



Teacher's Notes

Activity 12

(Mystery Book page 111)

How Does a Landfill Work? *Demonstration*

Standards: **Application to “New Directions” Standards:**
Activity 12 The following Delaware Department of Education “New Directions” Standards for grades six through eight are addressed (whole or in part) in this activity:

Science 1, 2, 5, 6

English 1–4

Mathematics 1–10

Social Studies [Economics] 1, 3

(See the Standards section located in this workbook for more details.)

Overview: This demonstration illustrates the formation and migration of leachate. It shows the potential affect of leachate on groundwater and demonstrates the need for liners in landfills to protect groundwater systems.

It will require approximately 15 minutes to set up the demonstration equipment prior to student contact. Lead the class in a brief discussion of percolation of groundwater and formation of leachate. It will require approximately one, 45-minute class period to complete the discussion, demonstration and related tasks in the Mystery Book.

- Purpose:**
1. Use physical models to illustrate real life events.
 2. Illustrate percolation of leachate through a waste mass.
 3. Illustrate formation of leachate.
 4. Illustrate aquifer contamination by leachate.
 5. Illustrate the positive effects of landfill liners for leachate containment.

Materials and Equipment:



Video Field Trip demonstrates this activity

- Overhead "How Do Landfills Work"
- Overhead "Water Cycle"
- Overhead "Apparatus for Landfill Demonstration"
- Overhead "Close-up of Tube Apparatus"
- One ring stand
- Two "V" jawed single buret clamps with couplings for use with ring stand
- Cotton batting
- Two rubber bands
- Approximately 100 grams of potting soil
- 25 grams of shredded paper soaked in food coloring (red works best)
- Two 1000 mL beakers*
- Approximately 1 Kg pebbles (1/2" to 1/4" diameter)
- One 250 mL beaker
- Tape
- Bottom of a milk jug cut approximately one inch up from the bottom
- Red and blue food coloring

* *Note: Smaller beakers may be used. Adjust materials according to the size chosen.*

Assessment: Assessment should be based on the logic and completeness of responses to questions and student attentiveness during the demonstration.

Preparation: Overhead masters of a landfill cross-section and the water cycle are provided in the Overhead Masters envelope for background information. Set up the clear polystyrene tubes as shown in the diagrams found in the Overhead Masters envelope. Plug the end of both tubes with cotton batting. The cotton plug should extend upward into the tube approximately one and a half inches. Tape the rubber band across the end of the tube as shown. This will secure the plug when it gets wet.

Clamp the tubes to the ring stand using the buret clamps. Fill the tubes with approximately one inch of potting soil. This will represent the soil on which the waste is placed. Place about two inches of the dried, shredded paper which has been soaked in food coloring on top of the potting soil. This represents the waste mass.

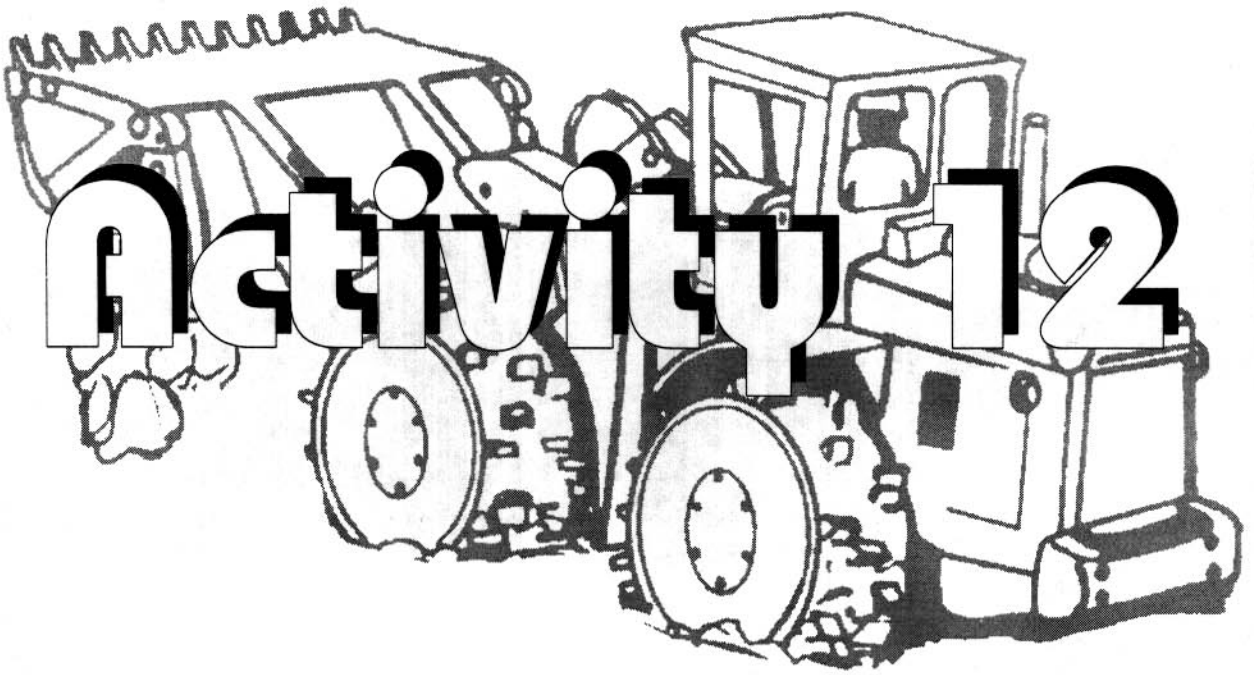
Place approximately one inch of potting soil on top of the "waste mass." This represents the daily cover commonly used in landfills.

Fill the 1000 mL beakers approximately one half full (500 grams) with pebbles. These will represent the aquifer. Then fill the pore spaces with water with enough food coloring to give it a light, but noticeable, blue color. This blue water represents the groundwater. Place the beakers under the tubes. Label one "OLD CITY DUMP" and the other "MODERN LANDFILL." Place the bottom of the milk jug on top of the 1000 mL beaker representing the aquifer under the landfill. This represents a plastic liner.

With the 250 mL beaker, pour approximately 100 mL clear tap water into each of the tubes (use more if necessary but no more than 500 mL or you'll have quite a mess). It will take a little time to percolate through the layers. Shortly, you should see red water seeping through the cotton plug. This is the leachate.

Under the "Old City Dump," the water in the aquifer should be turning brown. Under the "Modern Landfill," the water in the aquifer should remain its original color because the leachate has been trapped by the liner.

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Activity 12

LANDFILL OBSERVATIONS



Activity 12

How Does a Landfill Work? Demonstration

STUDENT OVERVIEW:

Your teacher will explain a simple model which shows how leachate is formed as rainwater percolates through a waste mass. It compares the possible effects on groundwater under the old style city dump and a modern landfill. Both contain exactly the same waste products. The only difference is that a modern landfill has liners and collection systems for leachate. Pay close attention and *observe* carefully what happens.

PURPOSE:

1. Observe a physical model that illustrates real life events.
2. Observe the formation of leachate.
3. Observe percolation of leachate through a waste mass.
4. Observe aquifer contamination by leachate.
5. Observe how landfill liners contain leachate.

PROCEDURE:

1. Observe demonstration; carefully note what occurs on page 110.
2. Answer the following questions.

QUESTIONS:

1. What color was the water that was poured into the top of the tubes? What does this water represent?

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2. What does the rainwater do as it enters the waste mass in the two models? What happens to the color of the water as it percolates through the waste mass?

3. What color is the water coming out of the bottom of the two models? Why did it turn this color? What does this colored water represent?

4. What does the light blue water in the beakers below the tubes represent? What do the pebbles in this beaker represent? What happens to the color of the water in the beaker below "The Old City Dump"?

5. Why did the water in the beaker below "The Old City Dump" change color? What does this color change represent?

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6. What happened in the beaker below "The Modern Landfill"? Did the water change color? Why did this happen? What does the milk jug bottom represent?

7. Why is it important to put liners under landfills? Do you think this is an effective way to protect the groundwater supply from landfill leachates? Why do you think this?

Activity 12**Landfilling: Where We Store
What We Can't Convert***Vocabulary*

AQUIFER — rock or sediment below the earth's surface that holds water in its pore space.

CONDENSATION NUCLEI — small particles of dust in the atmosphere that water vapor condenses around to form a raindrop.

CONDENSE — change from the gaseous to liquid phase by cooling.

DISSOLVE — to mix one substance with another so that, after mixing, only one physical state is observed.

EVAPORATE — change from liquid to gaseous phase.

GROUNDWATER — water that is stored in the pore space of an aquifer.

LANDFILLING — The disposal of solid wastes on land in an engineered manner under regulatory control which protects the environment.

LEACHATE — from a landfill: rainfall which infiltrates the landfill, collecting organic and inorganic salts as it percolates through the solid waste.

PERCOLATE — movement of liquid downward through the pore spaces of a substance.

PORE SPACE — spaces between the pieces and grains of a substance, i.e. space between sand grains.

PRECIPITATION — rain, snow, sleet or hail.

RUN OFF — water which drains over the ground surface.

SOLUTION — a mixture of substances in which one is evenly distributed within the other.

WATER VAPOR — water in the gaseous phase.