



Filling Our Land With Landfills

Solid Waste Disposal



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Grade Level	9th – 12th Grade	Time Frame	250 minutes
Subject	Science	Duration	4-5 class periods
Course	Environmental Science		

Essential Question

What is the best solution for waste disposal?

Summary

This lesson is intended for AP environmental science, and the workload reflects that. For non-advanced courses, there are modifications to make the lesson suited for your classroom. Students will learn about the purpose of a landfill. Students will also learn about the features of a well-designed landfill and possible problems that can occur if the landfill is improperly constructed or has a structural breakdown. Finally, students will research alternatives to landfills and present an argument for landfills or one of the alternative solutions for waste disposal.

Snapshot

Engage

Students view a picture of a landfill and discuss its purpose as a class. Next, students watch a video of the landfill process. Finally, students label and discuss the parts of a landfill.

Explore

Students design and construct working models of three different landfills (i.e., open dumping, an improperly designed landfill, and a properly designed landfill) and make observations about the effectiveness of these models.

Explain

As a class, students discuss the three different landfill models using questions from a study guide.

Extend

Students read an article about landfills and think about why landfills may not be the solution in the future. Students then research alternative solutions (i.e., waste-to-energy incineration, anaerobic digestion, reduce-reuse-recycle, composting, and pyrolysis) and present that information to the class.

Evaluate

Students write a letter explaining why we should put more tax dollars into landfills or one of the alternatives and why.

Standards

Next Generation Science Standards (Grades 9, 10, 11, 12)

HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Oklahoma Academic Standards (Environmental Science)

EN.LS2.4.1: Plants or algae form the lowest level of the food chain.

Attachments

- [Landfill Slides.pptx](#)
- [Leaky Landfill Lab - Spanish.docx](#)
- [Leaky Landfill Lab - Spanish.pdf](#)
- [Leaky Landfill Lab.docx](#)
- [Leaky Landfill Lab.pdf](#)

Materials

- Computer (for research)
- Pens and highlighters
- Red food coloring (enough for all group sponges)
- Newspaper or paper towels (enough for all groups)
- 1 clear, wide-mouthed glass jar (per group)
- 1 measuring cup (per group)
- Soil (per group)
- 1 cup of gravel or pebbles (per group)
- 1 sponge cut into 9-12 1/2-inch by 1/2-inch sponge pieces (to represent garbage), previously soaked in red food coloring with excess squeezed out with paper towels (per group)
- Plastic wrap (per group)
- Water (per group)
- 2 rubber bands (per group)
- 1 cheesecloth (per group)
- 1 heavy-duty plastic sandwich bag (per group)
- Landfill Slides (attached)
- Leaky Landfill Lab (attached)
- Leaky Landfill Procedures Handout: p. 14 of Purdue University Discovery Park Environmental Science Unit (one for each student)
- Leaky Landfill Lab Data Sheets: p. 15 of Purdue University Discovery Park Environmental Science Unit (one for each student)
- Leaky Landfill Study Guide: pp. 16 and 17 of Purdue University Discovery Park Environmental Science Unit (one for each student)

Engage

Teacher's Note: Lesson Preparation

Prepare the lab setup before beginning the lesson, as the Engage section is intended to be quick.

Using **slide 3** from the attached **Landfill Slides**, have students view landfill pictures and ask them what they notice.

Next, have students watch this "[Landfill Process](https://www.youtube.com/watch?v=s-ps_0UFmfl)" video. Have them document what components they see in the pictures that are talked about in the video.

Embedded video

[https://youtube.com/watch?v=s-ps_0UFmfl](https://www.youtube.com/watch?v=s-ps_0UFmfl)

Teacher's Note: Video Timestamp

The important part of the video begins at around 0:50. Before that is a fun intro, but if you're pressed on time, fast forward. Please note the grammar in the video is slightly off because it was made by people who don't primarily speak English; address that only if students point it out.

Explore

Teacher's Note: Pre-Lab Prep

Be sure to put some red food coloring in the sponges, so students can see the level of leaking. Otherwise, it will all be clear and there will be nothing to observe.

Have students work in groups of three or four. Pass out a copy of the attached **Leaky Landfill Lab** handout to each student.

Each group will construct three different landfill models to determine the elements of good landfill design (see the three model design instructions on the lab handout).

Then, distribute the materials for the landfill model and assist groups as needed as they make their landfills. Finally, instruct groups to label their containers and let the landfill models sit undisturbed overnight.

At this point, assign students to read two articles, [Department of Environmental Protection FAQs](#) and [Landfill Caps and Enhancements](#), as homework.

Teacher's Note: Time for a Break

Sitting undisturbed overnight is an important aspect of this lab; this allows time for leaking. The lesson must pause at this point, so try to be done with this by the end of the class period.

Teacher's Note: Homework?

Homework has been assigned in this lesson, as it is intended for AP Environmental Science. If you feel homework isn't suitable for your class, keep in mind that the articles have to be read around this time or at least before the Explain portion.

The next day, students will examine their models and record changes in the appearance (e.g., color and clarity) of the groundwater in each model under the first question of Day 2 in their Leaky Landfill Lab packet. Each group should discuss their results and complete the post-lab questions that will help facilitate the discussion.

Teacher's Note: Simulation Reminder

Remind students that this activity is a simulation. In real situations, many chemical contaminants in groundwater are invisible and so more testing needs to be done to figure out the level of contamination.

Explain

Go over the post-lab questions as a whole group. Clear up any misconceptions as they arise, and let students edit their responses as needed.

Also, ask students if they have any questions for the articles assigned for reading. Have a discussion about how they felt about the articles and what information they gained that they wished they had known before the experiment.

Teacher's Note: Discussion Expectations

If this is not an AP class, asking for an open-ended debrief on the articles (which were read as homework) might go badly. Even with AP students, this might not go well if they are not used to it (even though this should be a regular thing in an advanced classroom). Be ready to scaffold, instead of the worn out "Any questions? No? Okay, moving on." Ask questions that relate specifically to the articles or what you want students to get from the articles.

Extend

Have students imagine that Oklahoma's governor is looking to shift her focus to waste disposal and would like to understand if landfills in OKC are the solution of the future. Continue by stating that the governor is doing research on alternative solutions to landfills so she can decide where tax dollars can be used most effectively.

Teacher's Note: Which Elected Official?

This lesson previously mentioned Mary Fallin, a former governor of Oklahoma. In this imagined research scenario, you may refer to whatever elected official is relevant to your school's location.

Explain to students that their role is to conduct research for Oklahoma's governor and present a compelling written argument about which solution they think will be better for the environment.

Students will begin by reading two articles entitled [The Problem With Landfill](#) and [Trash, Garbage and Waste Removal Solutions That Don't Involve a Landfill](#) to think about why landfills may not be the solution in the future.

Using the lab groups from earlier, assign each group an alternative solution (waste-to-energy incineration, anaerobic digestion, reduce-reuse-recycle, composting, and pyrolysis) to using landfills listed in the articles.

The groups will research the alternative solution using Chromebooks or other devices with internet access and construct a slide presentation illustrating their solution and why it is beneficial. The slide presentation should include the following:

1. Name of the alternative solution
2. Brief description of the alternative solution
3. Image that is related to the alternative solution
4. Pros of using the alternative
5. Cons of using the alternative solution.
6. At least two pieces of important information, charts or statistics
7. Describe if the group is pro or con the alternative solution versus landfills and why
8. References page

The groups will then present their slides to the class.

After listening to all of the presentations and considering the information learned about landfills, have students write their own letters to Oklahoma's governor explaining why we should either (1) put more money into landfills and their improvement or (2) shift our focus to one of the alternative solutions and why. The letter should be typed using the correct professional format. The letter should be compelling and state which alternative solution is better and why.*

Alternative Pacing*

If you are teaching a non-AP section, shift the letter writing to the Evaluate section in place of the free response question.

Evaluate

Pass out one free response question to each student (from [question 2 from the 2008 AP free response questions](#)). Allow 20 minutes for students to answer all parts of the question, so that students can get used to pacing for the AP exam.

Teacher's Note: Practicing for the Real Thing

Twenty minutes is the intended pace per free response question on the AP environmental science test. Granted, some questions may take less than 20 minutes, some may take more. That's an average. However, considering students are allowed only 90 minutes to answer four questions, if they're pushing 30 minutes, they're taking too long. Students need to be able to feel how long 20 minutes is when testing, so share out time benchmarks when they are doing the free response questions.

Then, share the [rubric](#) (which starts on page 8) so students can grade their own answers and see models of what the College Board is expecting.

Teacher's Note: Dancing the Dance

Students may be learning a lot, but if they don't include the details expected of them from the College Board graders, they will not get the points. This can be a tough pill to swallow, especially for struggling students, but going through the rubric with every free response question and talking about the language and the details they are expecting will help students understand how to construct their answers the College Board way.

Resources

- Center for Public Environmental Oversight. (n.d.). Landfill Caps and Enhancements. <http://www.cpeo.org/techtree/ttdescript/lanacap.htm>
- The College Board. (2008). AP environmental science 2008 free-response questions. https://secure-media.collegeboard.org/apc/ap08_env_sci_frq.pdf
- Fantell, J. M., & Flannagan, T. (2011). The ABCs of landfill ADCs. Waste 360. http://www.waste360.com/Landfill_Management/landfill-alternative-daily-covers-201101
- Massachusetts Department of Environmental Protection. (n.d.). Frequently asked questions: Closure of the unlined landfill located on Old Fall River Road, Dartmouth, MA. <http://www.mass.gov/eea/docs/dep/about/region/offrlfaq.pdf>
- miss obey. (2013). Landfill process [Video]. YouTube. https://www.youtube.com/watch?v=s-ps_0UFmfl
- Panda Environmental Services. (2017). Trash, garbage and waste removal solutions that don't involve a landfill. <http://pandaenvironmental.com/Trash-Garbage-and-Waste-Removal-Solutions-that-Don-t-Involve-a-Landfill.htm>
- Sustainable Living. (2013). The problem with landfill. Environment Victoria. <https://environmentvictoria.org.au/resource/problem-landfill/>