Name _____ Class _____ Date _____

Skills Practice Lab

MODELING

Modeling Sanitary Landfills and Garbage Dumps

In the past, many garbage dumps were major eyesores and ecological nightmares. They produced unpleasant odors, attracted scavengers such as rats and seagulls, and oozed leachate into water supplies. However, in recent decades engineers have created more environmentally friendly facilities known as sanitary landfills. In these facilities, liners prevent liquids from leaking into the soil and contaminating groundwater supplies. Alternating layers of waste and soil reduces odors and scavengers. Some disposal operations even recycle, reuse, and compost organic material. But like most solutions to real-world problems, sanitary landfills have drawbacks, such as increased maintenance costs and space requirements.

In this lab, you will build models of a traditional garbage dump and of a modern landfill. You will then compare the rate of decomposition and the amount of pollution produced in both.

OBJECTIVES

Construct models of a sanitary landfill and a traditional garbage dump.

Measure indicators of decay and pollution in the two models.

Evaluate your methods of measuring decay and pollution and the validity of your models.

MATERIALS

- beaker, 500 mL
- bottles, plastic, 2 L (2)
- garbage, mixed, such as food, paper, lawn clippings, paper clips, and plastic bags
- gravel or sand
- heat lamp
- knife, craft
- nail, large
- pan, shallow
- pencils, blue and red
- soil
- spray bottle
- tape, masking
- thermometers, 12-in. (2)
- water

Procedure

PART I—BUILD MODEL LANDFILLS

1. Use a nail to punch 10 to 20 holes in the sides and bottom of one plastic bottle. Use the craft knife to carefully cut the tops from both bottles. Save one of the tops to use in step 4.
2. Place a thin layer of gravel or sand in the bottom of each container.
3. In each container, alternate layers of mixed garbage and moistened soil to create three layers of each. You will need enough mixed garbage to fill each container half way. Add an extra layer of soil on top to control odor and animal pests. Be sure to wear gloves while handling the garbage and soil.
4. Make a few small slits in the cut-off bottle top to reduce hazardous gas build-up during the experiment. Carefully tape this top back onto the hole-free bottle. Leave the other bottle open. You now have a model of each type of landfill.
5. Place each bottle in a shallow pan, and place the set-up in an area designated by your teacher.
6. Place a heat lamp next to the shallow pan, turn it on, and focus its light on the bottles. It will remain on for six weeks, with a one-day-off period every week for measurement purposes.

PART II—OBSERVE CHANGES

7. On day six, switch off the heat lamp. It must be off for 24 hours before making an observation to ensure that the measured temperatures are due only to decomposition.
8. The next day, rate the changes in the look and smell of each bottle's contents. Use a scale of 1 to 5, with 1 indicating no change and 5 indicating complete decomposition. For example, if the waste looks unchanged, rate the contents a "1." **CAUTION: Be careful when moving the bottles. The liquid leachate could stain clothes.** Record the ratings in table on the next page.
9. Insert a thermometer through the top opening of each bottle into the center of the landfills and wait five minutes. Record the temperatures in the table. When done, be sure to put the cap back on the closed landfill.
10. Remove the bottles from the shallow pan. Pour the liquid leachate from the shallow pan into a measuring beaker and measure its volume. Record this volume in the *Pollution-Leachate-Open* column in the table. Record 0 (zero) in the *Pollution-Leachate-Closed* column. Put the bottles back in the pan. Dispose of the liquid in the beaker as directed by your teacher.
11. Dampen the soil in the open model with a spray bottle to keep the bacteria active.
12. Put the bottles back under the heat lamps, and switch on the lamps.
13. Repeat steps 7–12 once each week for five more weeks.

DECOMPOSITION DATA

	Decay Look(1–5)		Decay Smell(1–5)		Decay Temp. (°C)		Pollution Leachate (in mL)		Brief description	
Week	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed
1										
2										
3										
4										
5										
6										

Analysis

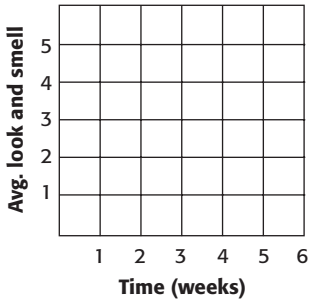
1. **Explaining Events** Which bottle models a modern sanitary landfill? Which represents a traditional garbage dump? Explain.

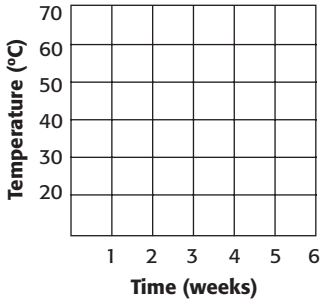
2. **Constructing Graphs** Graph the temperature changes in each bottle in the left-hand graph on the next page. Use blue for the traditional garbage dump model and red for the sanitary landfill model. What do you notice about the temperature changes in each model?

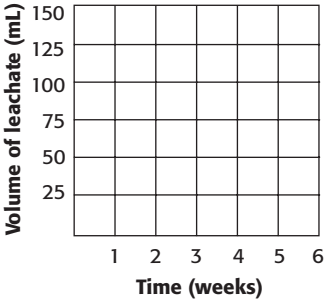
3. **Constructing Graphs** Calculate the average look and smell ratings for decay for each model and plot the averages for each week in the middle graph on the next page. Use blue and red pencil as you did in Analysis question 2. What do you notice about the amount of decay in each model?

4. **Constructing Graphs** Plot the cumulative volume (sum of all recorded volumes up to that week) of leachate per week for the traditional garbage dump model. Use the right-hand graph on the next page. Use the blue pencil.

INDICATORS OF DECOMPOSITION







Conclusions

5. Interpreting Information Compare the observed decay in the two types of landfills. What factors do you think influence decay?

6. Making Predictions Which type of landfill most likely will produce less leachate in the short run and in the long run? Explain your answer.

7. Applying Conclusions What kinds of garbage items decay most slowly? How can you reduce the environmental impact of slow-decaying items?

8. Evaluating Models Assess the validity of the models that you used in this lab. Are they good representations of real landfills? Explain your thinking.