LESSON 3: The Consequences of Improper Management of Household Hazardous Waste

LESSON'S CONCEPT

Any disposal of used motor oil and other household hazardous wastes can harm the environment and people.

PURPOSE

Students will become aware that any disposal of used motor oil and other household hazardous waste can have a severe impact on the environment.

OVERVIEW

In this lesson students will:

- Observe a demonstration of simulated used motor oil poured on soil and water.
- Listen to the story *Someday a Tree* by Eve Bunting and conclude that disposing of household hazardous waste on the ground pollutes the environment and can kill trees and other plants.
- Trace the path that rainwater would take from the school grounds to a storm drain and find out what local body of water the storm drain feeds into.
- Predict where household hazardous waste could end up if it were disposed of on the ground.
- Complete a chart to identify the damaging effects of the improper disposal of hazardous household waste.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND TO *BENCHMARKS FOR SCIENCE LITERACY*

- Students conduct demonstrations to show that the disposal of used motor oil and other household hazardous waste can harm people and other living things.
  - "Certain poisons in the environment can harm human beings and other living things." (*Benchmarks for Science Literacy,* page 144)
  - "Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept . . . Students recognize whether evidence is consistent with a proposed explanation." (*Science Content Standards, Grades K–12*; Grade 6; Investigation and Experimentation, Standard 7e)
- Students draw and share the maps they have drawn of the drainage patterns on the school grounds and predict into what body of water the rainwater running from the school grounds will flow.
  - "Students will: . . . record data using appropriate graphical representation (including charts, graphs, and labeled diagrams), and make inferences based on those data." (*Science Content Standards, Grades K–12*; Grade 5; Investigation and Experimentation, Standard 6g)
- Students discuss the meaning of the story *Someday a Tree* by Eve Bunting that they listen to or read.
  - Students "identify the main problem or conflict of the plot and explain how it is resolved." *(English–Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve,* page 29)

SCIENTIFIC THINKING PROCESSES

observing, communicating, comparing, ordering, relating.

TIME

30–45 minutes to prepare for the lesson; 60–90 minutes to implement the lesson

VOCABULARY

pollution, used oil (Select additional words that students are curious about in this lesson.)

PREPARATION

___ **1.** Read the "Background Information for the Teacher" at the end of this lesson.

___ **2.** Prepare a two-liter beverage bottle for the used motor oil demonstration:

- Cut the top part of the beverage bottle about two inches from the top to make a wide-mouth bottle.
- Poke several holes on the bottom of the container to catch water filtering through. One way to do this is to straighten out part of a paper clip and heat the straight end in a candle's flame and then poke the hot end through the plastic.
- Place gravel on the bottom of the bottle. This will represent the groundwater aquifer.
- Lay a piece of mesh screen or nylon stocking to keep the soil from sifting into the gravel.
- Place two cups of soil on top of the mesh screen or nylon.

___ **3.** Select an area on the school grounds where students can diagram drainage patterns. Locate any storm drains or ditches into which rainwater from the school grounds would drain.

___ **4**. Make copies of student pages on disposal options: "A. Soil or Ground" (page 545); "B. Street or Storm Drain" (page 546); "C. Sink and Toilet" (page 547); and "D. Garbage Can" (page 548).

___ **5**. Make a copy for each group of the student's page, "Where Will It End Up?" (page 549).

___ **6**. Make transparencies of "Where Will It End Up? Effects of Household Hazardous Waste Disposal" (page 550) and "Improper Ways of Getting Rid of Used Oil" (page 551).

___ **7**. If possible, obtain the video, *Recycle This!* from the California Integrated Waste Management Board.

MATERIALS

For "Part I, Conducting Demonstrations with Simulated Oil"

___ Quart jar
___ Empty 2-liter plastic soda bottles
___ Paper clip
___ Candle
___ Scissors
___ Gravel
___ Three cups of soil
___ A piece of 6- by 6-inch window screen or nylon stocking
___ One cup of molasses

For "Part II, Reading or Listening to* Someday a Tree *by Eve Bunting"

___ The book, *Someday a Tree* by Eve Bunting

For "Part III, Investigating the School Grounds for Drainage Patterns"

___ A cup of molasses (to simulate used motor oil) (Do not use real used motor oil because it is a hazardous waste. Note that water may need to be added to the molasses to simulate oil viscosity.)
___ A clear container of unused motor oil
___ Paper towels (several sheets)
___ Paper and pencil for each student on which to draw a map of the parking lot
___ Clipboards or pieces of heavy cardboard with a paper clip (to use as clipboards), one for each student
___ Optional: A map of the school to help students draw the drainage patterns

For "Part IV, Studying How Illegal Disposal of Household Hazardous Waste Can Harm the Environment"

___ Student pages on disposal options: "A. Soil or Ground"; "B. Street or Storm Drain"; "C. Sink and Toilet"; and "D. Garbage Can"
___ A copy for each group of the student's page "Where Will It End Up?"
___ The transparency, "Where Will It End Up? Effects of Household Hazardous Waste Disposal"
___ If available, the video, *Recycle This*

For "Application"

___ Transparency of "Improper Ways of Getting Rid of Used Oil"

PRE-ACTIVITY QUESTIONS

Discuss with students:

- What are some ways that people might dispose of a bucket of dirty water that came from washing their cars with a mild nontoxic soap? List these as students respond. *Pour it on the lawn; pour it on the driveway or street; pour it down the sink or toilet.*

- What happens to the water and dirt if they are poured on the places we just listed. (Accept all answers at this time.)
- Tell students that some people have been disposing of household hazardous wastes, such as used motor oil and paint thinner, in the same ways that we have listed. But it is illegal to dispose of household hazardous waste in those ways. Why do you think that is? List on the chalkboard some responses from students. Tell students that they will learn more about the problems associated with illegal dumping of household hazardous waste in this lesson.

PROCEDURE

Part I, Conducting Demonstrations with Simulated Used Motor Oil

A. Ask students:

- How many of you know people who change their own car oil (instead of taking the car to a gas station or automobile service center to have it done).
- Where do you think the used motor oil is placed by people, once they drain it from their cars? *Poured on the ground; placed in a garbage can; taken to a used oil collection center for recycling.* Note that pouring used oil on the ground or in a garbage can is illegal, but students might not know this at this time.
- Is used motor oil a household hazardous waste? *Yes.*
- Should it be poured on the ground? *No.* (Students might not know this yet.) Tell students that in this lesson, they will learn more about how used motor oil and other household hazardous wastes can affect the environment if these wastes are not managed properly.

B. To show students how used motor oil can pollute soil if poured on the ground, demonstrate the following:

- Place a cup of soil in a quart jar. Pour one-quarter cup of molasses on the soil. Tell students that the molasses is used to simulate used motor oil and that you are not using real used motor oil because it is toxic.
- Encourage students to feel the soil containing the molasses. Ask how easy it would be for plants to grow in this soil if the molasses represented used motor oil, which is hazardous. How will this oil affect the animals, such as earthworms, that live in the soil? *It could kill them.*

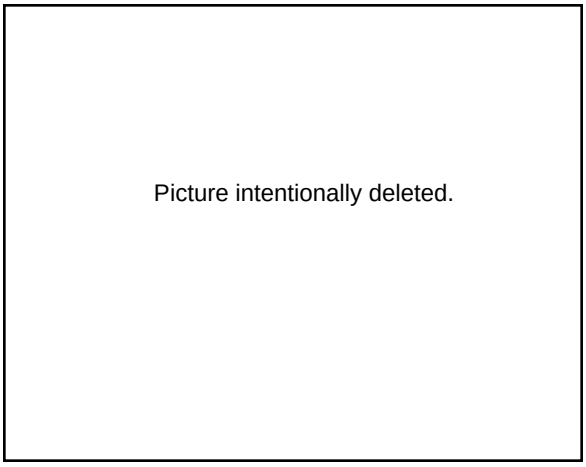
C. To show students how used motor oil can pollute groundwater if it is poured on the ground and rainwater leaches it, do the following:

1. Use the soda bottle you prepared in "Preparation #1." Describe the layers in the bottle: The gravel represents the groundwater. The top of the gravel represents the water table. The piece of mesh screen or nylon stocking is being used to keep the soil from falling into the groundwater aquifer. The soil on top of the gravel represents the soil on land. Molasses represents used motor oil.
   - Pour a quarter cup of molasses on the soil.
   - Simulate rain by sprinkling water on the soil.
2. Ask students to observe what happens to the groundwater. They should describe any color they see.

Part II, Reading or Listening to *Someday a Tree* by Eve Bunting

A. Read to students (or have students take turns reading parts of the book) *Someday a Tree* by Eve Bunting. Discuss:

- What happened to the oak tree? *It died.*
- Why did the oak tree die? *Someone poured something hazardous on the ground under the tree.*
- Why should household hazardous waste never be poured on the ground? *It might kill trees and other plants; it could pollute the groundwater.* (Help students to infer from Lesson 2 that if household hazardous waste in a landfill can pollute the groundwater, the waste can also pollute the groundwater if poured on the ground.)
- Where else might people dump household hazardous wastes that can pollute the environment? *In the*



A student from Janet Cohen's sixth-grade class at Gold Trail Elementary School reads *Someday a Tree* by Eve Bunting.

landfill; into a lake, creek, river or ocean; on the street; into a storm drain. (Students might not yet know about storm drains and their connection to waterways, but they will learn this in this lesson.)

- How else might people get rid of household hazardous waste (legally or illegally)? *Put it in the garbage can; recycle it by taking it to a household hazardous waste collection site.*

Part III, Investigating the School Grounds for Drainage Patterns

A. Ask students why motor oil is used in engines. *To lubricate the engine*. Show students new oil in a clear container. Have them describe the color. It should be golden yellow. Ask students what color they think used oil will most likely be and why? *Black, dirty because it picks up dirt from the engine.* Note that students may not know the reason why used motor oil looks different from new motor oil. Explain that inside the engine, motor oil picks up pollutants, like carbon, ash, and some heavy metals, which is why the engine needs its oil changed on a regular basis.

B. Tell students that they will be exploring drainage patterns on their school grounds. The purpose of this activity is to determine where household hazardous wastes could end up if they were dumped on the ground.

C. If students will have difficulty drawing a map of the school, provide a map of the school for them on which they can draw the drainage patterns. Ask students to bring pencils, paper, and clipboards (or pieces of cardboard with paper clips). Lead students around the school grounds and have them guess where rainwater might flow. Rainwater would flow down from high places to low places.

1. Decide on the signal you will use to gather the students back together.
2. Establish boundaries and have students work in pairs.
3. Instruct students to draw an overhead view of a section of the school grounds and to draw arrows to show the way rainwater might flow.

D. Gather the students in a group.

- Have students figure out what will happen to the rainwater. *Some rainwater will be absorbed into the ground (if your school grounds have unpaved areas); the rest will flow away.*
- Discuss with students where the water will flow or drain to. *Down the street; to a storm drain; into a ditch.*

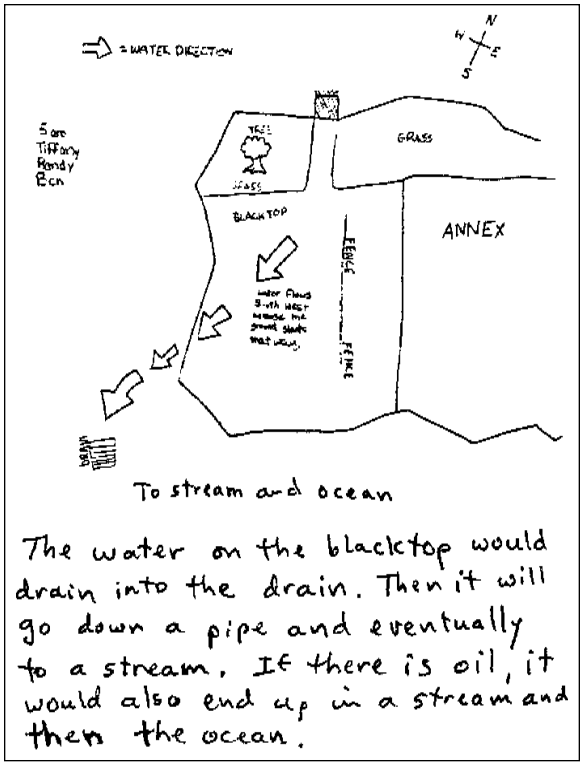
E. If there is a storm drain in the area of the school grounds, have students find it.

- Ask students where the water that runs into this storm drain will end up. (It usually ends up in a nearby creek, river, lake, or ocean.)

F. Back in the classroom, ask how students can find out where the water in the storm drain flows. For example, they can call the department of public works or the flood control office in their community. Ask for a couple of student volunteers to make the phone calls.

G. Once students know where the rainwater from the school grounds drains, ask them to help you trace its path—from the school grounds to a storm drain to a local body of water. This can be drawn on the chalkboard, or students could make a mural on butcher paper.

Where would the used oil go if someone poured it on the school grounds? *It might sink into the soil or sit on the pavement until the rains came, and then it would be washed away into the storm drain and into a natural body of water.*



Submitted by Stacy Byers, sixth-grade teacher, Cajon Park School, Santee Elementary School District.

Part IV, Studying How Illegal Disposal of Household Hazardous Waste Can Harm the Environment

B. Tell students that some management options, such as putting waste in landfills or pouring household hazardous waste on the street, are not legal, but for the purposes of this activity, they will find out where materials would go if they were poured on the street, soil, or down a storm drain; poured down a sink or flushed down a toilet; or put in a garbage can with the trash.

1. Divide the class into groups or pairs and assign a different improper disposal method to each group. Two or more groups could be assigned the same method of disposal.

- A. Soil or Ground
- B. Street or Storm Drain
- C. Sink and Toilet
- D. Garbage Can

2. Assign used motor oil as the household hazardous waste to study. Ask each group to brainstorm for several minutes on where used oil disposed of by their designated disposal method might end up. Questions that each group can ask are:

a. If we dispose of the used motor oil by this method, what might happen?

b. In ways, if any, might other living things, like wildlife and plants, be harmed?

c. In ways, if any, might people be harmed?

d. How could chemicals in this product get into our drinking water?

3. Distribute "Where Will It End Up" and ask the groups to answer the questions and complete the chart for the disposal method that they were assigned.

4. Provide groups with the pages of information on the type of improper disposal that they were assigned. Ask groups to read their pages. Allow groups to change their answers, based on what they have read.

5. Project the transparency, "Where Will It End Up?" Ask groups to share their answers with the rest of the class. Ask them to follow the format for explaining what they have learned: "Before, we thought . . . now we know . . .." For example, the group assigned the soil or ground disposal method would say, "Before, we thought that it was okay to dump used oil on the ground; now we know that it is against the law, because the chemicals in used oil can pollute the soil and even the groundwater if rainwater leaches the chemicals deep into the ground."

6. As each group presents its ideas, mark the chart on the transparency and ask other groups to do so on their charts.

7. After all the options have been covered, review with the class where used motor oil might end up and the damage that it could do.

8. Have students select another household hazardous waste, and as a class complete Chart II on the transparency.

C. If available, show the video *Recycle This* to the class. Discuss the message that the video is presenting.

DISCUSSION/QUESTIONS

A. How could pouring used motor oil into a street affect the animals and plants that live in water? *The used oil could be washed by rain into storm drains and then into a stream, river, lake, or ocean. It can harm them by the substances it contains.*

B. How could used oil in soil and water affect people? *Drinking water could become contaminated.*

APPLICATION

A. Project the transparency, "Improper Ways of Getting Rid of Used Oil."

1. Ask students to describe why each of the disposal methods shown is not appropriate. For example:

- Pouring household hazardous wastes on the soil or on the ground can pollute soil and groundwater; it can kill plants.
- Pouring household hazardous wastes on the street or down the storm drain pollutes water, because storm drains are hooked to pipes that go to creeks, rivers, and lakes or directly to the ocean in coastal areas. Ditches are also connected to a body of water.
- Pouring or placing household hazardous wastes in the garbage can harm the environment, wildlife, plant life, and human life. Garbage collectors have been injured by hazardous household waste. Workers at landfills can also be injured.
- Pouring household hazardous wastes down sinks and toilets affects sewer or septic systems. Wastes are broken down by small organisms, and hazardous substances can kill these organisms.

Note: All of these methods of disposing of used motor oil and other household hazardous wastes are against the law.

Note: Tell students that in the next lesson, they will learn that the only acceptable way to manage household hazardous wastes is by taking them to a household hazardous waste collection facility.

2. Discuss how the "Improper Ways of Getting Rid of Used Oil" apply to used oil filters.

Note: The following journal prompt could be assigned as a homework assignment.

B. Ask students to describe in their journals why household hazardous wastes should never be disposed of in the environment.

C. Ask students to share their journal entries.

Project Idea: Have students stencil storm drains to let people know where the water ends up. For example: "No Dumping, Flows to Willow Creek" or "No Dumping, Flows to Ocean."

D. When it rains (or after a rainstorm), take students on a walk on the school grounds to observe actual drainage patterns. Then have them adjust their drawings of the drainage patterns they completed in this lesson.

RESOURCES

Video

Recycle This. Produced by Seahawk Associates, Inc. Copyright by the Dow Chemical Company, 1990 (38 minutes) For more information call 1-800-441-4369.

A group of high school students explain to their friend the proper way to dispose of used oil for recycling and why used oil should never be poured in the garbage, on the soil, or down the storm drain. Taped live at Reseda High School, Reseda, California.

Book

Bunting, Eve. *Someday a Tree.* Illustrated by Ronald Himler. New York: Clarion Books, 1993.

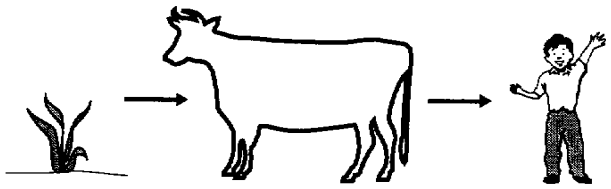
Someone dumps hazardous waste underneath an oak tree, and the oak ends up dying.

Student's Page

A. SOIL OR GROUND

If household hazardous waste is poured on the ground (or in a ditch), it might kill the plants in the area. Also, there's a good chance the waste will end up in a nearby stream, river, lake, or groundwater. Once in the water, household hazardous waste can adversely affect people, wildlife, and other living things.

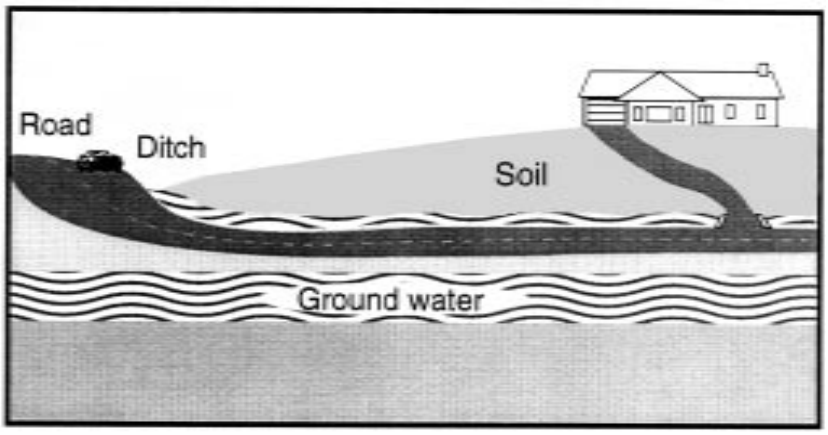
Some hazardous chemicals poured on the ground can be absorbed by plants. When these plants are eaten by animals, the animals may end up with the hazardous chemicals in their bodies. As a hazardous substance moves from one organism to another as a result of being eaten or absorbed, the substance is said to move through a food chain. Each organism, as a link in the chain, may accumulate the hazardous substance in higher concentrations. Human beings are often at the top of a food chain, which means the food we eat could contain a high concentration of some hazardous chemicals.



A food chain

When it rains, the water soaks into the ground, taking with it anything that dissolves in water. This might be chemicals from household hazardous wastes that have been dumped illegally. Water drains or soaks into the ground until it hits an impermeable (difficult to penetrate) layer. The water then collects in the spaces between sand, gravel, or rock particles. Underground areas where groundwater collects are called aquifers. Some aquifers replenish lakes or streams. Others are enclosed by layers of rock and do not move. Wells are drilled into both kinds of aquifers, those that flow and those that are like pockets.

Once the soil is saturated, rainwater runs over land to the nearest ditch or gully and downhill to the nearest waterway. If someone illegally disposed household hazardous waste, such as used oil, in a backyard and it rained hard the next day, the rain would carry the oil over land along the ditches to a waterway or down into the groundwater.



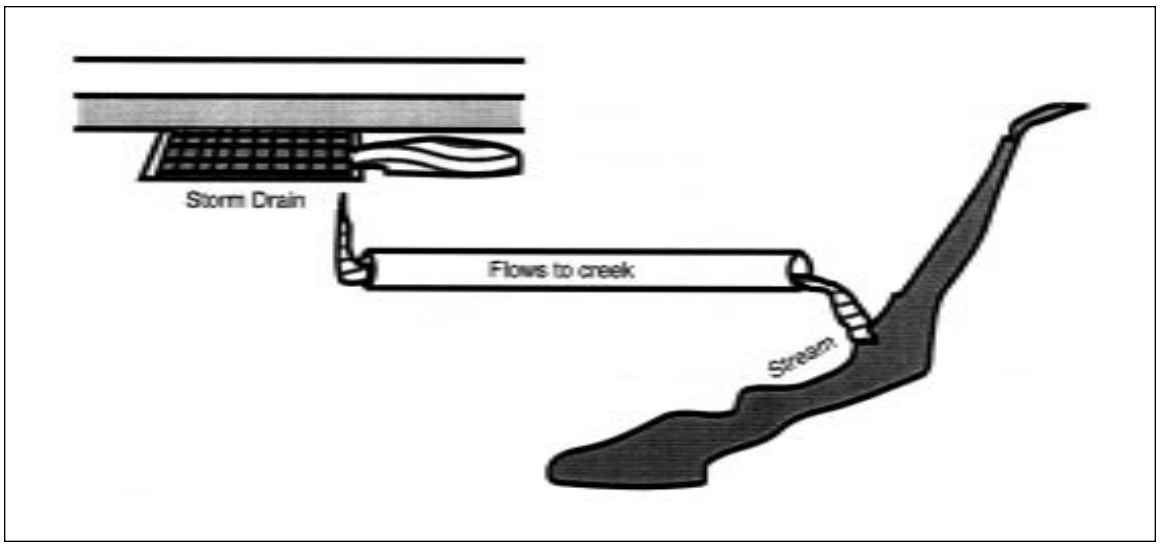
B. STREET OR STORM DRAIN

If a household hazardous waste is poured on the street or in a storm drain, the waste will most likely end up in a nearby stream, river, or lake. Let's figure out exactly where this waste might go.

Let's say that the hazardous waste was poured down the street. When it begins to rain (or people water their lawns), the water runs from streets into the storm drains (square metal grates at the sides or curbs of streets). The rainwater picks up anything soluble (that dissolves in water) or that floats on the water as it flows into the storm drain and also washes along solid materials and oils. Therefore, it will carry almost any hazardous waste.

As the water leaves the storm drain, it enters pipes which carry it to larger underground pipes or "trunk lines." These usually empty the water into the nearest waterway, such as a creek, lake, river, or ocean. So if used motor oil was poured down the storm drain along a street, it may end up on the feathers of ducks or in the gills of fish in a nearby lake or river.

In some communities the storm drains join sanitary sewer pipes and the runoff water goes to a sewage treatment plant. In this case water containing hazardous waste will be treated. What kind of sewage treatment systems do you have in your community?



Student's Page

C. SINK AND TOILET

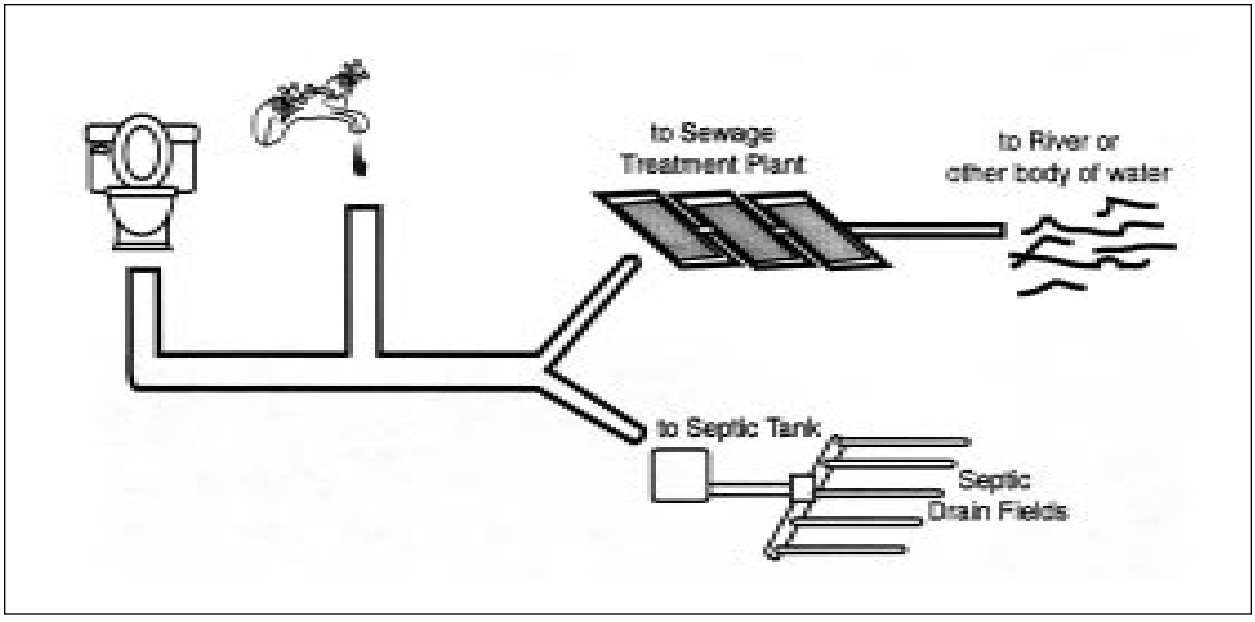
If a substance is poured down the sink or flushed down the toilet, where does it go? It goes either to the community sewage treatment plant or into a septic system.

The sewage system consists of a network of underground pipes that collect waste water from each house, store, office, factory, and building and bring it together into huge pipes called trunk lines. These trunk lines carry enormous volumes of waste.

Not long ago, sewage was dumped directly into rivers, lakes, and oceans. Now, most cities and towns have municipal sewage treatment plants to remove sewage before the transporting water is pumped into nearby lakes, rivers, or the ocean.

If a house is not connected to a sewer system, it is probably connected to a septic tank. Many gallons of water and sewage go through these septic systems each day.

Bacteria break down much of the waste entering a septic system. However, if household hazardous waste is poured or flushed into a septic system, the waste can kill this helpful bacteria and can contaminate the septic tank sludge or septic system's drain field soil. This sludge, pumped every four or five years from the septic tank, is disposed either at a sewage treatment plant in a septic lagoon or in a sludge landfill.



Student's Page

D. GARBAGE CAN

Until recently, once you had put your trash in the garbage can, you probably didn't think about it any more. The garbage truck came by every week and took it away. What happens to your garbage after it's picked up? Where does it go?

In some areas, the garbage truck takes your trash to a transfer station. From there, the garbage is placed in large trucks and hauled to a landfill. What happens to garbage after it reaches the landfill? What do you think can happen to household hazardous waste if you put it in the garbage?

Many years ago, trash in landfills used to be burned to reduce the volume. This produced a relatively nontoxic ash, but burning trash sent hazardous emissions into the air. Consequently, open burning was stopped and was replaced by compaction and burial of waste. The waste at a landfill is heavily compacted. As a result, almost any container will break and the contents will spill. If those contents are hazardous and they leach through the landfill into the ground, they will pollute the surrounding soil if the landfill is old and not properly lined with plastic to contain the leachate.

In addition rainwater soaks through the garbage. Soluble (dissolvable in water) substances from household hazardous waste may be washed down with them. This liquid mixture is called leachate. Leachate will go down through the soil until it reaches an impermeable layer (a layer it cannot go through), or it will flow downhill over the land's surface. Leachate can contaminate groundwater and surface waters. Landfills constructed today must have a protective lining, a leachate collection system, and a groundwater monitoring system. However, many of our existing landfills were established prior to these requirements, and they can leak hazardous leachate into the ground.

So if household hazardous waste is thrown into the garbage can, it may end up in the soil, the ground, or in water near a landfill.

These protective layers keep the leachate from contaminating the groundwater. A plastic liner is covered with a geotextile cushion followed by a layer of sand at the Eastlake Sanitary Landfill in Lake County. Garbage will be placed on top of the sand. Note the leachate pond on the right into which leachate is collected from the landfill.

Student's Page

WHERE WILL IT END UP?

Names of students:_____

Type of disposal method your group was assigned:_____

Answer the following questions. Then use the chart below to check off the areas affected by the disposal method you were assigned.

1. If we dispose of the household hazardous waste by this method, what might happen?
_____

2. What ways, if any, might other living things, like wildlife and plants, be harmed?
_____

3. What ways, if any, might people be harmed?
_____

4. How could chemicals in this product get into our drinking water?
_____

Product: Used Motor Oil						
Disposal choice	**Affected parts of the environment**					
	Air	Water	Soil	Humans	Wildlife	Plants
Pour the HHW* on the soil or on the ground.						
Pour the HHW on the street into a storm drain.						
Pour the HHW down the sink or toilet.						
Throw the HHW into the garbage can.						

*HHW = household hazardous waste

4–6 Module Unit 4

Transparency

WHERE WILL IT END UP?
EFFECTS OF HOUSEHOLD HAZARDOUS WASTE DISPOSAL

Chart I

Product: Used Motor Oil						
Disposal choice	**Affected parts of the environment**					
	Air	Water	Soil	Humans	Wildlife	Plants
Pour the HHW* on the soil or on the ground.						
Pour the HHW on the street into a storm drain.						
Pour the HHW down the sink or toilet.						
Throw the HHW into the garbage can.						

*HHW = household hazardous waste

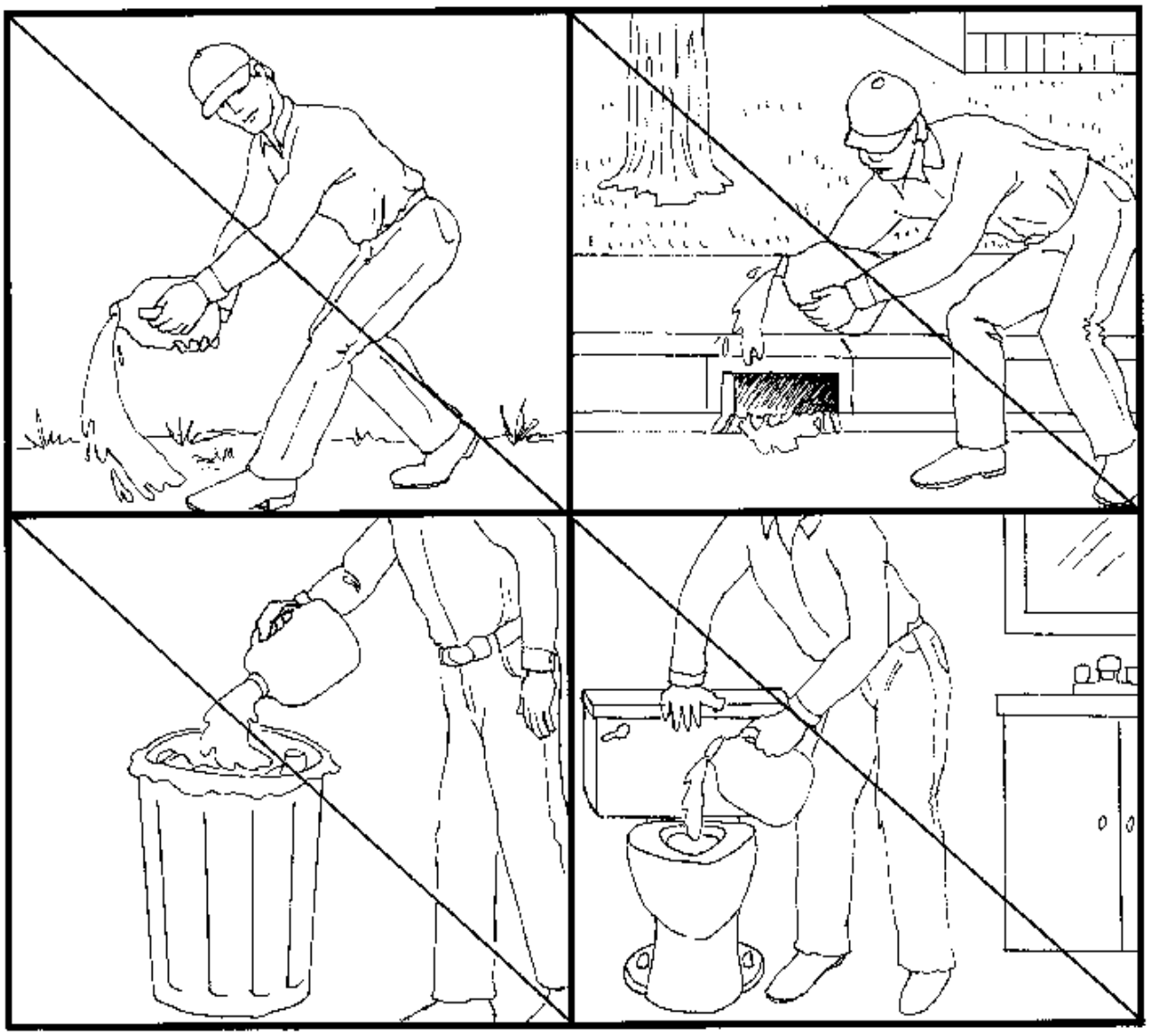
Chart II

Product: _____						
Disposal choice	**Affected parts of the environment**					
	Air	Water	Soil	Humans	Wildlife	Plants
Pour the HHW* on the soil or on the ground.						
Pour the HHW on the street into a storm drain.						
Pour the HHW down the sink or toilet.						
Throw the HHW into the garbage can.						

*HHW = household hazardous waste

Transparency

IMPROPER WAYS OF GETTING RID OF USED OIL



Why is each method of disposing of used oil, as shown above, not appropriate?

BACKGROUND INFORMATION FOR THE TEACHER

Many potentially hazardous products that people use at home and wastes, such as used motor oil, are called household hazardous waste when they are discarded.

It may not seem serious for individual households to improperly dispose of small quantities of household hazardous waste. However, even tiny amounts, such as parts per million or even parts per billion, of some substances will render a water supply undrinkable and dangerous to humans and other life. Some chemicals can produce such an effect after accumulation of minute amounts over many years.

Burying or pouring household hazardous wastes on soil is illegal and can damage or kill trees and other plants and contaminate water resources. Improper disposal of household hazardous wastes in wastewater systems (e.g. pouring down drains) can damage pipes and eventually damage sewage treatment equipment or home septic tank systems, because both of these processes are dependent on the actions of microbes to break down wastes. Pouring liquid waste (e.g., used motor oil or used antifreeze) on the street, driveway, or storm drain can pollute surface waters, such as streams and lakes.

Although unused motor oil is not considered a household hazardous product, once it has spent time inside an engine and is drained out, it becomes household hazardous waste. During engine use, the oil picks up metals, such as iron, lead, and cadmium; chemical contaminants; and dirt and ash. These contaminants and the motor oil are damaging to the environment.

Each year in California, approximately 20 million gallons of used oil are improperly disposed by persons changing their own oil. One quart of used motor oil can change the taste or smell of more than 250,000 gallons of fresh drinking water. This is enough water to sustain a family of four for one year.

There are many ways in which millions of gallons of used oil enter and pollute our environment each year. Many people change their own automobile oil and often dispose of the used oil on the ground or down storm drains and sinks, or throw it out with their trash. Limited understanding of the associated environmental and health hazards are prime causes of improper disposal. Additional information on used oil is provided in "Appendix C–V, Motor Oil."

Information about proper management of household hazardous waste is provided in Lesson 4. For additional information see "Appendix B–VI, Household Hazardous Wastes."