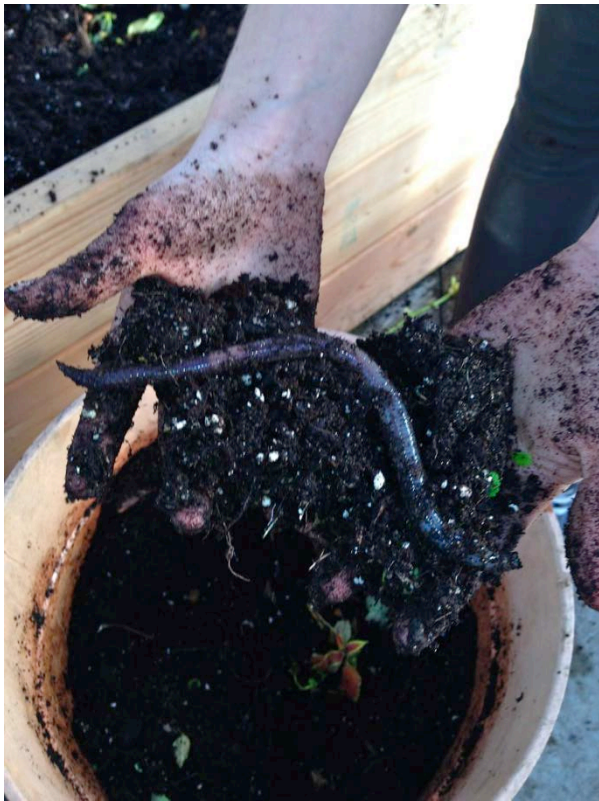
Flower Sale: Follow Up

- ❖ Did students reach their goal?
- ❖ How far off from the goal were we?
- ❖ Was the price too expensive or could the price be increased next time?

This business venture promotes teamwork and collaboration and has the potential to support student agriculture and nutrition projects. Consider these ideas for the future:

- Take pre-orders and send to all Five-Points schools.
- Using the mum plants from this year, keep the plants alive and generate new plants for sale through splitting and propagation
- Previously each student was responsible for several trays of their own kind of plant, and sold at \$1.50 per group of 6 cell pack during early May. This generated a greater diversity of plants and can be expanded to include vegetables.

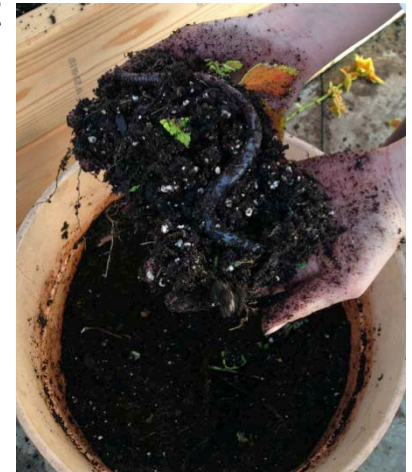
Composting and Worm Bed



Composting and Worm Bed

Providing nutrient rich soil using post-consumer organic material is great way to promote sustainability. Additionally...

- The usage of compost bins and worm beds decrease the amount of cafeteria food waste that is sent to a landfill each day.
- After adding organic material, little maintenance is needed.
- It's an organic way to create rich, fertile soil.
- Worm beds provide *vermite compost* which is extremely high in nutrients. The construction of the boxes also allows for the collection of liquids that are like an “energy drink” for plants.
- Though the purpose of a worm bed is to provide nutrient rich compost, new, baby worms can be transferred into raised beds and the larger compost bin.



Composting and Worm Bed: Supplies

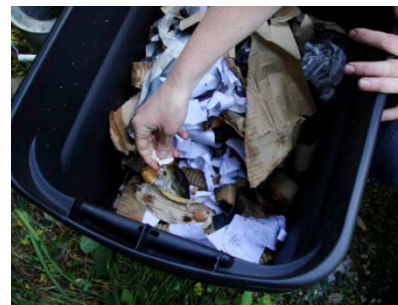
Compost:

- ❖ Large container (ideally 4ft x 5 ft) that can be sealed to prevent flies and ants from accessing food waste
- ❖ Hoe or pitchfork to aerate compost
- ❖ Shovel to extract nutrient rich product
- ❖ Food waste, plant waste



Worm Farm:

- ❖ Two, 12" deep sealable containers, dark color
- ❖ Worms (*Eisenia fedita*)
- ❖ Shredded newspaper bedding
- ❖ Food waste



<http://modernfarmer.com/2013/05/how-to-build-a-worm-farm/#!bS6j2R>

Composting: Instructions

1. Gather organic material such as:
 - a. grass clippings
 - b. coffee grounds
 - c. food waste (avoid dairy and meat)
 - i. fruits, vegetables, grains, etc.
 - d. dead plants, clippings from greenhouse activities, etc.
2. Keep all organic materials together with lid sealed.
3. Stir occasionally with hoe.
4. Once material is solid, dark, and rich, take out with shovel and use for planting.

What's Compostable?

→ Any biodegradable item such as food and organic materials (excluding plastic and metal):

- Fruits and Vegetables (apple core, orange peels, banana peels, salad with dressing)
- Meat or fish (including bones and egg shells)
- Meat alternatives (nuts, tofu, legumes)
- Dairy products (cheese, yogurt)
- Grain and cereal products (including bread, cakes, breakfast cereals with milk)
- Paper towels and napkins
- Soiled paper (paper food wrapping, paper plates, wet newspaper) and cardboard (pizza boxes)



image via Concordia University; designed by Sara Badreddine

Worm Bed: Instructions

1. The boxes for the worm farm are pre-made in the side room of the greenhouse. Make newspaper bedding using shredded newspaper. Make multiple layers and line the bottom of the bed.
2. Moisten bedding so it feels spongy.
3. Distribute food waste throughout layers of the bedding so that worms will be encouraged to crawl down through the layers. About 1 lb of food a day.
 - a. Fruits and vegetables will work best (avoid dairy and meat).
4. Distribute 1 pound of worms (*Eisenia fetida*) on top of the bedding.
5. Use a solid sheet of newspaper to “tuck” the worms in. Make sure the newspaper is tight around the sides of the bucket to ward off fruit flies.
6. Keep sealed and in a dark, cool place such as the dark storage room inside greenhouse.
7. Once left alone, the worms will decompose the fruits and vegetables into nutrient rich material.
8. To extract organic material to use for plants,
 - a. Lure the worms to one side of the box by putting in a new food item, like an old apple.
 - b. Collect the new material with your hands, avoiding picking up any worms with it.

Please see this tutorial for images and more detailed instructions. All the instructions provided in this manual are based directly on this source <http://modernfarmer.com/2013/05/how-to-build-a-worm-farm/#!bS6j2R>

Timeline

Worm Bed:

- ❖ A worm can eat up to its weight in food a day. In the first few weeks, the worms will be adapting to their new environment - so little progress will be made. Still, check the bin weekly and look for dark brown compost.
- ❖ Around 3 weeks-once worms have settled: harvest compost by putting new food waste in a different area from where the compost is located. The worms should gravitate towards the new area. After a few days, scoop out vermite compost with hands. This material will be dark brown and looks like coffee grounds.

Compost:

- ❖ This is a long term endeavor that does not have a specific timeline. Just continue to aerate the contents of the compost. If different waste items have decomposed and the contents look rich and dark - extract. Of course, this is a continuous process, so extract the rich compost while leaving in the younger, less mature contents.

Worm Bed and Composting: Follow Up

Once constructed, compost bins and worm beds are relatively low-maintenance.

- ❖ Having little critters in the greenhouse makes things a little more lively, and is an exciting way to engage students. Additionally, some worms can be transferred to the compost bin or the raised beds as their population grows.
- ❖ The simple construction of a worm bed could encourage students to make one at home.
- ❖ A composting program could recycle the food waste from the cafeteria and grass clippings from around the school and make BAHS more sustainable.
- ❖ Composting and worm beds provide nutrient rich soil, essentially eliminating the need for fertilizers and pesticides. This resource can reduce the cost of purchasing potting soil.

Hydroponics

- ❖ Develop and maintain multiple hydroponic set-ups with an emphasis on the “floating raft method.”
 - Hydroponics is the process of growing plants in a soilless/nutrient-rich medium. There are many different hydroponic set-ups, and they are all unique and beneficial in their own ways
 - Student-driven development of multiple hydroponics systems will provide them with experience and a fundamental understanding of hydroponics: it’s benefits and shortcomings.
 - Hydroponics requires fundamental understandings of the core nutrients (nitrates, phosphorus, and potassium etc.) necessary for plant growth.
 - These systems also provide a transition for young propagated plants.



Hydroponics System #1: Floating Raft



<http://www.progressivegardens.com>

Figure 1: An example of floating rafts in a Greenhouse from Progressive Gardens

The floating raft method is a form of hydroponics that places plants in a soilless medium that rests on floating Styrofoam sheets. **The height of the water reservoir is dependent on the extent of root growth.**

- ❖ This is the most commonly used method for commercial purposes.
 - The set-up may attract local hydroponic farmers willing to volunteer their time and expertise.
- ❖ Construct floating raft systems for groups of students to run experiments related to the effects of plant & nutrient variations on plant growth in a floating raft system.

Hydroponics Project #1: Supplies

- ❖ Plastic tubs (should have a height of at least 10" and a larger surface area for water to better regulate temp.)**
- ❖ 1"x4'x8' Polystyrene Insulation (you want a larger enough board to ensure that you can cut out a floating raft for each tub that you purchase)**
- ❖ Air Pumps with attachable water stone (head pumps also work. The key is to have a device that can aerate the water (not necessary, but helpful)
- ❖ The Flora Series three-part nutrient system***
- ❖ As many 72-98 packs of soilless unit cells such as Rapid Rooter***
- ❖ 1.5 cubic foot bag of expanded clay***
- ❖ 2" Dia potting nets (*as many as there are plants*)***



(<http://aquaponics.com/page/methods-of-aquaponics>)

** Can be purchased at Home Depot

*** Can be purchased at Harvest Moon Hydroponics or online (610)432-4949

Hydroponics System #1: Instructions

1. Using desired tub, trace its outline on the polystyrene insulation.
2. Use a ruler and pen to mark the locations where the hole saw will drill places for the netting pots.
 - a. Keep in mind that the plants should be roughly 8" away from each other with a rough clearance of 4" from sides of tub.
3. Take seedlings that have been propagated in rockwool and place them in the netting pots.
4. **OR** proceed to fill the netting pots with expanded clay and/or any other hydroponic medium of your choice and grow seedlings directly in the system.



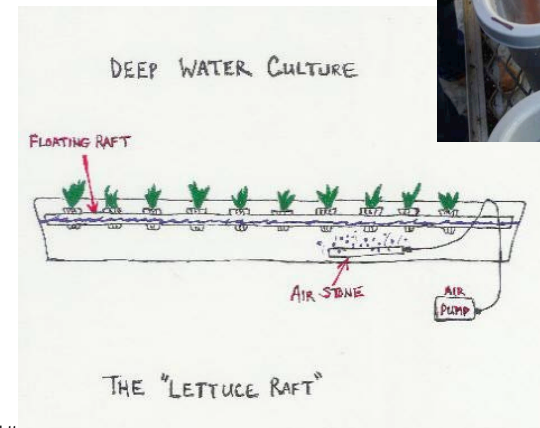
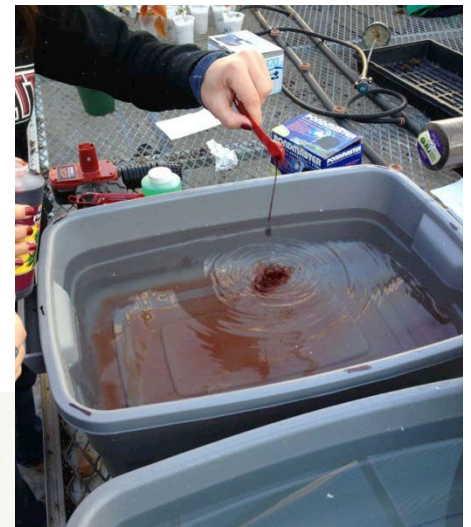
<http://hydronerd.com/category/hydroponics/>



<http://tinypic.com/view.php?pic=34oog9s&s=5#.VHQlbr7EbS8>

Hydroponics System #1: Instructions

5. Fill the tub with water such that roots extending from netting pots aren't completely submerged.
 - a. Soil must be well oxygenated.
6. Add nutrients while carefully following instructions so as to not provide too much or too little.
 - a. Bottles will provide information regarding nutrient to water ratios and when to replenish w/ nutrients.
7. Place polystyrene raft with plants into the tub.
8. If water aeration becomes an issue but a hole on the edge of the raft and drop an air stone into water reservoir.



<http://www.mylabreport.com>

Hydroponics #2 - Flood & Drain Method

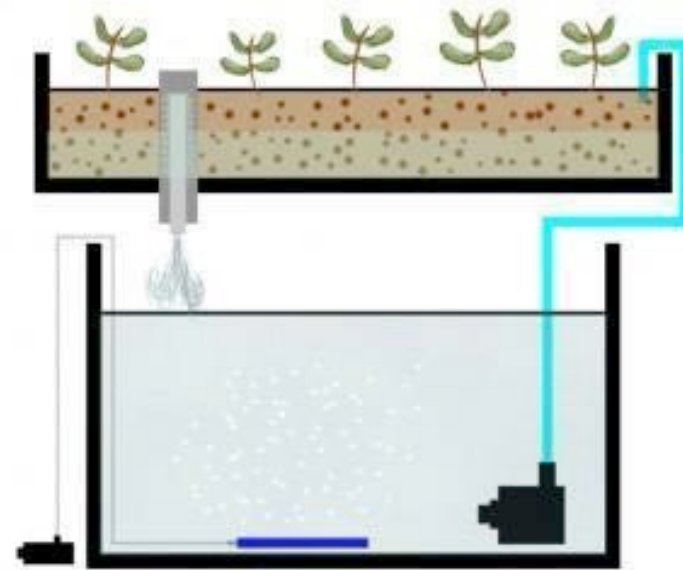
This system has various uses for the high school.

- ❖ Valuable **educational tool**, allowing students to learn more about inert hydroponic mediums such as expanded clay.
- ❖ Can serve as a **classroom model** for various elective periods as well as science classes
- ❖ Has the potential to be **sold commercially**, much like the greenhouse's bucket gardens



Hydroponics System #2: Flood & Drain Classroom Model

- ❖ Flood & Drain/Ebb-&-Flow is a type of hydroponic system that involves flooding a plant bed with water until a siphon quickly drains water back into the reservoir beneath the plant bed.
- ❖ Submersible pumps can either be on a timer or run 24/7.



<http://www.hydroponicsworld.co.za/hydroponics/flood-and-drain-ebb-and-flow-systems/>

Hydroponics System #2: Supplies

- ❖ 55 gallon barrel
- ❖ Screw Driver
- ❖ Reciprocating saw
- ❖ zip ties
- ❖ 1"OD PVC Piping (for Bell Siphon)
 - Cap for 1"PVC piping
- ❖ 1/2"OD PVC piping (for Standpipe)
 - two 90-degree elbows
- ❖ 3"OD PVC Piping (for Guard)
- ❖ Uniseal Fittings
- ❖ 3/16"OD 1/8"ID vinyl tubing
- ❖ Submersible Pump
- ❖ Expanded Clay (1.5 cubic ft.)
- ❖ 1/2" OD vinyl tubing



Hydroponics System #2: Instructions

1. Mark the barrel 12" from the top and cut in half with reciprocating saw.
 - a. Note: For more information read the following research:
<http://www.ctahr.hawaii.edu/oc/freepubs/pdf/bio-10.pdf>



Hydroponics System #2: Instructions cont.

2. Cut 6" deep v-cut w/
reciprocating saw
 - a. Use screw driver to create
holes
 - b. tighten cut with zip ties
3. Cut two holes on the 12" long
portion of barrel w/ hole saw, &
1 hole on the side of the
longer barrel half
 - a. place submersible pump
in barrel with chord
through newly cut hole.



Hydroponics System #2: Instructions cont.

4. Place uniseal fittings on top half of barrel.
 - a. place newly cut $\frac{1}{2}$ " piping through one hole & the $\frac{1}{2}$ " vinyl tubing through second fitting.
5. Place siphon, and guard over top standpipe.
6. Fill bed with expanded clay.
7. Fill reservoir with water (second half of barrel).



Hydroponics System #2: Instructions cont.

Bed to be filled
with expanded
clay

Reservoir filled
halfway with
water



Seedlings
grown in
netting pots
transferred to
clay

Plants propagated into
expanded clay

A photograph of a nasturtium plant with large, round, green leaves and a single bright orange flower. The plant is growing in a dark-colored pot. A horizontal green banner is overlaid across the middle of the image, containing the word "APPENDICES" in black, serif, all-caps font.

APPENDICES

Appendix 1: Interesting Possible Projects

The elective class at BAHS is set up in a way that makes the projects flexible and up to the teacher. The teachers and students are encouraged to conduct their own projects and ideas with the students. Here are some other ideas we have brainstormed that are potential projects in the greenhouse:

- ❖ Drip Irrigation System
- ❖ Vertical Gardens
- ❖ Effect of pH on Flower Color
- ❖ Phototropism

Drip Irrigation Systems

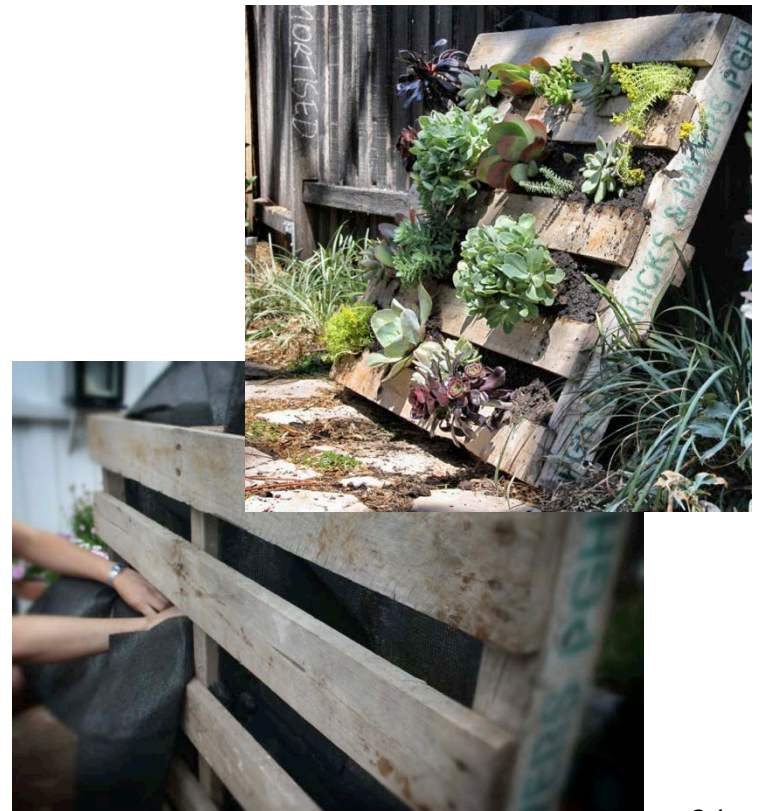
- ❖ This watering system provides slow constant drip cycles for plants.
- ❖ They can be combined with hydroponics and a recirculating water reserve to conserve and recycle water.
- ❖ Window gardens can be constructed of recycled plastic bottles.
- ❖ Recycling Club could contribute to project, along with composting.



<http://assets.inhabitat.com/>

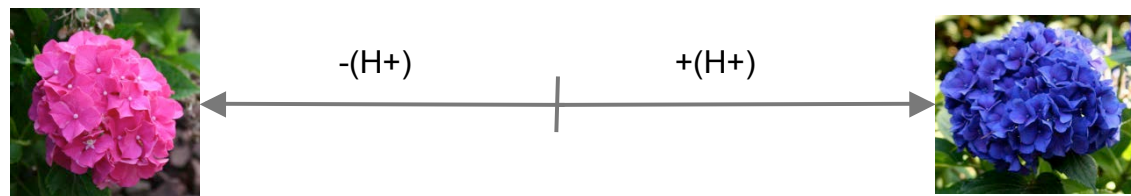
Vertical & Hanging Gardens

- ❖ Otherwise unutilized cubic footage of the greenhouse can be effectively employed through hanging gardens.
- ❖ It is made of recycled untreated wood pallets and can be incorporated along walls and partitions.
 - Local building contractors, lumber yards, and even local greenhouses are all willing donors.
 - Must be made of untreated wood!
- ❖ Pallet gardens, not easily watered by the automatic system, provide a potential opportunity for student engagement.
- ❖ Several pallets are at the greenhouse already.



Effect of pH on Flower Color

- ❖ Hydrangeas can be used to test the effects of pH on flower color.
- ❖ It is much faster to change a hydrangea from pink to blue rather than the reverse (by a matter of months). As such, we recommend starting with a pink hydrangea.
 - Purchasing “garden lime” at \$10 dollars a bag simplifies this process.
- ❖ Ideal pH for this experiment is 5.2-5.5 for blue hydrangeas, allowing the plant to uptake free aluminum.
- ❖ Adding organic matter such as fruit and vegetable scraps, coffee grounds, or grass clippings help to decrease the pH.
- ❖ Adding rusted nails expedites this process.
 - Bury at a depth of 6”, approximately 10” from the base.
- ❖ Several months must be allowed to see the effects clearly.



Phototropism

- ❖ Phototropism is defined as the orientation of a plant or other organism in the response to light, typically towards the light (positive phototropism).
- ❖ Using a well established plant, place the plant in a box such that only one side is exposed to the light.
- ❖ Leave the plant in this condition (maintaining watering) for several weeks, taking pictures every few days to each week.
- ❖ After a few weeks to a few months, observe how the plant's growth pattern has changed. Use the pictures as a reference tool to track the plants progress over time.



Appendix 2: Techniques for Growing Plants & Greenhouse Operation

The following pages include instructions for planting seedlings, seedling transplantation, and general instructions for plant propagation, as well as the watering system.



http://media01.bigblackbag.net/18070/portfolio_media/lwsm_stephenstudd-photography-planting_8775.jpg



http://2.bp.blogspot.com/_RXV5MKAh6ng/TSKtKRYA8BI/AAAAAAAAJA8/n6ZWPAoz_kA/s1600/DSC_2922.JPG

http://3.bp.blogspot.com/_LiREf0qwNng/TjmS6LReR3I/AAAAAAAAA7Y/JU70wv1MHNMs1600/DSC05269.JPG

How to Plant Seeds

1. Fill seedling trays with potting soil and water to get the soil moist
2. Plant one to 2 seeds in each cell by pushing one finger down into soil as far down as told for each plant (see back of seedling packet) to create a hole for the seed. Fill with the seed(s) and then gently covering with soil.
3. Lightly water or frequently mist the soil until germination. Seedlings need to be watered more often to keep the soil wet and warm to cultivate the new plant.

Notes:

1. Some seeds need light to germinate and should not be covered
2. Mixing small seeds with sugar will make them come out of the packet evenly and easier to see
3. If force of water is too high soil will be washed around and seeds buried too deeply



<http://blog.prnurseries.com/>

How to Transplant Seedlings

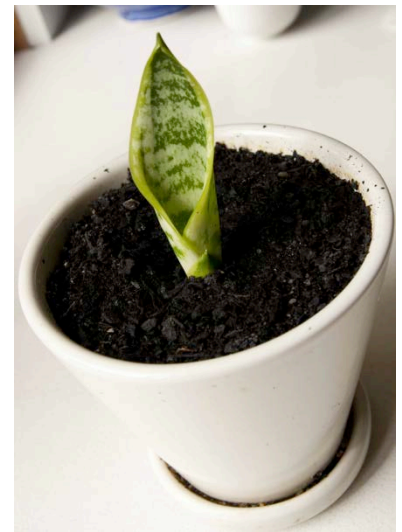
1. Make a hole slightly bigger than the seedling cell in the soil of the container the plant is being transplanted into.
2. Gently squeeze outside of seedling tray cell to loosen seedling and tip into the palm of your hand gently pulling on soil and plant if necessary. Be very careful not to uproot the seedling from the soil though! If soil doesn't stay together and crumbles, get as much in your palm as you can to put in the hole, the priority is keeping the roots intact!
3. Gently place the seedling in the hole and fill soil in around it from the sides.
4. Gently but firmly press soil around the plant down to secure the seedling.
5. Water well!
 - ❖ Newly transplanted seedlings need a good amount of water at first, but their roots are fragile after the move, and can easily be displaced by high water pressure.



<http://www.vegetablegardener.com/>

How to Propagate Plants: General Guidelines

1. Using clean scissors, cut a 3-4 inch segment of the plant to be propagated
 - ❖ Be sure that there is neither a flower nor a bud at the end, should it be a flowering plant
2. Remove any leaves on the lower 1-2 inches to expose growth nodes
3. The use of a small amount of **rooting hormone** to the end and recently exposed growth nodes
 - ❖ Rooting hormone helps signal the plant clippings to put energy into forming new roots
 - ❖ Adding too much rooting hormone prevents rooting, but the fungicide in the product will preserve the base of the plant
4. Place the portion of the clipping covered in rooting hormone directly into damp soil
 - ❖ It is important to keep the soil damp at all times, but high water pressure can easily displace clippings with unformed or fragile root systems.
 - ❖ Some plants, such as coleus or mums, have special growing conditions which should be observed; although for most plants it is easiest to propagate directly into soil.



<https://harvestbeyondmyfrontdoor.files.wordpress.com>

Appendix 3: Recommended Vegetables and Flowers

Recommended Spring Planting:

- ❖ Lettuce/Spinach/Kale
- ❖ Tomatoes
- ❖ Broccoli
- ❖ Cucumbers
- ❖ Peppers
- ❖ Basil
- ❖ Zinnias (started from seeds, other flowers are propagated)

Recommended Fall Planting:

- ❖ Lettuce/Spinach/Kale
- ❖ Basil
- ❖ Carrots
- ❖ Zinnias (started from seeds, other flowers are propagated)
- ❖ Mums and Coleus (propagation)

Tomatoes

- ❖ Germination time: 4-10 days
- ❖ Start seedlings 6-8 weeks before planting/before average last frost date.
- ❖ To start seedlings: Fill section $\frac{3}{4}$ the way with soil, sprinkle in seeds (just a few), cover with $\frac{3}{8}$ " of top soil and water gently. Seedlings need lots of light to germinate so start seedlings at end of March when the days are getting longer. Gently water only if/when surface soil dries out until seedlings sprout.
- ❖ More Information:
 - <http://www.grow-it-organically.com/growing-tomatoes.html>
 - <http://www.almanac.com/plant/tomatoes>

Broccoli/Cauliflower

- ❖ Germination time: 5-16 days
- ❖ Harvest time: 60-85 days
- ❖ Start seedlings 2-3 weeks before planting/average last frost date.
- ❖ To start seedlings: Fill section $\frac{3}{4}$ the way with soil, sprinkle in seeds (just a few), cover with $\frac{3}{8}$ " of top soil and water gently.
- ❖ Colder weather plant so start in early spring (February) to grow best.
- ❖ More Information:
 - <http://www.grow-it-organically.com/growing-broccoli.html>
 - <http://www.almanac.com/plant/broccoli>

Peppers

- ❖ Germination time: 8-25 days
- ❖ Harvest time: 60-80 days
- ❖ Start seedlings 8-10 weeks before planting outside.
- ❖ To start seedlings: Fill seedling section $\frac{3}{4}$ the way with soil, sprinkle in seeds (just a few), cover with $\frac{3}{8}$ " of top soil and water gently.
- ❖ More information:
 - <http://www.grow-it-organically.com/growing-peppers.html>
 - <http://www.almanac.com/plant/bell-peppers>

Lettuce, Spinach, and Kale

- ❖ Germination time: 2-15 days
- ❖ Harvest time: 5-6 weeks for baby greens, 6-8 weeks for salad bowl (45-55 days)
 - To harvest, cut lettuce at 1" above ground level.
 - If not harvested and maintained, it grows bitter (similar to Kale).
- ❖ Start seedlings 4-6 weeks before last average frost date.
- ❖ To start seedlings: fill seedling trays with soil, scatter seeds in each segment, lightly cover with $\frac{1}{8}$ " of soil and water thoroughly. Keep moist until germination.
- ❖ Great plant for hydroponics systems.
- ❖ Romaine is easiest to grow.
- ❖ More Information:
 - <http://www.grow-it-organically.com/growing-lettuce.html>
 - <http://www.almanac.com/plant/lettuce>

Cucumbers

- ❖ Germination time: 4-13 days
- ❖ Harvest time: 48-65 days
- ❖ Must be outside when flowering to get pollinated and grow cucumbers.
- ❖ Start seedlings 3 weeks before transplanting/average last frost date.
- ❖ To start seedlings: Fill section $\frac{3}{4}$ the way with soil, sprinkle in seeds (just a few), cover with $\frac{3}{8}$ " of top soil and water gently.
- ❖ More Information:
 - <http://www.grow-it-organically.com/growing-cucumbers.html>
 - <http://www.almanac.com/plant/cucumbers>

Basil

- ❖ Germination time: 5-14 days
- ❖ Harvest time: 55-70 days
- ❖ Start at any time.
- ❖ To start seedlings:
 - Fill section $\frac{3}{4}$ the way with soil, sprinkle in seeds (just a few), cover with $\frac{3}{8}$ " of top soil and water gently.
 - Start 4 weeks before transplanting.
- ❖ Maintenance:
 - Pinch off main branch when plant in 6" high down to where it branches off to encourage growth of smaller branches and to help the plant branch out and produce more.
 - Pinch off flowers as they grow to encourage more leafy growth.
- ❖ More Information:
 - <http://www.grow-it-organically.com/growing-basil.html>
 - <http://www.almanac.com/plant/basil>

Zinnias

- ❖ Germination time: 5-76 days in 60 degrees
- ❖ Time till bloom: 60-70 days
- ❖ To start seedlings: Sow seeds ¼" deep.
- ❖ Recommended varieties:
 - State Fair (grow 30" tall)
 - Thumbelina Series (grow 6" tall)
 - Profusion (12-16"; grow dozens of 2-3" flowers)
- ❖ More Information:
 - <http://www.almanac.com/plant/zinnias>
- ❖ This manual recommends profusions instead of zinnias, as profusions (a derivative of zinnias) make better potted plants.

Carrots

- ❖ Germination time: 6-21 days
- ❖ Harvest time: 60-80 days
- ❖ Plant in raised bed 2-3" apart
- ❖ To start: Don't start seedlings to transplant, just sprinkle seeds right into raised bed on top of soil and lightly sprinkle soil over the top.
- ❖ For more information:
 - <http://www.grow-it-organically.com/growing-carrots.html#planting>

Appendix 4: Example Calendar and Curriculum 2015

Classroom Organization

- ❖ To facilitate project consistency within the available greenhouse space the optimal class structure is:
 - 1-2 classes of 15-20 students
 - Class meets 2-3 times a week

- ❖ Students in the class need to be active and engaged in greenhouse activities to ensure the success of the plants and plant sale, thereby stabilizing the class budget,
 - ❖ Under this plan students can work as a team, as well as take initiative with individual projects, experimenting with new techniques and plants.

- ❖ We suggest the 30 minute class period be broken up into three sections:
 - 5-10 of basic instruction on the day's projects
 - 10-15 minutes of work
 - 5-10 minutes of cleanup

General

- ❖ This sample calendar and curriculum was put together for the Bangor Area High School students to:
 - Provide an outline for the semester projects.
 - Provide a timeline for planting.
 - Suggest plants and projects which have been previously successful.
- ❖ Is created with flexibility in mind.
 - Project schedule designed to accommodate varying plant growth rates.
 - Enables students and teachers to easily implement supplement additional projects based on student interest.

Spring Calendar and Curriculum

2015 Sample Curriculum

JANUARY 2015

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
28	29	30	31	1 New Year's Day No School Winter Break	2 No School Winter Break	3
4	5	6 Capstone of 5th Block (round table discussion)	7 Keystone Exam Literature Module 1 Exam	8 Keystone Exam Literature Module 2 Exam	9 Keystone Exam Exam Make-ups	10
11	12 Keystone Exam Algebra 1 Module 1	13 Keystone Exam Algebra 1 Module 2	14 Keystone Exam Biology Module 1	15 Keystone Exam Biology Module 2	16 Keystone Exam Exam Make-ups	17
18	19 ML King Day No School	20 Final Exams Blocks 1 & 3	21 Final Exams Blocks 2 & 4	22 Final Exam Make-ups End of Second Marking Period	23 No School	24
25	26 Introductions, overview of syllabus and major goals for new semester. Discussion of plant sales with possible visits by Chris Peters and Bridgette Pruett to discuss the impact that the elective can have on the school and greater community.	27	28	29	30	31

FEBRUARY 2015

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2 Groundhog Day	3	4	5	6	7
Class discussion of sale (both seedling sale and hanging herb basket), how to organize it, finalize order form, general prep. (help of Adam?), send out order forms for seedling sale by Friday						
8	9	10	11	12 Lincoln's B-Day	13	14 Valentines Day
Class discussions of agriculture, nutrition, show documentaries, bring in speakers on agriculture, 7 habits of highly effective teens, community gardens, nutrition, ect						
15	16 Presidents' Day	17	18	19 Chinese New Year	20	21
do research projects on simple hydroponics systems (i.e. Flood & Drain systems as well as Floating Rafts) (small groups projects) SEEDLING SALE ORDER FORMS DUE FRIDAY!						
22	23	24	25	26	27	28
prep for seedling sale planting: calculate amount of seeds needed, compile orders, develop organization system, aquire necessary supplies, decide on how many and what kinds of vegetables to plant for bucket gardens Tour Greenhouse and give general overview of general care and maintenance (Speak with Andrew Bisher)						BUY SEEDS & SOIL
1	2	3	4	5	6	7
8 Daylight Saving	9	January 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31		March 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31		Calendars by Vertex42.com © 2013 Vertex42 LLC. Free to print. Printable Calendars
		2015 Templates		2016 Templates		

MARCH 2015

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 BUY SEEDS & SOIL*	2 prep and organize greenhouse for spring planting as well as greenhouse systems as a whole(i.e. by plant sale and non plant sale), buy seeds, introduce composting and maintain throughout semester, ect Plants to start: Corn, Carrots, & Lettuce	3	4	5	6	7
8 Daylight Saving	9 start planting everything and start all seedlings for sale,vegetable bucket gardens, seeds for kale in raised bed, basil in hanging baskets, ect for next three weeks Plants to start: Broccoli, Cabbage, Collard Greens	10	11	12	13	14
15	16 Devout time to computer days where students can update blog, Purchase rapid roofer or rockwool for hydroponics Plants to start: Cauliflower, Kale Start spinach & lettuce in rockwool (hydroponics)***	17 St. Patrick's Day	18	19	20 Vernal equinox	21
22	23 start planting everything and start all seedlings for sale,vegetable bucket gardens, seeds for kale in raised bed, basil in hanging baskets, ect for next three weeks Plants to start: Vertical Bush Beans, Tomatoes	24	25	26	27	28
29	30	31	1 April Fool's Day	2	3 Good Friday	4 Passover
5 Easter	6	February 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28		April 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30		Calendars by Vertex42.com © 2013 Vertex42 LLC. Free to print. Printable Calendars
					2015 Templates	2016 Templates

Note: the plants listed for each day are the recommended planting days for highest success rates for each vegetable.

Sequence of planting: plant vegetable seedling for bucket gardens first, then plant sale seedlings.

APRIL 2015

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
29	30 Plants to start: Tomatoes (choose a large variety), other less hardy plants that class may chooseto add	31	1 April Fool's Day	2	3 Good Friday	4 Passover
5 Easter	6	7	8	9	10	11
	transplant any vegetable seedlings for bucket gardens into pots (as needed)					
12	13	14	15 Taxes Due	16	17	18
	plant sale prep				plant sale!!	
19	20	21	22 Earth Day	23	24	25
	plant sale clean up, overview, calculate revenue,		prep buckets gardens, mix in composting and worm bed fertilizer into soil for added nutrients			
26	27	28	29	30	1	2
	plant bucket gardens, class discussion and decision making on what to do with bucket gardens (donate? keep and maintain throughout summer and give produce to Chris Peter's class in the fall?)					
3	4	March 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31		May 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31		Calendars by Vertex42.com © 2013 Vertex42 LLC. Free to print. Printable Calendars
					2015 Templates	2016 Templates

MAY 2015

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday																																																																																		
26	27 transplant kale into raised bed	28	29	30	1	2																																																																																		
3	4	5	6 class discussion on improvements, new ideas, ect for the elective curriculum	7	8	9																																																																																		
10 Mother's Day	11 Keystones	12	13	14	15	16																																																																																		
17	18 Keystones	19	20	21	22	23																																																																																		
24	25 Memorial Day Keystones	26	27	28	29	30																																																																																		
31	1	<p>April 2015</p> <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td></td></tr> <tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr> <tr><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr> <tr><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td></tr> <tr><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td></td><td></td></tr> </table>	S	M	T	W	T	F	S			1	2	3	4		5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30			<p>June 2015</p> <table border="1"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr> <tr><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td></tr> <tr><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td></tr> <tr><td>27</td><td>28</td><td>29</td><td>30</td><td></td><td></td><td></td></tr> </table>	S	M	T	W	T	F	S			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30				<p>Calendars by Vertex42.com © 2013 Vertex42 LLC. Free to print. Printable Calendars</p>
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General Discussion and Teaching Supplements

The resources available in order to incorporate learning about nutrition, agriculture, growing techniques, and health into the curriculum are as follows:

1. Lead a class discussion on the students experiences on different topics and their opinion.
2. Show documentaries about agriculture in America.
 - a. This American Life, Episode 6 “Pandora’s Box”.
 - b. Growing Cities.
3. Bring in speakers.
 - a. On the page titled ‘Speakers’ is a list of people who have said they would be willing to come in and speak to the class about their topic.

Preparation and Organization for Planting

- ❖ Organization and clear preparation is the key to an effective and efficient greenhouse.
- ❖ Needs to be organized and prepped for each new planting season.
 - Anything remaining from previous semesters should be cleared out or reused:
 - seedling trays restacked
 - any pots or containers of soil dumped out to be reused
- ❖ Create the environment necessary for whatever the teachers/ students have decided to do with the space.
- ❖ Make sure the materials needed for starting new seedlings are ready: seedling trays, soil, seeds of plants decided upon, labeling supplies, etc.

Notes of Incorporating Composting

- ❖ Composting is a great way to encourage a sustainable system reusing food and plant waste to feed back into the new plants.
- ❖ There is a composting bin outside of greenhouse that is available for use.
 - Plants and vegetable food (not meat or dairy)
 - The nutrient rich material in the bottom can be used and mix in with the soil to add nutrients to the plants. Great place to use composted material is in the bucket gardens.
- ❖ To learn more about how to maintain and use composting:
 - <http://www.organicgardening.com/learn-and-grow/5-easy-steps-fast-compost>
 - <http://www.wikihow.com/Compost>
 - Gary Oiler: (717)-860-6097 or soiler@ptd.net

Notes on Plant Sale Discussion

- ❖ A plant sale is highly recommended because it is the best way to generate revenue to keep the greenhouse program running.
- ❖ It is important that students see the whole picture of their projects.
 - Talk with them about plant sale project at beginning of semester.
- ❖ This project should be mostly student led, with the guidance of a teacher.
 - Let students decide the plants they want to sell and price them according to their goal profit.
 - Students can create and finalize an order form (if conducting a pre ordered seedling sale).
 - The class should go into this plant sale with the mindset of teamwork and thinking of this plant sale as a learning experience.
 - Gary Oiler is a great resource for this project.

Notes on Plant Sale Discussion

Ways to assist the students in their plant sale projects:

- ❖ Discuss with students the concepts of:
 - The greenhouse budget (how much it takes to keep programming running).
 - Profits (set goal profit according to budget needs).
- ❖ Students need guidance in pricing, sale techniques, marketing strategies, etc.
 - Help of a business teacher to guide the students in the logistics of the sale, teach of marketing strategies, and give an overview of profits and pricing.
 - Marketing Ideas: flyers, posters around school, spring seedling pre-order forms, etc.
- ❖ Help students set a timeline, determine materials necessary, and decide plants they want to put on the order form.

Notes on Plant Sale Preparation

For the week leading up to the plant sale,

- ❖ Organization and preparation is key to a smoothly run sale.
- ❖ There needs to be a predetermined system for:
 - Collecting the money.
 - Clearly communicating the prices.
 - Clearly labeling the plants.
 - Pre-ordering plants.
- ❖ The greenhouse should also look clean and presentable, as appearance could impact customer satisfaction.
- ❖ The class should decide how they want to set up the plant sale and organize the plants within the greenhouse.
- ❖ Also, discuss the importance of good customer service, possibly providing a mechanism for customer feedback.

Fall Calendar and Curriculum

2015 Example Curriculum

AUGUST 2015

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday																																																																																			
26 Parents' Day	27	28	29	30	31	1																																																																																			
2	3	4	5	6	7	8																																																																																			
9	10	11	12	13	14	15																																																																																			
16	17	18	19 Aviation Day	20	21	22																																																																																			
23	24 syllabus day/ introduce semester	25	26	27	28	29																																																																																			
30	31	<p>start seedlings for kale, lettuce, basil (in hanging baskets), zinnias, sweet peas, carrots (for raised bed)</p>																																																																																							
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SEPTEMBER 2015

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	introduce and short class discussion of	1 plant propagation of plant sale plants -coleus and mums	2	3	4	5
6	7 Labor Day	8	9	10	11 Patriot Day	12
	plan plant sale, prices, marketing ideas, ect (with the help of Adam?), ask students: What needs to be done? What do we need to do to have this plant sale?					
13 Grandparents Day	14 Rosh Hashanah	15	16	17	18	19
	make signs and label and organize everything in the greenhouse (both plants and everything and plan for transplanting (prep bucket gardens, plan pots, ect)					
20	21	22	23 Autumnal equinox Yom Kippur	24	25	26
	bring in speakers on the 7 habits of highly effective teens, nutrition, agriculture, and/or community gardens (also in november)					
27	28	29	30	1	2	3
	transplant seedlings. bucket gardens, raised beds, flowers into pots, propagation into soil and plant sale containers, ect					
4	5	August 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31		October 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31		Calendars by Vertex42.com © 2013 Vertex42 LLC. Free to print. Printable Calendars 2015 Templates 2016 Templates

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OCTOBER 2015

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30	1	2	3
4	5 transplant seedlings, bucket gardens, raised beds, flowers into pots, propagation into soil and plant sale containers, ect					10
11	12 Columbus Day	13	14	15	16	17
	introduce research projects, choose topics and groups					
18	19	20	21	22	23	24 United Nations Day
	continue research, use computers and library resources					
25	26	27	28	29	30	31 Halloween
	finishe research, make posters and prep with groups for presentations					
1 Daylight Saving	2	September 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30		November 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30		Calendars by Vertex42.com © 2013 Vertex42 LLC. Free to print. Printable Calendars 2015 Templates 2016 Templates

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NOVEMBER 2015

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday																																																																																			
1 Daylight Saving	2 groups present posters to class	3	4	5	6	7																																																																																			
8	9	10	11 Veterans Day	12	13	14																																																																																			
	Watch agriculture documentary and discuss as a class agriculture in America																																																																																								
15	16	17	18	19	20	21																																																																																			
	side project: trophism unit, composting, worm bed, ect																																																																																								
22	23	24	25	26 Thanksgiving	27	28																																																																																			
	make flyers for plant sale and distribute to families and faculty																																																																																								
29	30	1	2	3	4	5																																																																																			
6	7 Chanukkah	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>October 2015</p> <table style="font-size: small; border-collapse: collapse;"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td><td></td></tr> <tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr> <tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td></tr> <tr><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td></tr> <tr><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td></tr> </table> </div> <div style="text-align: center;"> <p>December 2015</p> <table style="font-size: small; border-collapse: collapse;"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr> <tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr> <tr><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr> <tr><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td></tr> <tr><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td><td></td></tr> </table> </div> </div>		S	M	T	W	T	F	S				1	2	3		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	S	M	T	W	T	F	S				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		<p>Calendars by Vertex42.com © 2013 Vertex42 LLC. Free to print. Printable Calendars</p> <p style="font-size: x-small; margin-top: 10px;">2015 Templates 2016 Templates</p>	
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DECEMBER 2015

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
29	30	1	2	3	4	5
			make posters and advertise around school for plant sale			
6	7 Chanukkah	8	9	10	11	12
	plant sale organization and prep				plant sale day!	
13	14	15	16	17	18	19
	talk about how to improve class for future semesters, watch documentaries, ect				End of Fall Curriculum	
20	21	22 Dec. Solstice	23	24 Christmas Eve	25 Christmas Day	26 Kwanzaa begins
27	28	29	30	31 New Year's Eve	1	2
3	4	November 2015 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30		January 2016 S M T W T F S 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31		Calendars by Vertex42.com © 2013 Vertex42 LLC. Free to print. Printable Calendars 2015 Templates 2016 Templates

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Notes on Starting Seedlings for Fall

- ❖ Seedlings need to be started right away in the order to make the last end of the growing season for the year.
- ❖ Refer to the “Greenhouse Projects and Instructions Manual” pg. 6 for more detailed instruction on the proper way to plant seedlings

Plant Propagation

- ❖ For instructions, see the How-To guide in the manual.
- ❖ Plant Propagation is the best way to get plants such as Mums and Coleus started for plant sales. It provides a new learning experience for the students, allowing them to experiment with new growing techniques, and makes a plant sale doable within the semester's time frame.

Notes on Plant Sale Discussion

- ❖ The plant sale is highly recommended because it is the best way to generate revenue to keep the greenhouse program running.
- ❖ It is important that students see the whole picture of their projects.
 - Talk with them about plant sale project at beginning of semester.
- ❖ This project can be mostly student led, with the guidance of a teacher.
 - Let students decide the plants they want to sell and price them according to their goal profit.
 - Students can create and finalize an order form (if conducting a pre ordered seedling sale).
 - The class should go into this plant sale with the mindset of teamwork and thinking of this plant sale as a learning experience.

Notes on Plant Sale Discussion

Ways to assist the students in their plant sale projects:

- ❖ Discuss with students the concepts of:
 - the greenhouse budget (how much it takes to keep programming running)
 - profits (set goal profit according to budget needs)
- ❖ Students need guidance in pricing, sale techniques, marketing strategies, ect.
 - Get a business teacher to guide the students in the logistics of the sale, teach of marketing strategies, and give an overview of profits and pricing.
 - Marketing Ideas: flyers, posters around school, spring seedling pre-order forms, etc.
- ❖ Help students set a timeline, determine materials necessary, and decide plants they want to put on the order form.

Notes on Advertising and Signs

- ❖ Remember to make sure any posters made for advertising are noticeable but not overwhelming
- ❖ A few things to be included on poster:
 - Event Name (i.e. “BAHS Greenhouse Flower Sale”)
 - Date
 - Time
 - Location
 - Contact info for a person that can answer any questions customers may have
- ❖ Another great way of advertising is to send a letter home to all parents and send out an email blast from the school to faculty and administration
- ❖ Use the newspaper as a resource to advertise to the community
 - Express Times
 - Morning call

General Discussion and Teaching Supplements

Here are resources available in order to incorporate learning about nutrition, agriculture, growing techniques, and health into the curriculum.

1. Lead a class discussion on the students experiences on different topics and their opinion.
2. Show documentaries about agriculture in America
 - a. This American Life, Episode 6 “Pandora’s Box”
 - b. Growing Cities
3. Bring in speakers
 - a. On the next page titled ‘Speakers’ is a list of people who have said they would be willing to come in and speak to the class about their topic.

Notes on Group Presentations

- ❖ In the fall, because there is a shorter growing season, group presentations are a great way to get the students learning about plants and greenhouse growing techniques.
- ❖ The class can be divided into small groups of 3-4 and assigned (or they can pick) a topic, plant, or growing technique to do research on, create a poster, and then present to the class.

Speakers

Here is a list of people that have expertise in a specific area that would be good to bring in as guest speakers:

1. Victor Rodite
 - a. 7 Habits of Highly Effective Teens
 - b. This ideology has been taught and is used in the Bangor elementary and middle schools. It is about the steps and mindsets that lead to productive and proactive teens in America.
 - c. Contact him at:
2. Gary Oiler
 - a. Teaching on Composting and Fertilization
 - b. Contact him at: (717)860-6097 or at soiler@ptd.net
3. Jim Sandt
 - a. Talking about agriculture in general
 - b. Contact him at: (610)-759-6275
4. Sarah Edmonds
 - a. Talking about community gardens
 - b. Contact her at: edmondss@lafayette.edu
5. Chris Peters
 - a. Speaking on nutrition and the importance of fresh produce
 - b. Contact her at: chrispeters517@gmail.com
6. Patrick McCollian
 - a. Speak on hydroponics (owns a hydroponics farm)
 - b. Contact at: Patrick.McCollian@ge.com
7. Bridgette Pruettt
 - a. Project Manager at Slater Family Network
 - b. Contact at:610-599-7019 or pruettb@bnet1.bangorsd.org

Experts and Consultants

If you are looking for advice, expertise or people willing to help, we recommend contacting:

1. Victor Rodite
 - a. General greenhouse programming and student involvement
 - b. Contact at: rodite@slatebeltcog.org
2. Jim Sandt
 - a. Information and expertise on agriculture and growing vegetables
 - b. Contact at: (610)-759-6275
3. Gary Oiler
 - a. Information and extensive experience with flowers and plant sales at Bangor
 - b. Contact at: (717)-860-6097 or soiler@ptd.net
4. Nancy Serulneck
 - a. Contact at: serulnen@bangorsd.org
5. Chris Peters
 - a. Contact at: chrispeters517@gmail.com
6. Patrick McCollian
 - a. Knowledge and experience with hydroponics
 - b. Contact at: Patrick.McCollian@ge.com
7. Andrew Bisher
 - a. Knowledge of general greenhouse maintenance
 - b. (610)-442-5309