

Understanding Leachate

Grades: 6

State Standards: Grade 6 Ecology 5.c Students know moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).

Preparation Time: 20 minutes

Groups; of 2

Activity Time: 50 minutes

Key Words: municipal landfills, landfill, liners, groundwater, leachate, permeability, garbage disposal, waste, environmental engineer, pollution

OBJECTIVE

The students will design, construct, and test a landfill plastic liner and determine if it can be made to hold in water.

MATERIALS

For the whole class to share:

A measuring cup or graduated cylinder to measure water poured into plastic bags

A measuring cup or graduated cylinder to measure water that has leaked

Water supply source (sink or jug of water)

Each group/individual should have:

5 2"-wide garbage bag strips

1 12" length of masking tape

BACKGROUND

Every newly constructed landfill today is required to have an Environmental Protection Agency (EPA) certified liner. Each layer has a distinct purpose to stop leachate (the water that seeps through the garbage) from reaching the underlying groundwater. Leachate is often highly polluted with toxic chemicals that can be very harmful to people. Can you think of why this is? Well, leachate is often produced by the water run-off of rainwater or precipitation that flows through the garbage pile. What kinds of things do you throw into the garbage? Well, rotting food will contain bacteria that get into leachate, and any item that is not completely rinsed out will add chemicals to leachate. Also, as items degrade, the chemicals that make them will break down into leachate. Would you want all of these leachate contaminants in your glass of drinking water?

Engineers have designed landfill liners that consist of several layers. First, it has a layer of normal soil as a foundation for the waste. The next few layers include a filter layer called a geotextile (a synthetic permeable membrane) layer that is meant to allow water through and filter out any particles of trash; a leachate collection layer or system, which has permeable gravel that allows water to seep through; and pipes to collect the water or leachate that can be sent off and treated. Lastly, liners are required to have two barriers

layers: a plastic layer and a thick layer of impermeable clay. Landfill operators are required to repair any leachate outbreaks detected at the sanitary landfill facility by doing the following:

- (a) Contain and properly manage the leachate regularly.
- (b) If necessary, collect, treat, and dispose of the leachate, including, if necessary, following a contingency plan for leachate storage and disposal.
- (c) Take action to minimize, control, or eliminate the conditions which contribute to the production of leachate.

The EPA put a lot of thought into how to construct a liner; you would think, therefore, that if they did a pretty good job, the water would not flow through plastic, right? And even if it did leak, there is a thick clay layer to stop the water there, too. Unfortunately, all liners leak. How is this possible? Imagine trying to lay down plastic over entire football field. Plastic wide enough to cover a football field does not exist, so engineers have to piece it together. Not only is it very difficult to make perfect seams when taping plastic together, it is also very easy to puncture or tear the plastic when it is installed. Generally, there is a lot of room for defects in the plastic liners. Engineers are continuously working on better ways to make plastic liners for sanitary landfills. This is important to keep harmful contaminants from our groundwater supplies.

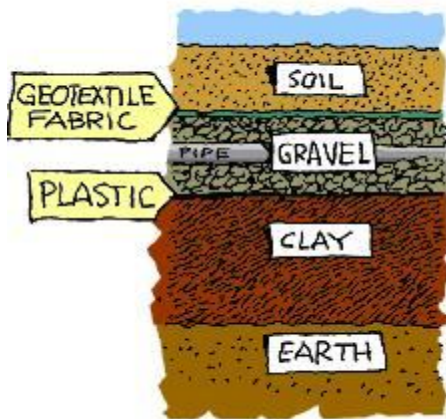
Vocabulary

Leachate is water that is produced by leaching or filtering through a landfill. Leachate often contains high amounts of organic matter and/or toxic chemicals. Leachate can also cause erosion if not managed properly.

PROCEDURE

Cut garbage bags into 2"-wide strips. (Note: The length of the strips will vary depending on the garbage bag and how you cut them, but try to make the stripes equal in length.) Measure out a 12" length of masking tape for each group. Make an example bag out of 5 strips to show the class.

With the Students go over the layers of a landfill liner with the students.



Give each pair of students five 2"-wide strips of garbage bag and 12" of masking tape. Instruct students that they are environmental engineers who are working to build a thin plastic liner layer for a sanitary landfill using limited materials (a liner that is cost effective). Instruct them to make a plastic bag that can hold one cup of water without leaking. Ask the students to think about why a bag might leak while making their designs. If competition works well in your classroom, tell the students the bag that leaks the least amount of water wins (you determine the prize).

Have students test bags as soon as they have put one together.

To test the bags, have one student hold the bag over a large beaker or measuring cup. The teacher or another student can pour exactly one cup of water into the constructed plastic bag. Time one minute and then measure the water that leaked through the bag. Have students record their times on a piece of paper or on the board.

Students can redesign their liner as many times as time allows. They can opt to fix where their bags were leaking or construct a new bag. With five minutes left, let students clean up. Announce the winner if there was one, and ask the students where they thought their bags leaked. (Answer: hopefully the students realized that the seams between the strips leaked the most.) Ask students if they think real landfill liners will leak. (Answer: All liners constructed have leakage, but the amount of leakage varies.) Ask students why they think landfill liners leak? (Answer: Students may come up with the seams or defects in the liner.) Ask students to imagine trying to design the same type of liner for a landfill the size of a football field. Would it leak? Remind students that this liner is a challenge that environmental engineers face when developing sanitary landfills.

Discussion

Ask students to brainstorm a list of pollutants that could get into groundwater from a landfill. What effects do these pollutants have on us and our environment? Ask students if they have ever placed cleaning chemicals, paints, stains, nail polish or even white-out in the trash? Could these materials create toxic leachate? What are possible solutions for reducing these types of pollutants?

Ask the students how they could improve their landfill liner and have them redesign and test their ideas. Casually monitor how many times the students test their bags. Each student should test their bags at least once. Have the students "show and tell" to the rest of the class the landfill liners they created, explaining their work to the other students.

Have the students draw a picture of a landfill. Then, ask them to draw an engineering liner system in their picture and try to name as many of the layers as they can. If time allows, have them use arrows to represent the flow of contaminants through the landfill into the ground water and associated aquifer. Have them name the path of groundwater as well.

Have the students brainstorm ideas to design a sanitary landfill liner and leachate treatment system for a landfill that has mostly waste from household garbage. First, assign one student in the group to be the recorder. Then have someone toss out an idea. Next, another person in the group provides an idea that builds on the first. Go around the group in this fashion until all students have put in enough ideas to put together a design. When they are done, have them share their ideas with the class.

ASSESSMENT

After this activity, students should be able to:

- Describe leachate and its effects on ground and surface waters if not captured.
- Use the engineering design process to design a prototype plastic landfill liner.
- Collect data by measuring volume of water retained by their model.