

How to Make an Edible Landfill

Supplies (per student)

Clear plastic cup
Spoon
Zip close bag – may be reused at end to hold completed landfill
Food (see below)

Teacher/adult should also make a landfill. A “spill” may occur and teacher may need to give his to student.

Layers of an Edible Landfill

Oreo (crushed)
2” piece of Fruit by the Foot
1 string of Pull ‘n’ Peel Twizzler, encircled on the top of fruit by the foot
½ Graham Cracker (crushed)*
½ Graham Cracker (whole)*
3” Twizzler Section, stand along side of cell (cup)
1/3 cup Cereal & M&M’s ***
2 Nilla Wafers (crushed)
[Imaginary layer]
Spoonful of Pudding
Sprinkling of Décor Sugar

Layers of a Real Landfill

Clay
Plastic Liner
Leachate Pipes
Drainage Layer
Drainage Blanket
Methane Gas Pipes
Trash
Daily Cover
Cap (Clay & Plastic Liner)
Top Soil
Vegetative Cover

***Additional activity: Have students separate out 10 items from their “trash”. Out of these 10 items, have them make three piles: a pile of 6, a pile of 3, and a pile of 1. The 6 represents 60% of the trash in this country which is land-filled, so have them put that pile into their edible landfills. The 1 represents the 10% of trash in this country that is incinerated, or burned, but since we don’t have an incinerator, have them eat it. The 3 items represents 30% - the amount of trash in this country that is recycled. Recycle these 3 items as - food! (Students can pop them into their mouths!)

*It’s best to give out the two halves of graham cracker separately so that students understand they represent two *different* layers that are working together.

Edible Landfills Presentation

Background & Introduction

Begin by asking students what they know about landfills, and especially what else they might call them. Someone will say it's a "dump". Explain the difference between a landfill and an open dumping situation.

Dumps are somewhere people decided to throw trash on the ground, either on their property or someone else's. It's ugly, dangerous and illegal! Have the students think about what all they throw out in their trash everyday – how might it be a problem if it were just laying in their backyard? To begin with, it probably won't all stay there since animals are likely to spread it around. They are attracted by the odors and think they might find something to eat. What's worse, besides the smell, some items can give off toxic fumes after being exposed to the elements. These are potentially harmful to humans and animals. Fire is another concern, as are gases escaping from large items like appliances. Refrigerators, freezers, and air conditioners all contain Freon – a poisonous gas. But ultimately, the primary concern with a large open dumping situation is soil and water pollution. As it rains, anything in or on the garbage is washed into the soil and trickles down into the water table. This can poison the water not just at the site of the open dumping, but can spread to contaminate the water supply of many people through the water table. It may also simply run downhill to a nearby stream, potentially poisoning the animals that rely on it for their water.



A landfill is something altogether different, although it looks like a big pile of trash! A landfill starts with a shallow hole. The first concern is to protect the water table, so the first two layers ensure that nothing can seep down into the soil. The first layer is a thick **compacted clay liner**. It provides a solid support for the second layer, a **flexible plastic membrane liner**. This liner is a heavy duty plastic with threads like dental floss running through it to make it stronger. This way when it rains or when the garbage is squished, the "juices" are trapped by the liners. Any water that runs over garbage is called **leachate** and the next layer is the pipe that is used to empty out the leachate from under the landfill. The pipes carry the leachate to a special holding area called leachate tanks. The system of pipes and tanks are called the **leachate collection system**.

The next two layers work together to hold these pipes in place and to keep the garbage from clogging them up. The first is called the **drainage layer** and can be made up of sand, shredded tires, or crushed glass. Over top of this goes the **drainage blanket** – a mesh type fabric that lets water through but keeps the garbage out. The drainage blanket acts just like a colander in your kitchen. Making spaghetti is a good example; when you drain the cooked spaghetti, the colander holds the spaghetti in but lets the water run out. This is what a drainage blanket does in a landfill. Finally, we can put in the garbage.

But wait! Once you start to pile up all that garbage, it begins to produce **methane gas**, which is a result of the minor decomposition that is taking place. Methane gas is flammable

and something we don't want trapped in pockets inside the landfill. To keep it from collecting inside, we pipe it out like we pipe out the leachate, but these pipes run vertically, right through the trash. The vertical pipes are called **methane gas pipes**. At a small landfill, like the Wood County Landfill, we can let it dissipate into the air since there isn't much of it. At a larger landfill, like Evergreen Disposal Facility in Northwood, the gas is collected and piped to nearby businesses to be reused for energy.

In a landfill, space is precious. We have to have permits from the Ohio Environmental Protection Agency if we want to expand horizontally (use more land acreage) or expand vertically (go higher). This can be a long and expensive process. In order to conserve space, we pack the trash using a **compactor**. It's a large, heavy vehicle (80,000 pounds!) with spiked tires that crushes and compacts the garbage. The compactor runs over the garbage all day as it is being brought in. At the end of the day we have a lot of trash laying out in the open. To keep it from blowing around and from attracting small scavengers, we cover it. Options for a **daily cover** include 6" of topsoil, 1" of tire shreds, or 1" of Con Cover, a recycled newspaper product. Because vertical height is so important, the 1" of material is the better choice. The Wood County Landfill uses Con Cover, which is sprayed on by a special machine. It's dyed green so that it's easy to see where you've already applied it, but it does make the trash look moldy!

Eventually, after many days and years of trash and daily cover, the landfill **cell** does fill up and must be closed. In order to do this, the trash must be contained (locked in) to keep the Earth and everyone safe. The first step is to cover the garbage with another set of liners like the ones on the bottom, the clay liner and the plastic liner. When the liners are at the top of the landfill, they're part of the **cap**. Then comes 12" to 18" of topsoil to protect the new cap and, finally, something to keep the soil from washing away. That's when usually grasses are planted and this is called the **vegetative layer**. Shallow rooted bushes can also be planted, but larger things, like trees, would send roots too deep and could puncture through the clay and plastic liners.

As you can see, this is a lot more complicated – and a lot safer – than a “dump”. The Wood County Landfill is a small landfill. We only bring in approximately 100 to 150 tons of garbage per day, that's 200,000 to 300,000 pounds. That sounds like a lot, but, for comparison, a medium sized landfill such as Evergreen Landfill in Northwood, Ohio brings in about 3,500 tons of garbage *per day*...which calculates to 7 million pounds. A larger landfill, such as the Rumpke Sanitary Landfill in Cincinnati, is permitted to accept up to 10,000 tons *per day*, or 20 million pounds! That's a lot of trash!

It's important for the students to realize that this is *their trash*! The garbage trucks collect people's trash. People throw a lot of stuff out, sometimes it's stuff that is still good or could have been recycled. But once it's “trash”, someone has to do something with it! We don't have a really good way to “get rid of” trash; the best we can do is lock it up in the Earth with liners so it isn't harming people, animals, or the environment. To do that, we use the system of layers that we just talked about. In this project, you'll build a representation of those layers out of something much tastier than clay, plastic, and trash.

You Figure Your Waste

How much garbage do you make?

In U.S.A = 2 pounds to 7 pounds per day

National Average $2 + 7 = \underline{\hspace{2cm}}$ $\div 2 = \underline{\hspace{2cm}}$ *

*pounds of garbage each day: fast food, home, school, work.

X days in month of = pounds per month.

X 12 months in a year = pounds per year.

X years, how old you are = pounds.

Divide this by 2,000 pounds (which = 1) = Tons*

*This is how much garbage you have had since you were born!!

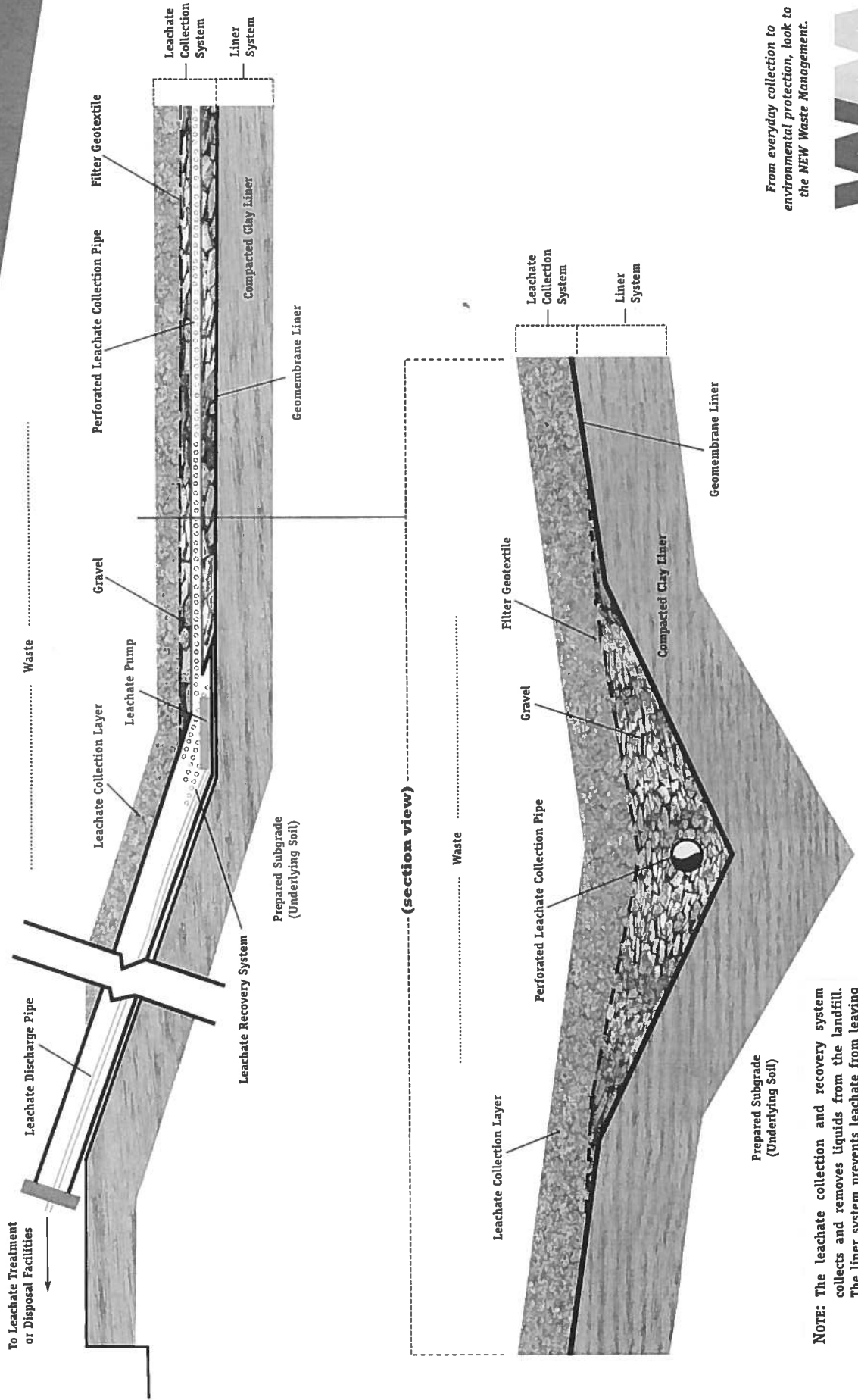
X number of people in your class = Tons.

+ your teacher's waste since he/she was born = Tons.

X number of students and adults in your school = Tons.

What about in your town/city, county, state, country, the world?

Typical Leachate Collection and Recovery System



NOTE: The leachate collection and recovery system collects and removes liquids from the landfill. The liner system prevents leachate from leaving the landfill.

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(Not to scale)

Typical Anatomy of a Landfill

Protective Cover

- 1 COVER VEGETATION**
As portions of the landfill are completed, native grasses and shrubs are planted and the areas are maintained as open spaces. The vegetation is visually pleasing and prevents erosion of the underlying soils.
- 2 Top Soil**
Helps to support and maintain the growth of vegetation by retaining moisture and providing nutrients.
- 3 PROTECTIVE COVER SOIL**
Protects the landfill cap system and provides additional moisture retention to help support the cover vegetation.

Composite Cap System

- 4 Drainage Layer**
A layer of sand or gravel or a thick plastic mesh called a geonet drains excess precipitation from the protective cover soil to enhance stability and help prevent infiltration of water through the landfill cap system. A geotextile fabric, similar in appearance to felt, may be located on top of the drainage layer to provide separation of solid particles from liquid. This prevents clogging of the drainage layer.
- 5 Geomembrane**
A thick plastic layer forms a cap that prevents excess precipitation from entering the landfill and forming leachate. This layer also helps to prevent the escape of landfill gas, thereby reducing odors.
- 6 Compacted Clay**
Is placed over the waste to form a cap when the landfill reaches the permitted height. This layer prevents excess precipitation from entering the landfill and forming leachate and helps to prevent the escape of landfill gas, thereby reducing odors.

Working Landfill

- 7 Daily Cover**
At the end of each working period, waste is covered with six to twelve inches of soil or other approved material. Daily cover reduces odors, keeps litter from scattering and helps deter scavengers.
- 8 Waste**
As waste arrives, it is compacted in layers within a small area to reduce the volume consumed within the landfill. This practice also helps to reduce odors, keeps litter from scattering and deters scavengers.

Please Note: This illustration depicts a cross section of the standard environmental protection technologies of modern landfills. While the technologies used in most landfills are similar, the exact sequence and type of materials may differ from site to site depending on design, location, climate and underlying geology.



(Not to scale)

Leachate Collection System

Leachate is a liquid that has filtered through the landfill. It consists primarily of precipitation with a small amount coming from the natural decomposition of the waste. The leachate collection system collects the leachate so that it can be removed from the landfill and properly treated or disposed of. The leachate collection system has the following components:

- 9 Leachate Collection Layer**
A layer of sand or gravel or a thick plastic mesh called a geonet collects leachate and allows it to drain by gravity to the leachate collection pipe system.
- 10 Filter Geotextile**
A geotextile fabric, similar in appearance to felt, may be located on top of the leachate collection pipe system to provide separation of solid particles from liquid. This prevents clogging of the pipe system.
- 11 Leachate Collection Pipe System**
Perforated pipes, surrounded by a bed of gravel, transport collected leachate to specially designed low points called sumps. Pumps, located within the sumps, automatically remove the leachate from the landfill and transport it to the leachate management facilities for treatment or another proper method of disposal.

Composite Liner System

- 12 Geomembrane**
A thick plastic layer forms a liner that prevents leachate from leaving the landfill and entering the environment. This geomembrane is typically constructed of a special type of plastic called high-density polyethylene or HDPE. HDPE is tough, impermeable and extremely resistant to attack by the compounds that might be in the leachate. This layer also helps to prevent the escape of landfill gas.
- 13 Compacted Clay**
Is located directly below the geomembrane and forms an additional barrier to prevent leachate from leaving the landfill and entering the environment. This layer also helps to prevent the escape of landfill gas.
- 14 Prepared Subgrade**
The native soils beneath the landfill are prepared as needed prior to beginning landfill construction.

Landfill Vocabulary

Best Available Technology (BAT)

An acronym for environmental engineering practices that utilize the latest technology.

Cells

A series of areas designed and prepared to accept waste.

Compacted Clay

Dense firm earth made with very small particles; compacted with construction equipment, to be used as a protective layer in a landfill cell. The clay also serves as a stable base for the plastic liner.

Compactor

A large, heavy machine that spreads out and rolls over garbage as it is delivered to the working face. The spiked steel tires allow it to crush garbage and minimize the amount of space it requires. A compactor may weigh up to 120,000 pounds.

Daily Cover

Applied daily over the working face of a landfill to help prevent blowing trash, prevent odors and to discourage scavengers. It can be composed of topsoil or products such as Con-Cover (a mixture of water biodegradable powder and shredded paper).

Drainage Blanket

A non-woven geotextile blanket that allows liquids to pass through and into the drainage system of a landfill.

Drainage Layer

A layer in a landfill made up of sand, shredded tires, or ground glass designed to hold the leachate pipes in place and provide a base for the drainage blanket.

Final Cap System

A multi-layered system consisting of vegetation, a soil layer, and a barrier layer. Capping prevents infiltration of rainwater into landfill cells and covers a landfill for safety and aesthetic reasons.

Flexible Membrane Liners

A high density polyethylene (HDPE) plastic liner, 60 mil thick, constructed on the bottom and sides of a landfill to prevent the release of contaminants to the environment.

Ground Water Monitoring Wells

Wells placed around the perimeter of a landfill. They are used to monitor ground water for potential migration of contaminants.

Leachate

Precipitation or liquid that falls on the landfill or comes into contact with solid waste.

Leachate Collection System

A series of pipes embedded in the drainage layer at the bottom of a landfill. It collects any leachate that travels through the waste. The leachate is pumped out of the system and treated.

Methane Gas

A by-product of landfills as waste decomposes. Methane gas consists mostly of methane and carbon dioxide. It is an odorless, colorless, flammable gas. When extracted and processed, it can be used as a source of clean energy.

Methane Gas Pipes

Pipes through which methane gas escapes to the surface.

Municipal Solid Waste

The type of waste generated by people in their homes and at work, as well as non-hazardous materials discarded from commercial and institutional businesses.

Sanitary Landfill

A state-approved and designated area of land where natural conditions and man-made modifications produce an environmentally safe location for disposing of solid wastes.

Subtitle D Regulations

Refers to the minimum environmental standards enacted by the federal government. Each state has the responsibility to apply these standards for the treatment and disposal of solid wastes in landfills.

Surface Water Control System

A series of channels to collect and transport rainwater off of a landfill's cap system and slopes to a sediment pond where the sediment settles before the water runs off the site.

Tipping Fee

A monetary charge placed on the acceptance of solid waste at a landfill, transfer station, or other facility. The fee is determined by weighing the waste load of each truck at the gate, and it is applied on a "per ton" basis. Another form of tipping fee is the measurement of a load of garbage, calculated in cubic yards.

Toxic

Poisonous

Working Face

The area in a cell where waste is disposed of at a given time.