Lesson Plan: Where the Waste Goes Part 2

The Dump-Investigating Trash Decomposition (Part 2 of 2)

Subjects: Earth Science, Ecology, Biology, Environmental Science, Marine Biology
Materials required: Paper, pencil, trash from numerous households, two sturdy containers, soil (store bought or dug up), wax pencil or permanent marker.
Grade-level: Elementary [3-5], Middle [6-8], High [9-12]
Time required: 50 minute for 4 days*
Related links: History and Use of Landfills and Dumps

*(At least one month is required for experiment to 'incubate' to produce optimum results for discussion. Additional time is required for homework assignments and assessment tools.)

Related documents:

- Golabi, MH; Denton, GRW; Wood, HR; Wen, Y; Iyekar, C. "Impact of Ordot Dump on water quality of Lonfit River Basin in central Guam. 1. Soil characterization of nutrient retention." *Micronesica* 39, Vol. 1 (2006): 41-54.
- Denton, GRW; Golabi, MH; Wood, HR; Iyekar, C; Concepcion, LP. "Impact of Ordot Dump on water quality of Lonfit River Basin in central Guam. 2. Aqueous chemical and biological contaminants." *Micronesica* 20, Vols. 1/2 (2008): 149-167.

Description

In this lesson students will conduct hands on experiments investigating how 'trash' degrades over time.

Emphasis

This lesson emphasizes on building conceptual knowledge regarding where our waste goes once it is disposed of. In addition students will comprehend the difference between types of trash and their impact on the environment.

Objectives/Skills

- Students will understand that materials decompose at varying rates.
- Students will comprehend that the rate of decomposition depends on the composition of the decomposing material.
- Students will understand how recycling may off set the overall trash production in their household, community, island, and the world.
- Students will comprehend the process of trash disposal, from your house to the landfill.

Questions or Assessment

- Go Away Trash Survey – functions as a pre- and post-test
- Take Home Assignments

Day 1: My Trash Cycle

Teacher prep

Administer the Go Away Trash survey prior to instruction. For younger ages, students can be provided with a scaffold:

Draw a flow chart showing the production of trash in your household from where it is acquired to where the trash goes when it is out of your hands. Illustrations encouraged.

Background Information

We all throw our trash 'away'. But where does it go after that? In our case, the trash we produce goes to a dump, currently Ordot dump. This dump is at capacity and has been since October 2007, that's over two years ago! The Ordot dump is an area roughly 54 acres in size located in Ordot, Guam. Trash is received from trash trucks and community members on a daily basis. What happens when our trash arrives at the dump? This process can be broken down into several basic steps: (Consult with students' responses to the previous activity what they think happens to their trash, then discuss what happens)

1. Our trash arrives at the dump, whether its picked up at the house or you drop it there yourself.
2. The trash is moved beyond the dump gates and piled along with all of the waste that was collected that day.

3. After the trash reaches a certain height it is covered with limestone rocks. Standards dictate how much limestone rock should be deposited. The limestone rock aids in decomposition and filtration of the leachate that is a byproduct of the dump (more on leachate below).
4. There are major differences between a dump and a landfill.
   - Both landfills and dump produce leachate, a toxic liquid byproduct of the decomposing matter in the dump. Leachate is formed primarily by precipitation that filters through the landfill contents. Leachate can vary in its composition, depending on what the dump or landfill contains. ** This provides a good opportunity to review or introduce the water cycle!**
   - Think of a dump as a hole in the ground where trash is deposited, the pile keeps getting higher. A landfill is more sophisticated in that it is a hole in the ground, lined with durable plastic to prevent leachate from contaminating the surrounding soil. In a landfill there are mechanisms in place to remove some of the toxic leachate and the toxic gas methane that builds up as a result of decomposition. In dumps, these mechanisms are not present, so both the leachate and methane gas escape into the environment.
     - Consult this video for information about a landfill in Massachusetts. Vimeo File: So how does a modern lanfull work? Dumps get old and there are protective mechanisms for environmental safety that can fail. Even the best landfill gets old, and leachate is deposited in the environment and can present risks to the population, as is the case in this video.
     - In Guam's case, rain is the primary form of precipitation forming leachate. When it rains, the H20 seeps into the soil and the dump contents eventually making it to the bottom of the dump where the leachate directly enters the environment. The lechate that exists in the Ordot Dump has been researched by professors, Dr. Golabi and Dr. Denton, at the University of Guam. Their work has been very important in identifying how the dump affects our local environment. These scientists sampled areas within the landfill and at sites along the Lonfit River. Their findings are summarized below, the articles are published in Micronesica (references below):
       - A significant amount of leachate leaks from the surface of the dump.
       - The leachate contaminates the ground water and springs minimally due to the type of soil that surrounds the dump.
5. The soil that surrounds the dump is able to retain toxic nitrate and phosphate compounds. This soil is known as kaolinitic soil, commonly known as china clay. The clay reduces the concentration of toxicants in runoff and thereby reduces the contaminants infiltrating the Lonfit River, a major waterway in the Pago Bay Watershed.
6. Heavy metals, such as lead, manganese, iron, chromium, and barium, are found in the leachate. In some cases these heavy metals exceed the Guam Water Quality Standards for surface and/or drinking water (i.e., Lead, Chromium, Manganese and Nickel). Small amounts of some heavy metals (iron, cobalt, copper, manganese, molybdenum, and zinc) are required for normal physiological processes, however, excessive amounts can be hazardous to organisms, including humans.
7. Levels of Enterococci and E. Coli (bacteria that can be toxic to humans) exceeded U.S. EPA recreational water quality standards from the dump to the extent of Pago Bay.
8. Nitrates, likely from fertilizers and pesticides, were often found to exceed U.S. EPA surface water quality standards for nitrates. Nitrates can be hazardous to our health and that of ecosystems. Nitrate can can cause nitrification of our water systems supporting the growth of algae and plants which negatively affects the propagation of coral reef ecosystems.
9. Phosphate levels were insignificant. This is good because phosphates can also be damaging to our bodies and healthy coral reef ecosystems.
10. Read more about the history and use of landfills and dumps here: History of Landfills

Activity

Have the students draw a picture/poster of the trash disposal process.

Challenge Questions

1. Considering what you learned in the last week with Where the Waste Goes lesson plan, how long do you think it will take the Ordot dump to decompose all the waste that has been collected since 1941 when it was created?
2. What is the difference between a landfill and a dump?
   - Find your answer here: Ordot Fact Sheet
3. Why it is important to know what contaminants are entering our waters from a dump or landfill?
4. How do scientists test for contaminants?
5. What do we know about the soil composition at the new landfill site (Dan Dan Landfill)?
6. What happens if the soil is not capable of filtering the leachate as it does at the Ordot Dump?

Revisit what it means to be biodegradable
The information in this lesson plan aims to build on the information in Lesson Plan 1 by the following:
1. Give students an opportunity to compare and contrast decomposing matter of varying makeup,
2. Visualize that organic materials (biodegradable) decompose at a faster rate than non organic (non biodegradable) materials.

In the simplest terms biodegradable means a material that is able to be degraded, or broken down. Refer to the websites listed below for more information about biodegradable vs. non-biodegradable resources. Examples of biodegradable materials are: apple core, bones, paper, and flowers. Non-biodegradable refers to materials that are not broken down by organisms. Examples of non-biodegradable materials include: plastic, glass, polyester clothing items, and aluminum cans.

Things that are biodegradable are often made of organic materials, or things naturally occurring in our environment, not those synthetically produced in a lab. For instance, a banana peel is biodegradable and will take approximately 3 days to degrade, but a plastic bottle will take hundreds of years!

Assignment
Each student should be tasked with bringing in trash. A suitable amount of trash would be that produced by their family unit within one day. Family unit defined as those people with which the student resides. Encourage students to include all trash, smelly or not, plastics, fish bones, food parts, etc. If you conduct the experiment the following day, you won't have to worry about a smelly classroom! Have students create a log of the trash they have brought in (this way they don't have to log it in your classroom.)

Using the trash log that you have created, answer the following questions:
1. What percentage of your trash is biodegradable?
2. What percentage of your trash is non-biodegradable?

	Biodegradable	**Non Biodegradable**	**Totals**
Number of Items			
Percentage of Total			

Day 2-3 (and beyond): Making a DUMP/Landfill!
This part of the lesson plan involves long-term monitoring, the longer the period of 'incubation' the more conclusions can be made from the results of the experiment. Follow the following steps to create your own mini-DUMP. It may be best if you can arrange with your school principal for a outdoor location for you mini-DUMPs to incubate, the heat and exposure to the elements (rain, wind, etc) will best replicate that which occurs in our very own Ordot Dump. *What we are replicating is most like a landfill because we have an impermeable lining at the bottom of our depository.*

Prep work
Drill several small holes in the top the plastic container that will act as your landfill for the next 30 days or so. *Clear plastic bins are nice so you can visualize the decomposition process over time.* The class can be divided into small groups to minimize supply cost, so each group of students will place their trash into one plastic container.
1. Place some soil on the bottom of the container.
2. One at a time, have students dump the contents of their trash collection into the bin. Make sure that the contents of each dump are spread out evenly over the surface of the dump. After each deposit into the dump, cover the contents with 6 inches of soil.
3. When all the students have deposited their trash into their dump place another 6 inches of soil on top of the contents.

4. Place the lid on container and wait.

Follow-up
Check back on the contents of the dump on a weekly basis. Ideally, the dump should incubate for 30 days or more.

Challenge Questions
(to be completed at the completion of the dump incubation)
1. After dissecting the contents of your dump, what contents had degraded? (Use your trash log to reference what you put in it in the first place).
2. What contents had not degraded?
3. List the contents that did not degrade:
4. Why did some contents not degrade in the given period of time?
5. What percentage of the items rang true to their names, biodegradable or non-biodegradable?
6. How could you change your trash production to increase the percentage of biodegradable trash that you produce?

Day 30+: My Trash Cycle (post-activity)
Activity
Administer the Go Away Trash survey prior to instruction. For younger ages, students can be provided with a scaffold:

Draw a flow chart showing the production of trash in your household from where it is acquired to where the trash goes when it is out of your hands.

Editor's Note: Funding for this lesson plan was provided by the Sea Grant Program, University of Guam. Please email Laura Biggs, PhD at biggs.laura@gmail.com with any questions or comments.