CAMPUS AS A LIVING LAB LEARNING MODULE

MODULE TITLE: Home composting (prepared by David Sauter, Professor)

CAMPUS: Foothill, Horticulture Facility, Compost Demonstration Area

MODULE BACKGROUND

The Campus as a Living Lab Project

San Jose State University, Foothill College and De Anza College have collaborated on a project to infuse sustainability throughout the curriculum at our institutions. This project, called the Campus as a Living Lab, is funded by the California State University Chancellor's Office. The Campus as a Living Lab program is focused on using physical sustainability features on our campuses to promote sustainability through hands-on learning activities. For our collaboration, each campus developed a series of one-session teaching modules (approximately 1-3 hours each) that faculty members can use to incorporate sustainability into their courses. Each module focuses on a physical feature at SJSU, De Anza or Foothill. All modules are designed to address specific GE area student learning objectives and provide students with an active learning experience.

General sustainability definition and principles.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs." (Bruntland 1987)

By definition, this requires citizens who wish to act sustainably to engage in actions that are ecologically sound, economically feasible, and socially responsible.

Specific sustainability principles that apply to this feature.

This feature is a working example of an action that is ecologically sound, economically feasible, and socially responsible. The disposal of residential waste without overwhelming landfills and waste disposal facilities and using the products of that waste to improve the quality of soil for growing food and productive plants provides the complete cycling of inputs at a residential scale.
Discussion of the feature and its sustainability elements.

The Compost Demonstration Area at Foothill College provides students with an opportunity to observe and participate in one of the most viable methods for creating soil amendments for the typical homeowner. Soil science has proven the benefits of regular addition of soil amendments, particularly compost, to soil that is challenged in supporting plant growth. By understanding how compost is created and how it can be added to the home garden, lawn, planting beds, and orchard as a soil amendment, the student will discover the benefits of creating a healthier soil. This healthier soil will allow homeowners to grow more productive gardens, use less synthetic fertilizers, use less water, and engage in local home-scale low-impact agriculture that reduces the dependence on large-scale agriculture.

Discussion of how this feature helps promote a sustainable society.

Students will learn the connection between soil health and plant health, and the resulting benefits of maintaining soil health for growing plants that produce food, cleanse the atmosphere, and provide a more beneficial and rewarding environment. A healthy soil can also store, rather than repel water and will reduce erosion. Soils of any conditions, poor or healthy, can benefit from the application of compost as a regular amendment, and understanding those relationships and the methods for compost production on a home level will improve overall community sustainability.

Key concepts presented in this module.

Students will receive instruction in the benefits and methods of composting in a home setting. Scientific presentations will include the process of component degradation, conditions necessary for adequate decomposition, and activities that increase and/or support the process of decomposition. Lab related activities will include measuring and performing maintenance on an active compost pile, creating a new compost pile, or measurements of compost and native soil samples to allow the students to compare and contrast the differences between native soil and the soil amendment created through the composting process.

Description of activities used in this module.

-lecture on the above topics (this can be completed in a classroom or outdoors at the Composting Demonstration Area)

-touring of the Composting Demonstration Area at Foothill’s Horticulture Department to see various methods of home composting

-observing the conditions of compost in various states
-lab activities, including any/all of the following:

-making basic measurements and comparisons of compost with native soil (basic)

-participation in the maintenance of compost bin (turning, measuring temperature and watering) (intermediate)

-starting a new compost pile (intermediate)

-testing a native soil sample and completed compost to compare organic matter content, moisture content and pH (advanced)

Connecting the feature’s elements to GE course principles.

This component would relate, but not specifically connect to, GE course principles of the following Natural Science area criteria:

N2. The ability to make judgments regarding the validity of scientific evidence;

N5. The practice of thinking critically, including evaluating ideas and contrasting opinions;

N6. The ability to evaluate, use and communicate scientific data;

Student Learning Outcomes for this module.

At the completion of this unit the student will be able to:

-List 8 methods of home composting

-Identify the concept of material composting

-Compare the moisture content and organic matter content of completed compost and native soil

-State the benefits of amending native soil with compost

Educational resources and textbooks.

Resources that can be used for this module include the following:

-Santa Clara County Master Composters website at http://mastergardeners.org/scc.html

-The Rodale Book of Composting: Easy Methods for Every Gardener Paperback by Grace Gershuny and Deborah L. Martin

-Science of Composting by Marco de Bertoldi
MODULE GENERAL INFORMATION

Materials required to complete the activity.

Students will need access to the following (these can be purchased at Gemplers.com and some kits area available at Foothill):

- access to the composting area (access will need to be arranged by contacting Hort staff, see sections above)

- equipment to measure and maintain the compost piles (hay forks, loping shears and temperature probes available at no cost in the tool box next to the arbor in the compost demonstration area)

- LaMotte soils test kit with supplies to test soil Organic Matter Content and pH. (these can be supplied by the instructor, or with advance notice, supplied by the Foothill Hort department by contacting the names above)(if the instructor wishes to purchase their own test kit they are available for around $50 through www.gemplers.com or from the Common Ground store in Palo Alto)

- A moisture test meter (available from Foothill with advance notice)(these can also be purchased for about $25 from www.gemplers.com)

- A 1 pint sample from a finished compost (from the Foothill bins or off-site bin) and 1 pint from a native soil sample (can be taken from the hill behind the compost area or from off-site).

Applicable disciplines.

Horticulture, Environmental Science

Applicable full credit course is available at Foothill College (HORT 91A)

This module is excerpted from Hort 91A - Composting Theory and Techniques (offered through Foothill College Horticulture)

Comprehensive introduction to the theory and practices utilized in composting of organic materials. Course provides a combination of classroom lectures, demonstrations, and lab activities geared to providing a clear understanding of various composting techniques including sustainable waste management practices, recycling of organics, backyard composting, and vermicomposting.

Time required for delivery.

2 hour class periods on 1 day. Follow-up may be done at later dates.

This module can be delivered at any time during the year.
Recommended student load.

25 to 30 students

Delivery location options:

This module can be delivered either in a classroom at Foothill College or at your campus, combined with field work at the Composting Demonstration Area, or can be delivered entirely outdoors at the Composting Demonstration Area if no electronic or video connections are desired. To reserve a classroom at Foothill please contact David Sauter (noted below) at least two weeks prior to your scheduled date(s).

Campus contacts for activity.

The Compost Demonstration Area is located within the Environmental Horticulture and Design complex on the Foothill Campus. The facility is locked generally from 6 PM to 8 AM Monday through Friday and on weekends. Parking is in lot 8, just to the left of the circle drive at the end of the main entrance road. Parking permits cost $3. Access, and tools necessary to do your module, can be obtained by contacting the following:

-Mike Diefenbach, lab assistant,  diefenbachmike@foothill.edu  650-222-6133

-David Sauter, instructor,  suaterdavid@foothill.edu  650-949-7427

Instructor preparation for the module.

To prepare for delivering this module, it is recommended that the instructor consider the following activities:

- tour the composting facility prior to the class to identify the composting techniques and locate necessary supplies
- review classes and literature available from master composters or various city composting programs (google master composters santa clara county)
- take a short course in composting
- view the film “Do the Rot Thing” (https://archive.org/details/DoTheRotThing)

If desired, any questions can be answered by David Sauter (650-949-7427). David is also available for mentoring if assistance is needed in preparing for delivery of this module.
MODULE LECTURE NOTES AND CLASS LESSON PLAN

Definitions.

- composting: decomposition of plant remains into organic matter/humus
- organic matter: the remains of plant and animal matter
- humus: completely decomposed organic matter, no parent material is obvious
- C:N ration: the ratio of the weight of carbon to nitrogen in a material
- colloids: soil particles that hold nutrients for future plant consumption

Home Composting Lesson.

-discussion of how this feature helps promote a sustainable society.

-Students will learn the connection between soil health and plant health, and the resulting benefits of maintaining soil health for growing plants that produce food, cleanse the atmosphere, and provide a more beneficial and rewarding environment. A healthy soil can also store, rather than repel water and will reduce erosion. Soils of any conditions, poor or healthy, can benefit from the application of compost as a regular amendment, and understanding those relationships and the methods for compost production on a home level will improve overall community sustainability.

-benefits of composting:

- natural way to create organic matter
- addition to soil creates more om, better colloids, improved structure, improved water retention and soil porosity, inoculates soil with beneficial microbes
- used as soil amendment, top dressing for lawns, mulch, tea (1 part water and 1 part compost for intense treatment)

-how composting works

-components mixed together in presence of microbes
- if pile is set up so that conditions are correct, components will decompose into a useable material

-correct conditions:
-heat; not essential but can speed the process, decomposition can occur at 50 degrees F and above, hotter temps will increase speed and kill some harmful pathogens and weed seed
-presence of worms and some insects will enhance operation
-location
-components are air, water, food

-air: microbes need air to perform decomposition (anaerobic will continue to decompose, but causes malodorous situation); air provided through passages or by turning

-water: wetness of wrung sponge required
  -provided by green additives or by wetting
  -avoid slicking and compacting
  -too dry will slow activity, too wet will go anaerobic
  -tarp or cover in rain

-avoid complete exposure to sun if possible to avoid drying pile out too fast

-food: materials for microbes to decompose
  -browns: dry materials, primarily the C component
  -greens: fresh materials, primarily the N component
  -need approximately equal amounts for speedy turnaround

-C:N ratios (weight/weight)

-materials with large quantities of Nitrogen (green leaves, green grass, fresh vegetable waste) compared to quantities of Carbon (dried and non-living materials, dried grass, newspaper, sawdust) will compost faster because the abundance of Nitrogen provides fuel for the microorganisms that perform the decomposition.

-materials with low quantities of Nitrogen compared to quantities of Carbon will take longer to decompose because of the lack of fuel for microorganisms.

-some typical C:N ratios include:
  -sawdust: 400:1
  -newspaper: 250:1
  -fresh lawn clippings: 25:1
  -fresh fruit and vegetable waste: 30:1

-either can come from the following:

-greens:
  -fresh lawn clippings
  -fresh leaves and branches from pruning
  -kitchen veges, fruits
  -manure from vegetarian animals
  -coffee grounds and filters
weeds not in seed or pernicious
- browns:
  - cut up branches
  - dried leaves or grass
  - wood chips and sawdust (placed in thin layers)
  - hay straw
  - cardboard (the protein in cardboard is good for worms)
  - paper (cut into strips 6” x 1” or shredded)

-don’t use the following:
  - meat, fat, milk products, bones (pest issue)
  - chemically treated wood
  - human waste
  - pet waste
  - bones
  - diseased plants (except hot piles, not over one third allelopathic)
  - pernicious weeds (ivy, morning glory, etc.) can compost is certain they are dead/dry

-starter: not necessary but may speed process, add commercial starter if it makes you feel more proactive

-when is it done: depends on intended use, most of product has turned to humus, some skeletons may be visible, fresh compost may be too hot for new seedlings

-process for creating a compost pile
  - chop/cut an equal amount of greens and brown. Pieces should be less than 6” long
  - in the compost bin, or on a square of ground no more than 6’ on a side, begin piling a thin layer of brown material (approx. 2” deep). Follow with a similar layer of green material. Alternate green and brown layers until 3 layers of each material has been placed
  - spray the pile with water until lightly wet (like a wrung out sponge)
  - continue alternate layering of materials and wetting until all materials are gone, the pile should be no more than three feet high
  - using a garden fork, mix the materials until the greens and browns are uniformly distributed throughout the pile

-systems for composting

-home compost piles
  - trench: 8” deep trench in garden, place materials and leave for 3-4 months, plant
  - heap: scarify soil, pile 8’ square with 6’ height (also 4’ x 4’), smaller piles at lower temps
  - simple containers: trash can with bottom cut off and buried in soil, drill 50 quarter inch holes in sides, leave in place, scarify soil
-single bin: layer in materials and turn periodically, use from bottom, slatted wood or aviary wire bins

-multi-bin: similar process as single bin, but one for new, one for intermediate stage, one for finished, turn into next bin as work progresses

-biostack: stacking trays

-sheet/lasagna: alternating layers of bonemeal, wetted paper or cardboard, manure, leaf material, clippings, covered

-tumblers: rotating bin is filled half full of mix, tumbled daily, faster and hotter than bins/piles

-commercial bins of wide range of sizes and types

-vermiculture (worm enhanced composting): improves process because worms digest and leave castings with better texture, red worms used, moist bedding with garden additives worked between

-good insects
  -red tigers, red wigglers
  -pill bugs, earwigs
  -springtails
  -nightcrawlers in top 4’

-bad insects
  -no centipedes
  -no ants (avoid placement on concrete)

MODULE LAB ACTIVITIES (CHOOSE ANY OR ALL OF THE ACTIVITIES BASED ON TIME AVAILABLE AND COURSE GOALS)

-Making basic measurements for a compost pile (a basic activity):

-using a temperature probe, compare the temperatures of an active compost pile, a new or inactive compost pile and the native soil sample. Expected results: Temperatures of 120 to 140 degrees indicate active aerobic decomposition is taking place, this would be expected only of the active compost pile.)

-using a moisture probe, compare the moisture levels of an active compost pile, a new or inactive compost pile and the native soil sample. Expected results: The moisture level of the active and new should be high, while the inactive pile would be low and the native soil variable. Moisture level indicates an adequate presence of moisture for aerobic decomposition

-Maintenance of compost piles (an intermediate activity):

-using a probe thermometer, check the temperature within the pile

-place your hand into the pile to determine the moisture level
-if the temperature is below 120 degrees or the pile is dry, use the garden fork to remix the
materials. Additional water should be added during turning if the pile is dry

Expected results: After turning and adding water, the temperature level should rise as new
microbial activity is initiated. This temperature rise may not be apparent for one to two days.

-Starting a compost pile (an intermediate activity):

-begin a compost pile using the materials available in the green and brown bins at the facility.
Use the instructions from the lecture section above.

Expected results: After approximately one week, with proper maintenance, the temperature of
the compost pile should be between 120 and 140 degrees with a moderate to high moisture level.
This indicates aerobic microbial decomposition activity, or composting, is taking place

-Testing samples for humus (organic matter) (test both native soil and completed compost) (an
advanced activity):

Expected results: The samples of completed compost should have higher levels of humus
(organic matter) content (up to 5%) when compared to native soil (typically around 1 to 2%).

SOILS TEST PROCEDURES FOR ORGANIC MATTER

NOTE: FOLLOW SAFETY PRECAUTIONS WHEN PERFORMING TESTS

Background
Organic matter is that portion of soil that includes animal and plant remains at various stages of
decay. Organic matter improves conditions of all mineral soils. It improves water- and nutrient-
holding capacity, it loosens clay soils and improves tilth.

Materials Required (all available in LaMotte soil test kits for humus):

1. .5 gram spoon.
2. 2 extraction tubes with caps.
3. .5 cups deionized water.
5. Soil flocculating reagent.
6. Filter paper.
8. Native soil sample and completed compost sample (strained to remove organic debris)

Procedure for determining organic matter:

1. Use the .5 gram spoon and add four level measures of soil (or strained compost) to a
soil extraction tube.
2. Add 14 milliliters of deionized water, cap and shake.
3. Use a .5 gram spoon to add two level measures of humus screening reagent powder to the extraction tube, cap and shake vigorously for 1 minute.
4. Add 15 drops of soil flocculating reagent, cap and mix gently. Allow mixture to settle for 10 minutes.
5. Filter through filter paper into a second extraction tube.
6. Compare the clear filtrate in the second extraction tube to the humus color chart.

-Follow-up activities (an advanced activity):

-using a soil test kit, test a garden soil for Nitrogen, Phosphorus and Potassium content before compost has been added and then retest approximately one month after compost has been added. Compare the values.

Expected results: One month after addition of compost a soil should show a slight increase in Nitrogen, Phosphorus and Potassium levels. If the soil has been fertilized between the compost addition and testing the values should be significantly higher.

MODULE EVALUATION AND SUPPORT

Methods of evaluation and grading schema for activity. Students may be evaluated based on written quizzes, reports, or lab activities. Grading can be administered guided by the following rubric.

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<thead>
<tr>
<th>CRITERIA</th>
<th>ACHIEVEMENT LEVEL</th>
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<tbody>
<tr>
<td>Methods of home composting</td>
<td>Lower level Can identify and describe 4 methods of home composting</td>
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<td></td>
<td>Average level Can identify and describe 6 methods of home composting</td>
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<td></td>
<td>Above average level Can identify and describe 8 methods of home composting</td>
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<tr>
<td>Concept of material composting</td>
<td>Lower level Can describe how materials decompose</td>
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<td></td>
<td>Average level Can describe how materials decompose and what organisms facilitate decomposition</td>
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<tr>
<td></td>
<td>Above average level Can describe how materials decompose, what organisms facilitate decomposition, and identify when the process is not performing as necessary to decompose</td>
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<tr>
<td>Comparison of native soil and compost using testing methods</td>
<td>Lower level Can identify the differences between native soil and compost physical and chemical characteristics</td>
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<td></td>
<td>Average level Can identify the differences between native soil and compost physical and chemical characteristics, and can state what conditions are conducive to improved plant growth</td>
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<tr>
<td></td>
<td>Above average level Can identify the differences between native soil and compost physical and chemical characteristics, can state what conditions are conducive to improved plant growth, and can state how to improve the conditions</td>
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<tr>
<td>Stating benefits of amending native soil using compost</td>
<td>Lower level Can identify 2 benefits of amending native soil using compost</td>
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<tr>
<td></td>
<td>Average level Can identify 3 benefits of amending native soil using compost</td>
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<tr>
<td></td>
<td>Above average level Can identify 3 benefits of amending native soil using compost and the mechanism by how the soil is improved</td>
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