



## Lesson: Making A Model Landfill

**Grade:** 4-5

**Subject:** Science

**Objectives:**

Students will:

- construct a model of a landfill and analyze the most effective design
- identify the way in which a landfill is different than a natural cycle
- identify the pros and cons of landfill disposal and alternative forms of disposal
- practice map reading

**Teaching Time:** 50-60 minutes

**Materials:** Instructions, Making a Model Landfill; worksheet, Layers of a Landfill in a Bottle; transparency, Construction of a Landfill in a Bottle and Diagram of a Landfill

(Optional:) Video: "Time's a Wasting: Garbage and Recycling in Oregon" (see the Resource section for availability)

### Background:

(Prerequisite: Our Natural Resources). Almost all garbage is eventually disposed of in a landfill. (See "There is No Away" Background for more detail). As of 2001, there are 36 active municipal solid waste landfills in Oregon. Some, but not all, of these landfills have upgraded modern systems that maximize environmental protection. "Modern" landfills (all landfills or sections (called cells) of landfills built after 1991) are called sanitary landfills because they are lined with a thick plastic and clay layers and have leak monitoring systems in order to protect our groundwater. Older unlined landfills continue to be a source of environmental pollution that we must pay to clean up until they no longer exist.

According to federal law, all closed landfills must be monitored for 30 years. Landfills are monitored for two reasons. First, to control methane buildup which can cause fires and explosions and second, to control "leachate" which can leak out. With regard to the first issue, the technology has now developed so that we can "harvest" the excess methane from large landfills and actually use it as a source of energy. However, this is still not a very efficient process and is still not being widely used, but it may be important for future energy conservation efforts.

The second issue, controlling leachate, is very difficult and complex. Leachate is any liquid that comes into contact with garbage and commonly contains undesirable components such as volatile organic compounds (VOCs), nitrates, trace metals, and other salt compounds. Additionally, the pH of leachate is usually corrosive, so when it migrates through the soil it can remove naturally occurring iron and manganese which can pollute surface and groundwater.

Leachate is dealt with by two primary approaches. The first approach to dealing with the problem of leachate is to keep the landfill as protected and dry as possible so that excess leachate is not formed. In Oregon this is how it is handled. This means that garbage is not receiving much air or water and will not break down for an unknown period of time, possibly hundreds of years or more. Modern landfills with leachate monitoring systems will test the leachate for presence of hazardous constituents. If the leachate is not hazardous, it is removed and sent to the waste water treatment facility. Hazardous leachate is processed the same as any other hazardous waste.

The second method for dealing with leachate is being tried in other parts of the U.S. This method involves the "recirculation" of the leachate and air through the landfill in order to speed up the decomposition of garbage. This method tries to deal with any problems stemming from the decomposition such as toxins or methane right away while the landfill is still open and being actively monitored. There are critics of both methods for dealing with landfilled waste and the "best" method has not been agreed upon.

**REDUCE**  
**REUSE**  
**RECYCLE**

## Procedures:

- **Where does all waste end up? In Oregon, unless recycled, 92% of our waste goes to a landfill, the rest is disposed of by incineration which is a special type of burning done by experts.**
- In a landfill, each day's trash is covered with a layer of dirt to control rodents, odor, and scavenging birds. Landfills are lined with a thick plastic liner and clay to keep liquid from the garbage from leaking into the ground. This liquid is called 'leachate'. Write the word on the board.
- **Today we are going to build different models of landfills and study their effectiveness.**
- Teacher may choose to have small groups of students each build a model of one type of landfill, or do as a demonstration lesson, using student-helpers to build the models before the whole group.
- Follow the procedures as listed on the instruction sheet.
- Display the transparency, "Diagram of A Landfill." Have class note similarities and differences in their models and the real thing.

## **To demonstrate the models:**

Have students write a hypothesis about which model will best protect the groundwater.

Mix the water with some food coloring to represent the "leachate" that rain will pick up as it runs through the garbage. Carefully pour the leachate over each model. Be sure not to oversaturate the lined landfill model or the liner will not be able to protect the groundwater! (But you may want to continue adding water to the lined model to demonstrate how sometimes landfill liners fail and some pollution can still leak into the groundwater.) \*If the bottles become too full of water, simply unscrew the cap at the bottom of the landfill to drain the water into the base or into a sink.

## Reflection/Response:

- Have students record the changes in groundwater in their journals or on data sheets. Students should note problems they can see with open dumps compared to a sanitary landfill. (They should record things like smell, will attract animals and flies, is very unsightly, windblown trash will become litter, etc.)
- Have the class brainstorm the pros and cons of placing waste in landfills. Pros might include: the garbage needs to go somewhere, landfills can handle large amounts of waste, landfills keep waste away from where people live, landfills keep other places waste-free, landfills can be designed to protect the environment, and are sometimes converted into "green spaces" after closed. Cons might include: landfills take up space making it impossible for people and wildlife to use the land, landfills are ugly, they can create unpleasant odor and attract pests, things that end up in landfills are usually no longer available for people to use and sometimes landfills leak into our groundwater supply.
- Have students explain how a landfill violates the principal of a natural cycle. (Light and air are not available inside a landfill and very little moisture is allowed inside, so natural decomposition cannot occur).

- Have students develop a list of alternatives to placing things in the landfill individually or as teams. (Students should be encouraged to think BIG--for example, instead of throwing away an old item it could be donated somewhere where it would be reused, or instead of throwing a product away, the company that made it would agree to take it back and use its parts to make a new item, or organic material would be composted).

### **Extensions:**

- Ask students to draw and label a model of a sanitary landfill.
- Go on a field trip to a local landfill or tour the Coffin Butte Landfill on the web at: [http://www.cof.orst.edu/cof/teach/for365/tours/lf\\_tour/](http://www.cof.orst.edu/cof/teach/for365/tours/lf_tour/)
- Show the video, “Times A Wasting”.
- Ask a landfill coordinator or local trash hauler to speak to your class about how local garbage is handled. (See Field Trip Guide for opportunities in your area).

#### **Oregon Common Curriculum Goal:**

##### **Science:** Unifying Concepts and Processes

- Apply explanatory concepts of model, system, theory, probability, and replication.

#### **Grade 5 Benchmark:**

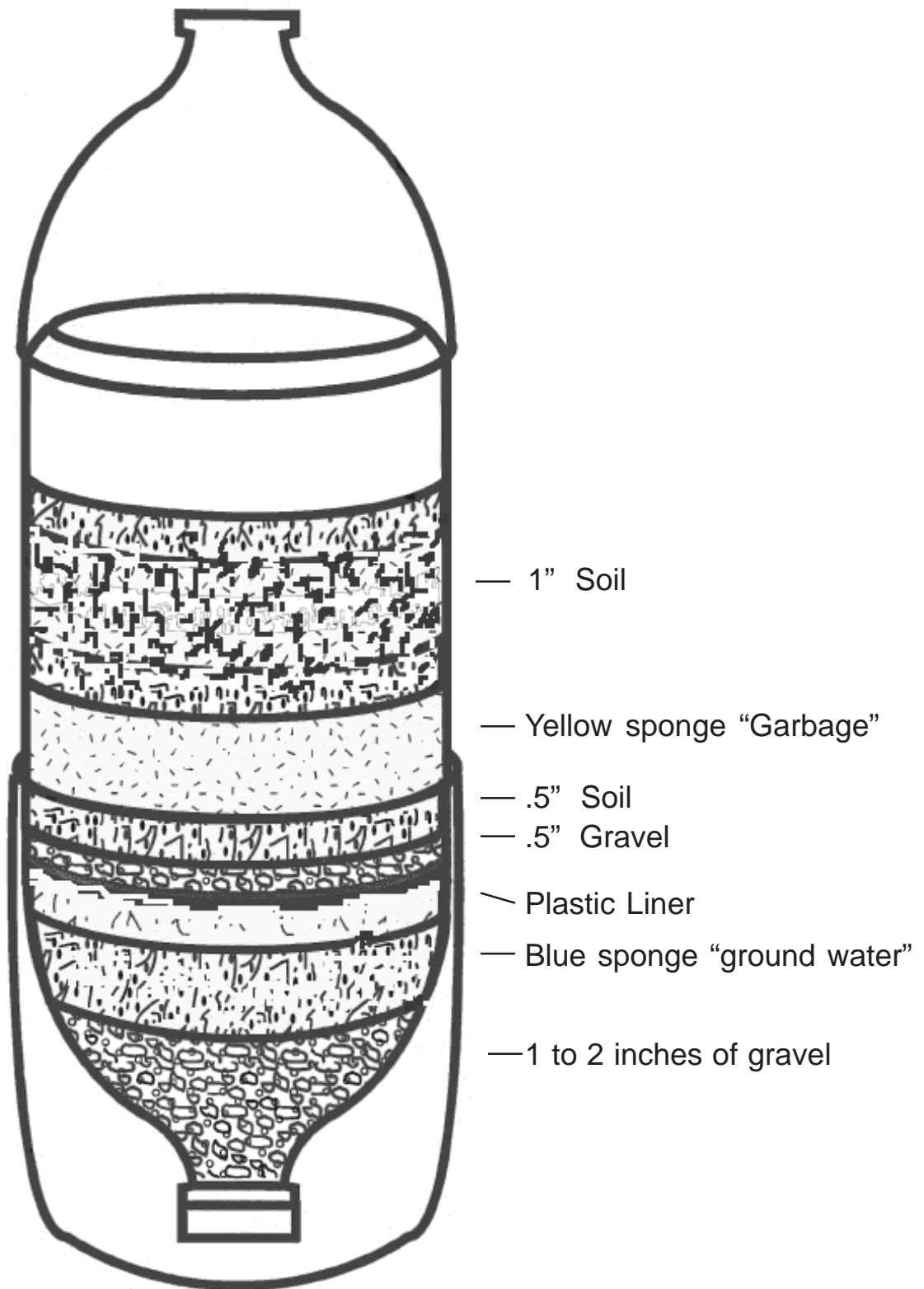
- Use models to explain how objects, events, and/or processes work in the real world.

**REDUCE**  
**REUSE**  
**RECYCLE**





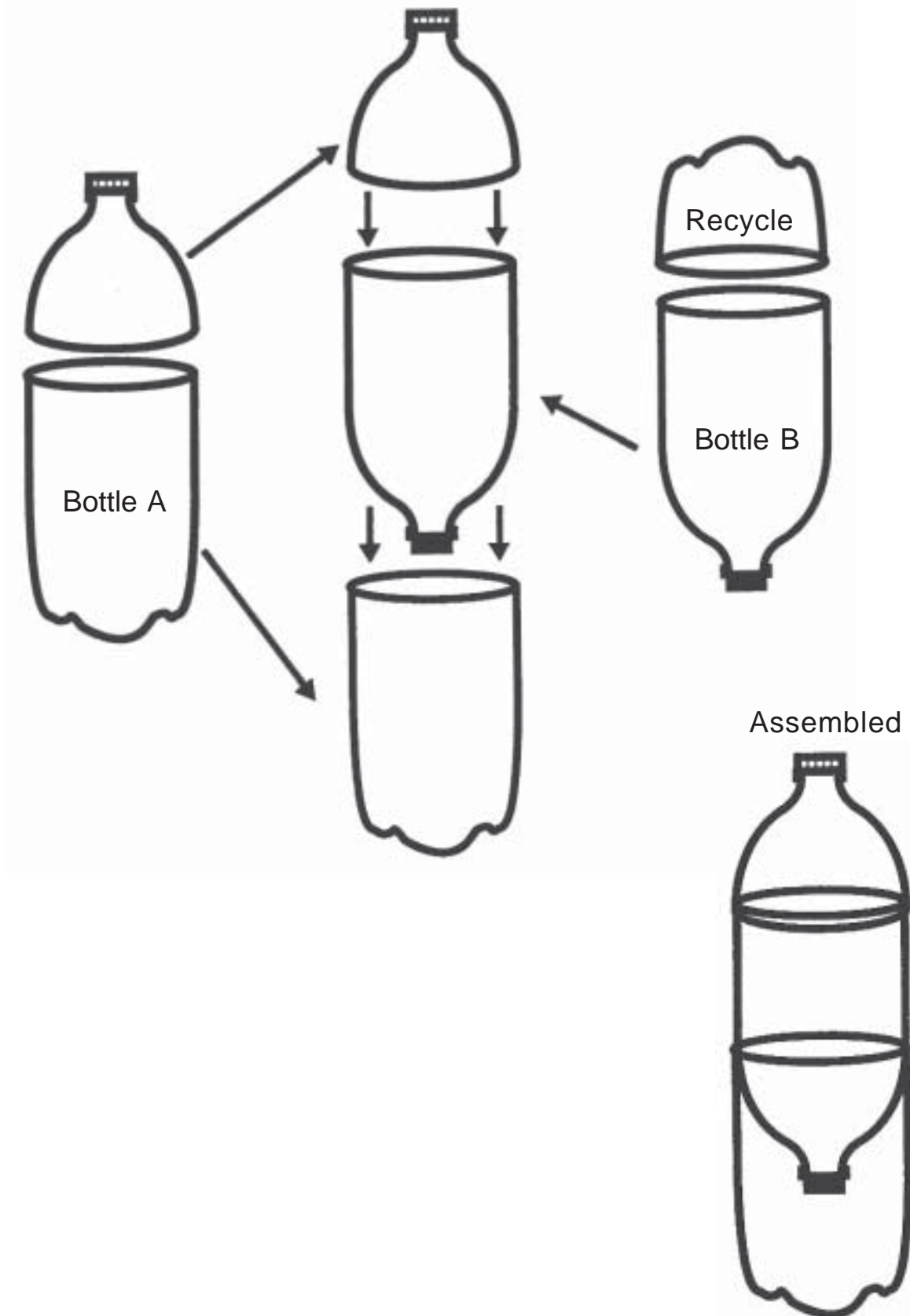
## Example of a Lined Landfill Model



Source: California Integrated Waste Management Board: *Closing the Loop: Exploring Integrated Waste Management and Resource Conservation K-6* (2000)



# Overhead: Construction of a Landfill in a Bottle





# Making a Model Landfill Instruction Sheet

## Materials:

- 3 two-liter bottles (peel off the labels)
- 3 blue sponges cut into the shape of the bottle
- 2 yellow sponges cut into the shape of the bottle
- A plastic grocery bag or plastic film
- 6 cups of potting soil
- 3 cups of rocks or aquarium gravel
- Red or green food coloring
- 3 cups of water

## Open Dump

Place the bottle top into the base. Place the gravel into the bottom. Place a blue sponge on top of the gravel to represent the groundwater. Fill the bottle with potting soil and place some “garbage” into and on top of the soil. (Students can use paper scraps, small food scraps, paper clips, etc. to represent the garbage). Be sure to place most of the garbage near or on the surface of the model.

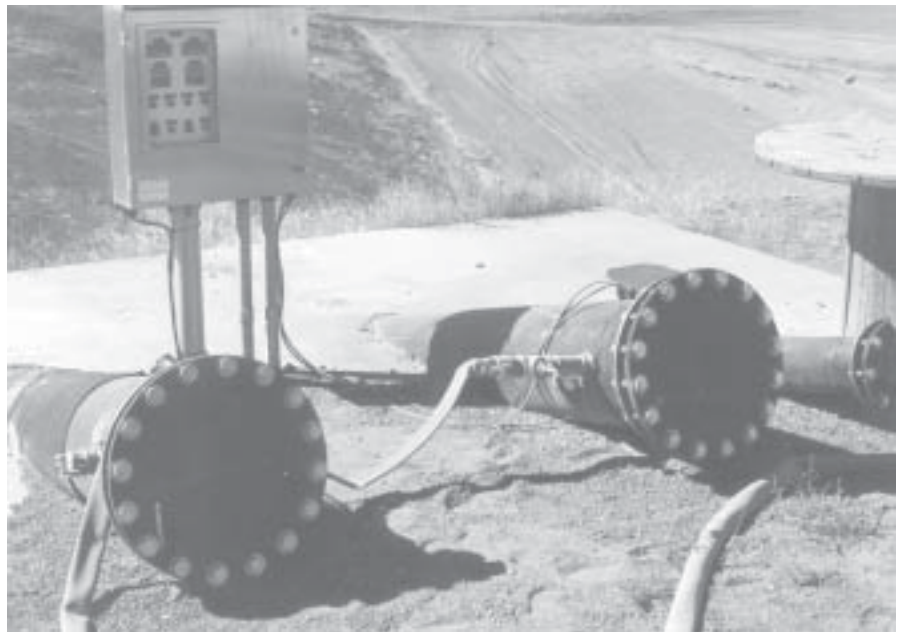
*\*Placing the tops of the 2-liter bottles on top of the models is optional.*

## Unlined Landfill

Place the bottle top into the base. Place the gravel into the bottom. Place a blue sponge on top of the gravel to represent the groundwater. Add 2 inches of soil and top with a yellow sponge to represent the garbage. Cover to the top of the model with soil.

## Lined Landfill

Place the bottle top into the base. Place the gravel into the bottom. Place a blue sponge on top of the gravel to represent the groundwater. Add a plastic bag that is carefully cut to the shape of the bottle so that it completely covers the surface. Add about half an inch of gravel on top of the plastic. Add about half an inch of soil, then top with the yellow sponge to represent the garbage. Then fill the model to the top with soil.



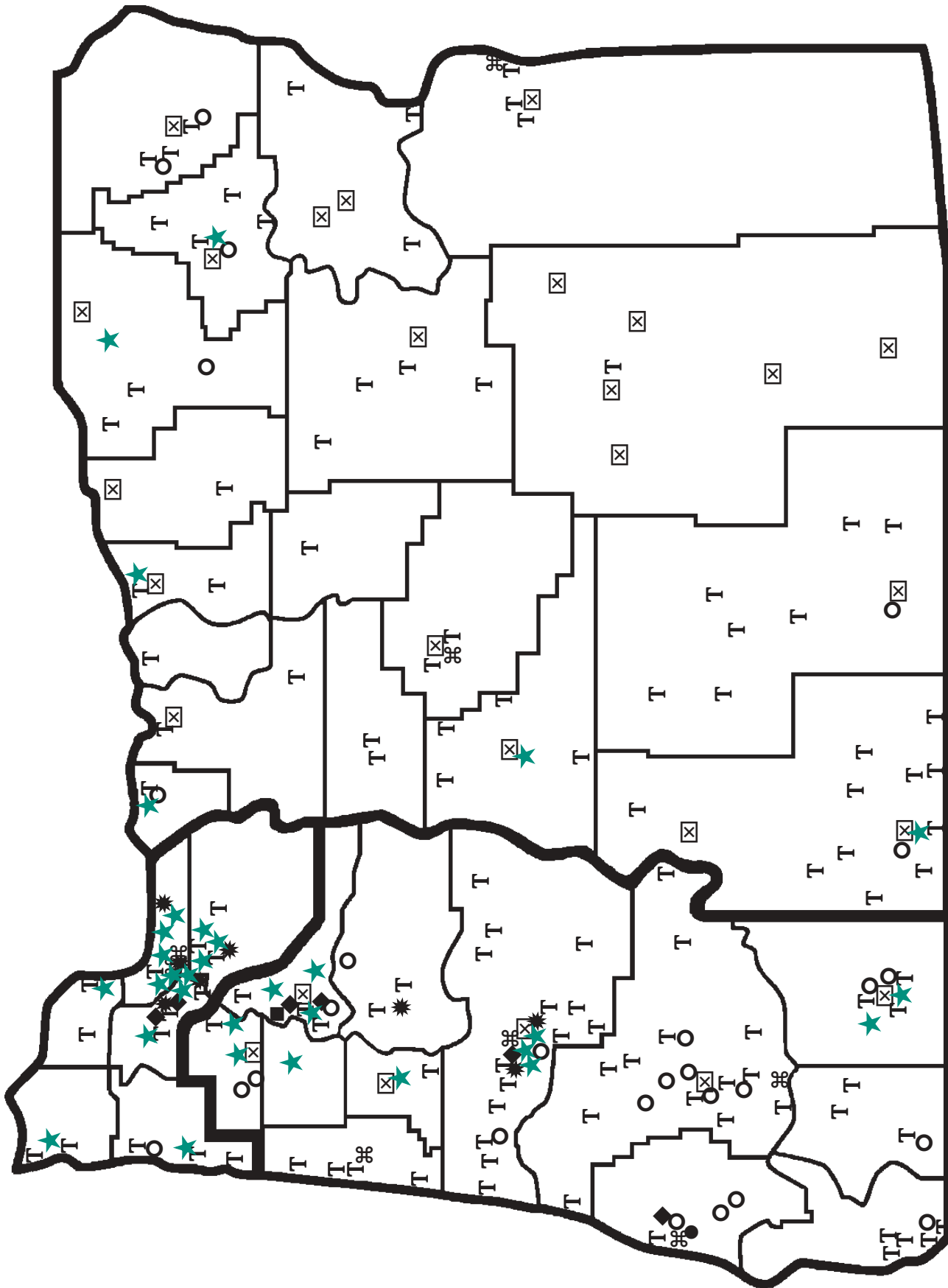
A leachate monitoring system at the Knott Pit Landfill in Bend, Oregon.

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**REUSE**  
**RECYCLE**





# Handout: Active Facilities in Oregon (as of October 2000)

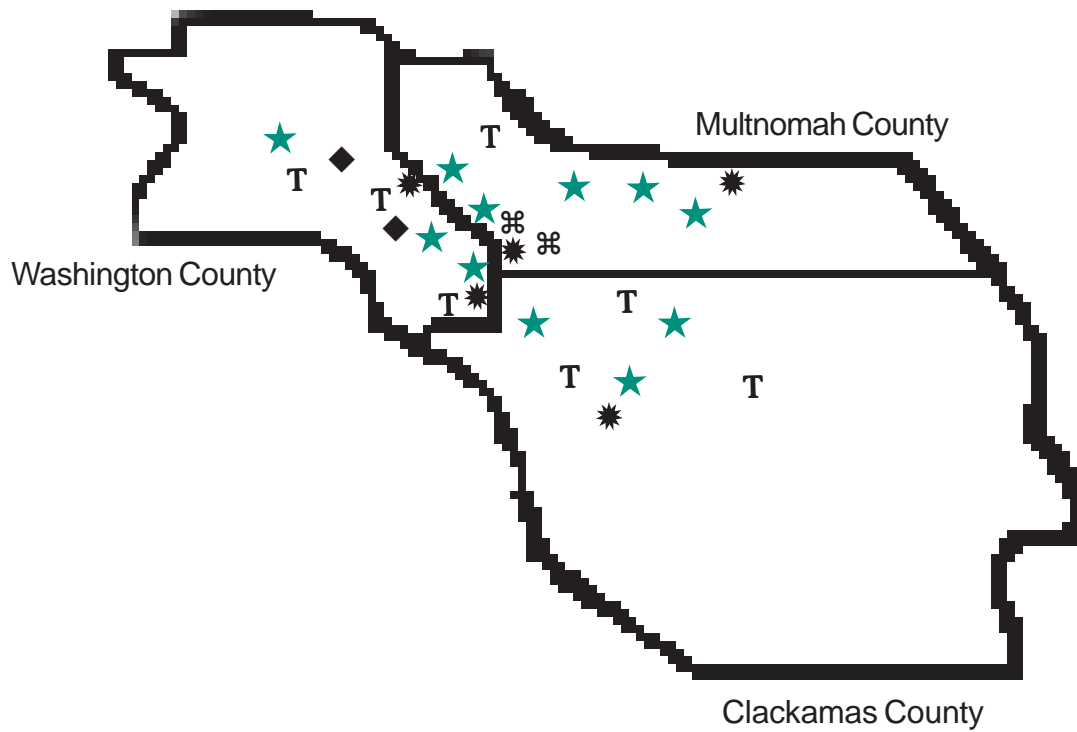


### Key

- ☒ Municipal Solid Waste Landfills
- ◆ Waste-to-Energy Facilities
- ⌘ Industrial Waste Facilities
- Incinerators
- ★ Composting Facilities
- ✱ Material Recovery Facilities
- ◆ Construction/Demolition Landfills
- T Transfer Stations
- Wood Waste Facilities



# Handout: Active Facilities in Metro Area (Enlarged View)



## Key

- |                                     |                               |
|-------------------------------------|-------------------------------|
| ◆ Construction/Demolition Landfills | T Transfer Stations           |
| * Material Recovery Facilities      | ⌘ Industrial Waste Facilities |
|                                     | ★ Composting Facilities       |



# Map Exercise: Making a Model Landfill

**Student Name:** \_\_\_\_\_

Study the Active Facilities in Oregon map and answer the following questions.

Definitions of the terms described on the map:

**Composting Facilities:** Places that collect yard debris or “green waste” such as leaves, grass, small branches, weeds, etc.

**Construction/Demolition (C&D) Landfills:** Places that only accept waste that is generated from creating new buildings, houses, roads, or waste from tearing down buildings, houses, etc. This waste contains materials such as concrete, dry wall, wood pieces, paneling, ceramic tile, etc.

**Incinerators:** Places specially constructed for burning garbage that is generated by us at home instead of landfilling it. Hazardous materials cannot be sent to an incinerator or a landfill. These facilities have special equipment to help keep pollution out of the air. Once the garbage is burned, there is a waste by-product called “ash” which can be hazardous. This ash must be disposed of at a special type of landfill.

**Industrial Waste Facilities:** Places that take waste created by factories and other types of businesses. This waste is usually the by-product created from making some type of product and often contains various types of chemicals.

**Material Recovery Facilities (MRF):** Places that take waste from people or from businesses. The garbage is then sorted through to recover materials that can be recycled such as metal, glass, wood, etc. and the rest is sent to a landfill or incinerator.

**Municipal Solid Waste (MSW) Landfills:** Places that take the garbage generated by us at home. This waste can be made of all types of materials that we throw away. However, MSWs do not take any materials that are considered hazardous. The by-products from landfills are methane and “leachate”. Leachate is the liquid that comes from the trash and mixes with rainwater. Leachate and methane can be dangerous to people and to the environment.

**Transfer Stations:** Places where small garbage trucks drop off trash that is later compacted into metal containers so that it can be carried to the landfill in larger trucks. This means that more garbage is carried by a single truck which is more efficient for transporting materials.

**Waste-to-Energy (WTE) Facilities:** Places where garbage is burned and the heat is captured and converted into electrical energy that can then be used to power our homes, schools, and offices.

**Wood Waste Facilities:** Places that collect large pieces of wood materials, such as tree stumps, that have been removed and also construction wood when buildings are torn down. Wood that has not been treated with chemicals is often “chipped” or “mulched” into small pieces that can be used for gardening and landscaping.



## Map Exercise: Making a Model Landfill

1. Locate the county where you live and place the number of facilities next to each term below. (Ask your parent or teacher for help if you are not sure where your county is).

\_\_\_\_ MSW Landfills      \_\_\_\_ WTE Facilities      \_\_\_\_ Incinerators  
\_\_\_\_ MRF      \_\_\_\_ C&D Landfills      \_\_\_\_ Transfer Stations  
\_\_\_\_ Composting Facilities      \_\_\_\_ Wood Waste Facilities      \_\_\_\_ Industrial Waste Facilities

2. Now record the number of facilities located in the county directly North of your county. If there is no county to the North, then use the county directly South.

\_\_\_\_ MSW Landfills      \_\_\_\_ WTE Facilities      \_\_\_\_ Incinerators  
\_\_\_\_ MRF      \_\_\_\_ C&D Landfills      \_\_\_\_ Transfer Stations  
\_\_\_\_ Composting Facilities      \_\_\_\_ Wood Waste Facilities      \_\_\_\_ Industrial Waste Facilities

3. How many Industrial Waste Facilities are there in the entire state? (Hint: use the Portland Metro Area Map Blow-up for better clarity). \_\_\_\_\_

4. How many composting facilities are located just in the Portland Metro area? \_\_\_\_\_

5. What year does this data represent? \_\_\_\_\_

6. What is the difference between sending your garbage to a landfill or sending it to an incinerator? \_\_\_\_\_

7. What are the two places represented on the map where garbage is only sorted or compacted but not actually disposed at that place? \_\_\_\_\_

8. (Optional:) Using an accurate map of Oregon, compare the two maps and estimate the distance from your city to the nearest MSW landfills or incinerators in your county.

*\*Note that in some areas garbage must be transported long distances in order to get to the nearest MSW or incinerator which means that even more pollution is created just by transporting our garbage. So, remember to think before you waste and recycle everything that you can!*