



ELEMENTS OF WASTE

Post-Visit Class Activity

Bottle Biology – Decomposition Investigation

Description:

Students were introduced to the concept of composting and decay during the *Elements of Waste* laboratory experience. *Bottle Biology* extends this experience. Using common 2-liter plastic bottles, your students will observe and compare how different types of matter decay over the period of several weeks. The activity is built around the Bottle Biology program created by Dr. Paul Williams, Professor of Plant Pathology at the University of Wisconsin – Madison.

Objectives:

- Conduct an extended investigation into decomposition.
- Experience making observations over time and constructing hypotheses.
- Compare the decomposition of organic and inorganic materials.
- Develop understanding of the process of decay in nature and in landfills .

Duration:

- Preparation: 30 minutes plus additional time for gathering, organizing and constructing decomposition columns.
- Instruction: about 25 - 45 minutes with additional time throughout the investigation for observations and discussion.

Correlation to California Academic Standards

California Content Standards

Fourth Grade

Life Sciences 2c. *Students know decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.*

Students observe relationship between the growth of mold and the decay of matter.

Fifth Grade

Investigation and Experimentation 6e. *Identify a single independent variable in a scientific investigation and explain how this variable can be used to collect information to answer a question about the results of the experiment.*

Students observe how water affects decomposition. Students may try other variables such as the amount of air or light available.

Sixth Grade

Ecology (Life Sciences) 5e. *Students know the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.*

Students control the amount of water to determine how quickly decomposers act on matter.

Education and the Environment Initiative

Principle III – Concept a. *Students need to know that natural systems proceed through cycles and processes that are required for their functioning.*

This activity provides students with concrete experience in natural decay and creates understanding of how organic material decays compared to inorganic material.

Materials List:

- Tools for constructing decomposition columns:
 - Box top or drawer to stabilize bottle while making cutting lines
 - Marker, wax pencil or crayon for drawing cutting lines
 - Cutting blade or utility knife to start cut
 - Scissors to cut bottle
 - Diaper pin, awl, or “poke” to make air holes
 - Clear waterproof postal or bookbinding tape to join columns
- Organic matter to decompose:
 - grass and leaves
 - shredded paper and cardboard
 - Paper products - coffee filters, ripped-up egg cartons, newspaper
- Inorganic matter that won't decompose:
 - Styrofoam cup
 - pieces of plastic bottles
- Plastic bags or re-usable containers to bring food scraps
- Measuring cup to keep track of how much water is added to column.
- Plastic bag or tarp for spreading and sorting matter brought in by students.
- Gloves for each student (optional).
- Notebooks or class chart to record observations.

Getting Ready:

1 – 2 weeks before:

1. Read the tips for using and maintaining decomposition columns. See the Bottle Biology website:
[http://www.bottlebiology.org/investigations/decomp_fill.html].
2. Decide how many decomposition columns you plan to have for your class. Will each small group have one (allows for greater comparisons) or will you have just one or two (easier to manage and regulate)? Two or more decomposition columns will allow your students to observe how different environments and materials affect the rate of decay.
3. Identify space in your classroom. If you have limited table space, consider using a hanging configuration. See the “hanging bottles” section of the Bottle Biology website
[<http://www.bottlebiology.org/investigations/hanging.html>].

If you are planning multiple decomposition columns in your classroom, consider building an “Umbrella Bottle Tree” [http://www.fastplants.org/sandbox.php?entry_id=77].

Because decaying matter naturally produces odors, consider positioning the columns by the door or windows that could open.

4. Collect bottles
5. Collect containers or bags for students to bring in
6. Schedule volunteers to help you prepare bottles the day before you plan to start the investigation.

1 day before:

1. Clear sufficient space for the decomposition columns.
2. Start to collect matter for decomposition (see “Procedure” below)
 - Distribute bags or containers
 - Explain to students that only organic material such as fruit and vegetable peels as well as twigs and leaves should be brought to school. Fats, oils, and grease (FOG) like butter, cheese, etc. should NOT be brought in.
3. Print and copy instructions for volunteers. See the “bottle basics” page of [www.bottlebiology.org](http://www.bottlebiology.org/basics/index.html): <http://www.bottlebiology.org/basics/index.html>
4. Experiment with filling up an investigation column.

DAY ONE Procedure:

1. REVIEW THE CONCEPTS OF DECAY AND DECOMPOSITION

- Ask students to think about what happens when a leaf falls to the ground. How come that leaf “disappears” a month later?
- Write the words “decay” and “decomposition” on the board. Describe decomposition as the breakdown of matter into simpler chemicals. Describe decay as going through decomposition.
- Write the word “decomposers” on the board. Explain decomposers as simple organisms like bacteria and mold that eat away and break matter down into simpler materials. Explain that just the right amount water is necessary to control the rate of decay. Too much water will create an environment in which there isn’t enough oxygen to control microbes that can create extremely stinky odors.

2. INTRODUCE ACTIVITY

- Display the decomposition column(s).
- Explain that over the course of the next week(s), the class will examine how quickly different materials decay.

3. TAKE INVENTORY & MAKE PREDICTIONS

- Have students spread out the contents of what they brought in.
- Using gloves, organize the material into categories: inorganic/organic, paper-product, peels, etc.
- Direct students to list the material by category in their notebooks or on the class chart.
- Discuss what might be reasonable amounts of time to expect each material to decay.

4. FILL DECOMPOSITION COLUMNS

- Direct students to place material in the decomposition columns.
- Demonstrate how to keep the columns moist but not too wet.

DECOMPOSITION INVESTIGATION Procedure:

1. PERIODIC INVESTIGATIONS

- Direct students to make observations each week.
- How quickly does matter decay? Do some items take longer than other?
- What organisms can you identify – is there mold growing?
- What odors can you detect?

2. MAINTANENCE

- Periodically, check the moisture level to make sure the material is damp but not too wet.

3. DISCUSS RESULTS

- Review what your students observed. Which materials decayed more quickly than others? Did some materials not decay at all?
- Ask students to think about what they normally throw away. Which items would most likely stay around for years if not centuries? Which items could they leave in a pile in their backyards and use as soil in a few weeks?
- Encourage your students to continue the experiment at home by putting together a compost pile. Students, and their families, can call 774-5780 to get on a list for a city-provided compost bin.

Extensions:

- Compare the rates of decomposition in a decomposition column without any air holes or that is completely dry.
- Compare decay in nature with that in a landfill. Line a box with a heavy-duty garbage bag and create layers of material that you cover with garbage bags. After a period of time, examine both the decomposition chamber and the model landfill. Discuss with students how the lack of oxygen, water, and types of materials in landfills affects the time it takes for matter to decay.
- Use the “compost tea” from a decomposition column to run a bioassay experiment. See the Bottle Biology site:

[\[http://www.bottlebiology.org/investigations/bioassay.html \]](http://www.bottlebiology.org/investigations/bioassay.html)