Compost

The American Society of Agricultural and Biological Engineers (ASABE) needs your help in designing a container for composting garden and household waste. The goal of this project is two-fold – to create a nutrient-rich mixture that can be used to enrich garden soil and to reduce the amount of waste that is currently being deposited in landfills.

DESIGN REQUIREMENTS

- Maximum size: 1 cubic meter
- Ability to access raw materials inside the container for maintenance and harvest

TESTING EQUIPMENT

- Vernier Interface
- Stainless Steel Temperature Probe
- Optional: O_2 Gas Sensor

DELIVERABLES

- Prototype–either the actual device or a picture
- Detailed design specifications (so the unit can be replicated exactly)
- Carbon-to-nitrogen ratio (browns-to-greens)
- Moisture content of a 1-liter sample after one week
- Shrinkage percentage after one week
- Daily temperature data log
- Maintenance requirements
- Projected “harvest” time
- Impact statement on the benefit of your design to the environment

CONSTRAINTS

- Construction materials must be readily available from a local hardware store
- Budget limited to $25

JUDGING CRITERIA

- Ease of construction
- Ease of maintenance–convenience
- Placement profile (size; location)
- Aesthetics–how well does it blend into the existing landscape
- Ability to stay within a 40–60°C temperature range
- Smell
- Animal resistance

Teacher Tips

OBJECTIVE

Students will design and build a container for composting garden and household waste.

BACKGROUND

Compost is dark crumbly humus derived from the breakdown of organic waste. It is used to add nutrients to soil, improve soil texture, and increase the ability of soil to hold air and water. It will not harm plant roots like commercial fertilizers can.

Two types of organic waste are commonly used to make compost – *greens* and *browns*. Green materials, such as fresh grass clippings, garden refuse, coffee grounds, feathers, and food scraps, are high in nitrogen, while brown materials, such as autumn leaves, paper, peat moss, sawdust, cornstalks, straw, and dried grass, are high in carbon.

To build a compost pile, you should start with a 50/50 mix by weight of browns and greens. You want a pile that is large enough to prevent rapid loss of heat and moisture, yet small enough to allow good air circulation. Building the pile in layers will help you judge the proportions, and cutting the materials into small pieces will help the compost decay faster. The materials should be moist to the touch, but not water-logged (approximately 40-60% by weight). Storing the materials in a container during the decomposition process helps to retain heat, control moisture, and keep out rodents.

A properly constructed compost pile will generate heat when microorganisms feed on the organic waste. Heat accelerates decomposition and kills harmful bacteria; however, excessive heat (such as that generated by the summer sun) may kill off beneficial microbes. A temperature range of 40-60°C should be maintained. When a compost pile won't heat up, it is either an indicator that the compost is ready to be harvested or the pile is deficient in water, air, or greens. The compost pile should be stirred periodically to provide oxygen and stimulate aerobic decomposition. A rotten-egg smell is a signal that the pile needs to "breathe."

Finished compost looks and smells like newly-turned soil. A compost pile is ready to be harvested when you can no longer identify any of the original materials and it will not heat up no matter how many times you turn it.

TEACHER PROCEDURE

1. Instruct the class on the definition of compost. Students should be able to discuss the principles of aerobic decomposition, the difference between brown and green materials, and the environmental benefits of composting.

2. Calculate the moisture content of some typical compost ingredients, such as freshly-mown grass, fallen leaves, garden weeds, or kitchen waste.

3. Have students brainstorm ideas for compost containers.

4. Assemble the container in its final location, and fill with a 50/50 mixture of brown and green materials. Larger materials should be shredded or cut into smaller pieces. Make sure your container allows for sensor access.

5. Develop a maintenance schedule for adding water and air to the compost, as well as taking daily sensor readings.

TIME ALLOTMENT

This is a long term project.

This activity requires 1–2 class periods to build the container and layer the waste materials inside it, but you should allow an additional 6–8 weeks of regular maintenance before the finished compost can be harvested. Maintenance, which includes aeration, hydration, and sensor reading, can usually be accomplished in just a few minutes.

CONSTRUCTION TIPS

This project is better suited to an outdoor location. It is difficult to generate the heat required to decompose waste materials in a small room-size container, plus administrators might be averse to the proximity of microbes working on a "successful" project or the "smell" coming from on unsuccessful project. You can choose to have students build individual compost containers at home or build one large class container in an appropriate spot outside the building.

The creation of compost is more dependent on the aeration and watering plan than it is on the container that holds it. A pile of waste materials left out on the ground will eventually decompose. Encourage your students to brainstorm creative, yet simple, low-cost ways to contain their waste materials, while analyzing the advantages and disadvantages. Wire mesh is an inexpensive way to contain the materials, but direct exposure to air can cause the outer materials to dry out much faster than the inner materials. Covering with an old tarp can help retain moisture, but may impede air flow. An old barrel works well for aerating materials in that it can be rolled around on the ground. Even a brown paper yard waste bag can be used to produce compost and it has the added advantage that the container itself will eventually become recycled into the garden.

Since students are required to gather temperature and oxygen data, they must devise a way for their sensors to access the interior of the compost. A length of PVC tubing with holes drilled into the sides can be installed in the center of the container before adding the compost materials. The sensors can be inserted down through the center of the tubing to gather data readings.

CALCULATING MOISTURE CONTENT

To calculate the moisture content of a material, use the formula: $M = \frac{W - D}{W} \cdot 100$

M = moisture content of material (%)

W = mass of wet sample (g)*

D = mass of sample after drying (g)**

** be sure to subtract off the mass of any containers*

****Drying Compost in a Microwave Oven**

Put a piece of paper towel in the bottom of a microwave safe container. Place organic material on top of the paper towel. Stack 2 more paper towels and wet them, making sure to squeeze out most of the water; place them over the top of the container. Put the lid on the top and press down 3 of the corners. (Leave the 4^{th} corner loose, so the steam can escape.) Microwave the container on the defrost cycle (about 40% power) for 1 minute. Let the container stand for 40 seconds. Check the status of the paper towels (bottom should be dry and top should be wet). Repeat the microwave drying for 3 more times or until the material is dry. Put a cup of water in the microwave to prevent over drying.

RESOURCES

- http://www.gnb.ca/0009/0372/0003/0001-e.asp
- http://www.composting101.com/