Solutions to the Garbage Explosion

Subject/Target Grade
Science
Grades 4th and 5th

Duration
One class (55 minute) period

Materials

Box 1: (one for whole class)
- Newspaper/Celotex ceiling tile & pencils
- Magazines (shiny)/Fast-food bags, egg cartons
- Corrugated cardboard/Cereal box, tissue products (Kleenex)
- Steel soup can (flattened)/new soup can
- Used clear glass bottle/new glass bottle
- #2 HDPE plastic milk jug/plastic “lumber”, etc.
- #1 PET plastic soda bottle/cloth bag
- Food wrapper (plastic & foil)/NOT recycled
- Styrofoam cup/plastic ruler
- Milk carton, juice box/envelope, (toilet) tissue products
- Styrofoam peanuts/REUSED by Shipping Store
- Labels: “Trash” and “Recycled Products”

Box 2: Design a Landfill (one for whole class)
- Gravel & sand (reuse each time)
- Clay (for 2’ clay liner)
- Spray bottle (blue dye & water to simulate rain)
- Garbage (shredded newspaper)
- Folded Saran Wrap for synthetic liner
- 2 plastic 1-liter pop bottles cut in half, with filter paper over covering

Alternatives to Hazardous Household Cleaners:
- Ammonia-based window cleaner
- Biodegradable (orange) window cleaner
- Spray bottle with vinegar & water
- Comet
- Baking soda and salt
- Paper towels (newspaper also works)
- Grease, oil, butter, or Vaseline

Handouts:
- Local Recycling Information
- Safer Alternative to Hazardous Household Chemicals
- Garbage Whiz Quiz!

Lesson Overview
Students find out what new products can be made from recycled materials and where materials can be recycled locally and elsewhere. Students discuss the differences between a dump and a sanitary landfill, then design a safe landfill. Finally, students compare commercial cleaners to “environmentally friendly” alternatives.

Essential Questions
What is garbage?
How does recycling save energy and reduce pollution?
How are recycled materials used in everyday life?
What are the differences between landfills and dumps?
What are smart choices in cleaning options?

Objectives
After this lesson, students will be able to:
- Understand that materials discarded into a landfill is a waste of natural resources and energy.
- Demonstrate how recycling can decrease the need to exploit natural resources and decrease pollution caused by the extraction of these resources.
- Compare the environmental impacts of a dump vs. a landfill.
- Design a safe landfill.
- Compare commercial cleaners to “environmentally friendly” alternatives.
Advance Preparation

♦ Teach Lesson I, *Taking Out the Trash*
♦ Assign “Home Garbage Survey” and “Recycling Survey” as homework prior to lesson
♦ Assemble handouts of local recycling options.

Background

Americans produce 220 million tons of trash a year; about 5 lbs/person/day. Where does it go? Between 1960 and 2007, the amount per person nearly doubled from 2.7 lbs to about 5 lbs/day.

Landfills are more complicated than a dump. They are a large hole in the ground, lined with clay or plastic. Rain produces toxic liquid by mixing with other poisons in the dump, but this is supposed to be contained by the liner. Ideally, pipes collect what seeps through, and it is treated so it doesn’t get into the groundwater. Each day, garbage is covered with a layer of dirt to contain odors and deter animals. When full, the landfill is covered with plastic and dirt. Different materials decompose at different rates in a landfill, and more slowly than when in the outside.

A large portion of our waste is food and yard waste which can be used for compost, by adding earthworms, air, bacteria and time. This reduces the amount of waste and creates dirt.

Throwing away paper or plastic packaging, glass jars, metal cans, cardboard boxes, wastes energy and resources because we have to mine the metals or oil all over again or cut down more trees.

Procedure

Follow-up to *Taking Out the Trash*:

● Garbage is something that we no longer need or can use.
● Garbage is made up of seven major categories: paper, yard waste, plastics, food wastes, metals, glass, or other (clothing, construction & demolition wastes, old appliances).
● Throwing away paper or plastic packaging, glass jars, metal cans, cardboard boxes, wastes energy and resources because we have to mine the metals or oil all over again or cut down more trees.
● We can reduce our garbage by recycling, repairing what breaks instead of buying a new item, giving away reusable items, and reducing what we use. Reducing packaging when we make our school lunches is a good place to start...
● Recycle food wastes by composting.

Report on Home Garbage and Recycling surveys

● Do families’ habits follow national trend (in decreasing order): paper, yard waste/other, plastics, metals, glass, food wastes?
● What is daily average weight of families’ garbage (Michigan, 3—4 pounds/person)
● Families’ annual weight?
● Review families’ recycling habits—do the students know people who recycle?
● What items are most frequently recycled? Why?
Recycling: What are recycled materials turned into?

- Place all of the “trash” items on one table with “Trash” label.
- Place all items that are new, “recycled” products onto another table with “Recycled Products” label.
- Invite pairs of students to select items from the “trash” table to match with an item on the “recycled” table. Mention whether or not the item is recyclable in your area or elsewhere. Use resource list attached.
- Review what recycled items can be made into.
- How much garbage can be reduced if the 4Rs and composting are practiced:
  - If everybody did everything possible: 75%
  - If everybody did something: 50%
  - What will you choose to do?

Design a Landfill—Class discussion (write comparison table on board):

Even if everyone did the best possible job, there would still be garbage.
- Where does it go?
- Does it cost money? (“Tipping fee” to dispose garbage in a landfill or to have it picked up.) Dumping garbage in the woods is free (we “pay” for the pollution).
- Landfill sites must be on well-drained soil with a low water table, collect contaminated water (leachate) beneath so it doesn’t trickle into the groundwater, must be lined with either 2’ of clay or a composite plastic liner made of HDPE (high-density polyethylene), have monitoring wells installed to detect downward or sideways leaks into groundwater, and must be covered to prevent water from getting into landfill.

(Sample table from class discussion:)

### Dump vs. Landfill

<table>
<thead>
<tr>
<th></th>
<th>DUMP</th>
<th>LANDFILL</th>
</tr>
</thead>
<tbody>
<tr>
<td>No liner</td>
<td>Have clay and plastic liners</td>
<td></td>
</tr>
<tr>
<td>Can be anywhere</td>
<td>Carefully located</td>
<td></td>
</tr>
<tr>
<td>Smells</td>
<td>Smells less</td>
<td></td>
</tr>
<tr>
<td>Not covered, so attracts wildlife and exposes them to hazards</td>
<td>Garbage covered with soil &amp; sand—deters wildlife</td>
<td></td>
</tr>
<tr>
<td>Free now; more expensive to clean up pollution</td>
<td>More expensive</td>
<td></td>
</tr>
<tr>
<td>Human danger</td>
<td>Fenced to keep people out</td>
<td></td>
</tr>
<tr>
<td>Not monitored</td>
<td>Monitored for leaks</td>
<td></td>
</tr>
<tr>
<td>Unregulated to protect public health &amp; safety</td>
<td>Regulated for public health &amp; safety</td>
<td></td>
</tr>
<tr>
<td>More likely to pollute groundwater &amp; drinking water</td>
<td>Less likely to pollute groundwater &amp; drinking water</td>
<td>Produces methane gas that can be used for energy.</td>
</tr>
</tbody>
</table>

**Solutions to the Garbage Explosion**

Provided through a partnership of the Western Upper Peninsula Center for Science, Mathematics & Environmental Education and The Sustainable Futures Institute at Michigan Technological University with financial support from The Wege Foundation.

Tel: 906-487-3341 Email: jchadde@mtu.edu  Websites: www.wupcenter.mtu.edu and www.sfi.mtu.edu
**Make a Mini-Landfill and a Dump** (demonstration)

**Landfill:** Layer gravel, sand clay and/or plastic Saran Wrap, garbage. Cover garbage with clay/Saran Wrap and then soil/sand.

**Dump:** Layer gravel, sand, garbage. No cover on top of garbage.

- Pretend it rains on top of the dump and landfill—pour water on top.
  - *Do you think pollution will leak into the groundwater from the dump or the landfill? Which will do a better job of protecting water quality of streams, rivers, lakes, and groundwater? (Landfill)*

**Alternatives to Hazardous Cleaning Materials** (demonstration)

Assemble window cleaners.

- Commercial cleaner (Windex type): cautions user against drinking, or getting on clothes or skin. Why would we flush it down the drain to get into the drinking water?
- Homemade cleaner—equal parts vinegar and water
- Biodegradable (orange) window cleaner.

*Which will clean better?* Choose students to clean a window smeared with Vaseline, butter or oil with each product. Compare

Assemble household cleaners

- Comet with bleach (poisonous)
- Homemade cleaner (salt and baking soda)

*Which will clean better?* Choose students to clean two dirty desks and compare results.

If both products work equally well, why not use the cleaner with the least amount of poisonous ingredients to clean, and protect our water at the same time?

**Summary** (whole class discussion—record on board)

*What can you do to REDUCE, REUSE, or RECYCLE your garbage?*

<table>
<thead>
<tr>
<th>REDUCE</th>
<th>REUSE</th>
<th>RECYCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy bulk rather than</td>
<td>Paper/plastic shopping bags</td>
<td>Aluminum cans/glass bottles</td>
</tr>
<tr>
<td>individual servings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compost food &amp; yard</td>
<td>Plasticcloth lunchbox</td>
<td>Newspapers</td>
</tr>
<tr>
<td>wastes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoid using paper</td>
<td>Donate usable clothes, toys,</td>
<td>Used motor oil</td>
</tr>
<tr>
<td>plates, cups, plastic</td>
<td>furniture, appliances</td>
<td></td>
</tr>
<tr>
<td>tableware</td>
<td>Repair items rather than replace</td>
<td>Milk jugs</td>
</tr>
<tr>
<td>Avoid excess</td>
<td></td>
<td></td>
</tr>
<tr>
<td>packaging</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Post test**—compare results with pre-test from *Taking Out the Trash* lesson.
Garbage WHIZ QUIZ!!
What Do You Know About Garbage??

1. How long will it take a plastic bag to decompose: (circle one)
   - 1 year
   - 20 years
   - 50 years
   - 10,000 years

2. Which makes up the largest category of garbage by weight: (circle one)
   - plastic
   - paper & cardboard
   - food
   - metal

3. We can recycle our food and yard wastes by ____________________.

4. List 3 things you can do to reduce the amount of garbage you throw away:
   _________________________, _________________________, _____________________.

5. To prevent pollution of groundwater, the bottom of landfills are lined with: (Circle the one or more answers that are true.)
   - sand
   - clay
   - plastic
   - gravel

6. Newspaper can be recycled into: (Circle the one or more answers that are true.)
   - egg cartons
   - newspaper
   - glass jar
   - motor oil
   - ceiling tile
   - tissue
   - pop can
   - pencils

7. Plastic milk jugs can be recycled into: (Circle the one or more answers that are true.)
   - flower pots
   - newspaper
   - toys
   - plastic lumber
   - pop cans
   - glass jar
   - cereal box
   - magazines

8. Glass bottles can be recycled into: (Circle the one or more answers that are true.)
   - flower pots
   - newspaper
   - toys
   - cloth bags
   - plastic lumber
   - glass jar
   - cereal box
   - aluminum pop cans

9. Aluminum pop cans can be recycled into: (Circle the one or more answers that are true.)
   - flower pots
   - newspaper
   - toys
   - cloth bags
   - plastic lumber
   - aluminum pop cans
   - glass jar
   - cereal box

10. Where can people in our area take newspapers, plastic milk jugs, cardboard boxes, glass jars and magazines to be recycled?
    _______________________________________________________

11. Why is throwing away garbage a problem? _______________________
    _______________________________________________________

12. Why are landfills better than dumping garbage in the forest?_________
    _______________________________________________________
<table>
<thead>
<tr>
<th>“Trash” Item</th>
<th>Recycled Product</th>
<th>Where recycled locally:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspaper</td>
<td>Ceiling tile, house insulation, newsprint, cardboard, tissue products, animal bedding, pencils</td>
<td></td>
</tr>
<tr>
<td>Magazines, catalogs, other shiny paper</td>
<td>Newsprint, computer &amp; office paper, label stock, fast-food bags, egg cartons</td>
<td></td>
</tr>
<tr>
<td>Corrugated cardboard</td>
<td>New corrugated or linerboard, paperboard cereal box, tissue products</td>
<td></td>
</tr>
<tr>
<td>Steel soup cans</td>
<td>New soup can, other steel products</td>
<td></td>
</tr>
<tr>
<td>Aluminum cans</td>
<td>New aluminum can</td>
<td></td>
</tr>
<tr>
<td>Clear glass bottle</td>
<td>New glass container, glasphalt, road aggregate, fiberglass</td>
<td></td>
</tr>
<tr>
<td>#2 HDPE plastic (milk jugs)</td>
<td>Plastic lumber, motor oil/detergent bottles, pipes, buckets, recycling bins, flower pots, toys, bags</td>
<td></td>
</tr>
<tr>
<td>#1 PET plastic (soda bottles)</td>
<td>Cloth bag, carpeting, fiberfill, clothing, non-food containers</td>
<td></td>
</tr>
<tr>
<td>Plastic/foil wrappers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk carton/juice box</td>
<td>Envelopes, stationary, tissue products</td>
<td></td>
</tr>
<tr>
<td>Styrofoam cup</td>
<td>Ruler</td>
<td></td>
</tr>
<tr>
<td>Styrofoam “peanuts”</td>
<td>Original materials are re-used for packing</td>
<td></td>
</tr>
<tr>
<td>Motor oil</td>
<td>Re-refined into new motor oil, cleaned and burned for heat value</td>
<td></td>
</tr>
<tr>
<td>Tires</td>
<td>Shoe soles, door mats, playground equipment, road materials</td>
<td></td>
</tr>
</tbody>
</table>