Title: Composting: Why Bother?

Description: Will we drown in our own garbage? Most organic waste is being trucked and deposited unnecessarily into our landfills. In this study, students learn how to make compost and begin to understand the social impact of composting. Students also engage in the “Rot Off!” composting challenge. In this challenge, student teams divert the school’s kitchen and yard debris from the waste stream into uniquely designed compost bins, turning garbage into “black gold,” beautiful and rich compost.

At a Glance

Grade Level: 8-10

Subject sort (for Web site index): Science

Subject(s): Science

Topics: Biology, Environmental Studies

Key Learnings: Economics of Waste Management, Sustainability, Biodegradation and Decomposition

Higher-Order Thinking Skills: Synthesis, Investigation

Time Needed: 10-12 weeks, 1 period daily during the first week, 2 or 3 periods each week thereafter

Background: Pennsylvania, United States

Unit Summary

Some students may have been involved in recycling programs, which are basically waste separation activities. In this unit, students engage in the entire process of making new material from waste, as they turn biodegradable garbage into the gardener's "black gold"—rich compost.

In this ecology study, students learn about the composting process, and participate in the "Rot Off!” challenge, a contest that involves making the most compost from the school's kitchen and yard waste. To win the contest (and end up with something other than smelly sludge), students have to learn how to get organic material to decompose (an aerobic process) rather than rot (an anaerobic process). Win or lose, students learn from their composting experiences and use their expertise to help inform others about composting. As a final activity, the compost is used in the school or community garden and sold by the bagful as a classroom fundraiser.

Curriculum Framing Questions

- **Essential Question**
  How can I contribute to making a better tomorrow?
- **Unit Questions**
  How can our community manage waste better?
  How can composting today benefit the future?
- **Content Questions**
  What are the scientific factors involved in a successful compost?
  How can I set up a long-term experiment with many variables?
  How is composting an example of conservation of mass?
  What types of chemical reactions occur during the compost process?

Assessment Processes

View how a variety of student-centered assessments are used in the Composting: Why Bother? Unit Plan. These assessments help students and teachers set goals; monitor student progress; provide feedback; assess thinking, processes, performances, and products; and reflect on learning throughout the learning cycle.

Instructional Procedures

Introductory Activities—Motivation (Week 1, 5 periods)

Have students brainstorm a list of ways they can contribute to making a better tomorrow. Encourage students to write down anything that comes to mind (ideas do not have to be school or class related). Have students share their top five ideas with a partner. Have a set of partners share with another set and then have that group share with the whole class the top five ideas. Conduct a short discussion about the items on their lists. Capitalize on any waste management ideas to launch into the next step. If no related ideas are mentioned, guide the discussion to incorporate pollution and waste.

Introduce the topics of waste management and composting by holding up a jar of well-developed compost for students to examine (preferably made from household and yard biomass, refer to Internet resources for a recipe). Ask students to identify the material in the jar. Many will refer to it as *dirt*. Follow up with the question, *What is dirt?* Guide a discussion about the components or qualities of dirt to lead students to the discovery that the jar is filled with a substance we call *compost*, one important component of dirt, or soil. (Introducing soil terms* may be helpful.) Ask the question, *How can this jar of dirt contribute to making a better tomorrow?* Stimulate discussion with guiding questions to provoke inquiry and spark ideas. Save these questions until the end of the unit and have students see how many they can answer. Set the scene for classroom composting with the Bullfrog Films video *It's Gotten Rotten** to teach the basic mechanisms of organic decomposition.

Discuss how waste is managed in your city and reasons why attempts are made to reduce the amount of waste going to landfills. Challenge students to track their garbage from the point they throw it away to its final resting place. Ask a municipal waste management specialist to visit the class and explain the economics of waste management, and the reasons for diverting waste through reuse (as with building materials), recycling (glass and plastics, made into new products), and composting. If possible, send some students to visit a local waste management facility and create a report with photos, drawings, essays, video, and audio interviews for presentation to the rest of the class. A Web fieldtrip to New York City's Fresh Kills Landfill* is edifying, too. The site was set to be closed on July 4, 2001, but it is now the repository for the debris that was the World Trade Center Towers.

Have students use the information learned from these activities to start thinking about the Unit Question, *How can our community manage waste better?* Introduce the student project rubric and discuss requirements and expectations for the upcoming projects. Then, organize students into groups of three and instruct them to conduct a composting survey. The syllabus provides the guidelines for the survey. Brainstorm a list of questions students might ask others about composting. Give students the opportunity to share their results and compile the information from the different surveys. Use this information to discuss a rationale for a composting program in your community.

Challenge (Weeks 2-12, 1 or 2 periods weekly)

Distribute a syllabus that outlines activities and expectations for the "Rot Off!" challenge. Explain to students that at the end of the challenge they should be able to answer the question, *How can composting today benefit the future?* Explain that specific examples and rationale should be included.

Challenge students to design and build a compost bin or pile that makes the most compost as efficiently as possible using the school's kitchen and yard waste. Before the challenge is launched, show the Bullfrog Films video *Compost: Truth or Consequences** and have students research some of the Internet resources for more background information. Haves students take notes on what scientific factors contribute to successful composts. Factors can be added later based on experience as well.

Instruct the students on how to set up long-term experiments with multiple variables. Lead students through a mock experiment (use a different topic, such as accelerated plant growth) to demonstrate the format using the scientific process.

Divide the class into teams of four or five, and have each team divide the following tasks among themselves:

- Evaluate an effective compost design and construction (use the How Do You Control the Odor? handout)
- Determine what materials can become compost (Important Note: Do not use yard waste that has been chemically treated)
- Identify a proper location for the composting project
- Specify and gather the materials needed, such as organic matter; soil; water; tools; probes for moisture, temperature, and pH measurements; a bathroom scale; and other implements
- Manage all data in a spreadsheet

After research is complete and designs are selected, direct students to submit a written plan following the directions in the syllabus. Once the plan is approved, direct students to start acquiring materials and building their compost.

When the composts are built and students are ready to begin, help them set up a composting log to keep track of their processes. Direct students to use their syllabus to check the information they should record during this process. Instruct students in the use of probeware*, which can be used to measure nitrogen, moisture, pH, and temperature. Temperature cycles, at a minimum, should be measured, because heat is an indicator of decomposition. Hot compost is healthy compost! Emphasize that measurement and data collection are essential parts of the experimental process. Review with students the evidence that indicates chemical changes are taking place (such as a new color, odor, new solid, new gas, emission of light, heat energy released or absorbed, and so forth). The use of probeware can also be taught before the unit begins.

In the middle of this process, ask students, *How is composting an example of conservation of mass?* Review the concept of the conservation of mass if necessary. Students should be able to understand that matter has not been created or destroyed, only rearranged into new substances. Further this lesson by teaching (or reviewing) the five chemical reactions:

- Combustion
- Decomposition
- Double Displacement
- Single Displacement

- Synthesis

Instruct students to observe, record, and give examples of the type of chemical reactions they think are taking place during the compost process.

Digital pictures can be taken to illustrate the process and be added to the composting log.

Research Project (Weeks 5-10, 2 or 3 periods weekly)

As the composting project gets underway, assign each team of students (or have each team choose) a research question that further supports the project and informs others of one of the topics listed in the syllabus. Have each team write a thesis or proposal describing the topic in some detail, and the media and processes they will use to present their information (oral presentation, newsletter, brochure, spreadsheets, charts and graphs, posters, photo essay or design project, Web site, electronic slideshow, or other idea). Teach students how to cite sources and organize and refine information. Tell students that this research component is to be integrated into the final presentation. Set aside time to meet with each group and conference about their progress and review their proposals.

Optional: To assist the research process and teach students how to work collaboratively, show students how to use a FURL*. Setting up* a FURL is free and an easy way for students to collect great Web sites for their topic as well as another group's topic. Display each team's topic so it is visible for students and set up the class FURL site accordingly.

Synthesis (Weeks 11-12, 5 periods weekly)

Invite a master gardener to judge your "Rot Off!" challenge (some are registered with the county extension service or with other local agencies). The team that diverted the most waste AND made the most thoroughly decomposed compost in 3 months is declared the winner. Consider getting press coverage of the event.

Direct student teams to synthesize their research project studies and composting experiences into a final presentation for the class or a specific interest group in the community (horticulture society, neighborhood association, and so forth). Explain that presentations must answer the questions, *How can our community manage waste better?* and *How can composting today benefit tomorrow?* Hand out the peer assessment scoring guide and explain to students that they will be assessing one another's work. Review the scoring guide and answer any questions. Have each team choose one or more of the following methods for presenting their information:

- Make a slideshow presentation to a community group (city council, neighborhood association, or gardening group) and explain your research project.
- Design a pamphlet describing how to compost, and include resources from the community.
- Create a Web site for the community providing the latest consumer education on recycling and composting resources in your area.
- Design a video that shows the value of composting. Public access television channels may air this for you.
- Create a flowchart poster using graphic organizer software to illustrate the composting process and/or waste reduction process in your community to post in your community. (You can show students the *Seeing Reason Tool* as a possible tool to show the cause-and-effect relationships occurring during the compost process.)

Prerequisite Skills

- The following concepts could be taught before this unit or within it (if teaching within the unit, plan for more time):
  - Conservation of mass
  - Five types of chemical reactions— combustion, decomposition, double displacement, single displacement, and synthesis
  - Evidence of chemical changes—new color, odor, new solid, new gas, heat energy released or absorbed, emission of light, and so forth
- Basic computer and Internet research skills
- Familiarity with the use of probeware to measure temperature, pH, nitrogen, and moisture (use of probeware could also be taught within the unit if desired)

Differentiated Instruction

Resource Student

- Assign the student specific, more precise tasks in the team challenge, such as daily temperature measurements
- Use a daily outline of tasks to aid organization and work completion
- Reduce assignments targeting only the most important concepts
- Have a teaching aide assist groups with the resource student to help the student contribute meaningful work
- Break assignments into small, manageable activities and write the activities on a checklist
- Select specific Web sites based on readability level and mark them so the student has more meaningful sites to use while researching
- Partner the student with another student who is more proficient

Gifted Student

- Provide opportunities for independent study of the following topics:
  - Population Growth
    - *Should populations stop growing?*
    - *What is the idea of carrying capacity?*
    - *Does the Earth have a finite carrying capacity for people?*
    - *What are the limits to human growth?*
    - *What are the advantages of controlled population growth?*
  - Environmental Law
    - *What individual responsibility does a person have in protecting the Earth?*
    - *Should law require recycling and composting? Why or why not?*
  - Use of Compost beyond Landscaping
    - *Describe bioremediation and pollution prevention*
    - *Research disease control for plants and animals*
    - *Research erosion control*
    - *Can contaminated soils be used for composting?*
    - *Describe reforestation and wetlands restoration*
    - *How can a habitat be revitalized?*
  - Waste Management and Sanitary Landfills
    - *Describe a sanitary landfill and explain its use*
    - *Devise a plan for your community to shrink a landfill*
    - *Where is the landfill in your community?*

- *What are the disposal and trucking costs?*
- *Imagine a world where decomposition doesn't occur. What would happen to organic materials? Could plants/animals survive?*

English Language Learner

- Develop a two-language vocabulary of unit terms for the unit
- Assign specific tasks within the group project and have the task translated into the student's first language
- Allow the student to complete work in the student's first language and then have it translated into English later
- Have a more proficient bilingual student help the English language learner
- Create templates and graphic organizers for the student to fill in when there is appropriate material to do so
- Pair the student with others during project work when the language load indicates this and while completing visual parts of the project independently (such as spreadsheets, graphs, and illustrations)
- Shorten oral speaking and reading activities
- Have the student prepare materials in the student's first language and then translate the materials into English with the help of an ELL assistant

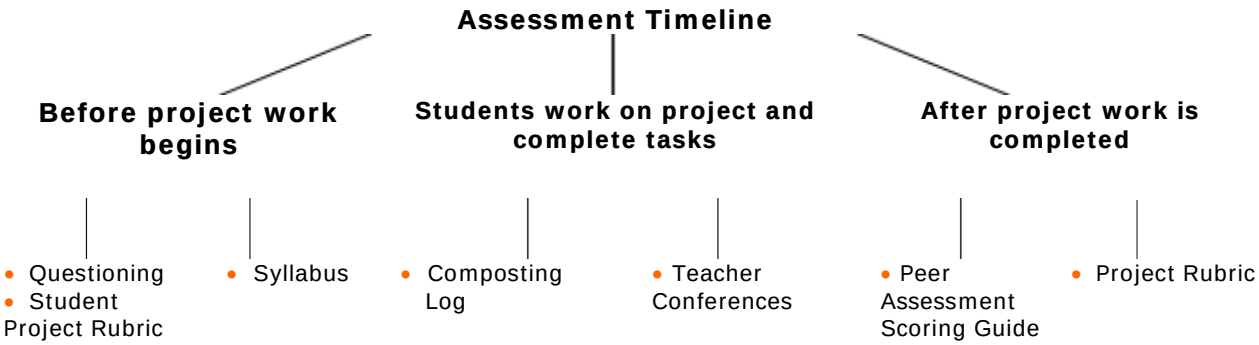
Credits

A teacher participated in the Intel® Teach Program, which resulted in this idea for a classroom project. A team of teachers expanded the plan into the example you see here.

THINGS YOU NEED (highlight box)

The following **sections** are listed in the Things You Need highlight box (Assessment, Standards, Resources) and are linked to pages that contain that section's content.

Assessment Plan



Questioning throughout the unit facilitates discussion and prompts students to think at higher levels. Daily progress on the project is evaluated using the compost log and

syllabus, which helps students to stay on track and self-assess their progress. Ask students to use the student project rubric to help them self-assess work prior to completion. Conferencing with groups helps to ensure students stay on track and helps to assess student learning. Use the project rubric to assess the final media project as well as students' research and surveys. Have students use the peer assessment scoring guide to provide feedback for their classmates' final presentations.

Targeted Content Standards and Objectives

National Science Standards—Content Standard F

Develop an understanding of populations, resources and environments, natural hazards, risks and benefits, science and technology in society (Human activities also can induce hazards through resource acquisition, urban growth, land use decisions, and waste disposal.)

National Science Standards—Content Standard A

Design and conduct a scientific investigation; use appropriate tools and technology to gather, analyze and interpret data; develop descriptions, explanations, predictions, and models using evidence; communicate scientific procedures and explanations

Student Objectives

Students will be able to:

- Understand the conservation of mass principle as it pertains to composting
- Identify types of chemical reactions taking place during the compost process
- Increase environmental awareness regarding waste through research methods
- Evaluate the economic and ecological value of diverting organic materials from the waste stream
- Use the scientific process to meet a design challenge

Technology and Resources

Printed Materials

- Appelhof, M. (1997). *Worms eat my garbage: How to set up and maintain a worm composting system.* Kalamazoo, MI: Flowerfield Enterprises.
- Trautmann, N. (1997). *Composting in the classroom: Scientific inquiry for High School students.* Dubuque, IA: Kendall/Hunt Publishing Company.

Internet Resources

- Bullfrog Films
  www.bullfrogfilms.com/index.html*
  A source for educational videos in all subject areas
- Fresh Kills Landfill
  www.nyc.gov/html/dcp/html/fkl/ada/about/1_0.html*
  Photographic tour and information about New Your City's Fresh Kills Landfill

- Vernier Software and Technology
  www.vernier.com*
  Technology resources, products, and information about data collecting tools and software for science and math
- *Seeing Reason Tool*
  www.intel.com/education/seeingreason/index.htm*
  An online tool for mapping cause-and-effect relationships
- Furl, Furled, Furling
  http://www.classroomhelp.com/workshop/Furl_Guide.pdf*(PDF; 14 pages)
  An online book that explains what a FURL is and how to set one up
- Master Composter
  www.mastercomposter.com*
  A comprehensive site on how to build a compost pile and the methods and ingredients involved
- United States Environmental Protection Agency
  www.epa.gov/epaoswer/education*
  A very large site about the composting process; very high-level information
- Pennsylvania Department of Environmental Protection
  www.dep.state.pa.us/dep/deputate/airwaste/wm/recycle/RecyclingLinks.htm#anchor1087848*
  Explanation of how a community can recycle, reuse, and reduce waste through methods such as composting
- United States Composting Council
  www.compostingcouncil.org/index.cfm*
  References to other resources on composting and waste management from a company's perspective; also contains a questions section
- Canada's Office of Urban Agriculture
  www.cityfarmer.org/recipe.html#recipe*
  Simple and easy recipe for composting
- Canada's Office of Urban Agriculture
  www.cityfarmer.org/wormcomp61.html*
  Explanation of why to compost with worms specifically
- United States Department of Energy: Information on Waste Management
  www.em.doe.gov/em30*
  General site about waste management with links to waste storage, disposal, and treatment
- City of San Monica Sustainable City Program
  www.ci.santa-monica.ca.us/environment*
  Specific example of how a community implemented Earth-friendly waste management methods
- Environmental Defense
  www.environmentaldefense.org*
  Information about global warming, the air, and the oceans as they pertain to pollution
- Tropical Savannas CRC
  http://savanna.ntu.edu.au/information/ar/glossary_of_soil_te.html*
  Glossary of soil terms and definitions

Supplies

- Well-developed compost in a jar for class demonstration
- Materials for compost bins (many of these can be donated from home, including wood, plastic bins, worms, and so forth)

- School kitchen and yard waste for compost material
- Pitchfork for turning compost material
- Buckets to carry compost material
- Hoses for keeping compost wet
- Bathroom scale to measure mass

Technology-Hardware

- Computer to conduct research, create documents, and design presentations
- Digital camera for taking pictures of compost process for presentations
- Internet connection for research projects, student collaborative work, and teacher instruction
- Printer to print documents for presentations and distribution
- Projection system for instruction about probes, research, and lessons
- Scanner to scan images used in student presentations
- Television to display video presentations or show instructional videos
- VCR to show video presentations and instructional videos

Technology- Software

- Database or spreadsheet for data collection during compost process and to present results
- Desktop publishing to create documents and presentations about compost processes and research topics
- E-mail software for collaborative work
- Encyclopedia on CD-ROM for instructional lessons and basic knowledge definitions
- Graphic organization software for presentations about compost processes
- Image processing to process digital pictures for presentations and download Web sites
- Internet web browser to access the Internet for research and instructional lessons
- Multimedia for presentations on compost processes and research topics
- Web page development for presentations presented in an online optional format
- Word processing to create informational documents for presentations and daily assignments