PROPER AUTOMOTIVE WASTE MANAGEMENT

INSTRUCTOR'S GUIDE

INTEGRATED WASTE MANAGEMENT BOARD

October 2003

Zero Waste—You Make It Happen!

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The energy challenge facing California is real.
Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, **Flex Your Power** and visit **www.consumerenergycenter.org/flex/index.html.**

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ACKNOWLEDGEMENTS

Manual Production

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INTRODUCTION

This guide is intended to augment the Resource Manual. The student activities/exercises in this guide are presented in a manner geared toward the instructor.

The guide contains special instructions as well as answers to questions contained in the activity sheets. The exercises are organized into two sections:

1. Cognitive Activities
2. Hands-On Activities

This guide also includes quiz questions and answers covering information in the Resource Manual (with the exception of the appendices).

Copies of the PowerPoint slides are included for those who do not use PowerPoint.

COGNITIVE ACTIVITIES

These activities are theoretical in nature, not hands-on. They are designed to be thought provoking and to instill creativity in students. They should lead to discussions about pollution prevention and waste management.

The activity sheets in this Instructor's Guide are written for instructors and contain special instructions and answers to the questions. Certain areas do not have answers because they are subjective and/or need individual instructor input.

The cognitive activities are as follows:

Basics in Cleaning the Shop
Dealing with Waste
Earth's Resources Found in the Auto Shop
How Oil is Formed #1
How Oil is Formed #2
It's Up to You
Motor Oil
Removing Oil from the Earth
Throwing Oil in the Trash
Used Oil and You

BASICS IN CLEANING THE SHOP

The following practices and equipment significantly reduce the amount of water needed to clean shop floors, especially when used together. Less wastewater means fewer possible environmental problems caused by wastes in the water.

Objectives

- To learn how to reduce water needed for shop cleanup.
- To clean up the shop correctly.

Exercise

1. Form the students into groups and have them create shop practices, other than the ones listed that could be used to reduce waste and promote proper cleanup.

2. Have the students share their ideas with the rest of the class and have them talk about placing their ideas into the everyday shop routine.

   Would any of the practices be hard to follow routinely?

   Why?

   Why not?

How to Help Keep the Shop Clean

- Prevent spills from ever reaching the floor!

- Stop if there's a drop! Never walk away from a spill. **Why?** If spills are not cleaned up immediately....

   1. Workers can slip and fall causing injury.

   2. Oil, antifreeze, and other spilled material can mix and be tracked around shop and vehicles, causing contamination.

   3. More time and money will have to be spent cleaning up the floor and other contaminated areas.

- Carry rags so that the small spills can be wiped dry when they occur. *Never* saturate rags with liquids! Waste haulers may not pick up rags with "free liquid." Always use enough rags to prevent saturation.
- Use the "4-step method" to clean up spills:

    1. Use a "hydrophobic" mop to pick up oil from any spill.

    2. Use "dedicated mops" (that is, one for coolant, one for oil, and a third for wash water).

    3. Use shop rags to pick up residual liquid.

    4. Wet mop, if necessary, with a mild non-caustic detergent as a final cleanup. Empty the wash water into the sanitary sewer through a sink or toilet, *never* into storm drains!

- Cleanup equipment should be well marked. For example, attach red flags to mop buckets used for spill cleanup so workers can easily locate them. Keep ***all*** spills out of storm drains!

- *Absolutely never* hose down the work area!! This generates large quantities of contaminated wash water that is discharged into sewers, or worse, is flushed out of the shop and into a storm drain.

- If a pressure washer is used to clean your shop floors, be sure to dispose of the wash water properly. Even if a contractor performs the pressure washing, the shop is responsible for proper management of the wash water and can be held liable for its illegal disposal.

Consider This:

Sealing the shop floor with an epoxy or other suitable sealant.

An epoxy-sealed floor...

- Won't absorb spills as a concrete floor does.

- Makes spill cleanup easier. (Squeegee small spills into a dustpan and pour the liquid into the appropriate container.)

- Requires less time and water to clean.

- Lasts for years and reduces long-term liability for cleanup of a contaminated shop floor and soil below.

Storage

Store all of your hazardous liquids in covered containers to prevent evaporation, spills, and contamination. Make sure all storage units are locked and roofed, or are covered indoor areas with concrete flooring and curbs for spill containment.

Organize storage areas with enough room for easy and safe access. Inspect the storage area at least once a week for leaky containers, spills, leaks, and out-of-date supplies.

Control that Spill!

Help reduce spills by using a gravity spigot or pump to dispense bulk liquid materials. Always use a spout and funnel when transferring liquids. Keep lids on containers at all times except when in use.

Note: Check with your sewer utility to find out where the wastewater from your drains end up. Most outside drains and some inside drains do not lead to sewage treatment plants, but are actually storm drains that lead directly to a stream, lake, ditch, or to dry wells. Discharging contaminated water into any of these may pollute surface and/or ground water and result in significant fines and environmental damage.

Wastewater Contamination

If you can contain and clean up all leaks and spills without a discharge of wastewater to the either sanitary sewer or storm drain, then you may not need to monitor wastewater discharges. Use procedures and equipment that recycle rinse and wash water.

Collect leaking or dripping fluids in drip pans or containers. Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, or remove other parts. Drain and replace motor oil, coolant, and other fluids in a designated area of the shop, where the storm and/or sanitary sewer floor drains are protected. Clean up minor spills before they reach the drains.

Be sure to recycle, because if you do not you may have to dispose of the fluids as hazardous wastes. This can mean higher costs for you and the environment.

DEALING WITH WASTE

Objective

- To learn how to manage waste correctly.

Exercise

Have the students get into groups and discuss different ideas about how waste can be reduced as well as managed.

Have them look around the shop and note areas that need to be improved to better manage waste.

Ask them to discuss these ideas with the rest of the class and develop an action plan to make those improvements within the shop.

Why Properly Manage Waste?

One of the hidden roles of automotive repair employees is the protection of public heath and the environment through proper waste management practices. By maintaining these practices, you also allow your business to:

- Save money through reduction or recycling of wastes.
- Stay in compliance with local, State, and federal environmental regulations and avoid costly penalties.
- Gain customers who prefer to deal with a shop that acts in an environmentally responsible manner.
- Join other automotive repair shops in your area that take pride in maintaining a clean and healthy environment.

An automotive fluids management program will reduce costs, paperwork, liabilities, and the production of pollution if auto shop managers take the following steps:

- Promote inclusion of all staff in processes and rewards.
- Enhance employee communication about pollution prevention benefits.

- Establish a company policy of pollution prevention.
- Identify ways to reduce or eliminate automotive fluids waste.
- Instill a philosophy of proper health and safety practices.

Participation and Proper Handling of Wastes

Demonstrated upper management support of a proposed pollution prevention program is crucial to its acceptance by "line" employees. Management must establish waste minimization as a top priority in the hierarchy of a company's business goals. Everyone in the auto shop needs to understand and be able to implement the following waste handling and minimization practices:

- Keep all product and waste chemicals in sealed containers with tight-fitting lids.
- Keep solvent rags in a closed container when not being used.
- Keep lids on all solvents and turn off your solvent sink when not in use. Solvent losses due to evaporation, equipment leaks, or spills and inappropriate usage can range from 25 to 40 percent.
- Be aware that, when mixed with hazardous substances (for example, chlorinated solvents), otherwise safe products may need to be handled as hazardous wastes.
- Do not allow cleaning solutions to enter the sewer system unless you have approval from the wastewater treatment plant.
- Never discharge any waste to a street, ditch, storm sewer, stream, or the ground.
- Review the need to clean parts and the degree of cleaning needed. Perhaps not all cleaning that is done is necessary.

Possible Ideas for Reducing Waste:

- Switch to a re-circulating aqueous spray cabinet for cleaning parts instead of using solvents or hot tanks. This can reduce the volume of hazardous waste that requires disposal.
- Use dirty solvent first rather than finish solvent when cleaning parts. In addition, use a filter on parts washers to extend the life of the solvent.

- Consider switching to water-based or steam cleaners instead of using spray cans of brake cleaners, carburetor cleaner, or solvent parts cleaners.

Source Reduction

Source reduction is not as difficult as some might think. By simply walking through the shop and taking note of all processes that generate wastes, one can determine which wastes are most likely to be toxic or hazardous. Look at each process in the shop and determine if it can be modified in some way to limit the production of hazardous waste.

- Don't stockpile perishable supplies. Label, date, and inspect new materials as they are received, and use the oldest stock first. Keep records of dates of receipts and usage to help reduce overstock and material degradation.

- Purchase supplies in bulk and keep them in bulk dispensers. This eliminates empty waste containers that may need to be disposed of as hazardous waste.

- Keep on hand only the quantities of materials that you really need and use them on a "first-in first-out" basis, to avoid the need to discard unopened cans when the shelf life of the material expires.

- Consider reducing the number of different brands or grades of materials that you use; this will reduce the number of containers you keep in storage and reduce the risk and severity of fire or accident.

- Select suppliers who will allow you to return used materials and containers for recycling.

- Share unwanted materials.

Dealing with Waste that Cannot be Reduced or Reused

- Contract for a recycling service to pick up used antifreeze, lead-acid batteries, motor oil, oil filters, solvents, and scrap tires.

- Consider an on-site distillation unit to recycle used solvents and engine coolant.

- Fleet maintenance shops should consider using retread tires, re-refined motor oil, and engine oil analysis as means of reducing costs and reducing waste generation.

- Use an oil separator and water recycling system for the wash rack to reduce water usage and wastewater disposal.

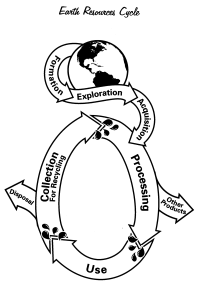
Recycle

When the process of reusing and reducing is not an option, recycle wastes whenever possible.

EARTH'S RESOURCES FOUND IN THE AUTO SHOP

Objective

- To understand the resources needed to produce various products.



Exercise

Have the students find three objects in the shop that are used on a weekly basis and determine the following about each object:

1. The components that make up the object.
2. The Earth resources used in each object.
3. The source or origin of those resources.
4. Whether the resources are renewable or non-renewable.

Note: Renewable resources are Earth resources that are replaced naturally within a human lifetime. Non-renewable resources are Earth resources that cannot be replaced naturally within a human lifetime.

Example Chart

Object: Pencil

Components	Earth Resources	Source/Origin	Renewable or Non-renewable
Wood	Trees	Seeds	Renewable
Graphite	Mineral ores	Earth's crust	Non-renewable
Paint	Crude oil	Decomposing plankton	Non-renewable
Rubber	Rubber plants	Seeds	Renewable
Metal	Mineral ores	Formed by cooling magma	Non-renewable

Discussion

Have the students fill out the attached chart with their findings.

Have the students gather in groups of two or three and share their results and then have them present their results to the class.

HOW OIL IS FORMED #1

Objective

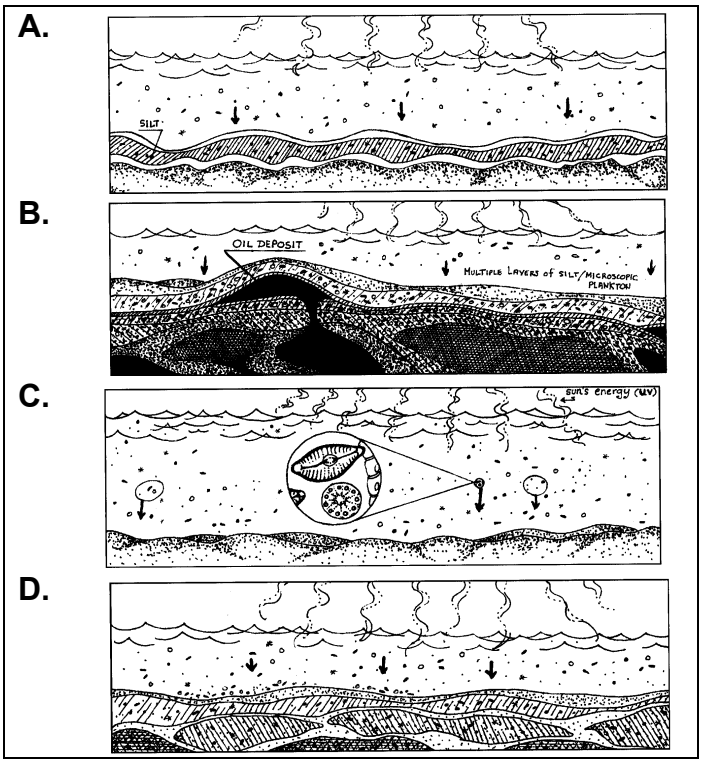
- To understand how oil is formed.

Exercise

Provide students with the following background information:

Oil that is used today was formed from the decomposition of marine organisms. Tiny organisms that lived in the sea died and settled to the bottom of the ocean. Soon deposits of silt, mud, and fine sand settled on top of them. This process continued causing pressure to build up on the deposits and the temperature to increase. The mud, sand, and silt hardened and the remains of the dead organisms were converted into hydrocarbon molecules or crude oil.

Review with the students the text and the pictures in the graphic. Note to them that they are out of sequence. Ask them "In what order should they be rearranged?"



1. Many layers of sediment form.
2. Microscopic plankton dies and sinks to bottom of the ocean.
3. Carbon compounds rearrange to form hydrocarbon molecules of oil and natural gas.
4. Sediments bury the dead plankton quickly.
5. Heat and pressure on decomposed material increase.
6. Microbes decompose dead plankton.

The table below lists possible answers to the table that is on the students' worksheet. Note that there could be other interpretations of the pictures and what they represent.

Order	Statement #	Picture
1st	2	C
2nd	4	A
3rd	6	A
4th	1	A or D
5th	5	C
6th	3	B

Note: Refer to Appendix E in the Resource Manual for additional information.

HOW OIL IS FORMED #2

Objective

- To understand how oil is formed.

Exercise

Using the Geological Time Chart included with this activity, have the students answer the following questions:

Write the stages of crude oil formation:

1. Microscopic plankton dies and sinks to bottom of the ocean.
2. Sediments bury the dead plankton quickly.
3. Dead plankton is decomposed by microbes.
4. Many layers of sediment accumulate.
5. Heat and pressure on decomposed materials increase.
6. Carbon compounds rearrange to form hydrocarbon molecules of oil and natural gas.

Have students carefully study the geological time chart, then answer the following questions.

1. What was the first time period in which algae and small animals became plentiful in the oceans?

   Ordovician period.

2. What geological formations were developing in this same time period?

   Limestone, sandstone, and shale.

3. How are the formation and location of crude oil specifically selected to geologic processes?

4. The dead organisms settled out and were covered with sediment. The buildup of sediment creates the pressure to cause the chemical changes that result in the formation of crude oil.

5. Why is it a myth that crude oil was formed from dinosaur remains?

   Crude oil was formed in marine environments.

6. What can you conclude or summarize about the origin of crude oil?

   Crude oil was formed a long time ago. More crude oil is not likely to form in our lifetime.

7. Instruct students to write a question beginning with “How” or “Why” related to the geological time chart and to answer it.

   Students will provide a variety of questions and answers depending upon their interests.

8. Ask them if it is possible that there is oil forming today? Have them explain their answers.

   Yes. Crude oil formation is an ongoing process, as marine plankton continue to die and decompose underneath layers of sediment, and heat and pressure bring about the necessary chemical changes. However, although oil is still forming, the process is so slow that it cannot offset the rates at which the world’s oil is being consumed.

GEOLOGICAL TIME CHART

The Earth's earliest history appears at the bottom of the chart, and its most recent history is at the top.

		Period or Epoch and Its Length	Beginning (Years Ago)	Development of Life on Earth		Development of the Earth
CENOZOIC ERA	Quaternary Period	**Holocene Epic** 11 1/2 Thousand Years	11 1/2 Thousand	Humans hunted and tamed animals; developed agriculture; learned to use metals, coal, oil, gas, and other resources; and put the power of the wind and rivers to work.	 Cultivated Plants	Streams, glaciers, and oceans eroded the land. Present river deltas and coastlines were formed. Ice Age glaciers melted and water collected, forming the Great Lakes of North America.
		Pleistocene Epoch 2 Million Years	2 Million	Modern humans developed. Mammoths, woolly rhinos, and other animals flourished but died out near the end of the epoch.	 Human Beings	Several times during the Ice Age, glaciers covered large areas of North America and Europe. The climate was cool. Mountains rose in western North America, and volcanoes erupted.
	Tertiary Period	**Pliocene Epoch** 3 Million Years	5 Million	Sea life became much like that of today. Birds and many mammals became like modern kinds and spread throughout the world. Humanlike creatures appeared.	 Horses	The Oligocene, Miocene, and Pliocene epochs were much alike. Rocks that formed during these epochs included clays, limestones, and sands. The climate was uniform and mild through the Oligocene and Miocene, but began to get cooler during the Pliocene, leading up to the following Ice Age. Mountain making was common, and many volcanoes erupted. Oil and natural gas formed in rocks made during these epochs.
		Miocene Epoch 19 Million Years	24 Million	Apes appeared in Asia and Africa. Other animals included bats, monkeys, and whales, and primitive bears, and raccoons. Flowering plants and trees resembled modern kinds.	 Apes	
		Oligocene Epoch 14 Million Years	36 Million	Primitive apes appeared. Camels, cats, dogs, elephants, horses, rhinos, and rodents developed. Huge rhinoceros-like animals disappeared near the end of the epoch.	 Early Horses	
		Eocene Epoch 17 Million Years	55 Million	Fruits, grains, and grasses developed. Birds, amphibians, small reptiles, and fish were plentiful. Primitive bats, camels, cats, horses, monkeys, rhinoceroses, and whales appeared.	 Grasses	Seas flooded the shores of the continents. Large areas were covered by swamps where lignite, a kind of coal, later formed. Oil and gas also formed in clays, limestones, and sands.
		Paleocene Epoch 10 Million Years	65 Million	Flowering plants became plentiful. Invertebrates, fish, amphibians, reptiles, and small mammals were common.	 Small Mammals	Thick soil formed in hot, rainy lands. Mountains, not yet worn by erosion, were high. The climate was varied. Coal, gas, and oil formed in clays, limestones, and sands.
MESOZOIC ERA		**Creataceous Period** 73 Million Years	138 Million	Flowering plants appeared. Invertebrates, fish, and amphibians were plentiful. Many fish resembled modern kinds. Dinosaurs with horns and armor became common. Dinosaurs died out.	 Flowering	Oceans flooded large areas. Cool swamps developed. Rocks included chalk, limestones, sandstones, and shales. Gas, oil, and ores of gold and other metals were formed.
		Jurassic Period 67 Million Years	205 Million	Cone-bearing trees were plentiful. Sea life included shelled squid. Dinosaurs reached their largest size. The first birds appeared. Mammals were small and primitive.	 Birds	Shallow seaways cut across the continents. Some volcanic action occurred. Rocks included limestones, sandstones, and shales. Gas, oil, salt, and ores of gold and uranium formed.
		Triassic Period 35 Million Years	240 Million	Cone-bearing trees were plentiful, as were fish and insects. The first turtles, crocodiles, and dinosaurs appeared, as did the first mammals.	 Dinosaurs	Layers called *red beds* developed along with shales, sandstones, and limestones. Gas, oil, and ores of copper and uranium formed. Faults (cracks) occurred in eastern North America.
PALEOZOIC ERA		**Permian Period** 50 Million Years	290 Million	The first seed plants—cone-bearing trees—appeared. Fish, amphibians, and reptiles were plentiful.	 Seed Plants	Glaciers in the southern hemisphere melted and left sedimentary layers. Rocks in the northern hemisphere included limestones, sandstones, and shales. Gas, oil, gypsum, and salt formed.
	Carboniferous Period	**Pennsylvanian Period** 40 Million Years	330 Million	Algae were plentiful. Fern trees grew from seedlike bodies. Fish and amphibians were plentiful. The first reptiles appeared. Giant insects lived in forests where coal later formed.	 Reptiles	Swamps covered the lowlands. Oil, gas, and large amounts of coal formed among limestones, sandstones, and shales. River deltas partially filled the Appalachian seaway.
		Mississippian Period 30 Million Years	360 Million	Algae were plentiful and the first mosses appeared. Trilobites were dying out. Crustaceans, fish, and amphibians were plentiful. Many coral reefs were formed.	 Amphibians	Large amounts of limestone formed among layers of shale and sandstone in deltas in the Appalachian and Cordilleran seaways. Coal, gas, oil, and deposits of lead and zinc formed.
		Devonian Period 50 Million Years	410 Million	The first forests grew in swamps. Many kinds of fish, including sharks, armored fish, and lungfish, swan in the sea and in fresh waters. The first amphibians and insects appeared.	 Fish	Red sandstones, shales, and limestones formed in Europe, and black shales, reef limestones, and sandstones formed in North America. Gas, oil, and quartz sand formed.
		Silurian Period 25 Million Years	435 Million	Algae were plentiful and spore-bearing land plants appeared. Trilobites and mollusks were common. Coral reefs formed.	 Eurypicrids	Limestones, coral reefs, sandstones, and shales formed, with the deepest deposits in the Appalachian and Cordilleran seaways. Gas, oil, gypsum, iron ore, and salt formed.
		Ordovician Period 65 Million Years	500 Million	Algae became plentiful. Trilobites, corals, and mollusks were common. Tiny animals called graptolites grouped together and formed branching colonies.	 Mollusks	Greatest floods of the era covered two-thirds of North America. A delta formed in the Appalachian seaway. Gas, oil, lead, and zinc formed in limestones, sandstones, and shales.
		Cambrian Period 70 Million Years (?)	570 Million (?)	Fossils were plentiful for the first time. Shelled animals called trilobites and some mollusks were common in the sea. Jawless fish appeared.	 Trilobites	Seas spread across North America from the Appalachian seaway in the east and the Cordilleran seaway in the west. Lead and zinc formed in sandstones, shales, and limestones.
		Precambrian Time Almost 4 Billion Years (?)	4 1/2 Billion (?)	Corals, jellyfish, and worms lived in the sea about 1,100 million years ago. Bacteria lived as long ago as 3 1/2 billion years. Before that, no living things are known.	 Bacteria	Copper, gold, iron, nickel, and silver formed in shales, siltstones, lava, volcanic ash, and metamorphic rocks. The earth's crust melted and cooled repeatedly during this time.

IT'S UP TO YOU

Objective

- To understand how to solve oil pollution problems.

Exercise

The students will discuss this scenario, presented to promote the creative solving of short-term and long-term problems to potential oil pollution. Students should be encouraged to research current and past events to source actual situations for their discussion.

Focus for the student:
Based on their expertise and knowledge from this school year, have them write a solution to the environmental problem below. Include suggestions about how this problem can be avoided in the future. Discuss this problem with three to four classmates and then participate in a class discussion. List 10 other short-term and long-term adverse environmental problems we've encountered in this country.

Scenario
One bright and sunny morning a large ship was on its way to deliver oil to the United States. Thirty minutes from docking at the shore the ship hit a sharp rock and a hole was punctured in its side. Before anyone knew it oil was gushing out of the hole. Eleven thousand gallons of oil poured into the ocean which many species of mammals, birds, and ocean life call their home. Since the oil spill happened in saltwater, the oil floated to the surface and eventually spread miles across the surface of the water.

Brainstorm Ideas

Solution to Oil Spill
How Future Oil Spills can be Avoided
Short-term Problems
Long-term Problems
Effects on the Environment
Preventions
Solutions and Cleanup

Further Information

Oil can have a dramatic effect on wildlife, especially those with feathers or fur. When oil collects on the feathers or fur of animals they will soon die if not de-oiled because their coats are no longer waterproof and they cannot move properly (that is, birds can no longer fly). It is very important to clean up an oil spill quickly in order to minimize damage to the environment and wildlife. Since oil spreads rapidly on the surface of water, one quick initial cleanup solution to is to manually collect oil from the ocean's surface with a lightweight skimmer. If the oil spill is on land a powerful vacuum can be used.

MOTOR OIL

Objective

- To understand how to manage motor oil.

Exercise

Have students form in to small groups to discuss each topic below and explain why it is important to manage oil with care.

Topics

1. **Environmental Problems:**
   Motor oil can make drinking water toxic and prevent oxygen from dissolving in water, threatening aquatic life. Because suspended oil travels in surface storm water, pouring 1 gallon of used oil on the ground even miles from rivers, lakes, and reservoirs can render 1 million gallons of water undrinkable.

2. **Oil Changes and a Limited Supply of Oil:**
   Vehicle and auto shop owners normally perform oil changes based on mileage and calendar schedules rather than the quality of used oil in the engine. Consequently oil changes are performed more often than necessary. If oil changes were based on oil quality testing, fewer oil changes would be required and less oil would be consumed. Since oil is non-renewable, the world's oil supply is decreasing and oil prices will inevitably rise, now is a good time to switch to changing motor oil only when it is sufficiently degraded.

3. **Importance of Oil Filters:**
   Oil filters remove solid particles and some liquids such as fuel, water, and antifreeze. They provide a constant cleaning process, which can safely extend oil change intervals, reduce oil use, and reduce the disposal cost of waste oil.

   Note: Using a reusable filter that has the ability to remove smaller particles and soot is better for the engine, does not require recycling and reduces cost to the vehicle owner.

4. **Purchase Re-refined Oil:**
   Oil does not wear out, it just gets dirty. Re-refining turns dirty oil back into fresh, "good as new" oil that can be used in vehicles. Re-refined oil is used oil that has been cleansed of contaminants and then blended with

fresh additives. Re-refined oil is of equal or better quality than oil made from virgin base stock and is typically the same price or cheaper. API licensed re-refined oils must pass the same tests that virgin oils do for cold start and pumpability, rust corrosion, engine wear, high temperature thickening, deposit and phosphorus.

Re-refining used oil consumes about two-thirds less energy than refining crude oil into lubricant quality motor oil. Thus, those who purchase re-refined oil not only extend the life of oil, but also increase our energy efficiency and decrease oil consumption. Thousands of different cars, trucks and fleets around the world used re-refined oil. Some users include: the State of California, the U.S. Armed Forces, Coca-Cola, United Parcel Services, Southern California Gas, Waste Management, the U.S. Postal Service, Frito-Lay, and the City of San Francisco. Re-refined oil is also used on the NASCAR race circuit.

Re-refined oil comes in a variety of blends suitable for different types of gas and diesel engines and can be purchased in bulk from a variety of blenders (Unocal, Chevron, Safety-Kleen, Coast Oil, Rosemead Oil, Lyondell) and hundreds of independent distributors throughout the U.S. Some auto supply stores carry re-refined oil in quart containers, including Unocal's "Firebird" brand and Safety-Kleen's "America's Choice" brand. A few retailers, such as Wal-Mart and Kragen, and Good Year Service Centers carry re-refined oil.

REMOVING OIL FROM THE EARTH

Objectives

- To understand how oil is removed from the earth.
- To discuss the problems with oil removal.
- To discuss oil transportation and associated spills.

Exercise

Divide the class into several small groups, have each group pick a topic from the list below and discuss it, and then present to the class. Be sure they include the advantages and disadvantages of each topic.

Topics

1. **Oil Extraction:**
   Modern wells can be thousands of feet deep, which may cause groundwater supplies to be contaminated.

   Original oil wells only extracted about one-third of the potential oil. These methods were inefficient, which led to the development of new oil recovery techniques.

   One new technique involves pumping water into the oil reserve under pressure. The water sweeps or pushes a large portion of the remaining oil into the wells. What are the problems associated with using water to extract oil? Are they solvable?

2. **Offshore Fields**:
   Pollution problems can arise from drilling for oil in offshore deposits. Since 1947, 20,000 offshore wells have been drilled. Many of these wells leak and cause harm to the surrounding environment.

   For example, in 1969 an oil rig in Santa Barbara California leaked and caused damage to the marine habitat and recreational beaches. Another example occurred in 1977, when a North Sea oil well blowout in late April caused a 20-mile oil slick.

   Lastly, in Mexico an offshore oil well blowout in 1979 contaminated Gulf fisheries and beaches with about 3.5 million barrels of oil. What effects does an oil spill have on the environment and wildlife and how can we prevent offshore oil well blowouts?

3. **Transportation and Spills:**
   Petroleum is transported by supertankers, barges, pipelines, railroad tanks cars, and highway truck tanks. Each one of these transportation methods can lead to accidents, spills, and leaks. How can these problems be prevented and what are the alternatives?

THROWING OIL IN THE TRASH #1

Objective

- To understand the effects on the environment of oil that is disposed of in the trash.

Exercise

Have the students read the scenario and background information below and answer the questions.

After answering the questions individually, have the students discuss their answers in groups of two or three.

Scenario

One day you are walking by your local landfill. You notice that a couple of kids are planning to throw a can of used oil away in the landfill.

With your knowledge you attempt to educate them on the disastrous effects waste oil will have on the environment.

Background

- Most municipal landfills have a protective lining underneath, to avoid soil and groundwater pollution.
- Landfills give off gases as a result of decomposed wastes.
- If oil is disposed of in a landfill, it eventually seeps until it reaches the protective lining between the waste and the soil. If there is a hole in the lining, then the oil passes into the ground and eventually reaches underground water, causing contamination.

Analysis

1. What is the difference between a landfill and a dump?
2. Why is it a problem if people discard their used oil into garbage cans that go to landfills instead of recycling it?
3. How does rain increase the chance of ground pollution?

4. What happens to an animal or a human being that drinks contaminated water?

USED OIL AND YOU

Objective

- To understand the natural resources used by a typical vehicle.

Exercise

Provide the students with the knowledge of how to use a car owner's manual and determine the natural resources a typical car might use.

Have the Students Answer the Following Questions About One Particular Car:

1. Type of car (pick any car you would like to explore):_____
2. Engine oil capacity (quarts of new oil per oil change):_____
3. Recommended number of miles between oil changes:_____

Conversion Factors
Typical Bathtub = 30 gallons
Tanker Truck = 8,400 gallons
Typical Swimming Pool = 42,000 gallons
4 Quarts = 1 Gallon
42 Gallons = 1 Barrel
55 Gallons = 1 Drum

4. Assuming the car you've chosen is your own, use the conversion factors shown above to calculate the number of gallons of used oil you could generate in your driving lifetime. **Note**: The average person drives about sixty-four years of his or her life and about 20,000 miles per year.

5. Convert your answer above into drums of oil. (See example on next page.)

6. Determine how many bathtubs of used oil would be produced in your lifetime of driving this car. (See example below)

Conclusion

- Why is it important not to waste or use more oil than necessary?
- Have the students gather into groups of three to four and share their findings.
- Now have the students discuss this with you and the entire class.

Example:

1. 1983 Mitsubishi
2. 4.2 quarts of oil per change
3. 3,000 miles between changes
4. Number of gallons of used oil in your lifetime.

$$64\ \text{yr} \times \frac{20{,}000\ \text{mi}}{\text{yr}} \times \frac{1\ \text{oil change}}{3{,}000\ \text{mi}} \times \frac{4.2\ \text{quarts new}}{\text{oil change}} \times \frac{1\ \text{gal}}{4\ \text{quarts}} = 488\ \text{gal}$$

5. Convert into drums:

$$488\ \text{gal} \times \frac{1\ \text{drum}}{55\ \text{gal}} = 8.1\ \text{drums of used oil}$$

6. Convert into bathtubs:

$$488\ \text{gal} \times \frac{1\ \text{bathtub}}{30\ \text{gal}} = 16.26\ \text{bathtubs}$$

HANDS-ON ACTIVITIES

In this Instructor's Guide, the activity sheets are designed for you in that they contain special instructions and answers to the questions. Some activities' questions do not have answers because they are subjective and/or need individual instructor input.

This group of activities is hands-on in nature and requires active student participation.

The hands-on activities are as follows:

A Rusty Nail
Café Reducto
Dumping Used Oil #1
Dumping Used Oil #2
Dumping Used Oil in the Backyard
Fry Guys
Fun Factory
Green Square Game
How Oil is Removed from the Earth
Making an Oil Filter
Oil Additives Help Protect Car Engines
Oil Filter Activity
Oil/Water Separator
Oily Washer
Throwing Oil in the Trash
Used Oil and Our Environment

A RUSTY NAIL

Objective

- To understand how oil affects the environment and items in that environment.

Exercise

Students will investigate the following questions:

1. How will an iron nail be affected when it is partially submerged in water? "Untreated"
2. How will an iron nail be affected when it is coated with lubricating oil and partially submerged in water? "Treated"
3. How will an iron nail be affected when it is left exposed to air? "Air"

Materials

6 non-galvanized iron nails
Water
3 plastic lids or shallow dishes
A sample of clean oil
Steel wool or fine sandpaper

Procedure

1. Clean each of the nails with the steel wool or sandpaper.

2. Mark one of the plastic lids "treated," the second "untreated," and the third "air."

3. Dip two of the nails in lubricating oil. Place in the "treated" lid and partially submerge in water.

4. Place two other nails in the lid marked "untreated."

5. Pour water over the nails in both lids so they are wet, but not totally covered. A portion of each nail should be exposed to air.

6. Make sure both lids have the same amount of water.

7. Place the last two nails in the lid marked "air."

8. Over the next few days observe any or all changes in each nail, such as color and shininess.

Observations:

Day 1:

Day 2:

Day 3:

When oil is introduced into the environment it changes the natural way things take place. The natural way, and correct way, for a nail to behave in the environment is to oxidize. Many other things need to oxidize as well. When the nail, or whatever, gets oil on or in it, then the nature of things is altered. The correct chemical reaction does not occur and the results are damaging to our world.

Some questions for students to research:

What happens to the rocks, soil, plants and animals that live in our waterways when they become coated with oil generated by human activity?

Does the majority of oil introduced to our waterways by humans come from oil spills from ships and oil drill rigs or from land-based improper oil disposal?

CAFÉ REDUCTO

Objectives

- To apply the concept of source reduction.
- To perform a waste audit.

Exercise

This activity is used as part of a training session for students who have had little previous exposure to the concept of source reduction. It is intended to teach the basics of assessing processes. Coffee-making was selected as a common process which everyone can readily comprehend and serves as a center point for discussions on how to identify source reduction options in a real process.

Approximately one and a half hours are needed for running the activity and completing discussions. It is highly recommended that you identify specific learning objectives for this exercise before you use it. The approach and role-plays presented here can be revised (or deleted) to meet specific teaching needs. Engage students to assist in running the exercise; it works best to ask students in advance (first thing the day of the activity will do). Provide specific guidance on what they are supposed to be doing in their roles and give them a few minutes to think about it before you start the exercise.

Instructor Notes **(Guided steps suggested for facilitating exercise)**

First Step—Introduction

Why do we use interactive tools?

First, it is fun. Students retain more of what they learn when they have fun and active experiences while learning.

Secondly, because students should know what it is they need to do to reduce waste. Much of what students are being asked to do is just common sense. They are simply reorganizing existing information in their own knowledge base.

Note about role-plays: In advance, hand out role-plays to selected recruits, brief them on their roles, the perspectives they represent, and give them a couple of sample questions.

Ask them to participate in the brainstorming with the rest of the group and to also think about the issues important to them, in their role, as they participate in the process.

Ask that they contribute their perspective as part of the “SOURCE REDUCTION OPPORTUNITIES” discussion and in the identification of incentives and barriers. (See diagram below.)

The purpose of the interactive tool is to model a process focusing the discussion on a process common to all. Process here is defined as: that which generates waste. We are looking at OUTPUTS, hold up the "dumpster," the PROCESS STEPS and INPUTS. Through this exercise we want to achieve these objectives:

Objectives	**Skill**	**Knowledge**
Perform audits	How	What and Why
Team building	How	Who

Constantly ask:

Why do we do it this way?

What are the consequences?

This is the core of the audit process. If you keep asking this you will understand the process and reveal the options. We are using the word *audit* to describe our analysis of the inputs, process steps, and the outputs of an activity.

You will need to identify what makes sense to include in your box. We are going to illustrate this by examining a process that you know well, making coffee. But first let me briefly describe where we are heading. (Describe briefly the whole process of Cafe Reducto).

Then ask for a volunteer, "Who makes bad coffee?” Recruit the first hand raised (or arrange a volunteer in advance, find an actor or actress).

Second Step—Make Coffee—Identify Inputs/Process Steps/Outputs

Have flip charts labeled: Inputs, Process Steps, and Outputs

Have a selected class member make the coffee. As the coffee is being made look into the dumpster and ask the students to identify: the inputs, the process steps and the outputs.

Write these down on flip chart sheets as the coffee is being made.

Ask who wants more coffee and serve the coffee in paper cups to those who want more.

Third Step—Recap *Inputs/Process Steps/Outputs.* Move the discussion to identifying *Source Reduction Opportunities and Incentives and Barriers.* Flip-charted/facilitated discussion.

Have the flip charts labeled: Source Reduction Opportunities and Incentives/ Barriers

Ask for ideas on how to reduce or eliminate what is ending up in the dumpster. Ask them to identify incentives for doing what they suggest. Ask them about barriers as well. For each barrier that they identify they must suggest a means to overcome it. To start discussion ask:

How much?

What kind?

Where does it come from?

How do you find out?

Who do you ask?

Who do you need on your team?

Who do you need as advisors?

Discuss implementation/incentives. Link opportunities to specific incentives or barriers that they identify. Identify through group process what is in it for them specifically at their facility.

Ferret out the differences that may exist as a result of organizational structure or mission.

For example, government agencies should act as role models—working smarter, not harder; private businesses—economically motivated/public relations benefit/does the process fit into existing channels?

NOTE: Role-play participants should be encouraged to bring their perspectives into the discussion.

Possible Class Role-plays:

- *Supplier/Vendor*—notify of new products/sell more.
- *Environmentally Aware/Health and Safety Conscious Customer*—healthier coffee.
- *Demanding Customer*—better coffee, faster coffee.
- *Waste handler*—mutter about increased regulations. Notify of cost increases.
- *Competitor*—you are better, cheaper and are more environmentally friendly.
- *County Representative*—more regulations, State and federal, are to blame; we have no choice.
- *Dr. Coffee, owner of Café Reducto', an academic*—process is fine, don't change process, it's perfect, how much will it cost?

Fourth Step—Identify Team Members

Flip chart labeled: Team Members

Emphasize:

- You need to ask questions, lots of questions.
- How do you find out?
- Who do you need on your team?
- Who can advise you?

You then use the team to generate and implement options. From this information and by touring your processes you will know who to have on the team and who to have as advisors.

Fifth Step—Derive Source Reduction Audit Procedure, "How Do I Start"?

Flip chart labeled: Source Reduction Audit Procedure

Let the class derive the generic audit procedure. Recap the audit steps. Explain facility-specific steps that are from the student's perspective; it

matters more where they end up, that is, implementing source reduction and reaching their goals, than where they start.
Begin where it makes sense to them. They need to complete these steps in order to finish but they can start where they want. Overview the audit steps to illustrate this point. Students are working toward creating a complete picture of their inputs/processes and outputs. They don't have to do this all at once. They can build toward this, completing the whole picture a piece at a time.

Looking at their outputs may provide students with the needed perspective on where to begin their source reduction audit. An understanding of outputs will lead to source reduction audits of specific activities.

The question for them to answer iswhat to put in the box. That is, what inputs and processes do they include and what do they leave out in analyzing source reduction opportunities?

Sixth Step—Conclusion

Café Reducto serves as a model process for your students;. Have themthink in the context of your own facility. You have identified an audit procedure; now have the students reference this audit procedure to what is in your facility.

Repeat that in this exercise, a process is an activity that generates waste. Emphasize that source reduction audits:

- Use audit team members' own knowledge.
- Identify what role audit team members should play and who they each might need to talk to.
- Include all available resources, even external ones.

Student Role-Plays

Supplier /Vendor

You have a number of low-impact coffee processing products such as new types of filters, water, beans and equipment which are all environmentally safe. Sure it costs more but Café Reducto customers won't object to paying a little more in doing their part to be "coffee correct."

Environmentally Aware Customer

You want better coffee and you want it faster. You heard that they cleaned their coffee beans before roasting and wondered whether this cleaning step was needed since they were heating them up to such high temperatures anyway. You suggest that they offer a discount to customers with their own reuseable cups.

Health and Safety Conscious Customer

You want better coffee and you want healthier coffee. Knowing that some of the imported coffees may be handled a variety of times before reaching your cup you want to know what is being done to insure the cleanliness of the beans before and during processing at Café Reducto. You are also concerned about their giving discounts to customers that have their own cups. Couldn't these cups transfer germs via the employees to other customers? Do they wash their hands between customers?

Cost and Time-Conscious Customer

You want better coffee and you want it faster and cheaper. Why does it already cost a buck for a lousy cup? Why don't they offer a discount to customers that bring in their own cups? How come they don't have a drive-up espresso like you saw in Seattle? You don't care if the beans are clean, you won't wait for your caffeine.

Waste Handler

You mutter about increased regulations and how your costs just keep going up and how sorry you are to notify Café Reducto of yet another cost increase for your services.

Competitor

"Muddy-Less-Water Coffee Shop," you are the better, cheaper, and more environmentally friendly shop and you advertise these facts a lot. You use low-impact everything.

County Representative

There are more and more regulations from both the State and the federal government you have to enforce. Your employer the county is not to blame; you have no choice but to enforce the rules. You do have some resources that might help prevent the coffee business from being subject to these regulations. You'llbe glad to tell the owner about them.

Dr. Coffee, Owner of Café Reducto, an Academic

You have spent years perfecting the process. It is fine. Don't change the process. It's perfect. You can find secondary uses for all of the valuable by-products generated from the coffee-making process. In fact, you have a research project that is identifying ways to use the spent disposable filter-packed coffee to serve in oil spill cleanup and toxic waste spill containment. So there is an added environmental benefit to these by-products.

Materials

Inputs:

Tap water	Spring water	Coffee

Processes

Coffee maker
Extension cord
Bleached virgin paper filters, recycled brown paper filters, mesh filter, silk filter
Roll of paper towels, cloth rag

Outputs

Paper cups	Reusable mugs
Thermos	Dishwashing detergent
Drano	Waste container
Drain or bucket	

DUMPING USED OIL #1

Objective

- To demonstrate the effects of dumping oil on the ground.

Exercise

Explain to the students that they will test the scenario below with the following activity.

Scenario

You ask your neighbor what he does with his used oil. He says that he dumps it down the storm drain at the end of the street.

You reply, "Isn't that illegal and a threat to public health?" "I don't think so," states your neighbor. "It's just a bit of oil, and it will become diluted when it mixes with all that water in the storm drain."

Have you ever thought about it this way? Could your neighbor be correct?

Materials

Bowl or basin
Motor oil
Talcum powder
Eyedropper

Procedure

1. Fill the basin with one-half inch of water. Let the water stand undisturbed until the water is no longer moving.

2. Sprinkle a fine layer of talcum powder over the water. The powder should be uniformly spread over the surface of the water and should not be very thick.

3. Predict what would happen if one drop of motor oil was placed in the middle of the basin.

4. Place one drop of oil on the surface of the water in the middle of the basin and describe in writing what happens.

5. Measure and record the length and width of the oil slick in centimeters. Calculate the area of the oil slick.

Length (cm) _____ Width (cm) _____ Area (cm^2)_____

Analysis

1. Using your measurements, calculate the actual area covered by 1 quart of oil in square meters.

Note: 1 drop = 0.05 ml, or approximately 20 drops per ml.
1 quart of oil contains 946 ml of oil

Area of water covered by 1 quart of oil = _____ square meters

$$\frac{cm^2}{1\ drop} \times \frac{ml}{1\ qt} \times \frac{drops}{1\ ml} \times \frac{1m^2}{1{,}000cm^2} = \frac{m^2}{qt}$$

2. What item in the following table has an area that is closest to your results?

Areas of Common Spaces

Typical parking space	17 m^2
Typical classroom	136 m^2
Volleyball court	171 m^2
Tennis court	266 m^2
Football field	4,550 m^2
City block	25,000 m^2

3. What would be the effect if many people dumped or leaked 1 quart of oil into local surface waters?

DUMPING USED OIL #2

Objective

- To demonstrate the effects of dumping oil on the ground, down storm drains and in water bodies.

Exercise

Based on the following scenario, during this exercise students will investigate the following questions:

Can you tell if a contaminant was present in surface water? How?

Would you drink or swim in water that has a concentration of 0.5 parts used oil per 1 million parts of water?

What levels of oil in oceans, rivers and lakes are considered safe for species other than humans?

Scenario

You ask your neighbor what he does with his used oil. He says that he dumps it down the storm drain at the end of the street. You reply, "Isn't that illegal and bad for both our health and that of animals?" "I don't think so," states your neighbor. "It's just a bit of oil, and it will become diluted when it mixes with all that water in the storm drain."

Materials

5 paper cups
Food coloring
Distilled water
A piece of white paper
Eyedropper
Toothpicks

Procedure

1. Number 5 cups, "1" through "5."
2. Place the cups, in order, on the white paper.

3. Place two drops of food coloring into cup 1 and add enough water to create a concentration of 1:10. Clean the eyedropper. How many drops of water did you use? _____

4. Remove one drop from cup 1 and place it into cup 2. Clean the eyedropper.

5. Add nine drops of water to cup 2. Stir the solution with a toothpick. What is the concentration of the mixture now? Record your data in the chart below.

6. Remove one drop from cup 2 and place it into cup 3. Clean the eyedropper.

7. Add nine drops of water to cup 3. Stir the solution with a toothpick. What is the concentration of the mixture now? Record your data in the chart below.

8. Continue with the same dilution process with cups 4 and 5. Be sure to clean the eyedropper after each dilution. Record your data in the chart provided.

Data

Cup	Concentration	Parts per Million (PPM)
1	1: 10	100,000 /1,000,000
2	1: 100	10,000/1,000,000
3	1: 1,000	1,000/1,000,000
4	1: 10,000	100 /1,000,000
5	1: 100,000	10 /1,000,000

Analysis

1. How many more dilutions would be necessary to get 1 part per million (1 ppm)? 1 more

2. Is there food coloring present at 1 part per million (1 ppm)? Yes

3. How do you know? Some amount is always present

4. Lead can be toxic to humans at *less than* 1 part per million. How much dilution would be necessary to simulate 1 part per billion (1 ppb)? 1 drop + 9 drops – Three more times

5. Freshwater fish suffer long-term health problems in water that has a 310-PPM concentration of oil. If you had 10 liters of contaminated water containing 5,000 PPM of oil, how many liters of clean water do you think would be required to reduce the concentration of oil to 50 PPM so that it would be safer for freshwater fish? Complete the chart below.

Dilution for Freshwater Fish
10 liters of 5,000 ppm + 90 liters of water = 100 liters of 500 ppm water
100 liters of 500 ppm + 900 liters of water = 1,000 liters of 50 ppm water

6. Could you safely dump the water contaminated with 50 ppm down the drain or into a lake or stream?

7. Some marine organisms suffer long-term health problems in water that has only 1-ppm concentration of oil. How could you dilute the 50-ppm water to 0.5 ppm to help avoid causing long-term health problems for ocean organisms? Complete the chart below.

Dilution for Marine Life
1000 liters of 50 ppm + 9000 liters of water = 10,000 liters of 5 ppm water
10,000 liters of 5 ppm + 90,000 liters of water = 100,000 liters of 0.5 ppm water

8. How much water is required to dilute the contaminated water to 0.5 ppm?
99,000 liters

9. How about 1 ppb?
99,000 + 900,000 + 9,000,000 + 40,000,000 = 49,999,000 liters

DUMPING USED OIL IN THE BACKYARD

Objective

- To demonstrate the effects of dumping oil on the ground.

Exercise

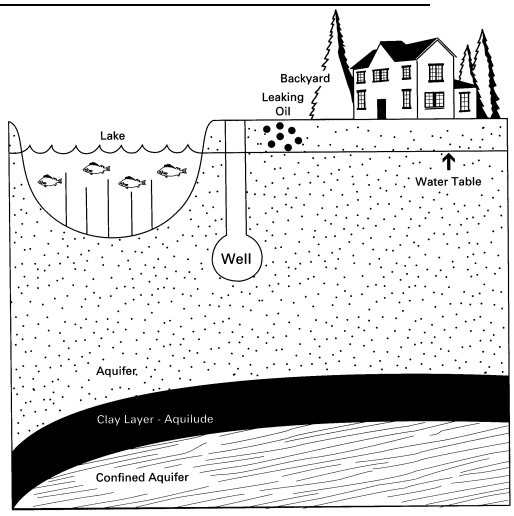
In this activity your students will be investigating oil contamination.

Scenario

Your friend's father tells you to pour your used motor oil onto a patch of dirt in the corner of the yard where there are no plants growing. He says, "After all, oil occurs naturally in the ground so why not send the oil back to where it came from? Besides, it keeps the weeds from growing back there." You reply, "I don't know about that. Used oil is a hazardous waste and I'm not sure what happens to the oil after it is poured onto the soil." You decide to investigate.

Materials

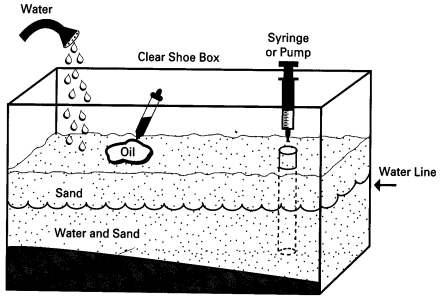
Clear plastic shoebox or terrarium
PCV or similar tubing 6–10" long *
Plastic syringe *
3" square piece of cloth
Rubber band
Sand
Clay (Optional)
Eyedropper
Food coloring
Watering can (some method for sprinkling water)
6 drinking straws
Razor blade
Paper towel



* When the syringe is inserted into the tubing, it must form an airtight fit.

Procedure, Part 1

1. Place the cloth over the end of the tubing and secure with a rubber band.



2. Assemble the groundwater model as shown in the figure to the right, pushing the tubing three-quarters of the way into the sand with the cloth end down.

3. Fill the model with water until it rises about three-quarters of the height of the sand as shown in the figure.

4. Dig a “lake” in the model deep enough to “hit” water.

5. Place the end of the syringe into the opening of the plastic tubing. A seal must form between the syringe and the tubing. Pull up on the plunger until the syringe fills with water. Record your observations. Disconnect and drain the syringe, then reconnect it.

6. Using an eyedropper, drop about 20 drops of food coloring onto the sand.

7. Sprinkle water (rain) onto the sand and wait several minutes.

8. Repeat step 5 and record your results.

Procedure, Part 2

1. One method used by geologists to study the ground is “core sampling.” From the groundwater model, remove six core samples to determine the extent of the ground water pollution. Hold your finger over the end of the straw and *carefully* insert the straw into the sand until the straw touches the clay layer. Now, slowly pull the straw out of the sand. The sand should stay in the straw, leaving a hole in the model. A *slight* twist will help remove the straw.

2. Continue this procedure five more times at different places in the model.

3. Lay each straw on a paper towel and carefully slit the straw with a razor blade. BE CAREFUL not to cut yourself with the razor blade!

4. Record your observations below.

Observations for Part 1

Step 5_____

Step 8

Observations for Part 2

Core#	Location of Sample	Distance from "Spill"	Description of Sample
1			
2			
3			
4			
5			
6			

Conclusions

FRY GUYS

"OUR SPUDS ARE NOT DUDS"

Objectives

- To understand pollution prevention.
- To explore waste management and source reduction.

Exercise

This activity is designed to strengthen students' understanding of pollution prevention by exploring pollution/waste management options in a mock industrial (food processing) setting. Students should have previously been introduced to the concept of source reduction and to the pollution prevention hierarchy.

Materials

Flip chart
Potatoes (various sizes)
Potato peeler/knife
Balance scale (to weigh potato peels)

Time Required

10–15 minutes for "brainstorming" activity.
30–60 minutes for full activity of peeling, frying and eating potatoes.

Background and Objectives

Explain to the students that the company, Fry Guys, received a notice of violation (NOV) from a State regulatory agency for hazardous waste violations for the characteristic waste (potato peels), citing too much hazardous waste. The Fry Guys plant produces french-fried potatoes and the potato peels exhibit a hazardous characteristic TCLP for lead. The company has four (4) key goals:

1. Resolve the NOV from the State regulatory agency.
2. Reduce waste disposal costs.
3. Improve worker health and safety.
4. Improve environmental regulatory compliance.

Disposal requires manifesting, transport by a licensed potato peeler hauler and disposal at a permitted potato peeling disposal facility. The company has decided now to consider options for reducing their potato peel lead problem.

Select one student to serve as a facilitator. Have the other students brainstorm suggestions for solutions to the company's problem while the facilitator records the ideas. Do this for five minutes. After brainstorming, classify each suggestion as source reduction, recycling, treatment, or disposal. Briefly discuss some of the advantages and disadvantages of the different ideas, particularly any advantages of source reduction options over other options.

Brainstorm Options

Leave peels on
Feed potato peels to hogs
Make peels into product
Use potatoes that produce less waste
Treat peels
Worker training
Breed non-toxic potato peels
Employee competition
Compost peels
Sharp knives vs. dull knives
Remove eyes for future crops
Convince people not to eat french fries
Use abrasive peel removal
Go out of business
Employee incentive program
Automate process for better production

FUN FACTORY

Training In Waste Reduction Using A Mock Industrial Process

Objectives

- To develop communication skills in an industrial setting.
- To explore waste reduction.

Exercise

This activity was developed in order to provide training to students who might have the opportunity to promote pollution prevention. The goal of this activity, which uses a mock industrial process to illustrate waste reduction principles, is to give students experience recognizing waste reduction opportunities. This includes recognition not only of options that might reduce waste generation, but also the difficulties encountered during the implementation phase. These difficulties arise because of the natural human resistance to change, pressures of day-to-day operation of a business, and the difficulties inherent in selecting and justifying process modifications. All of these are represented in the activity.

This activity should leave students with a feeling of empowerment. Discovery and implementation of waste reduction opportunities rely heavily on communication, as well as technical skills. What students discover is that even in a completely unfamiliar situation, they can make waste reduction happen by listening to the right people and asking good questions.

This activity includes real world manufacturing pressures, problems, and conflicts of interests. Although it is entitled “Fun Factory,” and it's hard to get too serious about Play-Doh, these challenges present serious issues and concerns for every manufacturer.

Disclaimer: Although some colors of Play-Doh are described as being hazardous materials and wastes here, the props are in no way, shape, or form hazardous. This is a “mock” industrial process demonstration for training purposes.

Materials

Tables large enough for the sheds, the machinery, and for all employees project
Cans of yellow Play-Doh
Cans of blue Play-Doh
Cans of any third color of Play-Doh

Fun Factory machines, with dyes and knives
Waste storage shed (sheet of paper divided into sections, see back page)

(The quantity of materials needed is determined by the number of students: have four to six students at each Fun Factory set up.)

Role Play Parts for Students

Plant Manager
- Normally ignores the operation
- Communicates customer orders to the Plant Engineer
- Nods knowingly to all other inquiries
- When in doubt, mumbles

Plant Engineer
- In charge of handling the drums
- Prepares the Play-Doh material for use in the machine
- Worker complaints
- Plans company Christmas party
- Developing ulcers is hobby

Storage Shed Manager
- Inventory control over wastes: proper labeling, proper storage, reports quantity of wastes to Plant Engineer (reports are generally three to four months behind production)
- Feels the company could save money by sending waste to brother-in-law's farm

Line Operator
- Extrudes the products as ordered
- Cleans up the machinery
- Minimum wage (plus 10 cents per hour premium due to seniority)
- Glad to have the job
- Believes Elvis is still alive

The Positions Below Are OPTIONAL; Depends on Number of Students at Each Table.

Waste Handler
- Assists the Line Operator by measuring the parts, performs cutting operation
- Hands the waste to Storage Shed Manager
- Minimum wage
- Glad to have any job
- Believes in Bigfoot

Regulatory Compliance Coordinator

Monitors the entire operation for environmental, safety, and solid waste compliance.
BS Chemistry
MS Environmental Engineering
CSP—Certified Safety Professional
CHWT—Certified Hazardous Waste Trainer

Company Policies

1. QUALITY is everyone's responsibility. Objections by anyone to the appearance, performance, or condition of any product makes the part a "REJECT."

2. SAFETY is vital to the economic feasibility of staying in business. Unsafe acts will result in corrective counseling. Repeated unsafe acts may result in discharge.

Rules

1. This is a military specifications job; while the material is in the hands of the Plant Engineer, it may be kneaded, rolled, and "worked." Once it is placed in the machine, it becomes either product or waste; there is no recycling or reuse of material.

2. Yellow Play-Doh is non-hazardous. Blue Play-Doh and the third color of Play-Doh are both hazardous materials. Therefore, any mixing of colors will result in a hazardous waste. (See disclaimer.)

3. Production must follow the sequence of customer orders.

Instructions to Be Given to Students

1. Set up materials for each facility, have "employees" decide on which position they will assume.

2. Once the customer orders are received and understood, begin production.

3. Waste will be accumulated in the Storage Shed. Separate by color and type of waste. Waste will be either Quality Control Waste, Process Waste, or Cleanup Waste. Quality Control Waste is defined as any product rejected by an employee. Process Waste is waste generated in the start-up or end-of-run material. Each time production is completed, any material left in the machine will be pushed through and declared Process Waste. Cleanup Waste is any material removed from the machine during the preparation for a color change.

4. Remember, you are in competition with the other companies; time is MONEY.

5. Once you have completed production of all parts, form a Quality Circle to discuss your wastes and the improvements you made, or could make during future production runs. Write these down.

Trainer's Top Secret Cheat Sheet

Customer Orders (Write on Board or Easel)

First: 3 Yellow Stars, made the width of a Play-Doh can lid
Second: 3 Blue Stars, made the width of a Play-Doh can lid
Last: 6 Ropes, third color, made 3 at a time, the length of a Play-Doh can w/o lid

Tricks

1. Before distributing the Play-Doh cans, place a piece of tape on the bottom of the blue cans with the expiration date. The tape should not be noticeable to the employees. After the activity is over this will become important.
2. After the companies have all begun production, invite the Plant Managers to a FREE Chamber of Commerce luncheon. After all managers have joined you in the hall (out of hearing range of the employees), inform them of a special customer order of your own design. , Instruct the managers that they are a to issue this EMERGENCY SPECIAL ORDER to their employees once they have completed their first set of 3 ropes The employees cannot continue onto the second set of ropes; they must clean up and begin immediate production of this new high priority order which has been requested by their best customer. They will earn 3 yellow stars for producing this special order. Timing and secrecy of this surprise special order *is* crucial.

Points To Cover

1. The difference in amounts of Quality Control Waste between the colors usually gets smaller, why?
   Reasons include: experience/learning curve, better procedures, “practice makes perfect.” Also: Cutting equipment can be improved. A pocketknife is a good replacement, or paper is even better. Demonstrates the advantages of process improvement.

2. Process Waste
   a. Difference in amounts of Process Waste between the yellow and blue stars usually gets smaller, why?

      Reasons include: learning curve, better batch size determinations for Play-Doh.

   b. What happens to the 3rd color process waste?

      Special Orders usually causes higher wastes; shows need for communication, inventory control, need for special prices (premiums) on special orders, especially since generated large amount of hazardous waste to process a non-hazardous product.

3. Compare your cleanup waste piles. Cleanup waste is usually the same for all three colors. Waste can be lessened by: process equipment dedicated to each specific color, better scheduling that would allow longer runs, better machine design for ease of cleaning.

4. Have the Plant Engineer examine the bottom of the Play-Doh cans for additional information. Look at the expired cans! First in, first out? Inventory control for shelf-life materials is essential. All blue products are now Quality Control Waste!

5. Open the floor for input from the Quality Circles to suggest other reduction options.

GREEN SQUARE GAME

Objectives

- Understand the challenges and frustrations of reducing waste in an auto shop or industrial setting.
- Understand that theoretical waste reduction and its implementation strategies do not always match the reality of waste reduction in an industrial setting.
- Become aware of the importance of communication in waste reduction efforts.
- Become aware of the many factors that make it difficult to actually implement waste minimization, such as labor relations, customer demands, and competition.

Exercise

This activity will heighten students' awareness of how waste is generated in an auto shop or industrial setting and how it can be reduced. At the same time, this activity will provide students with a sense of what it's like to work in an industrial setting and to use group problem-solving techniques.

The instructions show you in a step-by-step fashion how to take a group through the Green Square activity. The instructions also include a principles-of-operation section explaining how this activity was developed, what the basic ideas are behind the activity, and how students will benefit from the activity. Also included is a list of equipment and materials needed for this activity.

Purpose

To motivate students to promote and encourage waste minimization by taking them through a mock industrial process using business communication skills. This mock process is intended to heighten the students' awareness of the importance of communication in waste minimization efforts. In addition, it is intended to help students become more aware of sources of waste, waste minimization strategies, and human resistance to change.

Principles of Operation

Nearly all waste minimization training to date has been delivered via lectures and case studies, all of which are more properly termed education. Hands-on waste minimization training has been given a lesser priority because the information needed to conduct this type of training has been lacking.

Early training attempts at verbal role-plays and small group discussions, while useful, were not as effective as they could be. An activity approach such as the Green Square Game is a more effective training tool. It's a fun activity, and students who have fun while learning are more likely to retain what they've learned. The principle employed is that hands-on training allows students to become participants rather than observers. Students would rather have the actual tools to work with than simply reflect on concepts.

Students who participate in this activity might not be familiar with what it is like to function in an industrial setting. Because of this, the activity was constructed to give students a good sense of how a business operates day-to-day. By participating in this activity, they will also acquire a sense of how waste is generated and subsequently learn to recognize the processes that created that waste. In addition, students will understand how hazardous waste, even when properly disposed of, can re-enter the environment, and that landfills and incinerators don't reduce hazardous waste's threat to the environment. Finally, with their enhanced sense of an industrial setting and knowledge of how waste is generated, the students will be more effective in promoting waste minimization in their respective positions.

Instructional Organization for Instructor

1. Form teams
2. Explain activity
3. Hand out materials
4. Inform players of your role
5. Place order
6. Check on teams' progress
7. Begin discussion

    a. Ask the students to discuss techniques they used to minimize waste generation.
    b. Solicit ideas on how to dispose of waste generated by each company.
    c. If incineration is recommended, solicit ideas on how to dispose of the toxic ash and air pollution.
    d. If placing ash in a landfill is recommended, ask how the rainwater might become contaminated and enter drinking water supplies.
    e. Solicit ideas on how to clean up the contaminated water and what should be done with the toxics we remove from the water.
    f. Ask what would happen if these toxics were incinerated.
    g. Point out that while the volume of waste was reduced, the hazardous portion was not. It is simply being moved around without being completely eliminated.
    h. Solicit ways to overcome this problem; that is, how should we deal with hazardous waste generated in industrial processes? Is source reduction the answer?

i. Discuss the relative merits of buying and using products from industries that cannot entirely remove hazardous waste. Students may be interested in researching industries in their own communities that generate air, water, and land pollution and where they dispose of their industrial waste.

8. Cleanup

Instructions

1. Assemble students into teams of five and seat them around the “production floor” (24 x 36" paper).

2. Ask the groups to invent their own company name, and write the team names on a flip chart or blackboard.

3. Explain to the teams that they will mix blue and yellow tempura paints to color a square-shaped piece of paper green for an unspecified “customer.” Tell teams that their “product” should match the model you’ve provided representing the customer’s desired color. Paint as many squares as possible in the allotted time (so you experience the time/productivity crunch faced by all businesses.) Try to minimize the waste your group generates.

4. Explain that any surface or object that becomes contaminated with paint, whether blue, green or yellow, becomes “hazardous.” This includes all materials, hands, clothing, table surface, and the floor. Explain that teams will be evaluated on their ability to paint the square the correct color while generating the least amount of this “hazardous waste.”

5. Hand out painting materials to each team. Caution teams not to start until you tell them, and tell them they will have 20 minutes to complete the activity. You may wish to pause with your instructions until the teams are ready.

6. Tell the teams to begin the activity and note the time.

7. At the 20-minute mark, tell the teams to stop.

8. Begin an inspection of each team's product and evaluate their efforts with the following criteria:

    a. Color match with the customer model
    b. Number of squares painted
    c. Production floor cleanliness
    d. Number of contaminated brushes
    e. Number of contaminated cups
    f. Number of contaminated spoons
    g. Cleanliness of back of the green square
    h. Leftover green paint
    i. Contaminated hands, clothing, etc.

9. Begin discussion

    a. Ask the students to discuss techniques they used or could use to minimize waste generation during this activity.
    b. Solicit ideas on how to dispose of the hazardous waste generated by each company.
    c. What would happen if these toxics were incinerated?
    d. If incineration is recommended, solicit ideas on how to dispose of the toxic ash and air pollution created during incinerations. Ask how they will prevent rainwater from becoming contaminated by incinerator pollution and consequently harming water bodies and drinking water suppliers.
    e. Solicit ideas on how to clean up the contaminated water and what should be done with the toxics removed from the water.
    f. Point out that, while the volume of waste was reduced, the hazardous portion was not and is simply being moved around without being completely eliminated.
    g. Solicit ways to overcome this problem; that is, how should we deal with hazardous waste generated by auto shops and other industries? Is source reduction the answer?
    h. Discuss the relative merits of buying and using products that become hazardous wastes but cannot entirely be removed from our environment. Students may be interested in researching industries in their own communities that generate air, water, and land pollution and determine where and how that waste from that industry is disposed.

10. Instruct teams to clean up activity materials and paint drips.

Materials

Blue tempera paint (Use I teaspoon powder per team as a guideline.)
Yellow tempera paint (Use I teaspoon powder per team as a guideline.)
Four 8-oz. paper cups
Two water color brushes
Two spoons
24 x 36" sheets of white paper for production “floor” (Can be removed from flip chart.)
One 8 x12" piece of heavy grade paper, cut into 4 squares
One half-full cup of water
Flip chart or blackboard
Felt-tip markers for flip chart
Chalk and erasers for blackboard

HOW OIL IS REMOVED FROM THE EARTH

Objective

- To understand how oil is removed from the earth.

Exercise

Set up the simulated oil well as shown in **Figure A**.

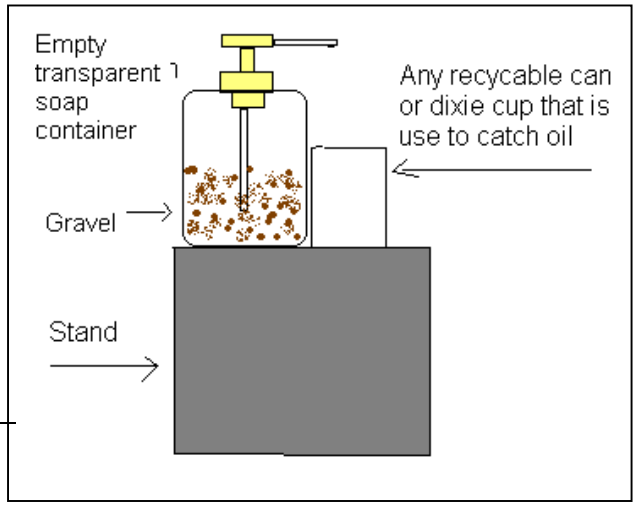


Figure A

Materials

An empty transparent liquid soap bottle with
a pump
Funnel
Any recyclable can or a Dixie cup
50–100 ml of oil
50–100 ml of water
Small gravel

Experiment

Have students fill the pump (the plastic container on top of the stand) with the small gravel half way. Then pour enough oil in the container to cover the rocks (keep track of how much oil you use).

Ask students how much of the oil do they think they will be able to remove.

Have students pump the plunger until they can no longer pump out any of the oil. Have them measure how much oil is in the glass container. Ask them to observe the gravel and write down their observations.

Ask students what prevented all of the oil from being taken out of the gravel?

Research Questions

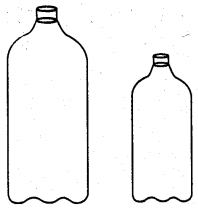
What methods are used to extract oil?

Why can't the oil companies extract all of the oil from a deposit?

How can oil removal be improved?

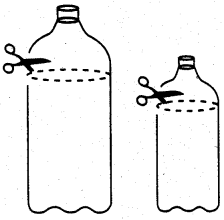
MAKING AN OIL FILTER

Objectives



- To understand how an oil filter works.
- To demonstrate an effective oil filter.

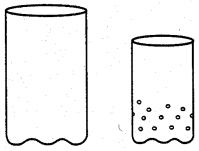
Exercise



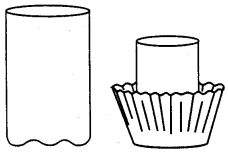
In this lab students will be investigating the following questions:

1. What substances will filter the oil most effectively?
2. What is the function of the oil filter in an automobile?

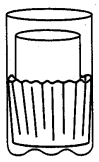
Materials



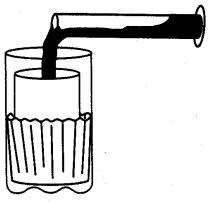
One 2-liter bottle (clear soda bottle)
One 16–20-ounce bottle (clear soda bottle)
Nail
2 coffee filters
2 rubber bands
Dixie cup
Simulated used oil: soil, dirt, vegetable oil, pieces of metal, etc.



Procedure for Students to Follow



1. Gather one 2-liter bottle and one 16–20-ounce bottle.
2. Cut the tops off of each bottle.
3. Using an nail, punch holes into the bottom of the small bottle
4. Wrap a coffee filter around the bottom of the small bottle (use a rubber band if necessary to keep the filter from slipping off of the small bottle).
5. Place the small bottle inside the larger bottle.
6. Pour 2 full cups of simulated oil into the small bottle.
7. Swirl the oil gently until all the oil has passed through the filter into the larger bottle.
8. Pour the clean oil into a Dixie cup.



9. Replace the filter and re-filter the oil that was just removed.

10. Record your observations.

Observations

Before the oil was filtered	After the oil was filtered once	After the oil was filtered twice

Analysis

1. How did the appearance of the oil change after it had been filtered?

2. Were there any particles left in the filters?

3. Were the particles large or small? Why would a certain size particle be able to go through the filter?

4. What are the disadvantages and advantages of allowing particles to escape thorough the filter?

5. What problem would occur if the filter were not changed after each use?

OIL ADDITIVES HELP PROTECT CAR ENGINES

Objective

- To understand how oil additives work

Exercise

How can detergent additives help oil protect the engine?

Materials

2 clear glass jars (jam, mayonnaise, etc.)
Water
Liquid laundry detergent or dish soap
2 dirty, greasy samples

Procedure for Students to Follow

1. Label Jar 1 “treated,” and Jar 2 “untreated.”
2. Place 30 ml of water, the sample, and ten drops of detergent into Jar 1.
3. Place 30 ml of water and a similar size sample into Jar 2.
4. Place the lids on both jars and shake the jars several times.
5. Describe to either your lab partner or the group what is happening in each jar.
6. Wait five minutes, shake the jars again, and then describe them.

Analysis

1. How might detergent additives cause problems in the engine?

2. Did the detergent dissolve more or less grease after five minutes or before?

3. How might the detergents be useful in protecting a car engine when the detergent is mixed with oil?

Explain to students that detergents are known for their cleaning properties. Soaps are better able to clean dirt and oil after the detergent has dissolved into the water. Since detergents can break down dirt and grime they can help protect the engine. One problem in allowing detergents to flow through the engine is that foam might appear and clog the engine.

OIL FILTER ACTIVITY

Objectives

- To demonstrate how oil is trapped in an oil filter
- To understand the difference between hazardous and non-hazardous materials
- To demonstrate how to properly handle, store, and dispose of used oil filters

Exercise

1. Students will learn how much oil remains in an oil filter that is not properly drained.

2. Know the difference between hazardous and non-hazardous materials.

3. Understand how to properly handle, store, and dispose of used oil filters.

Background

- Each drained filter can hold between 2 and 8 ounces of used oil, while each undrained oil filter can hold up to 1 full quart of used oil.

- Once the filter is removed from the car it is considered hazardous waste. This is due to the accumulation of lead and various metals from the engine.

- For a filter to be considered non-hazardous it needs to be drained of all free-flowing oil. The oil should drain for about 12 hours.

- After the oil is removed, it should be placed in a rainproof container (capable of holding about 55 gallons) in an auto shop.

- Used oil filters that are removed from the auto shop should be sent to a facility permitted to recycle oil filters.

- Note that 14 million oil filters are sold annually in California.

Safety Tips

- Wear gloves to prevent skin contact with contaminated used oil.
- Wear safety goggles to protect eyes.
- Used oil filters are considered toxic to your health, as well as to the environment.
- Properly store the used filters to make recycling easier.

Activity #1

Take a new oil filter and cut it in half with a hacksaw. Have the students observe all the different areas in which used oil is retained inside the filter when it is not properly drained.

- Have the students discuss the potential hazards to the environment from used oil filters that are not properly drained.
- Have the students discuss potential reuses for the metals and oil recycled from used oil filters.

Activity #2

Have the students demonstrate how much oil a filter that is not properly drained retains by taking a used oil filter from a vehicle. Pour used oil from the filter into a recycled container for 30 seconds. Place the partially drained filter upside down on a 2 to 4-quart-measuring cup. Wait 24 hours and observe how much has drained out into the measuring cup.

- Have the students discuss the potential environmental damages from thousands or even millions of disposed, undrained, or poorly drained used oil filters that are improperly disposed.

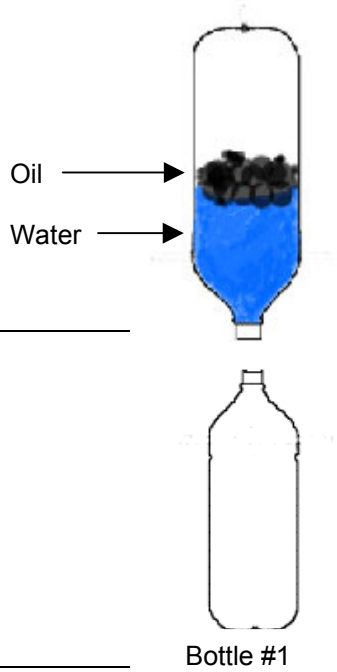
OIL/WATER SEPARATOR

Objective

- To understand how an oil/water separator works.

Exercise

To investigate the separation of oil, water, and dirt before disposal.



Materials

Dirty oil
Soil
Water
Two 2-liter soda bottles
Coffee filter
Funnel

Procedure for Students to Follow

1. Take one 2-liter bottle (#1) and fill the bottle one-quarter full with water and add a handful of soil and then add 1 cup of oil.

2. Place the cap on the bottle and shake it vigorously.

3. Take the second bottle (#2) and place the funnel with a coffee filter in it into the top of the bottle.

4. Slowly pour all the contents of bottle #1 into bottle #2.

5. Drill a hole in the cap of bottle #2 and screw the cap onto the bottle #2 which now contains a filtered mixture of water and oil.

6. Wait 10 minutes for the water and oil to separate into two layers.

7. Wash bottle #1 with soap. This bottle will be used for collection of the filtered water.

8. When the oil and water layers are separated in bottle #2, slowly turn it upside down and match the neck to the bottle #1 so the bottles are touching neck to neck (see figure above).

9. When just the water layer is transferred to bottle #1, stop the flow. We have now separated soil, oil, and water from each other.

Analysis

Have the students answer the following questions based upon the results of the experiment.

1. If there were contaminating materials in the water, how would it effect our environment if the water was not filtered?

2. If nothing was filtered from auto shop wastewater but it went directly into oceans, lakes, and streams, how would that effect wildlife in our environment?

3. Why is it a good idea to separate oil from water?

4. After the water and oil are separated would it be easier to dispose of the oil?

Discussion

Wastewater ends up in one of three places:

1. Storm Drains: Water flows untreated from storm drains directly to creeks, streams, lakes, bays, and oceans. If the water is contaminated, it can harm aquatic life and land-based life that drinks and bathes in water.

2. Septic Systems: Discharge to septic systems can cause soil, groundwater and drinking water contamination, creating site cleanup liabilities, and public health hazards.

3. Sanitary Sewers: Hazardous wastes that enter sewers leading to water treatment plants contaminate sludge and prevent its beneficial use.

OILY WASHER

Objectives

- To help students not familiar with industrial processes to understand these processes.
- To help students understand the challenges and frustrations of substituting aqueous cleaners for organic solvents in an industrial setting.
- To show you and students that your previous understanding of the mechanics of solvent replacement may have little in common with the reality of replacement efforts in an industrial setting.
- To help students become aware of the importance of communication in efforts to exchange aqueous cleaners for solvents.
- To make students aware of the many factors that make it difficult to actually implement substitution, such as customer demands and timetables.

Exercise

This activity can heighten students' awareness of the challenges and benefits of exchanging aqueous cleaners for solvents. At the same time, this activity will provide students with a sense of what it's like to work in an industrial setting and to use group problem-solving techniques.

The instructions show you, in a step-by-step fashion, how to take a group through the Oily Washer activity. Also included is a principles-of-operation section explaining how this activity was developed, the basic ideas behind the activity, and how students will benefit from it. A list of equipment and materials needed for this activity is included.

Purpose

To motivate students to promote and encourage substitutes for solvents in industry by taking them through a mock industrial process. In addition, it is intended to make students aware of why solvents are used, the process and difficulties of solvent substitution, and the cause of industry's resistance to these substitution efforts. This mock process is also intended to heighten the students' awareness of the important role communication plays in industry's solvent reduction efforts.

Principles of Operation

Nearly all waste reduction training to date has been based on lectures and case studies, all of which are more properly termed education. Hands-on training has been given a lesser priority because the information needed to conduct training has not been available.

Early training attempts at verbal role-plays and small group discussions, while useful, did not prove as effective as an activity like the Oily Washers training activity. It's a fun activity and students who have fun while learning are more likely to retain what they've learned. Employed here is the principle that hands-on training allows students to become participants rather than observers. Students would rather have the actual tools to work with than reflecting on concepts.

Students who will participate in this activity might not be familiar with what it is like to function in an industrial setting. Because of this, the goal was to construct an activity to give these students a good sense of how a business operates day-to-day. By participating in this activity, they will also acquire a sense of the difficulties encountered while substituting aqueous cleaners for organic solvents.

With their enhanced sense of an industrial setting and the challenges and problems of exchanging aqueous cleaners for solvents, students will have a clearer idea of how to promote effective solvent substitution efforts in industry.

Instructions

1. Assemble students into teams of five and seat each team around a parts-cleaning tray.

2. Explain to the teams that each individual will be given oily steel washers to clean along with three different cleaning solutions. Explain that they will be evaluated on how fast they clean the oil from the washers, and afterwards, how clean and dry they are in comparison to your model of a clean, dry washer.

3. Tell the teams that they, too, are going to evaluate the three cleaners, but during the activity. Tell them they will do this by deciding on criteria used to evaluate the cleaners and that they will be required to document how they evaluate each cleaner by making notes on each one.

4. Tell the teams that they also have to decide if their washers are clean by deciding on criteria to help determine if they are clean. Tell them they must document these criteria and their evaluation of the washers' cleanliness.

5. Explain to the teams that they are expected to clean 50 washers per minute, and all cleaned washers must be dry by the end of the time trial.

6. Hand out the pre-prepared trays containing the cleaning equipment to each team, and tell them they will have 20 minutes to complete the activity.

7. Tell the teams to begin and note the time.

8. At the 20-minute mark, tell the teams to stop.

9. Display the pre-prepared flip chart that shows the participants the cost of each cleaner. Tell the teams to note the cost of the cleaners and to debate the merits of each cleaner among themselves for another 15 minutes. Tell them they must decide which is the best cleaner.

10. At the end of the 15-minute period, visit each team and ask what cleaner they've chosen and why. While doing this, point out the rust that will have developed on the washers as proof that the washers are still wet, in spite of the team's efforts to dry them.

11. Next, ask all the teams how they know the washers are clean. To answer this question, ask them to refer back to their criteria and evaluation of how well they cleaned the washers.

12. Tell the teams you have a test to determine if the washers are/are not clean. Test each team's washers by dunking them in water and examining them for water beading. If water beads form on the washer, show the washer to the team and explain that the beading is caused by oil still present on the washer.

13. Begin discussion:

    a. Ask the teams how they would solve the washer drying time problem and ask them for their estimate of the costs of correcting this problem.

    b. Ask the teams how they would set a quality standard that results in oil-free washers and if this standard would vary, depending on the cleaning solution used.

Materials

Items #1 through #6 are readied and placed on each of the four trays in advance of the activity. Flip chart is readied in advance also (see #9).

1. 20 zinc-coated steel washers:

    a. Strip washers of zinc coating and immediately coat them with oil to prevent rust. Place washers in plastic bags for transport.

2. Four 6-inch pieces of stainless steel wire:

    a. Should be stout enough to hold one washer at a time.

3. One pair of latex gloves:
    a. One pair for each team to keep operator's hands clean while cleaning and racking.

4. Roll of paper towels:

    a. Provide at least two towels for each team.

5. Four 8-ounce paper cups.

6. Cleaning solutions:

    a. Ivory liquid soap mixed with water.

        i) Fill cup three-quarters full with water and add I tablespoon soap.

    b. Dawn dish soap mixed with water

        i) Same as above.

    c. Tri-sodium Phosphate (TSP)

        i) Can be found in powdered form at a hardware store.

        ii) Fill cup three-quarters full with water, add only 2 tablespoons powdered TSP.

7. Rinsing solution:

    a. Fill cup three-quarters full with water and then add 4 tablespoons vinegar.

8. Four trays:

    a. Food service trays work well, otherwise any tray with a lip.

9. Flip chart or blackboard:

a. Write cost of each cleaner on flip chart in advance of activity. Use this table format.

Cleaner	Cost per T.	Cost per Run	Life of Solution
#I			
#2			
#3			

10. Felt-tip markers if flip chart used; chalk and erasers if blackboard used.

11. Paper and pencils for each group.

THROWING OIL IN THE TRASH #2

Objective

- To understand the environmental effects of disposing used oil in the trash.

Exercise

Explain the following scenario to students:

> You help some friends change the oil in their car. They want to pour the used oil into old milk containers and throw them into the trash can. In their opinion, the sanitation company gets paid to take care of these things, so why not let them deal with it? You reply, "But what will happen to the milk containers and the oil in the landfill?" You decide to investigate.

Materials

Two 2-liter soda bottles
Food coloring
Water
Gravel
Soil
Organic matter

Procedure 1—Have Students Prepare the Bottles

Cut the bottles as directed below, referring to the landfill model diagram.

1. The base: Make an incision 2 cm below the shoulder of Bottle #1 and cut off the top; retain top and bottom.

2. The landfill receptacle: Make an incision 2 cm below the hip of Bottle #2 and cut off the base.

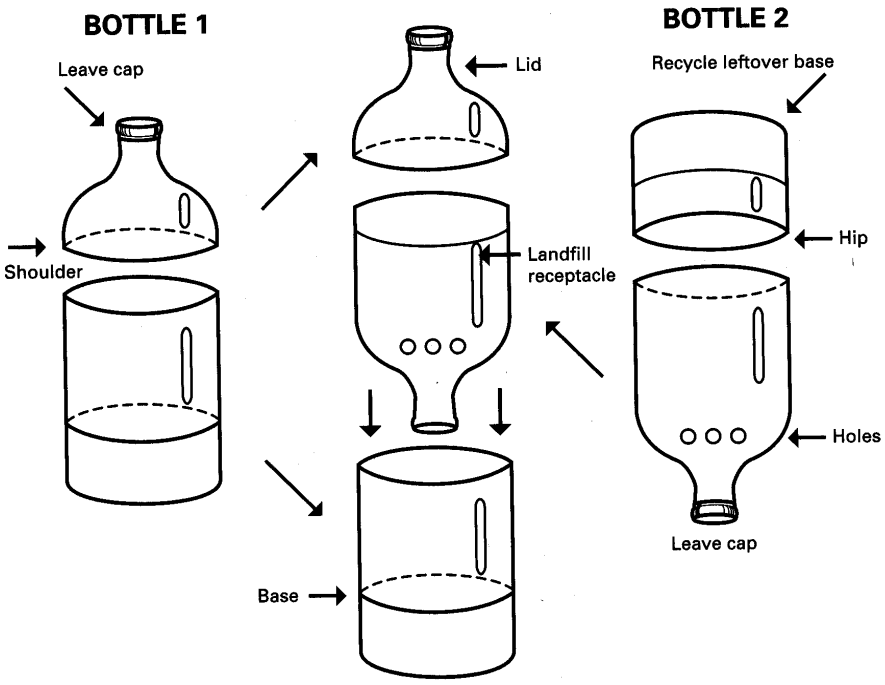
3. Recycle the base.

4. The sieve: Puncture the neck of Bottle #2 with a red-hot skewer, making 6 to 10 small holes.

5. Insert the inverted sieve tightly into the base from Bottle #1 and secure with tape. The tape must be secure but removable.

6. The lid: Use a 3-cm piece of tape to hinge the cut top from Bottle #1 to the top of the receptacle.

7. Write cost of each cleaner on flip chart in advance of activity. Use this table format.



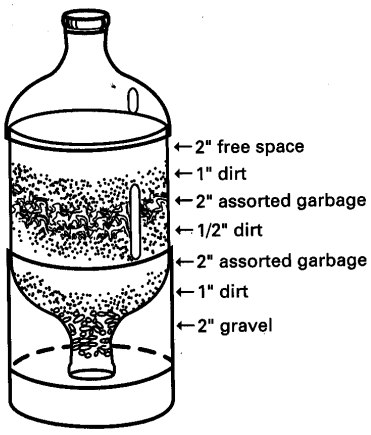
Landfill Model Construction

Procedure 2—Building the Landfill Model

1. After construction, check the students' landfill models for possible adjustment.

   Note: If they are adding a liner, be sure they attach the lining to the landfill container before adding the layers.

2. Have the students build the landfill: Remove the top of the model landfill and build layers of gravel, soil, and organic matter in the model, as shown in the diagram below. Be sure that the top layer is soil. Reattach the top of the model.



Finished Landfill Model

Procedure 3—The Students' Experiment Instructions

1. On the first day, drop about 3 drops of blue food coloring on the top of the soil to represent used motor oil that has leaked out of decomposed or crushed containers into the landfill.

2. Measure 100 ml of tap water.

3. Gently pour 100 ml of water into the landfill to simulate rainwater.

4. Store your landfill model in a dark place and keep it damp to simulate actual landfill conditions.

5. On the second day of this investigation, carefully lift the top of the model off of the base. Describe the water from the landfill (leachate). What color is it? Does it have any odor? Do you see anything that would indicate used motor oil in the leachate? Record your data in the chart below.

6. Repeat steps 2, 3, and 4.

7. On the third day, carefully lift the top of the model off of the base. Describe the water from the landfill. What color is it? Does it have any odor? Do you see anything that would indicate used motor oil in the leachate? Record your data in the chart below.

Data

	Leachate—Date	**Leachate—Date**	**Leachate—Date**
Observed Changes			

Analysis

1. Predict what will happen to your landfill after four days, after two weeks, and after one month.

2. Assuming that you continued to add 100 ml of water at the same time intervals, predict what will happen to the simulated used oil after four days, after two weeks, and after one month. Explain.

3. What happens to rainwater that falls on the landfill?

4. If the liner of a landfill were to fail, how might the groundwater be affected by the contaminated leachate?

5. What could happen if an animal ate discarded food from the landfill that had come into contact with the leachate?

Conclusions

1) What would happen if many people continued to place containers of oil in their trash?

2) Based on this investigation, write a fact-based statement to explain to your neighbor why it is the general public's responsibility to not dispose of used oil in the trash can but to recycle it instead.

USED OIL AND OUR ENVIRONMENT

Objective

- To understand the effects of oil pollution on the environment.

Exercise

In this activity, students will investigate how the environment is harmed by oil pollution.

Materials

2-liter container, clear
1 Dixie cup of sand
2 Dixie cup of soil
Water
Oil (motor or vegetable)
A small plant either found outside with roots still attached or purchased from a nursery

Procedure for the Students to Follow

1. Cut the tops off the containers to allow for planting the plants.
2. Fill the sand and the soil into the bottom of the 2-liter container, until the contents are about one-quarter of the container.
3. Place the plant into the center of the sand and soil mixture.
4. Add enough water to give the soil and sand mixture a moist texture. Observe mixture and make notes.
5. Put three to four drops of oil around the plant and on the leaves.
6. Mix the soil carefully around the plant so the oil is allowed to seep into the roots.
7. Wait overnight and then observe the plant and its roots by taking the plant from the soil and laying it on a paper towel.

8. Compare your results to your instructor's plant that was not exposed to oil.

Observation

Before Placing the Oil into the Soil	24 Hours After Placing the Oil onto the Plant	Plant Without Oil

Analysis

1. Was there a difference between the plants that were exposed to oil versus the plants that were not?

2. What were the differences?

3. What would happen to the plants in our environment if an oil spill occurred on land?

4. Is it a good idea to regulate oil wells?

5. If oil companies did not have any regulations for digging, what would change about our environment?

USED OIL RECYCLING

Objective

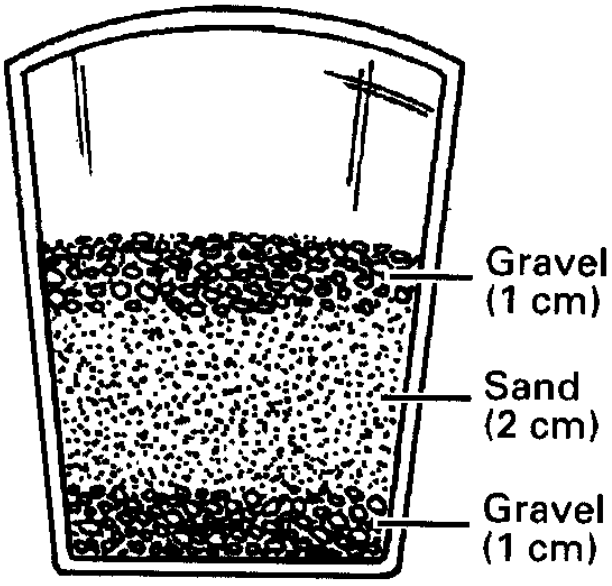
- To understand how oil can be recycled.

Exercise

In this activity, students will be investigating how contaminants can be removed from used oil.

Materials

Approximately half a cup of used oil
Paper cup (Dixie cup)
Paper clip or straight pin
Gravel
Sand



Procedures for the Students to Follow

1. Straighten out the paper clip and then use it to poke holes into the bottom of the paper cup.

2. Place approximately 1 cm thick layer of gravel into the cup. Add 2 cm layer of sand on top of the gravel. Add another 1 cm layer of gravel on top of the sand.

3. Observe the color, odor and presence of solids in the used oil before it is filtered.

4. Gently pour the sample of used oil into the cup. Make sure to catch the filtered oil in another container as it comes out of the holes in the paper cup.

5. Observe once again the color, odor and presence of solids in the used oil after it is filtered, taking note of any changes.

6. Dispose of the used sand, gravel, and oil accordingly.

Discussion

Have students discuss the questions below in groups:

1. How did the sand able to act as a filter?
2. How would your results been different if you had used:
   - Finer sand?
   - Coarser sand?
   - A deeper layer of sand?
3. How is sand similar to a paper filter in the way it separates a mixture?
4. Did you achieve the results you expected? If not, explain why your results deviated.
5. How can contaminants be separated from used oil?
6. What could you do with the solid materials that were filtered out of the used oil?
7. Can oil that has been filtered and cleansed of impurities through re-refining oil be re-used in vehicles?

In filtering the used oil, the sand helped to trap solids that were too large to fit between the sand grains. Had finer sand been used, then more contaminants would have been trapped. If coarser sand had been used, then fewer contaminants would have been trapped. Even using a thicker layer of sand would have trapped more contaminants. This process of separating contaminants from used oil is called filtration. The solid materials that were filtered out could be collected and sold as asphalt flux and used for street paving and roofing. The remaining liquid oil can be re-refined and used over and over again.

QUIZ QUESTIONS AND ANSWERS

The following questions cover the material in the Instructor's Resource Manual with the exceptions of the appendices.

You may choose to add to these from your current question pool as well. The questions are followed by the corresponding answers.

Questions

1. What is ecology?
   a. A government regulation
   b. The study of man
   c. The study of the interactions that determine the abundance and distribution of organisms.
   d. Both b and c

2. What events inspired most environmental regulations?
   a. Oil spills
   b. Elections
   c. Human deaths
   d. The greenhouse effects

3. Why are environmental concerns global?
   a. The United States does not want to be affected by foreign companies
   b. Pollution does not respect national boundaries
   c. The United Nations said so
   d. All of the above

4. What has led to global warming?
   a. The earth is getting closer to the sun
   b. The "El Niňo" effect
   c. Gases introduced into the atmosphere.
   d. All of the above

5. What are greenhouse gases?
   a. Carbon dioxide
   b. Methane
   c. Nitrous oxide
   d. All of the above

6. What is a major contributor to the depletion of the ozone?
   a. Carbon dioxide
   b. CFCs
   c. Gasoline
   d. All of the above

7. Fossil fuels are a major factor in what problem?
   a. Air pollution
   b. Ozone increase
   c. Weather pattern changes
   d. All of the above

8. Water pollution comes from what source?
   a. Point source
   b. Nonpoint source
   c. Both a and b
   d. Neither a nor b

9. In the United States how much of the drinking water comes from groundwater?
   a. 25 percent
   b. 50 percent
   c. 75 percent
   d. 100 percent

10. On average, how much of our usable groundwater is contaminated?
    a. 25 percent
    b. 50 percent
    c. 75 percent
    d. 100 percent

11. Industrially produced chemicals may cause
    a. Cancer
    b. Birth defects
    c. Genetic mutations
    d. All of the above

12. What does “environmental racism” mean?
    a. Certain people cause the most pollution
    b. Not all people are equally exposed to pollution
    c. Certain countries hate pollution more than others
    d. All of the above

13. Why should floors be kept clean?
    a. Prevent slips and injuries
    b. Reduce pollution
    c. Both a and b
    d. Neither a nor b

14. What is the most common way for vapors to enter the human body?
    a. Inhalation
    b. Ingestion
    c. Through the eyes
    d. All of the above

15. Dermal absorption means
    a. To enter a human body through the mouth
    b. To enter a human body through the skin
    c. Both a and b
    d. Neither a nor b

16. What health problem are employees least aware of?
    a. Ingestion hazards
    b. Dermal absorption
    c. Smoking
    d. None of the above

17. “Worker’s Right to Know” means
    a. Workers are responsible for their own safety
    b. Automotive shop owner/operators are responsible for warning employees of potentially hazardous substances used in the workplace
    c. Workers should be informed if there is a toxic spill
    d. All of the above

18. What is the Hazard Communications Standard?
    a. Information that is transmitted to employees concerning the physical and chemical behaviors of hazardous substances and the attendant health consequences that come with their use on the job
    b. All companies must inform their employees in the same way
    c. All workers must have access to a telephone
    d. All of the above

19. What should a hazardous material label contain?
    a. The identity of the chemical
    b. Specific hazards associated with the chemical
    c. Precautions
    d. All of the above

20. What is an MSDS?
    a. Modern System for Dispensing Safety
    b. Material Safety Data Sheet
    c. Most Shops' Death Statistics
    d. None of the above

21. In addition to hazardous materials, what else must be labeled?
    a. Hazardous waste
    b. Hazardous conditions
    c. Hazardous equipment
    d. All of the above

22. What are solid, liquid, or contained gaseous materials that are no longer useful for their original intended purpose(s), and are therefore ready to be discarded?
    a. Included costs
    b. Trouble for employees
    c. Wastes
    d. All of the above

23. What makes for a "hazardous waste"?
    a. It causes cancer
    b. It can pollute the air, water, and/or land if not handled or disposed of in a particular manner
    c. The fire department indicates
    d. All of the above

24. How do you determine if a waste is hazardous?
    a. Apply common knowledge
    b. Refer to the manufacturer's documentation
    c. Refer to the listing of hazardous wastes
    d. Have a sample of the waste tested by a laboratory
    e. All of the above

25. Hazardous waste is classified how?
    a. Characteristic hazardous waste
    b. Listed hazardous waste
    c. Both a and b
    d. Neither a nor b

26. What are Ignitability, Corrosivity, Reactivity, and Toxicity?
    a. The "characteristics" of a waste
    b. Listed wastes
    c. Common problems
    d. All of the above

27. What are F, K, P, and U wastes?
    a. The “characteristics” of a waste
    b. Listed wastes
    c. Common problems
    d. All of the above

28. A flash point of less than 140º F means a waste has
    a. Corrosivity
    b. Ignitability
    c. Reactivity
    d. All of the above

29. A pH of less than or equal to 2.0 or greater than 12.5 means a waste has
    a. Corrosivity
    b. Ignitability
    c. Reactivity
    d. All of the above

30. If, when mixed with water, a substance reacts violently, forms an explosive mixture, generates toxic gases, or contains cyanides or sulfides that are released when exposed to acid or alkaline materials, or is explosive, it means its waste has
    a. Corrosivity
    b. Ignitability
    c. Reactivity
    d. All of the above

31. If a waste fails the “Toxicity Characteristic Leaching Procedure” (TCLP) lab test for any one of 40 TCLP parameters, it has
    a. Toxicity
    b. Reactivity
    c. Ignitability
    d. All of the above

32. Hazardous waste generators are
    a. CESQG
    b. SQG
    c. LQG
    d. All of the above

33. Generating 220 pounds of waste or less per month makes you a
    a. CESQG
    b. SQG
    c. LQG
    d. All of the above

34. Generating more than 220 pounds but less than 2,200 pounds of waste per month makes you a
    a. CESQG
    b. SQG
    c. LQG
    d. All of the above

35. Generating more than 2,200 pounds of waste per month makes you a
    a. CESQG
    b. SQG
    c. LQG
    d. All of the above

36. What must a hazardous waste generator do?
    a. Generate only a minimum amount of hazardous waste
    b. Comply with the rules that are applicable to the amount of hazardous waste produced monthly by their shop
    c. Be able to dispose of their waste on-site
    d. All of the above

37. What is the preferred approach to environmental protection?
    a. Source reduction
    b. Material substitution
    c. Recycling
    d. None of the above

38. Raw materials or unused materials can become wastes if they
    a. Are stored improperly
    b. Are damaged in storage
    c. Become too old to use
    d. All of the above

39. Inventory control means
    a. Don’t stockpile perishable supplies
    b. Purchase supplies in bulk
    c. Keep on hand only the quantities of materials that you really need
    d. All of the above

40. Switching to non-hazardous or less hazardous substitutes for those hazardous materials is
    a. Source reduction
    b. Material substitution
    c. Recycling
    d. All of the above

41. Reuse, or recovery of usable components is…
    a. Source reduction
    b. Material substitution
    c. Recycling
    d. All of the above

42. If a particular waste is a nuisance or hazardous, the first priority should be to
    a. Reduce or eliminate production of that waste
    b. Contact the EPA
    c. Contact a waste hauler
    d. All of the above

43. Switching to non-chlorinated compounds for parts cleaning is
    a. Source reduction
    b. Material substitution
    c. Recycling
    d. All of the above

44. Using sound operating practices means
    a. Where possible, use funnels or pumps when handling liquid products or wastes
    b. Keep lids on all solvents and turn off your solvent sink when not in use
    c. Be aware that otherwise safe products that are mixed with hazardous substances become hazardous
    d. All of the above

45. Switching to a recirculating aqueous spray cabinet for cleaning parts instead of using solvents or hot tanks can
    a. Be harder for employees to use
    b. Be a larger job to clean up
    c. Reduce the volume of hazardous waste that will require disposal
    d. All of the above

46. Contracting with a recycling service to pick up used antifreeze, lead-acid batteries, motor oil, oil filters, solvents, and scrap tires is a example of
    a. Recycling wastes that cannot be reduced or reused
    b. Source reduction
    c. Secondary containment
    d. All of the above

47. Motor vehicle maintenance
    a. Is performed at all shops
    b. Is becoming less and less common
    c. Generates a number of wastes that are a nuisance or even hazardous
    d. All of the above

48. Good waste management practices are important to you for a number of reasons, among which are
    a. You may save money by finding ways to reduce or recycle your wastes
    b. You will ensure that you are in compliance with local, state, and Federal environmental regulations and avoid costly penalties
    c. You may gain customers who prefer to deal with a shop that acts in a responsible manner to protect human health and the environment
    d. All of the above

49. “Stop if there’s a drop” means
    a. There is a leak that needs to be fixed right away
    b. Never walk away from a spill
    c. Both a and b
    d. Neither a nor b

50. Which is the correct order for the “4-step method”?
    a. Use a dedicated mop, use shop rags, wet mop, use a hydrophobic mop
    b. Use shop rags, use a hydrophobic mop, use a dedicated mop, wet mop
    c. Use a hydrophobic mop, use a dedicated mop, use shop rags, wet mop
    d. Use a wet mop, a dedicated mop, use a hydrophobic mop, use shop rags

51. Store all hazardous liquids in covered containers to
    a. Prevent evaporation
    b. Prevent spills
    c. Prevent contamination
    d. All of the above

52. Check with your sewer utility to
    a. Find out where your drains lead
    b. Find out the cost of doing business
    c. Locate the nearest treatment plant
    d. All of the above

53. What is secondary containment?
    a. What you need to do after you have noticed a spill
    b. A method to prevent a container leak from causing pollution
    c. Where you put your waste when the primary containment is full
    d. All of the above

54. Preventing wastewater from being contaminated can be done by
    a. Collecting leaking or dripping fluids in drip pans or containers
    b. Preventing leaks and spills to avoid contaminating the water that is used during floor wash-downs
    c. Both a and b
    d. Neither a nor b

55. Used oil does not include
    a. Brake fluid
    b. Gear oils
    c. Transmission fluids
    d. Differential oils

56. Used oil contains
    a. Cadmium
    b. Chromium
    c. Lead
    d. All of the above

57. Why must used oil be tested?
    a. To determine if it is hazardous before disposal
    b. To see if it is still clean
    c. To determine the source of the oil
    d. All of the above

58. Householders who change their own oil (do-it-yourselfers)
    a. Are exempt from regulation as used oil generators
    b. Must manage their used oil appropriately
    c. Are allowed to transport their own used oil to a used oil collection center or to a used oil recycling facility if specified conditions are met
    d. All of the above

59. How can waste oil be reduced?
    a. Do not spill it
    b. Have a good understanding of a lubricant's life
    c. Reduce the miles you drive
    d. All of the above

60. Used oil can be recycled as
    a. Reconditioned oil
    b. Recycled oil
    c. Re-refined oil
    d. All of the above

61. Mixing used oil with other hazardous waste
    a. Is not allowed
    b. Is cost effective
    c. Reduces the containers in the shop
    d. All of the above

62. Store used oil
    a. With secondary labels
    b. With secondary containment
    c. Outside the shop
    d. All of the above

63. Householders and conditionally exempt small quantity generators are allowed to transport
    a. Up to 20 gallons of used oil per trip to an authorized used oil collection center
    b. The used oil in containers that hold 5 gallons or less and if specified conditions are met
    c. Both a and b
    d. Neither a nor b

64. It is unlawful to dispose of used oil
    a. On land, to sewers, or other water systems
    b. By burning it as a fuel or by incineration, including in space heaters and similar devices
    c. As a dust suppressant (road oiling) or for insect or weed control
    d. All of the above

65. How does motor oil get contaminated?
    a. The heat of engine operation
    b. Exhaust gases
    c. Fluids, such as water and antifreeze
    d. Wear and reactions cause heavy metal residues to dissolve in the engine oil
    e. All of the above

66. Pouring one gallon of used oil on the ground can ultimately cause
    a. 1,000 gallons of water to become undrinkable
    b. 10,000 gallons of water to become undrinkable
    c. 100,000 gallons of water to become undrinkable
    d. 1,000,000 gallons of water to become undrinkable

67. How much used motor oil is disposed of each year in an unknown manner in California by do-it-yourself oil changers?
    a. More than 20,000,000 gallons
    b. More than 1,000,000 gallons
    c. More than 100,000 gallons
    d. More than 10,000 gallons

68. How many gallons of oil are sold annually in the United States?
    a. 1,000,000
    b. 2,700,000
    c. 2,700,000,000
    d. None of the above

69. What are advantages of testing motor oil?
    a. Keeps minor repairs minor
    b. Saves money
    c. Conserves resources
    d. All of the above

70. What component can be added to a full-flow oil filter?
    a. By-pass oil filter
    b. An oil cooler
    c. A pressure gauge
    d. All of the above

71. What is re-refined oil?
    a. Secondary contained oil
    b. Used motor oil that undergoes an extensive process to remove contaminants, such as dirt, fuel, water, and additives, to produce a good-as-new base oil
    c. Synthetic oil
    d. All of the above

72. How should used motor oil be managed?
    a. Keep used oil in a separate container, clearly marked, “USED OIL ONLY”
    b. Contract with a used oil transporter/recycler that is registered with the U.S. EPA and has an EPA ID number
    c. Obtain a receipt, bill of lading, or manifest showing the amount of oil shipped off-site, and retain records for three years
    d. Have used oil tested to ensure that it is non-hazardous, if recycling is not available
    e. All of the above

73. Used automatic transmission fluid
    a. Must be handled separately from motor oil
    b. Is not made from crude oil
    c. Will not mix with motor oil
    d. Can be mixed with used motor oil

74. Used antifreeze is potentially dangerous in these ways
    a. Ethylene glycol is poisonous to animals and small children
    b. Antifreeze can become contaminated with a number of hazardous substances while confined within an automobile cooling system
    c. It pollutes the atmosphere
    d. Both a and b

75. Waste antifreeze should be recycled
    a. In an on-site unit
    b. By a mobile service
    c. Off-site
    d. Any of the above

76. How should used engine coolant be handled?
    a. Use dedicated antifreeze collection equipment, including funnels, transfer pans or buckets, and well-maintained storage containers
    b. Store antifreeze in separate, closed containers marked, “WASTE ANTIFREEZE ONLY”
    c. Keep antifreeze containers protected from the elements
    d. All of the above

77. Brake fluid should not be
    a. Dumped into septic systems, gutters, or storm systems or onto the ground.
    b. Disposed of in the trash
    c. Released into the environment
    d. All of the above

78. Brake fluid should be
    a. Collected in a separate, marked, closed container and recycled through a contract with a waste hauler
    b. Poured down any drain or on the ground
    c. Laboratory tested to determine if the fluid is hazardous
    d. Both a and c

79. Gasoline and diesel fuels
    a. Are hydrocarbons, and are damaging to the atmosphere
    b. Are known to be a part of the creation of photochemical smog
    c. Are liquid fuel hazardous wastes and cannot be released into the environment
    d. All of the above

80. Bad or old fuel
    a. Is a hazardous waste
    b. Can be burned
    c. Should be mixed with good fuel
    d. Should be left outside to evaporate

81. Cleaning solutions, solvents, and degreasers come in what form?
    a. Petroleum-based mixtures
    b. Halogenated solvents
    c. Aqueous (water-based) detergent cleaners
    d. All of the above

82. Solvents, principally from parts washers, are
    a. Typically the largest source of hazardous waste generated by vehicle repair shops
    b. The easiest to dispose of
    c. Okay to add to used oil containers
    d. All of the above

83. Aqueous (water-based) parts washers
    a. Are too expensive to be practical
    b. Do not clean parts well enough
    c. Have proven to be a cost-effective and environmentally friendly alternative
    d. All of the above

84. Pure n-hexane is
    a. Yellow in color
    b. Very fast-evaporating liquid
    c. Odorless
    d. All of the above

85. Long-term overexposure to n-hexane can
    a. Damage the nerves in the feet, legs, hands, and arms
    b. Ruin painted surfaces
    c. Cause lung cancer
    d. All of the above

86. How can you determine if a product has n-hexane in it?
    a. Ask your co-workers
    b. By its color
    c. Look at the MSDS
    d. All of the above

87. How does n-hexane enter the human body?
    a. When you breathe n-hexane vapors or droplets of spray in the air
    b. When hexane touches your skin
    c. When it gets in your food
    d. Both a and b

88. The best way to prevent exposure to n-hexane is to
    a. Not use it
    b. Use a gas mask
    c. Use rubber gloves
    d. Use in a well-ventilated area

89. Acids
    a. Are usually very concentrated
    b. Require very large amounts of water to dilute
    c. Must be disposed of according to local, State, and federal regulations
    d. All of the above

90. Some shops use hot tanks for cleaning greasy parts. These tanks contain
    a. A caustic (alkaline) solution with a pH greater than 7
    b. A caustic (alkaline) solution with a pH less than 7
    c. An acidic (acid) solution with a pH greater than 7
    d. An acidic (acid) solution with a pH less than 7

91. The presence of other substances within an alkaline mixture solution
    a. May cause the solution to blow up
    b. May cause the solution to be carcinogenic and very toxic
    c. Helps the solution clean
    d. All of the above

92. The runoff from engine compartment washing
    a. Contains oil and grease
    b. Is a threat to aquatic life and drinking water supplies
    c. Is a minor issue
    d. Both a and b

93. Many local governments require that wash water
    a. Be routed to a sanitary sewer for treatment in the local waterworks
    b. Be allowed to run into storm sewers
    c. Be routed through shop floor drainer to a passive oil/water separator before being discharged to the sanitary sewer
    d. Both a and c

94. Wastewater ends up in
    a. Storm drains
    b. Septic systems
    c. Sanitary sewers
    d. All of the above
    e.
95. Wastewater can be reduced by
    a. Keeping a dry shop
    b. Avoiding spills
    c. Using drip pans
    d. All of the above

96. Most oils are
    a. Heavier than water
    b. Lighter than water
    c. Easily mixed with water
    d. None of the above

97. Used oil filters
    a. Contain heavy metals
    b. Cannot be recycled
    c. Can be put in the trash
    d. Can be reused

98. What percentage of used oil filters end up in landfills?
    a. 40 percent
    b. 60 percent
    c. 75 percent
    d. 90 percent

99. How should oil filters be managed?
    a. Drain all free-flowing oil from them
    b. Store them in properly labeled closed containers
    c. Crush them whenever possible
    d. All of the above

100. Empty containers of motor oil
    a. Cannot contain any free liquid
    b. Cannot be recycled
    c. Can be used to put used oil into
    d. All of the above

101. Asbestos
    a. Has been banned from use in brake linings
    b. Causes shortness of breath, lung disease, or cancer
    c. Is no longer considered a health issue
    d. All of the above

102. Do not use compressed air to blow off brake assemblies because
    a. It puts dangerous particles into the air you breathe
    b. It is illegal
    c. Both a and b
    d. Neither a nor b

103. When using the “wet” methods for cleaning brakes
    a. Use only the cleaning liquid recommended by the manufacturer
    b. Carefully dispose of all waste that contains brake dust according to Federal and local regulations for asbestos materials
    c. Use only specially designed low-pressure spray equipment that properly catches the runoff
    d. All of the above

104. Automotive batteries have what components that can cause pollution?
    a. Lead
    b. Wastewater
    c. Acid
    d. Both a and c

105. How many automotive batteries are produced in the United States each year?
    a. 90,000,000
    b. 9,000,000
    c. 900,000
    d. 90,000

106. What percent of automotive batteries are recycled?
    a. 30–40 percent
    b. 50–60 percent
    c. 70–80 percent
    d. 80–90 percent

107. What can be recovered from a single automotive battery?
    a. 18–22 pounds of lead
    b. 1 gallon of sulphuric acid
    c. 3 pounds of polypropylene
    d. All of the above
    e. None of the above

108. Manage automotive batteries by
    a. Storing batteries upright in a secure, covered area on an impermeable (sealed) surface.
    b. Checking often for leaks
    c. Recycling used, undamaged batteries as soon as possible
    d. All of the above

109. Discarded tires are
    a. An excellent breeding ground for disease-carrying pests and rodents
    b. A source of toxins when burned
    c. Both a and b
    d. Neither a or b

110. What environmental problem do absorbents cause?
    a. The raw materials used to make them are in short supply
    b. The contained liquids can leech into our waterways
    c. Both a and b
    d. Neither a or b

111. The best way to recycle absorbents is to
    a. Use them more than once
    b. Treat them as hazardous waste; they cannot be recycled
    c. Both a and b
    d. Neither a nor b

112. Fluorescent bulbs and HID lamps can contain
    a. Mercury
    b. Carbon dioxide
    c. Both a and b
    d. Neither a nor b

113. Commonly used aerosol propellants are
    a. Carbon dioxide
    b. Propane
    c. Butane
    d. All of the above

114. A problem with aerosol cans is
    a. If punctured, contents may be released so forcefully that injuries could result
    b. Extreme temperatures may cause cans to rupture
    c. Moisture may cause them to rust, resulting in a release of the contents with potential to harm the air, water or land
    d. Pressurized cans sent to a landfill present safety concerns during compacting, and fire hazard becomes more acute if container contents are vacated using an aerosol-puncturing device for the purpose of disposal
    e. All of the above

115. U.S. EPA and many states may consider used aerosol cans that are not empty
    a. Hazardous waste
    b. Against the law
    c. Both a and b
    d. Neither a nor b

116. Why switch to refillable spray bottles?
    a. Money can be saved by avoiding the high cost of aerosol cans
    b. They help to protect the environment by decreasing the solid and potentially hazardous waste stream
    c. They need to be managed by a company specializing in hazardous and problem waste disposal
    d. All of the above

117. What is caused by the release of CFC-12 into the atmosphere?
    a. Damage to the earth's ozone layer
    b. Acid rain
    c. Both a and b
    d. Neither a nor b

118. What must a shop have in order to service an automotive air conditioning system?
    a. A recovery and/or recycling machine
    b. An EPA license
    c. Posted warnings
    d. All of the above

119. What is caused by the release of VOCs into the atmosphere?
    a. Damage to crops
    b. Damage to the earth's ozone layer
    c. Damage to newborn babies
    d. All of the above

120. How are VOCs created in a shop?
    a. Many cleaning solvents
    b. Spray cleaners
    c. Other processes
    d. All of the above

121. Exposure to VOCs can cause
    a. Headaches
    b. Depression
    c. Fatigue
    d. Change of personality, dementia, and paralysis
    e. All of the above

Answers

1.	c	46.	a	91.	b
2.	a	47.	c	92.	d
3.	b	48.	d	93.	d
4.	c	49.	b	94.	d
5.	d	50.	c	95.	d
6.	b	51.	d	96.	b
7.	a	52.	a	97.	a
8.	c	53.	b	98.	d
9.	b	54.	c	99.	d
10.	a	55.	a	100.	a
11.	d	56.	d	101.	b
12.	b	57.	a	102.	c
13.	c	58.	d	103.	d
14.	a	59.	b	104.	d
15.	b	60.	d	105.	a
16.	a	61.	a	106.	d
17.	b	62.	b	107.	d
18.	a	63.	c	108.	d
19.	d	64.	d	109.	c
20.	b	65.	e	110.	b
21.	a	66.	d	111.	c
22.	c	67.	a	112.	a
23.	b	68.	c	113.	d
24.	e	69.	d	114.	e
25.	b	70.	a	115.	a
26.	a	71.	b	116.	d
27.	b	72.	e	117.	a
28.	b	73.	d	118.	a
29.	a	74.	d	119.	b
30.	c	75.	d	120.	d
31.	a	76.	d	121.	e
32.	d	77.	d		
33.	a	78.	d		
34.	b	79.	d		
35.	c	80.	a		
36.	b	81.	d		
37.	a	82.	a		
38.	d	83.	c		
39.	d	84.	b		
40.	b	85.	a		
41.	c	86.	c		
42.	a	87.	d		
43.	b	88.	a		
44.	d	89.	d		
45.	c	90.	a		

PRESENTATIONS

Five PowerPoint presentations are associated with this curriculum:

- Problems
- Solutions
- Liquid Wastes
- Solid Wastes
- Gaseous Wastes

These tools have been developed to assist you with your delivery of the instructional materials. The following pages are copies of the slides for each presentation. You can use these to keep track of your progress during lectures or provide copies for students to follow during the presentation.

If you would like to access the PowerPoint slides online, you can find them at:

Problems
http://www.ciwmb.ca.gov/Publications/UsedOil/61003008A.ppt

Solutions
http://www.ciwmb.ca.gov/Publications/UsedOil/61003008B.ppt

Liquid Wastes
http://www.ciwmb.ca.gov/Publications/UsedOil/61003008C.ppt

Solid Wastes
http://www.ciwmb.ca.gov/Publications/UsedOil/61003008D.ppt

Gaseous Wastes
http://www.ciwmb.ca.gov/Publications/UsedOil/61003008E.ppt

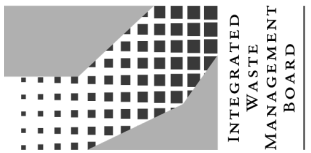
BINDER COVER AND SPINE INSERTS

PROPER AUTOMOTIVE WASTE MANAGEMENT

INTEGRATED WASTE MANAGEMENT BOARD

October 2003

Zero Waste—You Make It Happen!



Proper Automotive Waste Management