

What a Dump

Lesson Objective

In this lesson, students will be able to:

- Describe a landfill and its purpose.
- Explain the alternatives to dumping human-made garbage in landfills and ways to decrease the amount of waste that ends up in landfills.
- Describe how landfills can be hazardous for the environment if they are not well engineered.
- Describe the kinds of materials make good liner systems for landfills.
- Explain what it means to “optimize” something.

Activating Prior Knowledge & Concept Building

Americans generate about 250 million tons of trash every year. Since about 300 million people live in the United States, that works out to about 4½ pounds of trash per person – every single day!

How much of this garbage do you think gets recycled and composted? Only about one-third of it does, which means that on average, you make three pounds of trash every day that has to be put somewhere. (The U.S. total is 470 tons of trash every day.) Where should we put this trash? Can we just dump it out in a field? Why not? What if the dump or landfill is near a lake or a river?

The Science Behind It

Groundwater that is stored in **aquifers** is always flowing. People use wells to bring groundwater up from the aquifers to drink. We must keep dirty water that comes from the landfill (**leachate**) from getting into the groundwater, otherwise we can make people sick.

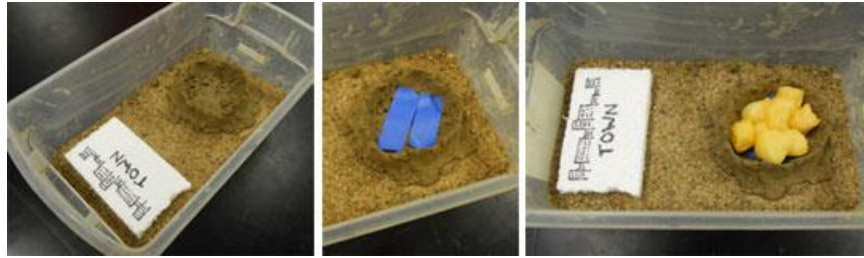
Erosion can affect your landfill if you are not careful. Landfills must be designed well enough to withstand erosion from rain, wind, or even earthquakes. Let’s make some models and learn what works best.

Materials:

- food coloring
- clear plastic tub in which to mix together food coloring, water, and cotton balls (“garbage”)
- (optional) gloves or spoon to “mix” the garbage
- strips of plastic garbage bags, to simulate geosynthetics used in landfills
- toothpicks
- straws
- popsicle sticks
- small, paper “Dixie” cups (~85 ml size), to measure and distribute clay, gravel and sand
- access to water
- watering can, water bottle, or other “rain storm” device

Instructions for Instructor:

1. Divide the class into groups of four students each.
2. Introduce the project objectives to the students: Each group must design a landfill that (a) can hold the most garbage, (b) minimizes the cost, while making sure that, (c) the landfill is able to contain the waste during a rainstorm without allowing leachate to get to the town. As you do this, just like engineers, you will be following the steps of the engineering design process: understand the need, brainstorm different designs, select a design, plan, create, test, analyze and improve.
3. Have students draw out his/her team’s landfill design.
4. Have students bring both their approved design to get their supplies.



5. Have students construct the base liner systems for their model landfills (see photo, above). The goal is to keep water from getting out of the landfill. Therefore, materials such as clay and geosynthetics are good choices, because water cannot flow through them easily. (Basically, the liner should look like a clay bowl or box. Of course, not all teams will choose this path – so you may see Popsicle sticks, toothpicks, etc., at this stage. The word “system” is used because students can use a combination of materials to make base liners [however, because of the budget constraint, they cannot afford to buy many things].) Remember to save some funds to purchase materials to build your top cap (to put on after the garbage is inserted). A landfill without a top is no good for anybody!
6. Fill the landfill with “garbage” (see photo above) making sure not to let the food coloring seep out into the area around the landfill before construction is completed. Count how many cotton balls you put in. Have the Project Engineer tell you how many to put in.
7. Have students record the quantity of garbage cotton balls that their landfills can hold on the worksheet.



8. Give students time to finish constructing the top cap liner systems for their landfills (see photo, above). The purpose of the top cap is to keep the rain out of the landfill. Therefore, like the bottom liner system, it should be made of materials water cannot flow through. Additionally, some protection (such as gravel) can be placed on top to keep rainwater and sunlight from eroding away the liner.

Test the landfill performance:

With the Students:



1. Create “rainstorms” by pouring water on the model landfills (see photo, above).
2. Use a pencil or Popsicle stick to dig into the sand outside of the landfill and near the town to look for any seeping food coloring (leachate) (see photo, above). Make multiple soils tests.
3. Repeat the rainstorm, if desired.
4. (optional) Apply other erosion forces to the model landfill, such as wind or earthquakes.

Closing

Review the activities of the day with the students and assess what concepts they took away or what they missed. List the key learning points on the board. Have students reflect on the activity by sharing out and writing about it in their science journals (or activity document).

Debrief Questions: So what should be put underneath all the trash in the landfill? How about once the landfill is finished? Should we cover the landfill or leave it open to the air? What should we cover it with?

Source:

<http://teachers.egfi-k12.org/what-a-dump/>