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.

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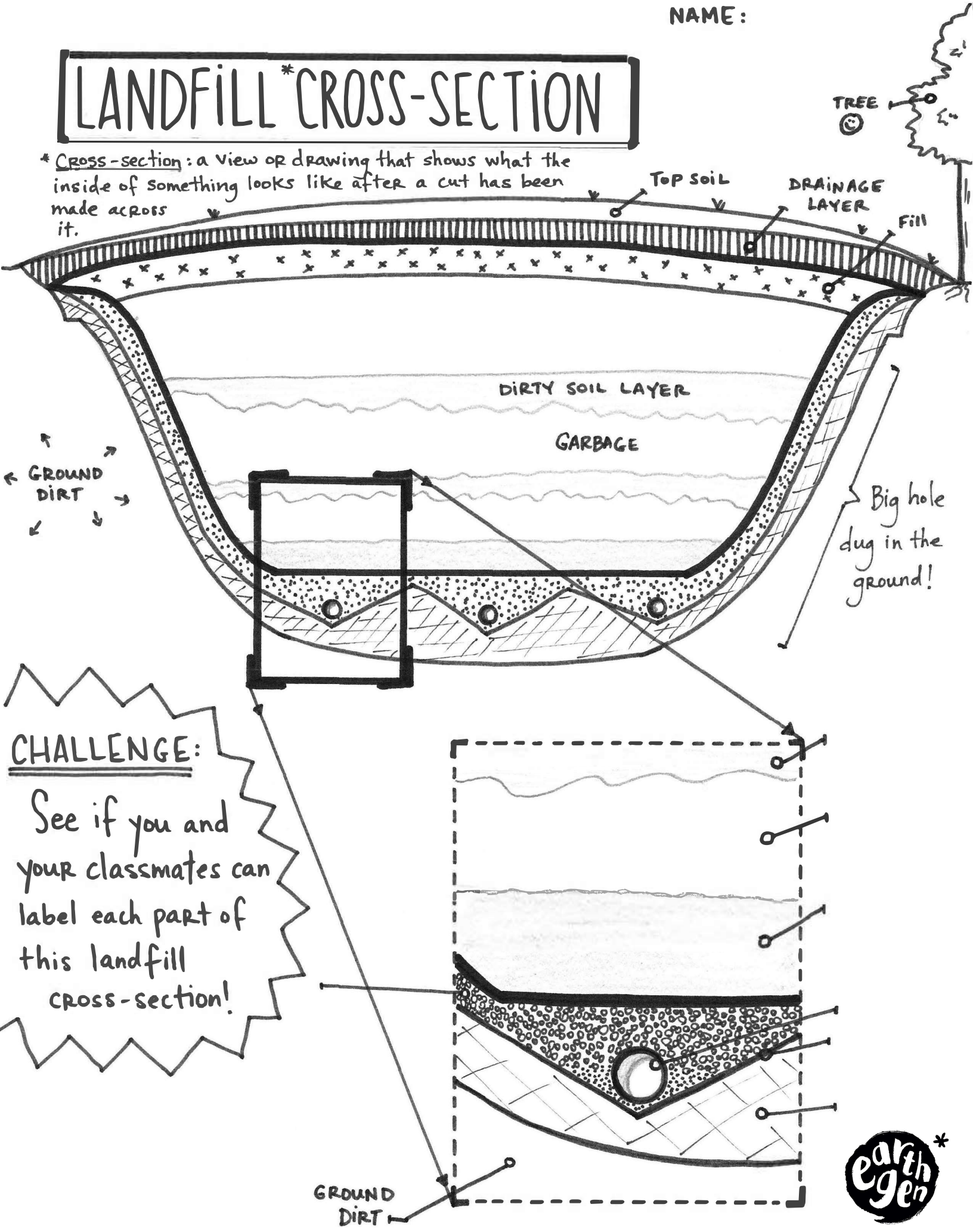
WASTE MANAGEMENT

From everyday collection to environmental protection, Think Green.® Think Waste Management.

NAME:

LANDFILL* CROSS-SECTION

* Cross-section: a view or drawing that shows what the inside of something looks like after a cut has been made across it.



CHALLENGE:

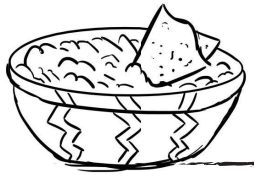
See if you and your classmates can label each part of this landfill cross-section!

earth gen*

Student Name:

Date:

Use this space to draw your idea! Label your drawing, and include your reasoning below.



WHY DID THE GUACAMOLE NOT DECOMPOSE?

Explain your reasoning:

IDEA CORNER:

- landfill
- trash
- sunshine
- oxygen
- gases
- guacamole
- parts of the landfill
- rain
- animals, plants, etc.
- liquids

What are those little packets inside my beef jerky?

Adapted from Why Does Beef Jerky Packaging Need An Oxygen Absorber? by ABC Packaging Direct. Rewritten and edited by R. Osias & N. Haroutunian

Have you ever eaten beef jerky? Maybe salmon jerky? Or how about turkey jerky? Everyone has their favorite, but chances are high that if you have ever opened up a plastic package of jerky, you have discovered something else inside of it: a small rectangular pouch or packet with a warning labeled on the outside saying “Do Not Eat”. What is that thing, and why is it sitting in the package with the jerky?

What is an Oxygen-Absorber?

The little white packet you can find inside a bag of jerky is an oxygen-absorber. These little packets made of porous paper are commonly filled with salt or activated charcoal. This breathable paper allows air to move in and out of the packet. The salts chemically react with the oxygen inside of the bag of jerky and absorb it. The salts are kept safely inside of the small oxygen-absorbing packet so a person enjoying their jerky does not accidentally eat the salt.

Why are Oxygen-Absorbers Used?

Oxygen absorbers are used in plastic bags of food to prevent the growth of fungi and bacteria, which can make the jerky unfit to eat. This is achieved by keeping oxygen levels inside the food packages or other packaging close to zero. Aerobic bacteria (those who need oxygen to survive) cannot live in an atmosphere without oxygen. So a lack of oxygen prevents the beef jerky from rotting. For manufacturers and consumers, this means fresher jerky, which means a longer shelf life.

Other Methods of Preventing Food from Rotting

Vacuum packaging is another method to prevent fungus and bacteria from growing in a package of jerky, which prolongs its shelf life. By removing all of the oxygen from the package, similar results are achieved. Manufacturers prefer oxygen absorbers because they are more convenient, they can be used with foods that are fragile, and they look better than vacuum-packed bags of food that looks crumpled when all the air is sucked out.

Food: Then and Now

Adapted from First Nations Traditional Foods by First Nations Health Authority and Preserving the School Garden Harvest by KidsGardening.org.
Rewritten and edited by R. Osias & N. Haroutunian

Have you ever thought about how much work goes into keeping our food fresh and close at hand? In the modern age, we have plenty of options in how we preserve, save, and store our foods. But can you imagine how food was preserved 200 or even 500 years ago before electricity, refrigeration, or even before canning?

Air, Sun and Freeze Drying

Seeds, fruits and vegetables of all kinds were naturally dried for winter storage in cool, dry places with good airflow. In fact, air drying was likely the most common means of preservation. A variety of special drying racks were created to hang herbs, garlic, onions, and other things for drying.

Sun drying was typically reserved for fruits, such as berries, tomatoes, and even some meats. Salmon and other fish were a common thing to see drying outside on racks.

Natural freezing was often used in colder climates. The Incas relied heavily on natural freeze drying. They learned that food stored in the frozen mountains in the Andes, which froze at night and was warmed by the sun during the day, dried faster.

Smoking and Salting

Natural smoke and salt were also commonly used for fish and red meat. Salted or unsalted meats were hung or racked in a tipi or shed smoking structure and slowly smoked with fragrant woods, like alder, mesquite or apple wood. Smoked meats were preserved by a combination of drying, cooking, and aromatic smoke, which protects meats from spoilage and insects.

What do they have in common?

There is one thing all preservation methods, contemporary and traditional, have in common. All keep food from spoiling by removing or inactivating bacteria that cause spoilage or insects that can eat away at food. This is done by the removal of water and often oxygen.

Salmon are a staple item in the diets of many people, and especially the First Nation People. Salmon are cut and cleaned in a manner that demonstrates reverence and facilitates preservation. The most common preservation method for many Pacific Northwest tribes was to spread the filets of salmon over long horizontal poles in the sun and wind. The sun acted as a moisture absorber, drying the meat out, and protecting it against bacteria and insects. Many individuals still use these methods today to preserve the season's catch, and to save the delicious harvest for all year long.

Mummy Mystery

Adapted from Case of the Rotting Mummy by the Harvard Gazette
Rewritten and edited by R. Osias & N. Haroutunian

Something strange has been happening at the University of Tarapacá's archeological museum in Chile. Over the past several years, the museum's famous collection of 120 Chinchorro mummies have been decaying at an alarming rate. In some cases, parts of the 7,000-year-old mummies have even turned into black ooze.

"In the last 10 years, the process has accelerated," said Marcela Sepulveda, a professor of archaeology. "It is very important to get more information about what's causing this and to get the university and national government to do what's necessary to preserve the Chinchorro mummies for the future."

Scientists from around the world began studying the mummies to figure out what was going on. "We wanted to answer two questions," scientist Ralph Mitchell said. "What was causing it and what could we do to prevent further degradation?"

Testing for Moisture

After months of testing mummy skin in the lab, Mitchell and his team believe they have solved the mystery. They say that extra humidity is to blame. The wetter weather allows tiny living things called microbes, otherwise known as bacteria, to thrive. And microbes are eating away at the mummies.

Scientists at Work

In the lab, the scientists exposed pig skin and then mummy skin to very moist air. After 21 days in the extra humid environment, both skin samples began to break down. "The water activates the microbes," Mitchell stated.
So, what do moist conditions in a lab have to do with the mummies' home in the museum?

Driest Place on Earth

The mummies are from a group of people called the Chinchorro, who lived along the coastal region between modern-day Peru and Chile, close to the Atacama Desert. The Atacama Desert is one of the driest places on Earth. The dry air has helped to preserve the mummies for thousands of years.

But experts say the area, which is also where the museum is located, has recently become extra humid due to climate change. In order to prevent the mummies from continuing to rot, Mitchell's team says the humidity in the museum must be kept between 40 and 60 percent.
With this mummy mystery solved, Mitchell can lend his experience to other problems. He says climate change could cause harm to other ancient objects. "Is climate change making important artifacts vulnerable?
The answer is yes," he says.

Museum Art – Preserving Against Time

Adapted from Preserving Plastics by Time for Kids.
Rewritten and edited by R. Osias & N. Haroutunian

On July 20, 1969, Neil Armstrong became the first person to walk on the moon. The space suit Armstrong wore to the moon has come to symbolize human achievement. In 1971, Armstrong's suit went to the Smithsonian's National Air and Space Museum (NASM), in Washington, D.C. It stood proudly on display. But there were changes to the suit. "Over time, the suit started to show signs of deterioration," Lisa Young told TIME for Kids. Young is an objects conservator at NASM.

Have you ever wondered why paintings, textiles, and other items, like space suits, don't degrade in a museum? Even after hundreds of years? How do museum staff prevent all this artwork from breaking down so future visitors can enjoy it?

The Science of Preservation

The materials and techniques used to make art vary enormously. In the paintings alone you might come across traditional media such as oil paint, canvas, resins, waxes, and wood. You may also encounter some unusual materials such as plastic, blood, insects, vegetation, and even chocolate!

Because of this huge array of materials and techniques, they have to use special science to figure out the best ways to care for art. Conservation scientists conduct experiments to find the best preservation techniques. Often, they will recreate a piece of art using the same materials and techniques. With this "clone" version they subject it to a variety of controlled conditions to see how it will respond to light, oxygen, and the aging process.

Sun and Oxygen

Have you ever left a piece of paper from school sitting near the window at home? Even a little bit of sun over a few days can rapidly change the ink on the paper! Special engineers and designers have constructed different cases and types of glass, which are made specifically to protect art against oxygen, moisture, and sunlight. Without the hard work of the conservation specialists and scientists, our art world would be completely different!

History Can Still Be Saved

Scientists have found that storing plastics in cooler temperatures can slow degradation. So can lower levels of humidity. Armstrong's suit is now in storage at a temperature of 63°F. The relative humidity there is 30%. These conditions will be the same when Armstrong's suit returns to a museum display case.

Oxygen-Free Museum Case

An oxygen-free museum case was created by the Getty Museum to hold their collection of mummies. (http://bit.ly/oxygen-case)

Sun-Faded Construction Paper

Materials, such as construction paper, which are exposed to long hours of sunlight, can be drastically affected, such as this construction paper art project. (http://bit.ly/sunprint-paper)

Photos: Neil Armstrong Spacesuit by NASA via Public Domain

Woolly Mammoth Sparks Debate

Adapted from Woolly Mammoth Sparks Debate Over Cloning by Teaching Kids News.
Rewritten and edited by R. Osias & N. Haroutunian

A woolly mammoth carcass that was frozen in ice for 40,000 years may make it possible for scientists to bring the extinct species back to life. The mammoth was found embedded in ice on a remote island off northern Russia in May 2013. The ice had preserved the body so well, a liquid that looked like blood oozed out of it when it was first discovered.

Scientists were very excited because fresh blood cells may contain DNA, or genetic information about the mammoth. If scientists can find the mammoth's complete DNA, they might be able to clone the animal.

Deep Freeze

After the mammoth carcass was dug up, scientists spent three days studying it and taking samples of its blood and tissues. Then they froze it again to prevent it from rotting.

Dr. Tori Herridge, a scientist at the Natural History Museum in London, England, helped study the wooly mammoth's body. She thinks scientists can learn a lot just by studying the remains of the woolly mammoth. So far, scientists have found out that the woolly mammoth, who they nicknamed Buttercup, was 2.5 meters tall and about 50 years old when she died. By studying the growth rings in her tusks, they can tell that she gave birth to eight calves. Her teeth show that she had dental problems. Poor Buttercup!

By examining the contents found in her intestines, scientists can tell she ate grassland plants like dandelions and buttercups. They think she died after she became trapped in the peat bog and then was attacked by predators such as wolves.

Insung Hwang is another of the scientists working with the woolly mammoth. He said they have not yet found complete DNA in any of the samples, but they have found pieces of DNA that could be pieced together. He added that it will take scientists a long time to analyze the genetic information from the mammoth, and even longer before they actually try cloning the animal.

NAME:

•EXPLORING THE READING•

•WHO is involved?

•WHAT is happening?

•WHEN did this happen?

•WHERE & WHY did it happen?

•HOW do you think decomposition did or did not happen?

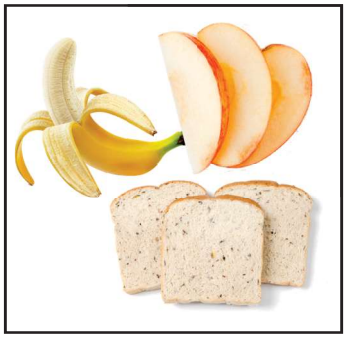
•Based on what you've read, what information do you think is the most important? Why?

RACE TO DECOMPOSITION

Materials List:

A clear container with a lid (can be plastic or glass)

Soil (not potting soil)



A piece of organic material (apple, banana, bread, etc.)

Any other materials that you would like to add to your jar to help speed up decomposition

A notebook or piece of paper (for sketching and observation notes)

A pencil or pen

Video Guide:

What makes an apple core decompose? This video kicks off EarthGen's "Race to Decomposition" – a simple investigation using everyday materials from home. Through a series of four online video lessons, we'll race against time and explore factors that affect decomposition.

Video Notes:

- Shannon uses a slice of apple in her jar, but any piece of organic material (see materials list for ideas) you have in your home will work.
- Shannon uses a small glass jar, but you can use any clear container (plastic or glass) that has a lid.

Share Your Progress:

Keep us updated on your investigation by emailing your drawings or photos to shannon@earthgenwa.org or tag @earthgenwa on social media. We'll share the images we receive, so we can all see your progress.

Questions?

Email Shannon Brennan at shannon@earthgenwa.org.

RACE TO DECOMPOSITION

Engineering and Design Flow Chart

Identify the Problem:
What is the challenge at hand?

Research and Explore:
What have you learned from earlier lessons that you can apply to this investigation?

Design: Create a model of your jar with drawings and labels that show how you would like to set up your jar.

Build:
Begin assembling your jar with materials from your kit and around your home.

Improvements:
Make adjustments to help increase the speed of decomposition.

•COLUMBIA RIDGE LANDFILL•

NAME:

#1 What is a landfill?

#2 How does our waste get from Seattle to the landfill? DRAW IT!

SEATTLE, WA

#4 Why do they transport our garbage that way?

DRAW HERE!

ARLINGTON, OR
- COLUMBIA RIDGE LANDFILL -

#3 _____ tons of garbage go to the landfill each day!

#5 What is "household" waste?

#6 Our tourguide said that the landfill is in an excellent location... Why?

#7 Environmental Protection is a BIG DEAL for waste management. What are 3 methods they use to help protect the environment from the effects of the landfill?

1.

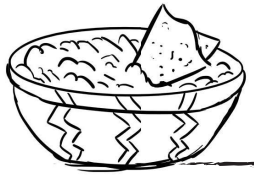
2.

3.

Student Name:

Date:

Use this space to draw your idea! Label your drawing, and include your reasoning below.



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