

A Recipe for Clean Water



■ **Grade Level:**
Middle School

■ **Subject Areas:**
Environmental Science,
Mathematics, Health

■ **Duration:**
Preparation time:
Part I: 15 minutes
Part II: 45 minutes

Activity time:
Part I: 50 minutes
Part II: 50 minutes

■ **Setting:**
Part I: Classroom
Part II: Classroom or
laboratory

■ **Skills:**
Analyzing (identifying
components); Interpreting
(drawing conclusions);
Applying (designing,
experimenting)

■ **Charting the Course**
Prior to this activity,
students can experience
the effort involved in
meeting drinking water
quality standards in
"Reaching Your Limits."
"Sparkling Water" intro-
duces students to the
challenges involved in
removing contaminants
from wastewater.

■ **Vocabulary**
toxin, corrosive, flamma-
ble, combustible, irritant

How do products we use at home affect water quality?

▼ Summary

Students examine labels of household products to learn what hazardous chemicals they may contain. They also try less toxic alternatives to some of these chemicals to reduce the amount of toxins that go down the drain.

Objectives

Students will:

- describe the types of information that are found on the labels of hazardous household products.
- test less toxic alternatives to these products.
- name ways that they could reduce the amount of toxic chemicals their household washes down the drain.

Materials

- *Copies of Labels and Reading Labels pages* (You may opt to provide copies of "real" labels from two of the products below.)
- *5 or more samples of hazardous household products from home* (Examples should include an all-purpose cleaner, glass cleaner, fabric stain remover, scouring powder, and dishwasher detergent.)

The following materials are needed for preparing, using, and storing alternative "green" cleaners:

- *Borax* (available at grocery stores and drug stores)
- *White vinegar*
- *Salt*
- *Baking soda*
- *Water*
- *Set of measuring cups* (will need to share)

- *Set of measuring spoons* (will need to share)
- *Plastic mixing bowl*
- *2 funnels*
- *2 spray bottles*
- *Paper towels or clean rags*
- *2 pint-sized plastic containers with lids*
- *Plastic scouring pad*
- *Dishpan with soapy water*
- *Hand mirror or window*
- *Fabric scraps*
- *Dirty desktops or lab tables*
- *Safety goggles* (one pair per student)
- *Rubber gloves* (optional; use if testing commercial scouring powder or all-purpose cleaner)

The following materials are suggested options for preparing stains. (Please note that stains should be prepared at least one day in advance. Most of the items below are appropriate for staining fabric scraps to test the laundry pretreatment. Smudge fingerprints on the hand mirror or glass to test the glass cleaner.

If desk or lab table surfaces are too clean to test all-purpose cleaner or scouring powder, the items below may be used to create dirt on these or other similar surfaces.)

- *Hot cocoa mix or powdered drink mix*
- *Pencil marks*
- *Milk*
- *Packets of catsup and mustard*
- *Small amount of soil from the school grounds*

Making Connections

When students read labels on common household chemicals, they will realize how many toxic chemicals their families use on a daily basis. As they learn how to prepare alternative cleaning products, they will be empowered to reduce the amount of toxic chemicals their households use.

Background

The average home in the United States contains more than 100 pounds of toxic chemicals. We clean our houses, polish our furniture, scrub our appliances, kill germs, dispatch dirt, and destroy pests of all kinds with them.

Many of us consider these everyday chemicals essential because they are efficient and effective cleaners, because they help us maintain our homes or workplaces, or because they save time. When used properly, these products do not usually cause harm. However, careless or excessive use or improper disposal of some of these products can be harmful to human health and the environment.

A toxin is any chemical that can harm a person if ingested, inhaled, or absorbed through the skin or other body surface. Toxic substances vary widely in the amount required to cause harm and in the type of harm they cause. The health effects associ-

ated with the improper use of household toxic chemicals can range from relatively minor ones (such as eye and throat irritations, headaches, dizziness, and nausea) to more serious ones (such as skin rashes or burns, liver or kidney damage, cancer, birth defects, and even death).

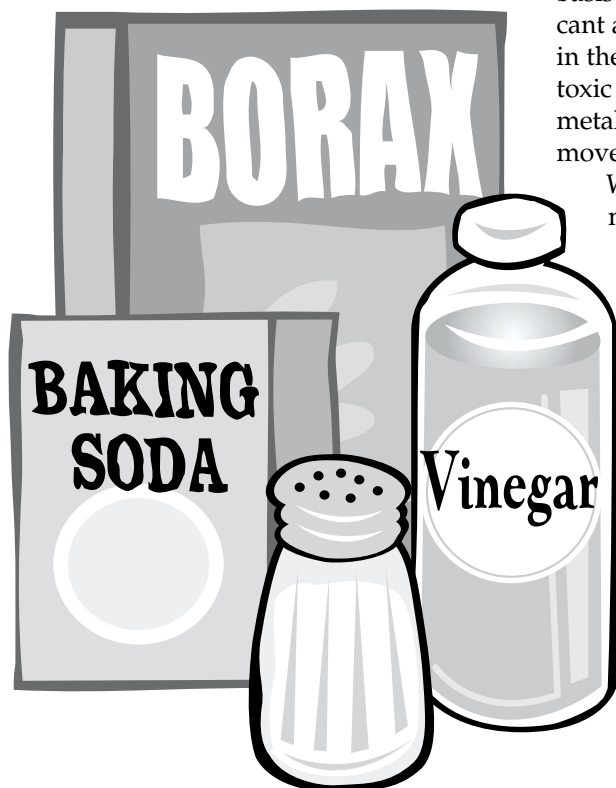
Many people are not aware that everyday household products can be toxic. The most dangerous substances in the home may be found in cleaners, solvents, pesticides, and automotive care products. When these products are used or disposed of improperly, they not only expose people and animals to their toxic effects but also can enter local waterways or pollute the air.

Multiplied by the millions of people who often live in an urban area, careless or excessive use of household chemicals can create a significant problem at the wastewater treatment plant. Even small amounts of hazardous substances on an individual basis can add up to a significant amount of toxic chemicals in the sewage system. Many toxic chemicals and heavy metals cannot be fully removed by sewage treatment.

When released after treatment, these pollutants flow into water bodies where they remain or accumulate in the sediment.

One way to learn about hazardous household products is to read the product labels. As a result of the Federal Hazardous Substances Act, any household product that contains hazardous substances must be labeled according to specific requirements. For products with a hazardous ingredient that causes acute effects, the label must contain:

- the common or chemical name of the hazardous substance.
- a signal word that tells the consumer a hazard is associated with the product. (“Poison” means that the product is highly toxic and can kill. “Danger” means that the product is extremely flammable, corrosive, or highly toxic. “Warning” or “Caution” means that the product is less hazardous, but still harmful.)
- a statement of the principal hazard, such as “Harmful if swallowed” or “Causes burns.”
- precautionary statements for avoiding the hazard. (Most hazardous household products say, “Keep out of reach of children.” Hazardous substances that can be absorbed through the skin may say, “Avoid contact with skin” or “Keep out of eyes.” Products with harmful vapors may say, “Use only in a well-ventilated area.”)
- first aid instructions in case of exposure. (While labels may contain instructions for first-aid, consumer advocates warn that this information is often incorrect or outdated. If exposure occurs, it is always best to call a doctor, poison control center, or rescue squad immediately.)





Measurement Conversions for Recipes

English Measures	Metric Equivalents
1 cup (c)	240 ml
1/2 cup (c)	120 ml
1/4 cup (c) = 4 tbsp	60 ml
1 tablespoon (tbsp)	15 ml
1 teaspoon (tsp)	5 ml

Note: The above equivalents are estimates based on the conversion 1 quart liquid = 0.9463 liters. For dry measures, use the conversion 1 quart dry = 1.101 liters.

Labels of pesticide products are much more complete and detailed than nonpesticide product labels. The user should always read and carefully follow the information given on these labels.

The user should also know what information is not included on product labels. The Federal Hazardous Substances Act is concerned with only acute or immediate effects of a product and does not take into consideration any chronic or long term effects. It also does not require the actual ingredients of all products to be listed. When ingredients are listed, they are frequently named by their function (for example, “polishing agent” or “grease cutter”) rather than their content. In other cases, the label may give only a general category name (for example, listing “aromatic hydrocarbons”) when this term covers a broad range of chemicals with varying levels of toxicity.

Many of us use and dispose of household chemicals in ways that can ultimately harm our health and our environment. Chemicals that go down storm sewers are not removed by wastewater treatment plants and enter the local waterway. Throwing leftover chemicals into the trash

means that they will end up in the landfill, where they can leak out into the ground water or harm workers.

To reduce the impact of household hazardous products, everyone should try to:

- Use the least toxic product possible.
- Buy only what is needed and use only the amount recommended on the label.
- Try to use up the product and share any leftover product with a friend or neighbor.
- Call a local health, water quality, or solid waste department for proper disposal instructions.

As awareness has grown about the environmental and health hazards posed by many household products, the search for alternatives has led some people to use “old-fashioned” cleaning solutions with ingredients such as vinegar, baking soda, and lemon juice. This awareness has also prompted increased consumer demand for safer, more environmentally friendly commercial cleaning products. Many companies have responded by developing “green” cleaners, often using compounds derived from plants, which are generally less hazardous than the synthetic, petroleum-based agents common in most household cleaners today. “Green” cleaning products represent a small but rapidly growing part of the \$11 billion spent in the U.S. each year for household cleaners. Although it is estimated that vegetable-based cleaners currently make up less than 1% of this market, the top companies producing these products report that sales as much as double each year. You can find these “green” cleaners at some supermarkets, food cooperatives, and natural foods stores.

Procedure

▼ Warm Up

Set up a display of household chemical products from your home. Make sure that the outsides of the containers are absolutely clean. Show students the products and ask them how these products might affect your city’s water. Ask them what else these products have in common. If necessary, point out that each of the products contains toxic ingredients that can harm people and the environment if they are not used and disposed of properly. Ask students for their ideas for where they could get information about the ingredients in the products and about how to avoid harm from using them.

Tell students that they will be working with potentially hazardous chemicals and should follow established laboratory safety rules. All students must wear safety goggles or other eye protection at all times. Students should also follow all safety precautions on the labels of commercial products (if these are tested), including the use of rubber gloves for those involved in testing the commercial all-purpose cleaner and the scouring powder.

▼ The Activity

Part I

1. Ask students to form small groups. Give groups copies of the *Labels* copycat page, and have them read the two labels. After reading, each group should answer the questions on the *Reading Labels* copycat page.

2. You may alternatively ask them to answer the questions on the *Reading Labels* page using copies of the labels from two of the “real” products on display.

3. Lead a discussion about the labels:

- What differences were found between the labels in terms of the information given?
- Which is more prominent: the brand name, the characteristics of the product, the safety instructions, or the instructions for using the product? What do you think about the relative importance given to each item on the label?
- Why is it important to know what ingredients are in a product?
- What should you do if a product label does not list the ingredients or does not give adequate instructions on how to use the product?

Part II

1. Set up workstations for each of the four recipes provided on the *Recipe Cards* copycat page, or set up ingredients and other necessary materials in a centralized location.
2. Explain that there are less toxic alternatives to commercial cleaners and other hazardous chemicals. Tell students that they will have a chance to make some alternative cleaning products and will then test and compare the effectiveness of these products with the effectiveness of commercial products. (Please note: If you have concerns about your students' ability to work safely with potentially hazardous toxic chemicals, you may opt to have students simply test the alternative cleaners rather than conduct a comparison test.)
3. Break students into groups, and assign each group one of the alternative product recipes. Point out the stained or dirty surfaces on which the students will test their products. As a class or in small groups, have the students identify the criteria and rating system they will use to measure the effectiveness of their prod-

SAMPLE DATA TABLE FOR TESTING CLEANERS

In *Part II*, students will design a chart such as the one below to help them collect and tally data from their product tests.

		Product Type	
		Alternative Product	Commercial Product
Surface to be cleaned	Type of surface		
	Type of dirt/stain		
Sample Criteria for Determining the Cleaning Effectiveness of Products	How well did the product remove dirt or stain?		
	How much did you have to use?		
	How long did the product take to work?		
Total Cleaning Effectiveness Rating			
Other Criteria for Evaluating Products	How safe did you feel using the product?		
	Were there any unpleasant side effects from use of product? (odor, etc.)		
	How likely are you to use product again?		
	How likely are you to recommend the product to a friend?		
Total Product Rating			
<i>(Please note: Students may use a numeric rating system (scale of 1–10, scale of 1–100, etc.), provide a letter grade (A, B, C, etc.), or otherwise devise a system of rating the effectiveness of their products.)</i>			

ucts. Give them time to design an appropriate data table (such as "Sample Data Table for Testing Cleaners").

4. Remind students to practice proper lab safety when preparing and testing products. This includes following all safety precautions and instructions for the proper use and disposal of the commercial household products (if these are tested). Have each group prepare their assigned cleaning product at a workstation.

5. Groups should test their products and rate them according to the criteria they identified in step 3. Have students record their findings from the test.

▼ Wrap Up

Bring the students back together and have the groups report their findings. What criteria and rating system did they use to judge the effectiveness of their product? Were their products effective? Would they want to switch from their regular brands to these alternatives? Why or why not?



Have the groups design labels or develop short commercial skits to help market their alternative cleaner to the rest of the class. Students should stress the benefits of using their products (cleaning effectiveness, environmental benefits, etc.).

Assessment

Have students:

- evaluate the quality and quantity of information found on household hazardous product labels (*Part I*, step 3).
- assess and compare the effectiveness of several less hazardous alternative cleaners to the effectiveness of commercial household products (*Part II*, steps 2–5).
- produce a marketing piece (label or commercial) for their alternative products (*Wrap Up*).

Extensions

Ask students to inventory their kitchens, bathrooms, broom closets, basements, and garages for household hazardous products using the *Household Hazardous Products Audit*. They must do this audit with the help of a parent or other adult (tell them that adults should sign the form showing that they helped). Caution students to wear gloves and to handle the items with care, being careful not to breathe fumes from any of the chemicals. How many different products did students find? Which parts of their homes contained the most products? Did their homes contain more than 100 pounds of toxic chemicals (the national average)? To help students calculate a personal household estimate, have them total the “amounts found (ounces or fluid ounces)” they recorded on their *Household Hazardous Products Audit* and divide the result by sixteen. What can students do to reduce their household’s use of toxic chemicals?



Worker sorts chemicals at a voluntary hazardous household waste drop-off site. FOLIO, INC.

Have students do a price comparison. How much does it cost to make the cleansers suggested in this activity? How much does it cost to buy products from the store that are intended for similar purposes?

What techniques did people use before stores carried such a wide variety of commercial cleaning products? Have students poll their grandparents or other elders to find out about these cleaners and how well they worked.

Resources

Berthold-Bond, A. 1994. *Clean and Green: The complete guide to non-toxic and environmentally safe housekeeping*. Woodstock, NY. Ceres Press.

Braus, Judy, Ed. 1998. *NatureScope: Pollution, Problems, and Solutions*. McGraw Hill.

Dadd, Debra Lynn. 1997. *Home Safe Home: Protecting yourself and your family from everyday toxics and harmful household products in the home*. New York. Putnam Books.

“Household Product Management Wheel.” Available from Environmental Hazards Management Institute, 10 Newmarket Road, Durham, NH 03824. (603) 868-1496. <www.ehmiworld.org>

“Household Hazardous Wastes: What You Should and Shouldn’t Do” (brochure). Available from Water Environment Federation, 602 Wythe Street, Alexandria, VA 22314. (800) 666-0206. <www.wef.org>

Reading Labels

Learning to read labels on hazardous products will help you to buy the least hazardous products and to use them as safely as possible. Use the two labels provided by your teacher to answer these questions.

	Product Name: _____	Product Name: _____
What does this product do?		
What are the active ingredients in this product?		
Which of these words does the label use: poison, danger, warning, or caution?		
What warnings are given for using this product?		
What first-aid instructions does the label provide?		
What information does the label provide on environmental effects?		
What does the label suggest for disposal of the container?		
Do you think this label provides enough information about the hazards of this product?		



Labels

SQUEEKY CLEAN

Caution:

Causes eye irritation. Do not get in eyes, or on skin or clothing. Wash hands thoroughly with soap and water after use. Avoid contact with food or food preparation surfaces.

First Aid:

For eye contact, flush eyes with water for 15 minutes. If irritation occurs, contact physician immediately.

Storage and Disposal:

Store out of reach of children. Do not reuse container. Rinse container and recycle.

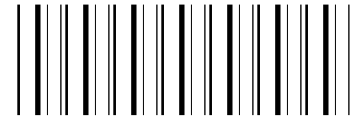
Contains no phosphates.

All-Purpose Cleaner

*Cleans everywhere you
want to clean!*

Cuts grease and grime
and kills germs on contact

To use, spray product onto soiled area and wipe clean with a dry paper towel or cloth. Repeat if the area is heavily soiled.



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Spotless!

Automatic Dishwasher Detergent Gets your dishes spotlessly clean!

Directions:

Fill detergent cups completely with Spotless! Use hot water for best results.

CAUTION: Avoid contact with mouth, eyes, and skin. Keep this and all cleaning products out of reach of children.

EMERGENCY FIRST AID TREATMENT:

If swallowed or gets in mouth—Drink a large glass of water or milk. Call a physician immediately.

Do not induce vomiting.

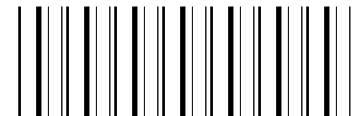
Eye contact—Flush eye thoroughly with water and call a physician.

Skin contact—Rinse thoroughly with water.

Ingredients: Water softeners (complex sodium phosphates and sodium carbonate), cleaning and water spot prevention agents (nonionic surfactant and chlorine), processing aid (sodium sulfate), and perfume.

Phosphorous Content: Averages 2.9% phosphorous, in the form of phosphate, which is equivalent to 0.4 grams per tablespoon.

Spotless! is safe for septic tanks.



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Please note: The product information provided on the labels above was taken directly from the labels of nationally advertised brands of all-purpose cleaner and automatic dishwasher detergent.



Recipe Cards

Scouring Powder	(makes 1 cup)
Ingredients:	
1/4 cup baking soda	Other materials needed:
1/4 cup salt	Measuring cups
	Pint-sized plastic container with lid
	Plastic scouring pad
	Paper towels or clean rags
Mix ingredients in a pint-sized container. Sprinkle on desk top or lab table. Scrub with scouring pad and wipe with a wet paper towel or a clean rag.	

Glass Cleaner	(makes 1 1/4 cup)
Ingredients:	
1/4 cup salt	Other materials needed:
1/4 cup water	Measuring cups
1 cup white vinegar	Funnel
	Spray bottle
	Paper towels
Pour salt into the spray bottle. Add liquid ingredients to the spray bottle using the funnel. Mix well. Be sure to label the container. Spray on glass or mirrored surface, and wipe with a dry paper towel.	

All-Purpose Cleaner	(makes 1 cup)
Ingredients:	
1/2 teaspoon borax	Other materials needed:
1 tablespoon vinegar	Measuring spoons
1 cup warm water	Measuring cup
	Plastic mixing bowl
	Funnel
	Spray bottle
	Paper towels or clean rags
Combine all ingredients in a mixing bowl. Mix well. Pour into spray bottle. Be sure to label the container. Spray on desktop or lab table, and wipe with a paper towel or clean rag.	

Laundry Stain Pretreatment	(makes 1/4 cup)
Ingredients:	
4 tablespoons (1/4 cup) baking soda	Other materials needed:
Water to create paste	Tablespoon or 1/4 cup measure
White vinegar to wet stain	Pint-sized plastic container
	Dishpan with soapy water
Measure baking soda into pint-sized plastic container. Slowly add water and stir until you make a thick paste. Spread the paste onto the stained fabric and wet with vinegar. Let soak in soapy water. Rub fabric together to remove the stain.	





Household Hazardous Products Audit

Remember:

1. You must have a parent or other adult conduct this audit with you. Adult's signature: _____

2. Wear gloves during the audit, and handle the containers with care.
3. Avoid breathing fumes from or touching any of the hazardous products.

Product Type	Where Stored	Amount Found (OZ or FL OZ)	Not Found
Cleaning Products			
grease-cutting cleanser			
glass cleaner			
dishwasher soap			
laundry soap			
fabric softener			
fabric stain remover			
bleach			
floor care products			
carpet cleaners			
furniture polish			
drain openers			
oven cleaners			
toilet bowl cleaners			
silver/metal polish			
air freshener			
Cosmetics			
perfumes/aftershave			
nail polish			
nail polish remover			
shoe polish			
Pesticides/Herbicides			
lawn pesticide			
lawn herbicide			
bug sprays			
insect or rodent poison			
Automotive/Hardware			
gasoline			
oil			
antifreeze			
batteries			
kerosene			
paint			
paint thinner			
glue			
Other Products <i>(list on separate sheet of paper as necessary)</i>			

