SAN MATEO COUNTY Sustainability Department

Build a Landfill

Background: Humans have always had to think about what to do or where to put the waste we create. What happens when we can't reuse, recycle or compost our waste? In the early 1900s, people would burn their trash at home or dump it in open areas around their towns. By the 1960s, cities decided that one way to deal with these informal "open dumps" was to create "sanitary landfills." Why did engineers think that it was important to build landfills in a special way? New landfill standards needed to protect groundwater, reduce run-off pollution and permanently contain the waste created by town and city residents.

Lesson: In this lesson, you will build a model landfill. You will then use it to demonstrate your understanding of the landfill layers concept used by landfill engineers around the United States.

1. Before you begin, read the following table of considerations that engineers must examine when constructing a landfill and each consideration's definition or purpose. Answer the prompts to the right.

Consideration	What it is/does.	**Answer or Predict:**
Groundwater	Freshwater running beneath the earth's surface that feeds wells and springs.	**Why do landfill engineers need to protect groundwater?**
Soil Type	There are 3 main soil types: sand, silt and clay. Each soil type has different qualities that are important to consider for landfills. For example, clay soil doesn't allow water to move as quickly through it as sandy soil would.	**Why do you think soil type is an important consideration when engineering a landfill?**
Liners	Liners are made of thick, impermeable plastic.	**Make a prediction on how you think liners are used in a landfill.**
Leachate	Leachate is a liquid that settles at the bottom of a landfill. This liquid comes from a combination of the liquids in the garbage itself and rainwater that comes into contact with the garbage in the landfill.	**Make a prediction on how leachate must be removed and treated so that it does not contaminate groundwater.**
Garbage	In a municipal landfill, garbage is any waste that comes from households and businesses. It should not include hazardous waste such as batteries, hazardous liquids or medical waste.	**Garbage is bulky and has a lot of air space in between all the different items. Make a prediction on how landfill operators remove all the extra air space in a garbage heap. How might this affect any hazardous waste sources that might be mixed in the garbage?**
Vegetation	Plants placed on top of a closed landfill heap.	**Grasses are favored over trees as landfill vegetation. Why do you think that is?**

2. Gather the following materials as you can:

- A clean, empty 2-liter bottle
- Craft foam sheets. If you don't have these, you can substitute cardboard.
- 1 or 2 plastic straws
- 1 plastic bag, to cut up and make layers
- Small "garbage" items (This is a model, so you will have to break your garbage material down into small pieces.)
- About a cup of small rocks, washed and rinsed clean
- Food coloring or a tea bag (to color water)

When gathering supplies, reuse or find recyclable materials from your home. Get creative and write your own key for the items you find in your home to represent each layer:

Clay	
Liner	
Leachate Pipes	
Soil	
Vegetation	

3. Now you will build a model landfill. Your goal will be to protect the groundwater underneath all the landfill layers. Here are some preliminary steps, but mainly you will use your materials and ingenuity!

A. Carefully cut the top of your two liter bottle off so it looks like the shape below.

B. Add about ¼ cup of water to the bottom of the bottle. This will be your groundwater. Place rocks in your groundwater to make it easier to build on.

C. Now you will begin to add layers corresponding to the different materials that are needed to construct a landfill. You'll notice that your first challenge is to keep your first layer from touching the groundwater.

D. Your next challenge is to use as many of the landfill elements as possible and to keep your groundwater clean. On a separate piece of paper, make sure to draw and label your finished landfill. Example:

E. Once your layers are complete, your last step will be to simulate rain by spraying or sprinkling about a ¼ - ½ cup of stained or colored water onto the top of your landfill model. Record your observations.

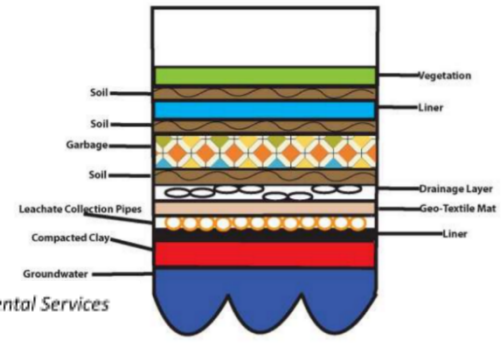

Image Source: Wake County Environmental Services

Finish your landfill investigation by answering the following questions:

1. Were you able to keep your groundwater clean? If yes, what strategies do you think helped your groundwater stay clean? If no, describe what you think happened.

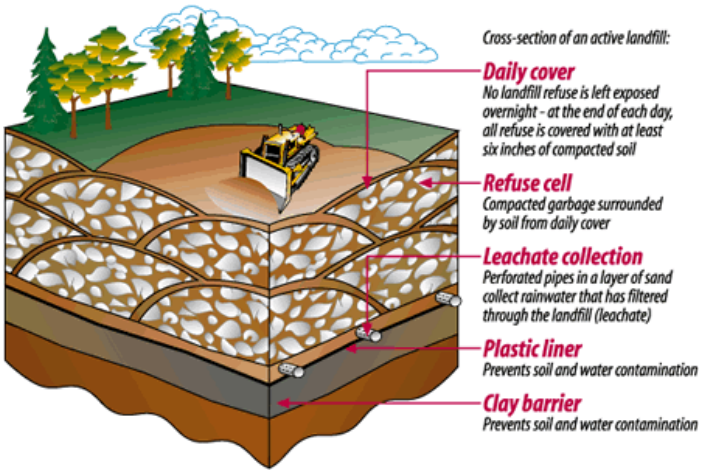

Image Source: teachengineering.com

2. Why are soil types an important consideration when constructing landfills? Besides soil, what other factors are affecting the movement of water in a landfill?

3. What other natural considerations do you think landfill operators have to consider when operating a landfill?

4. In the real world, what do you think happens to all the layers in a landfill over time? If we could slice through a landfill like a cake and look at the layers, would the layers look the same in 50 years? 100 years? 500 years?

This lesson was adapted from: Wake County Environmental Services, Solid Waste Management Division, Raleigh, NC