Activity: Landfill Depot Display

Grades: 5 and 6
State Standards: Grade 5; Science 6 a-h. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations.
Grade 6; Science 6 Resources, sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation.
Groups: 3-4 per group
Preparation Time: 25 minutes
Activity Time: 2 hours minutes
Key Words: groundwater pollution, sanitary landfill, soil, permeability, porosity, plume, garbage, trash, leachate, environmental engineer, waste

OBJECTIVE
Students will be able to accurately construct a model of a sanitary landfill, identify the parts of the landfill, explain their function and understand a trash trail. Students will quantify an average person’s daily waste and understand the importance of minimal waste to the landfill. Scientific thinking process includes observing, communicating, ordering, and classifying.

MATERIALS
Part one:
For each group of 3 or 4 students: clear plastic shoe box or deli salad container, large sheet of clear plastic, enough modeling clay to cover the bottom and top of the container, enough potting soil to make three or four layers in each container, paper scraps and other refuse scraps (do not include food or organic waste), plastic straws of various sizes, grass seed (optional)

Part two:
Bathroom scale, one bag for each group, students will pick up the litter for this part or classroom garbage can be used.

Recyclables: empty plastic containers, empty cardboard boxes, aluminum cans, empty cans, glass containers

BACKGROUND
Review key vocabulary words:

Reuse: Consuming and throwing away less. It includes: purchasing durable, long-lasting goods; seeking products and packaging that are as free of toxics as possible; redesigning products to use less raw material in production, have a longer life, or be used again after its original use.
Recyclable: Turns materials that would otherwise become trash into valuable resources. A product is broken down and re-manufactured into a new product. This may be the same type of product or may be an entirely new product. Ask them what products they have had or seen that they know have been recycled. Find out what kind of recycling they do at their home. How easy is the recycling; does the city provide pick up for items that they want to recycle? Ask if they have ever seen a playground with ground-up tires on the ground, rather than sand. Why might this use of old tires be an advantage? (both for depletion of trash materials, as well as safety issues) Advantages: Recycling is one of the best environmental success stories of the late 20th century. Recycling, including composting, diverted 72 million tons of material away from landfills and incinerators in 2003, up from 34 million tons in 1990. By 2002, almost 9,000 curbside collection programs served roughly half of the American population. Curbside programs, along with drop-off and buy-back centers, resulted in a diversion of about 30 percent of the nation’s solid trash in 2001.

Composting: Another form of recycling is composting. Composting is the controlled biological decomposition of organic matter, such as food and yard trash, into humus, a soil-like material. Composting is nature's way of recycling organic trash into new soil, which can be used in vegetable and flower gardens, landscaping, and many other applications. Advantages: keeps organic trash out of landfills, provides nutrients to the soil, increases beneficial soil organisms (e.g., worms and centipedes, suppresses certain plant diseases, reduces the need for fertilizers and pesticides, and protects soils from erosion.

Combustion: The process of burning trash materials. Explain that burning materials not only lessens the amount that is discarded, but also creates energy. Problems arise when the materials produce too much pollution or toxic chemicals when burning. For this reason, not all materials can be burned.

Landfills: A landfill is an area for disposing of solid trash on land. Its purpose is to dispose of trash materials in a safe way. Landfills have a special design using several layers of materials and drainage systems to keep the pollutants inside and contain the trash in the most effective way. Advantages: a place to safely store trash materials until they are broken down. Disadvantages: they take a great deal of space and potential accidents could cause the release of toxins. How long does it take for materials to break down in a landfill? (Paper: 2-4 weeks, glass jar: unknown length of time, banana peel: 4-5 weeks, aluminum can: 100 yrs)

Web-Directed Research
- U.S. Environmental Protection Agency “Terms of Environment” (http://www.epa.gov/OCEPAtersm/) and state municipal solid waste data (http://www.epa.gov/epaoswer/non-hw/muncpl/states.htm).
- How Stuff Works (http://people.howstuffworks.com/landfill.htm)
- The Solid Waste Association of North America (http://swana.org/)
- Environmental Career Organization (www.eco.org)
PROCEDURE

Part one

1. Begin by giving students background information on the difference between a garbage dump and a sanitary landfill. A garbage dump is a place where garbage is left in an open pit or pile, and is illegal. A sanitary landfill is a deep opening in the ground where refuse is buried under carefully monitored conditions. The bottom and sides are first lined with compacted clay and plastic liners to prevent ground water contamination. Daily, a layer of waste material is placed in a cell, or open area, and capped with soil. When a cell is filled, it is capped with another layer of clay and soil. When a landfill has been filled and is closed, grass and shrubs are planted on the top layer to keep the soil in place. Many closed landfills have been landscaped and developed into recreational facilities, such as a golf course.

All sanitary landfills must have systems for collecting and monitoring groundwater to ensure against contamination. They also have systems for collecting leachate, liquid that filters down through the landfill with rainwater and could contain harmful chemicals. Methane gas is also produced inside the landfill. In some cases this gas is simply burned off, in other cases it is collected and used as fuel. Systems for collecting ground water, leachate, and methane gas do not breach the lining systems of the landfill. As a landfill is air tight, the degradation processes which rely on the presence of light or air do not take place inside a landfill.

2. After students have taken notes on the proper construction of a sanitary landfill, have them work in groups to diagram a landfill. Make sure they have included all parts of the landfill and labeled them correctly.

3. Distribute to each group the materials to build the model landfills. Do not give students step by step instructions on how to construct the landfill. If their diagrams are correct, they should be able to accurately simulate the construction on their own:
   - Clay should line the bottom of the container.
   - Then, the plastic will line the bottom and sides.
   - The straws represent the leachate, groundwater, and methane collection equipment and should be placed so that they extend above the surface of the completed landfill.
   - Next, students should layer the waste material and potting soil.
   - The final layer of the landfill is covered with clay followed by top soil.
   - Students may wish to plant grass seed on this layer and decorate it to represent a golf course, etc.

Discussion: Public landfills must be planned responsibly, using judgment in using natural resources, disposal of waste and using the scientific process develop a reduce, reuse, or recycled by asking meaningful questions and observations.
Part two:
In groups, students are to organize recyclables and trash, measure the weight of each pile. Instruct them to record the weight data on their data sheet (Attachment four). Remind them to record their units (kg or lbs) on their own data table and to round to the nearest ½ unit (this will depend on the scale). Pounds of garbage- ask the students to find the total weight of each category of waste. At the bottom of their data sheet have the students make a pie graph and label each category. Discuss and analyze how their results affect our landfills across the world.

- According to the Environmental Protection Agency, the average American produces about 4.4 pounds (2 kg) of garbage a day, or a total of 29 pounds (13 kg) per week and 1,600 pounds (726 kg) a year.

- In the US 33.4% of solid waste is either recycled or composted, 12.6% is burned in combustion facilities and 54% makes its way into landfills

- In 2007 99% of lead acid batteries were recycled, 54% of paper and paperboard were recycled, 64% of yard trimmings are recycled and nearly 35% of metals were recycled

- The amount of recycling in 2007 saved the energy equivalent of 10.7 billion gallons of gasoline and prevented the release of carbon dioxide of approximately 35 million cars

- The number of landfills in the US are decreasing while their size is increasing. In 1998 there were 8,000 landfills but only 1,754 in 2007

- Each ton of mixed paper that is recycled can save the energy equivalent to 185 gallons of gasoline

- Approximately 8,660 curbside recycling programs exist in the United States

- There are about 3,510 community composting programs in the United States

- Disposal of waste to landfills has decreased from 89% in 1980 to 54% in 2007

- Recycling 1 ton of aluminum cans conserves the equivalent of 1,665 gallons of gasoline

- In 2007 the United States recycled and composted 85 million tons of the 254 million tons of municipal solid waste created

ASSESSMENT
Student models should contain all the elements of a sanitary landfill, and elements should be properly placed. Students should be able to explain the function of each part of the
landfill. Students should understand the pounds of waste each individual produces and apply ways to reduce waste in our landfills.

Attachment 1

Trash Trail

<table>
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<tr>
<th>Method Used</th>
<th>Definition</th>
<th>Examples</th>
<th>Advantages</th>
<th>Problems Associated with this Method</th>
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Attachment Two
BUILDING A LANDFILL

Look at the diagram displayed of the land fill. The cross-section drawing shows the structure of a municipal solid waste landfill. The arrows indicate the flow of leachate.

- **Bottom liner system** – The job of a landfill is to stop waste from creating environmental problems. The bottom liner, generally made of a synthetic material (plastic) and is sometimes combined with a clay lining or surrounded on either side by fabric to protect it from anything in the earth that may puncture the liner. This separates garbage and its run-off from getting into the ground water.

- **Cells (old and new)** – Garbage is divided into sections and stored within the landfill. These cells are designed to separate sections of trash for easier compacting.

- **Storm water drainage system** – It would be very dangerous for liquid to escape from the landfill into the soil. Rain water needs to be captured or collected so that it does not get into the garbage and create a run-off. Methods for being sure waste does not have a great amount of liquid are also used to keep the waste materials as dry as possible.

- **Leachate collection system** – Leachate is the liquid that does end up becoming run-off as it is impossible to keep the landfill totally dry. This liquid filters through the landfill and picks up contaminants (or pollutants). Special drain pipes are put in place in order to direct the liquid to a “holding tank” or specially monitored pond.

- **Methane collection system** – Materials in these airtight landfills break down due to landfill gasses, about 50% carbon dioxide and 50% methane. Since methane is combustible (or burns easily) it needs to be removed. To prevent an explosion the methane is piped out and burned or used elsewhere to provide energy.

- **Covering or cap** – Most landfills are covered with 6 inches of soil to protect the materials from “getting out”, as well as keeping animals and rodents from getting into the landfill. Scientists are trying to find alternative materials to cover the landfill that will not require 6 inches of space.