



Title: The Landfill Debate

Grade: Middle School

Subjects: Social Studies, Science, Health, Math, Language Arts

Time: 60 minutes

Objectives:

- Differentiate between a garbage dump and municipal solid waste (MSW) landfill.
- Identify and describe the problems and concerns people have about burying trash in landfills and justify their position on the matter.
- Evaluate the EPA's five methods of integrated solid waste management and determine whether the EPA's recommendation concerning landfills is justified.

Standards:

Geography Standard 15: Understand how physical systems affect human systems.

- Benchmark # 4: Understand relationships between population density and environmental quality (e.g., the denser the population the greater the amount of waste produced and the need to dispose of it safely).

Geography Standard 16: Understand the changes that occur in the meaning, use, distribution and importance of resources.

- Benchmark # 2: Know strategies for wise management and use of resources (e.g., community programs for recycling and reuse).
- Benchmark # 5: Understand the role of technology in resource acquisition and use, and its impact on the environment (e.g., the more resources used in manufacturing results in more waste that needs to be disposed of in a safe manner).

Geography Standard 18: Understand global development and environmental issues.

- Benchmark # 2: Understand the possible impact that present conditions and patterns of consumption, production and population growth might have on the future spatial organization of Earth.
- Benchmark # 4: Understand why different points of view exist regarding contemporary geographic issues (e.g., some communities find the recycling and incineration of waste too costly or impractical, and use a landfill solution as one of their primary methods of disposal)

Technology Standard 3: Understand the relationship among science, technology, society and the individual.

- Benchmark # 3: Know ways in which technology has influenced the course of history (e.g., improvements in sanitation and waste management- garbage dump vs. sanitary landfill).

Health Standard 2: Know environmental and external factors that affect individual and community health.

- Benchmark # 3: Know ways local, state, federal and international efforts to contain an environmental crisis and prevent recurrence (e.g., solid waste contamination).

Mathematics Standard 6: Understand and apply the basic and advanced concepts of statistics and data analysis.

- Benchmark # 5: Organize and display data using tables, graphs, diagrams, frequency distributions and plots.

Language Arts Standard 8: Use listening and speaking strategies for different purposes.

- Benchmark # 5: Use grade level appropriate vocabulary in speech (e.g., specialized language).

Materials:



- Pencils and journals
- Soil
- Corrugated box, at least 24 inches deep
- Two clear plastic containers, larger than the base of each box
- Two wire racks large enough to cover the top of the plastic containers
- Two equal size watering cans
- Collection of inorganic material: aluminum foil, plastic sandwich bags, bottle caps, wood shavings, paper scraps, etc.
- Collection of organic materials: plant leaves, coffee grounds or tea bags, cranberries or blueberries, onion skins, chips, crusts of bread, pastry crumbs, etc.
- Scissors
- Small trowel or scoop
- Empty, clear plastic bottle
- Water
- The use of the model landfill constructed in the previous lesson (Middle School Day 3: What Happens to Trash in a Landfill?)

Overview: The Environmental Protection Agency has designed a plan for dealing with the disposal of trash, which they refer to as “integrated solid waste management”. The EPA has identified five ways to properly handle waste materials: a) source reduction and reusing, b) recycling, c) composting, d) burning and converting to energy, and e) burying it in an engineered site. In most communities across the country solid waste ends up in at least one of three locations: a) a materials recovery facility, b) a waste-to-energy facility, or c) a landfill.

A landfill is a long-term disposal solution that buries trash in as safe and sanitary manner as possible. Some landfills use clay to line the bottom of the site and act as a barrier between the waste and the environment, while others, municipal solid waste landfills, have multiple layer liners for protection.

The EPA has identified eight categories of waste that are typically buried in landfills. These categories include: paper, yard trimmings, food scraps, plastics, metals, textiles-rubber- leather, glass and wood. While it is illegal to dispose of hazardous, toxic and liquid materials in landfills, the EPA has determined that most landfills contain some type of pollutants that can contaminate groundwater supplies. Since groundwater is a source for drinking water, this is a major concern, which threatens both human health and the environment.

Rainwater passing through the waste, can carry contaminants with it as it seeps through a landfill. This contaminated liquid is known as leachate. Leachate, left unchecked, can continue to seep through the soil until it reaches groundwater level, polluting drinking supplies. Liners and leachate collection systems are used in landfills to collect and remove the leachate from the site to eliminate the issue of groundwater contamination.

Kid’s Speak: People throw away all sorts of materials every day, and seldom think about where they go or what happens to them. The most common types of waste items include: paper, yard trimmings, food scraps, plastics, metals, textiles-rubber-leather, glass and wood. Unfortunately, most landfills also contain materials that can pollute our drinking water. This happens when rainwater passes through the waste in a landfill and picks up contaminants along the way. This contaminated liquid is called leachate. Most landfills today have leachate collection systems and liners that stop the leachate from reaching the groundwater.

Eco-Fact: A Styrofoam coffee cup thrown in the trash today will still be in the landfill 500 years from now.

Procedures:



Note: In the previous lesson one position in the landfill debate was studied—the composition and structure of landfills do not provide ideal circumstances for decomposition, resulting in waste that remains in landfills for very long periods of time. In this lesson the composition and structure of a landfill will be viewed from a different perspective - providing protection from contamination for groundwater supplies. This lesson requires the use of the model landfill constructed in the previous lesson.

Before Conducting the Lesson:

- Introduce the term leachate. Explain to students that leachate is formed when rainwater passes through the waste contained in a landfill and picks up contaminants that might be present. Explain the harmful effects leachate can have on the environment and the groundwater supplies.
- Review with students the difference between a garbage dump and a landfill. (A garbage dump is a hole into which trash is dumped. It can attract rats, mice, birds and other small animals, produce litter and develop offensive odors. It has no liner or barrier to protect groundwater supplies from the leachate that may develop as water passes through the trash deposited in the dump. Garbage dumps are illegal in the US. A landfill is much different. It is a carefully engineered site built into or on top of the ground. Trash deposited in the landfill is kept isolated from the environment through the use of various systems: e.g., liner system, leachate collecting system.)
- Review the discussion point from the previous lesson that addressed the pros and cons of landfills. One concern people have about landfills is that the waste buried there does not decompose quickly due to the lack of light, air and moisture, and as a result large tracts of land are continually being filled with trash. Others feel it is important to make sure landfills are carefully designed and monitored so that contaminants do not seep out of the landfill and enter drinking water supplies. The ideal situation would be to minimize the need for landfills.
- Review the construction of the model landfill built in the previous lesson. Explain to students that the model landfill simulates an MSW landfill, using a composite liner to protect groundwater supplies from contaminants. Explain that in this lesson the class will build a model of a garbage dump and conduct an experiment to see how each effect groundwater supplies.

Building the Garbage Dump:

- Place the materials out in the open where students can observe the construction of the model dump. Have volunteers serve as members of the construction team. As the construction process begins have students record in their journals what is happening at each step. Explain to students that they will compare the two models at the end of the lesson.
- Using the same size box as in the previous lesson, the first volunteer will poke ten to twelve tiny holes into the bottom of the box. Next have the volunteer fill the box with ten inches of soil. Ask students why they skipped directly to the soil layer? (A garbage dump has no protective liner to act as a barrier between the trash and the environment.) Have the same volunteer dig a hole in the center of the soil, approximately six inches deep.
- Have the second volunteer select some of the same kind of organic and inorganic waste materials used in the landfill model and place them in the hole. Cover the waste with two inches of soil.
- Have volunteers repeat the step three once again.

Conducting the Lesson:

- Fill two clear plastic containers with clean water. Tell students this water will represent groundwater.



- Place a wire rack over the top of each plastic container. Set each model on one of the wire racks, so they are completely suspended over the plastic containers, and so that any liquid escaping from the models will empty into the plastic containers. Place the hose extending from the landfill model into a clear, empty plastic bottle and place the bottle on the floor below the model.
- Ask student to hypothesize what will happen when water is poured onto each model. Have students record their hypotheses in their journals.
- Have two volunteers man the watering cans. One student will water the landfill model and the other the dump model. Attempting to maintain a moderate flow, have the students pour water over their assigned models. This water represents precipitation. The class will observe the process, monitor each model for a period of time and record the results. Having used coffee grounds, tea bags and rotting berries as organic waste, any seepage should have some color to it to provide a visual representation of contaminants in the leachate.

After the Lesson:

- Students will analyze the observation data collected and answer questions similar to the following:
 - Which of the models was more effective in protecting the ground water from the leachate?
 - Why is it important that leachate not reach the groundwater level?
 - Which of the types of landfill options do you think would be the most economical to build and maintain? Why?
 - Which type of landfill would you prefer to have in your community? Why?
 - What was your position about landfills prior to this lesson? Has it changed? Why or why not?
 - What recommendation can you make to the public about landfills?
- Students will develop a Venn Diagram to compare each type of landfill in terms of materials and maintenance, the environment, and human health and safety.
- Explain to students that research and experimentation is currently being conducted to address both the issue of biodegradability in landfills and the removal of leachate. One method being studied involves the “recirculation” of leachate and air through a landfill to facilitate the process of decomposition. At the present time this research is controversial, but experts in the field continue to look at different options and may, in the near future, find some viable alternatives to the current situation.

Adaptations:

- Students can be divided into small groups of two or three and make group models of the dumps and perform group experiments which may have different results that can be discussed and compared.

Extensions:

- Students can monitor both the landfill and dump for any signs of seepage, odors, etc.
- In several weeks students can excavate both models to determine which has the greatest amount of decomposition of the waste. Students can debate the pros and cons of sanitary landfills.