

Home Sweet Home?

The Mysterious Death of Janette Williams

Investigating the Safe Use of Hazardous Household Products

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For the
My Environment, My Health, My Choices project



University of Rochester
Rochester, NY

Abstract:

This learning experience is an interrupted case study to engage learning about hazardous household products. Students work in teams and assume the roles of Chemical Investigators as they assist in determining the cause of death of a young female in her home. The case study is interrupted as teams learn necessary background information in toxicology, exposure, routes of entry, dose-response curves, reading labels, and risk-benefit assessment. Students use this information to understand clues on the labels of household cleaning products found at the police scene. Using police, coroner, and forensic documents, the students reconstruct a scenario that might have created a toxic situation.

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Teachers, we would appreciate your feedback. Please complete our brief, online Environmental Health Science Activity Evaluation Survey after you implement these lessons in your classroom. The survey is available online at: www.surveymonkey.com/s.asp?u=502132677711

Note: All characters appearing in this work are fictitious. Any resemblance to real persons, living or dead, is purely coincidental.

Name _____

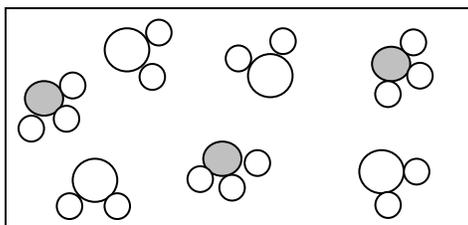
Student Pre/Post Test

1. Given the ingredients of 4 household products:

Heet[®]; methanol, blue coloring, water
Fruit Fresh[®]; dextrose, ascorbic acid, citric acid, silicon dioxide
Parson's[®] Ammonia; aqueous ammonia
Moth Balls; crystalline naphthalene

Which household product is composed of one substance, only?

1. Heet[®]
 2. Fruit Fresh[®]
 3. Parson's[®]
 4. Moth Balls
2. Given a particle diagram representing a sample of Windex[®].
In the particle diagram, ● represents an atom of nitrogen, ○ represents an atom of hydrogen, and ○ represents an atom of oxygen.



The composition of Windex[®] is best described as

1. one compound
 2. one element
 3. a mixture of compounds
 4. a mixture of elements
3. The formula, H_2O_2 is an example of
1. a molecular formula
 2. a structural formula
 3. an ionic formula
 4. an empirical formula

4. Which statement correctly describes the changes that occur when a sample of gas is heated in a closed container?

1. The average kinetic energy of the molecules decreases and the pressure of the gas decreases.
2. The average kinetic energy of the molecules decreases and the pressure of the gas increases.
3. The average kinetic energy of the molecules increases and the pressure of the gas decreases.
4. The average kinetic energy of the molecules increases and the pressure of the gas increases.

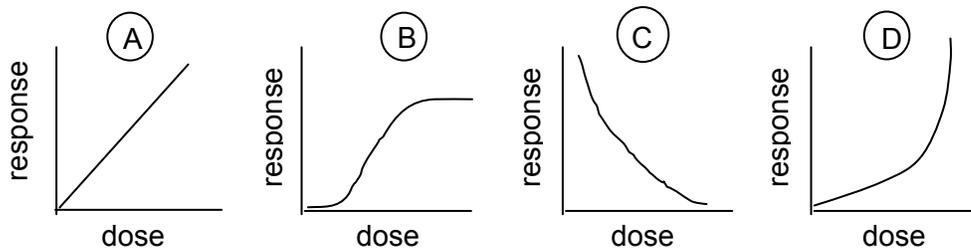
5. Which name is paired with the correct formula for the substance?

1. hydrogen chloride HCl_2
2. ammonia NH_4
3. sodium hypochlorite NaClO
4. sodium carbonate NaCO_3

6. The term, LD_{50} , is used in toxicology to refer to

1. Low Dosage for people age of 50 or less to prevent harm
2. Limit Duration of exposure to less than 50 seconds
3. Legal Document used in 50 states by the FDA
4. Lethal Dose for 50% of the exposed population

7. Which curve represents the relationship between dose of an administered substance and the response of the individual receiving the dose?



1. A
2. B
3. C
4. D

8. Which statement defines “dose-response relationship” in the context of hazardous substances?

1. Any dose will cause the same amount of harm
2. The harm from a hazard increases as the dose increases.
3. Small doses of a hazardous substance do not cause any harm.
4. Death is the result of contact with a hazardous substance.

9. Which term is **not** regulated for use to describe properties of hazardous substances?

1. Irritant
2. Corrosive
3. Deadly
4. Flammable

10. Labels on hazardous substances require, by law, the use of signal words to notify the consumer of the level of hazard. Below is a sample label.

®EASY-OFF HEAVY DUTY OVEN CLEANER

READ WARNINGS, PRECAUTIONS AND ENTIRE LABEL BEFORE USE.

PRECAUTIONS: Use only as directed. Recommended for use ONLY on porcelain enamel, iron, stainless steel, ceramic and glass surfaces. Do not puncture or incinerate container, expose to heat or store at temperature above 120°F.

DIRECTIONS: SHAKE CAN WELL AND FREQUENTLY.
Wear long rubber gloves. Do not get this on skin clothing, or in eyes.

KEEP OUT OF REACH OF CHILDREN

DANGER: Contains sodium hydroxide (LYE)
WILL BURN SKIN AND EYES. Avoid contact with skin, eyes, and mucous membranes.

HARMFUL IF SWALLOWED. Do not ingest.

FIRST AID: **SKIN** - rinse immediately and remove contaminated clothing. **EYES** - rinse immediately, and remove any contact lenses. Flush eyes with water for at least 15 minutes.

Which term on this sample label is an official hazardous substance “Signal Word”?

1. DANGER
2. FIRST AID
3. HARMFUL
4. PRECAUTIONS

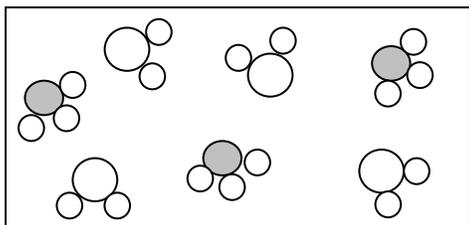
Pre-test and Post-test Answer Key

1. Given the ingredients of 4 household products:

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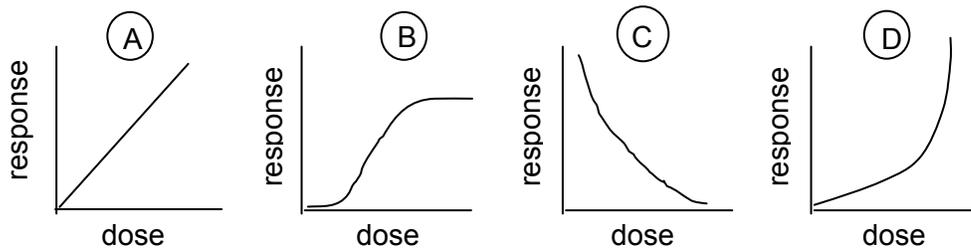
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Which term on this sample label is an official hazardous substance “Signal Word”?

1. **DANGER**
2. FIRST AID
3. HARMFUL
4. PRECAUTIONS

Home Sweet Home? The Mysterious Death of Janette Williams

Request for Assistance

Dear Chemical Investigators,



I am asking for your help in solving the unexplained death of Janette Williams in her home. Yesterday coworkers of Janette were concerned when she did not show up for work at Jiffy Lube, an automotive lubrication center. Janette was found dead at home, lying on the floor of her kitchen. Several household chemicals were seemingly in use at the time of death. The autopsy report from the County Coroner will be available in a few days. I will write a Forensic Specialist Report with an analysis of the crime scene. The Police Report follows.

Please help us consider what conditions in her home might have contributed to the untimely death of a healthy, young adult.

With Respect,
Murray Jones, Forensic Specialist
Vestal Police Department

Your responsibilities as a Chemical Investigator include:

1. Be a responsible, contributing member to your team of Chemical Investigators.
2. Read carefully the Official Police Report to become familiar with this case.
3. Research background information for insight into this case. You are individually responsible to report back to your team on a specific research topic.
4. Demonstrate expertise in all 4 topics of background information. The Chief Chemical Investigator (i.e. your teacher) will award a certificate of expertise to each Chemical Investigator upon mastery of the 4 research topics.
5. Read the County Coroner's Report and the Forensic Specialist's Report. Use your expertise as a Chemical Investigator to interpret the Reports.
6. File your Team's written report on the Mysterious Death of Janette Williams with the Chief Chemical Investigator.
7. (optional) Give a 3 minute oral presentation of your team's final report to the Association of High School Chemical Investigators (i.e. your class).

Official Police Report

Date: Monday, July 24, 2006
Deceased: Janette Williams
Location of Incident: 205 Main Street, Vestal, New York
Approximate Time of Death: 11:30 am, Saturday, July 22, 2006



Note; numbers in parentheses refer to evidence tag numbers used by the forensic specialist and will be further analyzed in a report to follow.

The body of Janette Williams was discovered by coworkers on the kitchen floor of her home in a middle-class neighborhood in Vestal New York. An empty unmarked plastic bottle (#1) lay close to the body. Assorted household cleaning supplies were on the countertop in the kitchen. A diffuse layer of white powder (#2) was found by the kitchen sink. The door to a kitchen cabinet with more cleaning chemicals was left open. Ant traps (#3) were on the floor in several locations around the perimeter of the kitchen.

All exterior doors and windows were shut, with no apparent forced entry by an intruder.

The vacuum cleaner was in the living room, with the TV on and tuned to VH1. Dust rags and polishing cloths were on the end tables next to the couch, which had all the cushions turned upright.

A small bathroom was located next to the kitchen. The rug on the floor inside the bathroom was wrinkled in parallel rows and twisted in a counter-clockwise direction. A white thick liquid (#4) with a granular texture was found in the bathroom sink. The white porcelain of the toilet was badly rust stained. The toilet contained an unidentified (#5) chemical. A bucket of liquid (#6) was near the doorway. The mop was propped in the corner of the small bathroom.

The door to the upstairs bedroom was closed. The door to the laundry room was open and the light was still on. The laundry room contained the washing machine (#7), which still had a load of wet towels. The dryer was filled with dry bed sheets.

Outside, the garage door was open and a 2006 red sports car was parked in the driveway.

Some of the chrome attachments on the car were covered with a white paste. A bottle of metal cleaner (#8) and cloth rags lay on the driveway near the car. In the garage was a long shelf of fertilizers, pesticides, and automotive products (#9), some of which were recently used. The sprinkler was still spraying water on the small backyard.



Janette Williams' husband was out of town, and was subsequently notified of the death of his wife.

Recorded statements by people who knew Janette Williams:

Coworker, Leroy Sadik:

"Janette was our best worker. She was always so enthusiastic about everything car related. She kept her own car clean enough to eat off of it. She was mad excited about buying her red sports car. She was always washing and waxing her "baby". She did more treatments to that car than we do here in the @Jiffy Lube. She could name any model of car that drove into the @Jiffy Lube. Man, I'm gonna miss her. Janette was one cool chick."

Coworker, Tasha Turner:

"I can't believe she is dead. She was so thrilled about getting married last month and buying this house. All she talked about was making this old house into their "home sweet home". She would hurry home after work each day to have a little time to work in her garden. Everybody loved Janette. I'm sure she didn't have an enemy in the world. I just don't know what could have happened to end her life."

Neighbor and Friend, Mary Ellis:

"I knew something was wrong when the car was left outside over the weekend. Oh, how I wish I had checked on Janette when I saw her washing her car Saturday morning! She was the best friend and neighbor a person could ask for. I know Saturdays were cleaning day for Janette. She would clean like a crazy person all morning, and then treat herself to a walk in the park. This was a special weekend for her, because it was the first time she and her husband were apart. She was trying to make everything perfect by the time he got back home. She was planning a romantic dinner for two..... Oh my, now it's all over!"

Husband, Bill Williams:

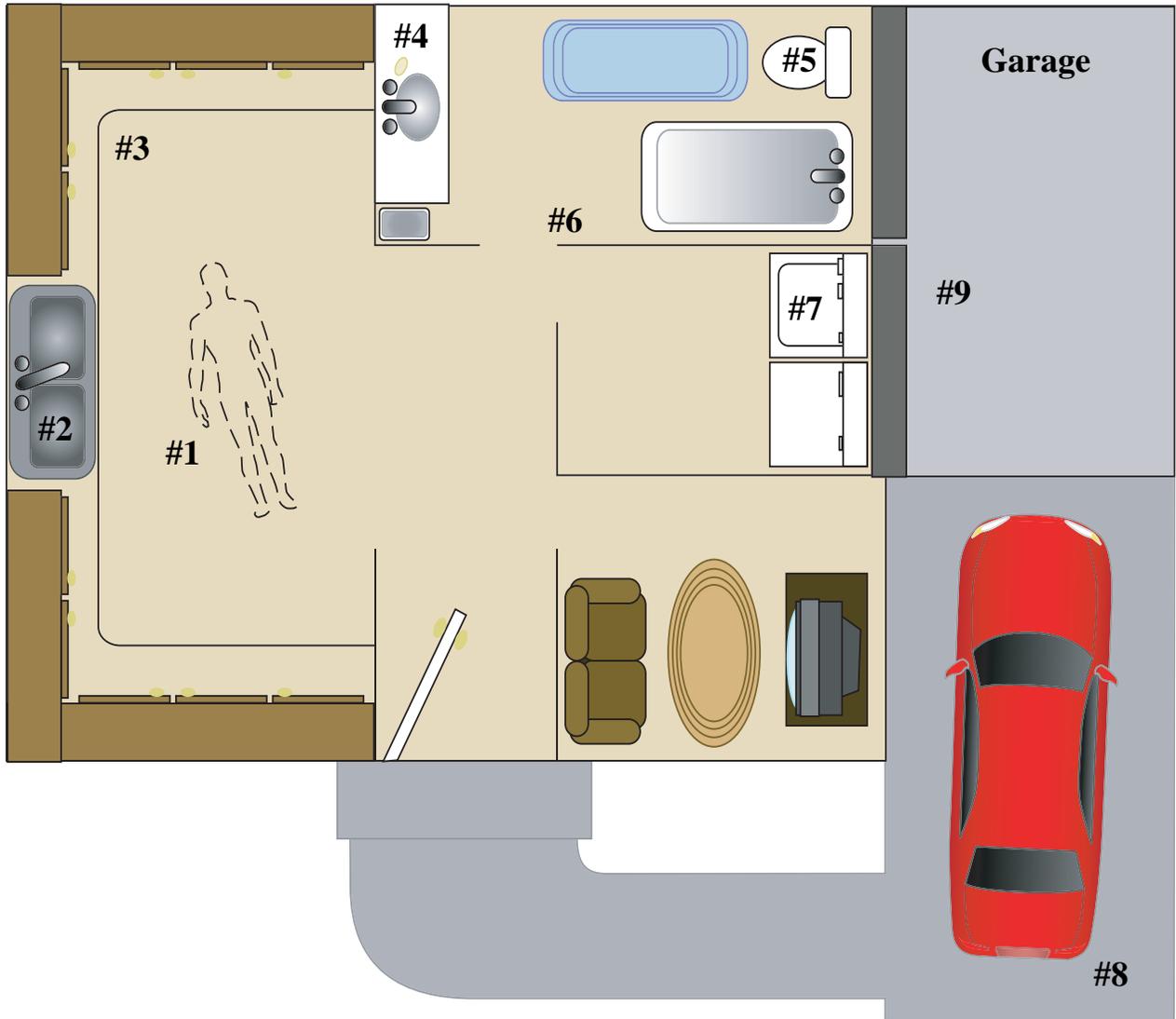
"I don't understand..... Janette was in perfect health, except for medicating for her asthma. She even had a physical with her doctor 2 weeks ago and was given a clean bill of health. She was always eating right and walking for exercise. How could she be dead? She knew I would be home Monday evening, and we had talked on the phone Saturday morning. She sounded anxious for me to get home, as if something special would be waiting for me. It's unbelievable....."

Official Police Report

Scene of Death of Janette Williams



Note: numbers in parentheses refer to evidence tag numbers used by the forensic specialist and will be further analyzed in a report to follow.



Task 2: Research Background Information About Household Chemical Products

Jigsaw Activity: Each person in your Team will become an expert on one of the research topics necessary to solve this case. When your individual research is done, come back together as a Team and report to the whole team concerning your research. The Team members will be learning from each other as you put all the pieces of information together. (Like a jigsaw puzzle, get it?) Remember, all members of the Team need to know all of this information, so work together!

Your Chief Chemical Investigator (i.e. your teacher) will explain how to access the materials necessary for your individual research on one of the four Research Topics.

RESEARCH TOPIC #1

What is Toxicology? What does toxicology have to do with Janette Williams?

RESEARCH TOPIC #2

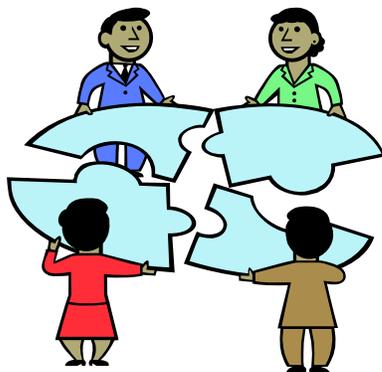
How can a household product be harmful? (Exposure, Routes of Entry, and Dose-Response)

RESEARCH TOPIC #3

What information is found on the label of household products?

RESEARCH TOPIC #4

Are household products good or bad for us? (Risk / Benefit Assessment)



TOPIC #1 What is Toxicology? What does toxicology have to do with Janette Williams?

A toxic substance means any chemical or mixture that may be harmful to the environment and to human health if inhaled, swallowed, or absorbed through the skin.

There are naturally occurring toxins (poisonous substances coming from living organisms) found in certain plants like poinsettias and even some wild mushrooms and berries. However, the toxic substances contained in most everyday household products are synthetic which means they are man-made.

Many of the products you find in your home may have toxic substances. These products include:

- drain cleaners
- oven cleaners
- laundry detergents
- floor or furniture polish
- paints
- pesticides



While these products are useful at home, some of the chemicals in these products can irritate your skin, eyes, nose and throat, or can even poison you!

The Federal Hazardous Substance Act (FHSA) has defined some terms commonly used in toxicology. The following definitions are from the FHSA website (www.cpsc.gov/businfo/fhsa.html):

"Toxic" refers to any substance (other than radioactive) that has the capacity to produce personal injury or illness to humans through ingestion, inhalation, or absorption through any body surface.



"Highly Toxic" refers to any substance that falls within the following three categories:

- a) produces death within 14 days in half or more than half of 14 or more white rats weighing 200-300 grams when orally administered
- b) produces death within 14 days in half or more than half of 14 or more white rats weighing 200-300 grams when inhaled continuously for 1 hour
- c) produces death within 14 days in half or more than half of 10 or more rabbits when administered topically

TOPIC #1 Continued.....

"Hazardous Substance" refers to any substance or mixture that is toxic, corrosive, is an irritant, is a sensitizer, flammable, or produces a gas when heated.

"Hazardous Substances" require specific "signal words" boldly written on labels to identify levels of risk involved in product use. More about this later.



A Simple Lesson on Toxicology

TOXICOLOGY... is the study of toxic substances and their adverse effects on organisms.

Each of us is concerned to some degree about the effects of chemicals on people, animals, and the environment. We know that some chemicals can have severely adverse impacts — for example, the many deaths from methyl isocyanate exposure in Bhopal, India a number of years ago, or the birth defects in children whose mothers took thalidomide during pregnancy. We are also aware of chemicals in the environment that affect public health, such as the effects on children of lead in soil and drinking water. How concerned should we be about the countless small exposures to chemicals we experience each day? This is the business of **toxicology**.

What substances are toxic?

Any substance can be toxic. The higher the exposure to a substance is, the greater the chance of an adverse effect. One example is sodium chloride, or table salt. Although essential to life, children have died from eating salt and many adults suffer from hypertension, which is associated with too much salt in the diet. A number of vitamins are toxic at high doses. Vitamin D, in fact, is classed as a highly toxic substance and only tiny amounts are needed for proper nutrition. Many foods and beverages actually contain chemicals that could be toxic if you ate very large quantities. Carrots, for example, contain arsenic. Many plants produce toxins and many spiders, snakes, and insects produce venoms that contain powerful toxins. Certain bacteria also produce toxins, e.g., the *botulinus* toxin found in improperly preserved foods.



Chemical toxicity is NOT a simple picture...

TOPIC #1 Continued.....

Most chemicals have both risks and benefits associated with their use. It is important to know the good and bad consequences of using a particular chemical. For example;

- Atropine is a super toxic chemical produced in the deadly nightshade plant. It is also an antidote for organophosphate pesticides poisoning and nerve gas poisoning.
- Botulinus toxin is the most acutely toxic chemical known. Yet, it has also been used to treat muscle spasms and hide wrinkles (Botox).
- Thalidomide produces serious birth defects in humans. However it is also a potent immune response modifying drug, and is being studied for use as an immunosuppressant in organ transplant recipients and as a drug to moderate some AIDS-related conditions.
- Vitamin A is an essential nutrient. It is also know to causes birth defects in humans.

Toxicologists need to quantify the degree of toxicity of a particular toxin. The term LD₅₀ is the dose of toxin that results in death of 50% of the exposed population. People in general often have misconceptions as to how toxic a particular substance is. For example, botulinus toxin is one of the most toxic substances known, with an LD₅₀ of 0.00001 mg/kg. Look at the following chart and see if you can predict the next three most toxic substances on the list.

The LD₅₀'s are on the next page. Do not look until after you have made your choices!

Toxic Substance	LD ₅₀ (mg/kg) (i.e. ppm)
Brown Recluse spider venom	
DDT	
Tetanus toxin	
Ethyl alcohol	
Aspirin	
Mothballs	
Dioxin	
Cholera toxin	
Mercury (II) nitrate	
Morphine	
Botulinus toxin	0.00001
Nicotine	
Arsenic	
Cyanide	



TOPIC #1 Continued...

So what does a person need to know to be informed to make good decisions? Toxicity and the field of toxicology require knowledge into the following areas:

- frequency and duration of exposure to toxin
- chemical properties of toxin
- route of entry of toxin
- dose of toxin
- individual traits of exposed person (age, weight, gender, health, etc)
- dose and response relationship of toxin

Chemical toxicity is NOT a simple picture...



Answers

Toxic Substance	LD ₅₀ (mg/kg) (i.e. ppm)	
Brown Recluse spider venom	85	
DDT	250	
*Tetanus toxin	0.001	
Ethyl alcohol	10,000	
Aspirin	250	
Mothballs	500	
*Dioxin	0.001	
Cholera toxin	250	
Mercury (II) nitrate	25	
Morphine	900	
*Botulinus toxin	0.00001	
*Nicotine	1	
Arsenic	100	
Cyanide	10	

References: <http://www.epa.gov/kidshometour/toxic.htm>
http://www.msmr.org/LAB_Notes_Toxicology.pdf
<http://www.niehs.nih.gov/external/faq/clean.htm>

TOPIC #2 How can a household product be harmful? (Exposure, Routes of Entry, and Dose-Response)



Exposure

Exposure is the mode of contact made with a hazardous substance. Factors such as “how strong and how long” you come in contact with a chemical will help determine how harmful the chemical is to you.

Knowing about your exposure is very important in trying to find out if a chemical will cause you health problems. It can be tricky because sometimes it can be a long time after you come in contact with a chemical before you get sick. Toxic herbicides, such as Agent Orange, might have a delayed response of up to a decade or more. Or, it can take repeated contact with a chemical before you get sick or have a response. For example, repeated exposure to high levels of asbestos can cause the respiratory disease asbestosis.

If you have a reaction to any household products that have been used around your home, you will need to know about your “exposure” to the product. The four (4) descriptions and example questions below will help you to understand.

1. Your exposure is based on **how** and **where** on your body you came in contact with the chemical.

Did some spray from a glass cleaner get on your skin while cleaning the bathroom mirror? Did you accidentally walk into the room where a fogger or insect bomb had just been set off and breathe the fumes? Did you play on the grass after a weed killer was put on your lawn? Were you washing your dog with a flea and tick shampoo?

2. Your exposure is based on **how long** you were in contact with the chemical.

Were you playing all day on the lawn after a weed killer was used? Did you spend a half hour picking tomatoes after an insect killer was sprayed in your garden? Did you sleep all night in a room that had just been painted?

3. Your exposure is based on **how much** of the chemical you come in contact with.

How much insect spray got on your arm? Was it just a few drops or enough to make a large wet spot? How much of the insect powder to kill ants got on your hands? Was it a little on your fingers or was it all over your hands? How much of the container of liquid cleaner spilled on your clothes? Was it a little splash or half the bottle?

TOPIC #2 Continued.....

4. Your exposure is based on **how strong** or **toxic** the chemical is.

Did the spray from a pesticide container brought from the store get on you?
Did the liquid from a container of weed killer and water that your Dad mixed together spill on you? What is the "Signal Word" on the label of the container - Caution, Warning or Danger/Poison?

Routes of Entry

How does exposure occur? Before a toxic effect can occur, there must be exposure. A toxic substance may enter the body through the mouth, lung, or skin.

- lung/inhalation - by breathing in the fumes of the chemical
- skin/dermal - having the chemical splash or spill on your skin
- mouth/ingestion - eating or swallowing a chemical



The lung is usually the most rapid means of entry into the bloodstream. For example, gaseous anesthetics act very rapidly. And inhaled toxins, such as the fumes released by burning plastics, can have rapid and catastrophic effects.

Skin is usually a defense against toxic substances, but it can also be a point of entry. For example, the pesticide parathion is absorbed through the skin into the bloodstream. In a recent case, a scientist was poisoned by mercury absorbed through laboratory gloves.

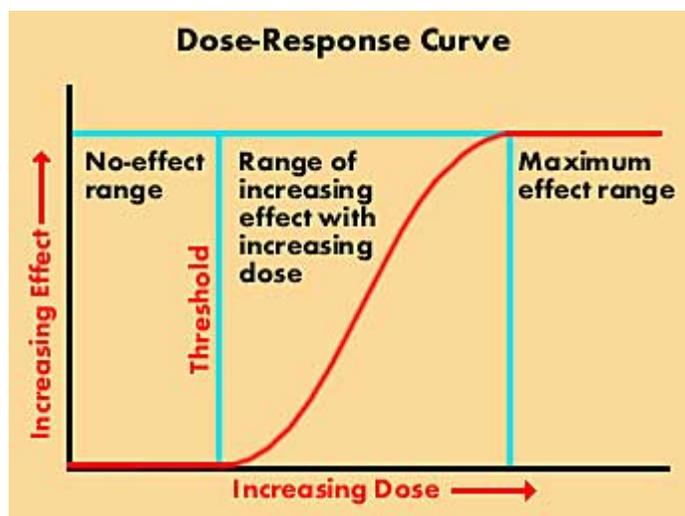
Once ingested by mouth, a chemical may be absorbed across the wall of the gastrointestinal tract into the bloodstream. Most of a chemical absorbed in this way is carried first to the liver. The liver metabolizes the chemical into a less — or sometimes more — toxic form.

TOPIC #2 Continued.....



Dose-Response

For many chemicals, there is a dose at which there are no toxic effects, there is a dose at which the effects are reversible, and there is a dose at which the effects may have permanent consequences. This pattern can be seen in the following graph representing a typical dose - response curve. As the dose increases, the effect of the chemical also increases. A common phrase to express this relationship is "the dose makes the poison".



http://www.safetyline.wa.gov.au/institute/level2/course16/lecture127/l127_02.asp

Examples of some toxic chemicals that adults are exposed to regularly are caffeine, tobacco, and alcohol. At doses normally consumed by the average person, the effect felt by the individual can be quite different. One person may be able to drink 5 cups of coffee without visible effects, while another person might get the shakes after 2 cups of coffee. This is an example of how the dose and response varies from one person to the next.

At some point, caffeine, tobacco, and alcohol can have a much more serious effect on the individual. At extremely high doses caffeine is capable of making changes at the cellular level), and is a probable carcinogen. At high doses, nicotine, the active ingredient in tobacco, can be a very potent poison causing nausea, vomiting, convulsions, and even death. Alcohol can cause birth defects, brain damage, coma, and death.

TOPIC #2 Continued....



Caffeine, tobacco, and alcohol are examples of toxic chemicals that as a society has evaluated, and some have made a conscious decision to continue their exposure to these toxic chemicals, despite the known risks.

So the issue is not whether a chemical is toxic, it is the nature of the toxicity.

Household cleaning products are definitely an area where we can exercise some choice over the degree of toxicity to which we expose ourselves and our families.

References:

<http://www.niehs.nih.gov/external/faq/clean.htm>

<http://www.epa.gov/kidshometour/exposure.htm>

http://www.msmr.org/LAB_Notes_Toxicology.pdf

<http://www.epa.gov/kidshometour/accident.htm>

TOPIC #3

What information is on the label of household chemical?



About Labels

Many household products contain toxic ingredients that can be harmful to humans, animals, or the environment. The average home has between 3 and 10 gallons of hazardous products. Even so, we use these products to clean or maintain our home. Hazardous chemicals have important label warnings that require our attention before we use the chemicals. The label is your guide to using products safely and effectively.

Signal Words

Labels use signal words to show how toxic or hazardous a product can be. Signal words are large lettered words meant to attract the attention of the consumer. The signal words are.....

POISON

DANGER

WARNING

CAUTION

You need to be careful when products with signal words on the label are used. Make sure you do not come in contact with any of the chemicals from these products. Remember to always "Read the Label First" to know how to properly use these products and for safety information.

- **Poison and Danger** are the strongest signal words. If the hazardous material contains deadly substances that are highly toxic, the signal word POISON is used along with or instead of DANGER, and a skull and cross bones symbol is displayed.
- **Danger** is a signal word to heed. If a label has the word *Danger* on it, you must be extremely careful using the product. If it is used the wrong way, you could get very sick, be hurt for a long time, go blind or even die. *Danger* is also used on products that could explode if they get hot.
- **Warning** is less strong than *Danger*, but it still means that you could get really sick or become seriously hurt. *Warning* is also used to identify products that can easily catch on fire.
- **Caution** shows that the product could hurt you, but it is less harmful than products with a danger or warning signal word. *Caution* is used on products that could bother your skin, make you sick if you breathed the fumes, or really hurt if the product got in your eyes.

TOPIC #3 Continued...

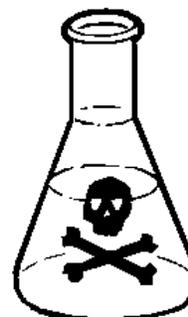
The signal words used in the precautionary statements on the labels of hazardous substances represent quantitative information about the chemicals in concern.

Signal Words for Hazardous Substances	Toxicity	Dose (LD ₅₀) (mg/kg or ppm)
POISON	deadly	0-50
DANGER	highly toxic or corrosive	0-50
WARNING	moderately toxic	50-500
CAUTION	slightly toxic	500-5000

Not all household chemicals are hazardous. Some household products will have no signal words on their labels. A hazardous substance is defined in federal regulations as "one that may cause substantial personal injury or illness during reasonable handling or use, including possible ingestion by children." According to the Federal Hazardous Substance Act (FHSA), the term "*hazardous substance*" means any substance or mixture having at least one of the following properties; toxic, corrosive, irritant, strong sensitizer, flammable, or generates pressure.



The term "hazardous substance" does not apply to pesticides subject to the Federal Insecticide, Fungicide, and Rodenticide Act, nor to foods, drugs, and cosmetics subject to the Federal Food, Drug and Cosmetic Act.



The table on the next page lists the properties used in conjunction with signal words on labels. Think about the meanings of these 6 properties. Work individually to match the following properties to their definitions. The answers are on the bottom of the page, but do not look now!

PROPERTIES OF HAZARDOUS SUBSTANCES

Write letter here	<p>Toxic</p> 
	<p>Corrosive</p> 
	<p>Irritant</p> 
	<p>Strong Sensitizer</p> <p>You think of a symbol.</p>
	<p>Flammable</p> 
	<p>Generates Pressure</p> 

- A. A substance that destroys human tissue by means of a chemical reaction. The product can severely burn skin or eyes. Tissue is destroyed or irreversibly altered.
- B. A substance that harms human tissue only after repeated exposure. On first exposure, little or no effect can be noticed.
- C. A substance that ignites easily and burns rapidly.
- D. Some substances are unstable and undergo a chemical reaction which produces a gas due to decomposition, heat, or other means. If in a sealed container, an explosion may occur.
- E. A substance that causes long-term negative effects in living organisms.
- F. A substance that that harms human tissue after one or more exposures. Can cause a reversible inflammatory effect on living tissue.

References: <http://www.epa.gov/kidshometour/labels.htm>
http://www.euphoricorganics.com/taking_action/green_clean_hazard_label.html
<http://pasture.ecn.purdue.edu/~epadados/waste/src/readhaz.htm>

Answers: Toxic E, Corrosive A, Irritant F, Strong Sensitizer B, Flammable C, Generates Pressure D

TOPIC 4

Are household chemical products good or bad for us?
(Risk / Benefit Assessment)



RISK versus BENEFIT:

You Decide...

Aspirin is a drug with many beneficial uses. It is generally regarded as quite safe. However, it is not without side effects. Aspirin has a complex range of effects. It is a pain reliever and reduces fever and inflammation. It is also an acidic compound and may act as a stomach irritant in some people. It may also have adverse effects on pregnant women in the third trimester. With prolonged use of the drug also comes a risk of some hearing loss. Doctors often prescribe 4-8 aspirin each day for patients suffering from arthritis, a painful and debilitating disease. Imagine that your joints ached constantly, limiting your activity. Aspirin could help relieve your pain. *Would you take the aspirin? In other words, would you prefer to live with the pain or with the possible side effects of the treatment?*

List the Risks and Benefits of using aspirin in the table below:

Household Product	Risks	Benefits
Aspirin		



RISK ASSESSMENT

There is no way to eliminate the risk involved with exposure to synthetic and natural chemicals. However, toxicologists working with government regulators have developed means to assess risk. Risk assessment is a process in which the toxicity of chemicals in animals and other models, as well as the level of human exposure, is examined. From this evaluation is calculated a "safe dose" of the compound. Risk assessment is used to set standards (levels that should not be exceeded) -- for example, the level of pesticide residue on fresh fruits and vegetables. The risk assessment process is deliberately conservative. When definite answers are not known, worst case assumptions are made to ensure that even very sensitive people would not be harmed by a standard exposure.

Scientists seek to minimize risks associated with use of consumer products and other chemicals.



Risk vs. Benefit

Household cleaning products present the need for a risk vs. benefit assessment. Disinfectants are commonly used around the house to kill germs that might lead to illness. Thus, disinfectants, by the nature of their action, contain toxic chemicals. Yet the level of toxicity needs to be kept to killing germs and not harming the individuals the use of the product is meant to protect. In other words, do the benefits of using disinfectants outweigh the disadvantage of possible adverse side effects in some people?

Similar risk-benefit analysis is used in many of our daily personal decisions. Will you eat red meat even though heart disease runs in your family? Will you get exercise by jogging along the road even though the risk of personal injury increases? Will you use pesticides on your lawn knowing the risk of harming the ground water supply?

WHY IS RISK ASSESSMENT IMPORTANT?

- Humans make risk assessment and risk management decisions every day. Consider the risk in just driving your car.
- There is no such thing as zero risk, therefore an informed and balanced perspective is important to make wise choices.
- If perceptions of risk are faulty, efforts at environmental and public health protection will be misdirected.
- Only when you know the risks, can you take the necessary precautionary measures.

TOPIC #4 Continued...

Ten Common Hazardous Household Products



Consider the Risk vs. the Benefit of using these household chemicals. Complete the chart by adding several beneficial reasons why these products are used in the house. Do the benefits outweigh the risks?

Household Product	Risks	Benefits
1. Bleach		
Sodium hypochlorite	<ul style="list-style-type: none"> — Strong corrosive- burns eyes, skin and lungs. — Causes respiratory tract damage. — May cause pulmonary edema if ingested 	
2. Carpet & Spot Cleaners		
Ammonium hydroxide	<ul style="list-style-type: none"> — Corrosive, extremely irritable to eyes, skin and respiratory passages. 	
3. Dishwasher Detergent		
Sodium Silicate (powdered)	<ul style="list-style-type: none"> — Corrosive. Burns to eyes, tissue, and skin. — Burns to the mouth, throat, and stomach if swallowed. 	
4. Disinfectants		
Dioxin	<ul style="list-style-type: none"> — Carcinogen. (500,000 times more deadly than DDT) 	
5. Drain Cleaner		
Sodium or Potassium hydroxide (lye)	<ul style="list-style-type: none"> — Highly caustic- burns skin and eyes. — If ingested will burn esophagus and stomach. 	



TOPIC #4 Continued.....

Ten Common Hazardous Household Products Continued



Household Product	Risks	Benefits
6. Floor Cleaner/Wax		
Petroleum Solvents	<ul style="list-style-type: none"> – Linked to skin and lung cancer. – Irritant to skin, eyes, nose, throat and lungs. 	
7. Laundry Detergent		
Sodium Silicate powdered)	<ul style="list-style-type: none"> – Corrosive. Burns eyes and tissue. Damages skin. – Burns to the mouth, throat, and stomach if swallowed. 	
8. Oven Cleaner		
Sodium or Potassium hydroxide (lye)	<ul style="list-style-type: none"> – Highly caustic, burns skin and eyes. – Poisonous if ingested due to severe tissue burns and damage. 	
9. Toilet Bowl Cleaner/ Tub & Tile Cleaner		
"Active" acids	<ul style="list-style-type: none"> – Acid-based products can cause SEVERE burns skin. Can permanently damage eyes and lungs. 	
10. Window Cleaner		
Ammonia	<ul style="list-style-type: none"> – Damaging to eyes, mucus membranes, respiratory tract and skin. – Causes headaches. – Poisonous fumes when mixed with chlorine chemicals like bleach 	

Reference: http://www.euphoricorganics.com/taking_action/green_clean_hazard.html
http://www.msmr.org/LAB_Notes_Toxicology.pdf
<http://pmp.cce.cornell.edu/issues/risk-fifra-891.html>

Task 3: Check For Understanding

After your research team puts together all the research components presented in this case, each member of the team must be prepared to answer questions on ALL of the research topics. Contact the Chief Chemical Investigator to certify your understanding of Toxicology, Exposure, Routes of Entry, Information on Labels, and Risk/Benefit Assessment.

***All team members must be certified in these areas before continuing with the investigation.

Certification Questions for Task 3

Toxicology

1. What is meant by toxicology?
2. Give an example of the saying "the dose makes the poison". In other words, what is a substance that is beneficial in certain quantities but harmful in larger quantities?
3. What does it mean that the LD₅₀ of botulinus toxin is 0.00001 mg/kg?
4. Name several factors that determine the level of toxicity?
5. How is the study of toxicology related to the death of Janette Williams?

Exposure, Routes of Entry, and Dose-Response

6. What are three routes for exposure to a chemical?
7. What other factors determine the response to exposure of a chemical?
8. Do you think all routes of exposure are equivalent for a specific toxin? Explain.
9. What is the first thing that you do if....
 - a. You splash a harmful chemical on the skin of your arm?
 - b. A harmful chemical mist irritates your eyes?
 - c. The smell of a noxious gas makes you feel dizzy?
10. Sketch the shape of a dose-response curve. What does this shape imply?

Household Product Labels

11. Name and rank the 4 signal words found on labels of hazardous household products?
12. What term describes the property of a hazardous substance if it can
 - destroy human tissue by a chemical reaction and severely burn skin or eyes?
 - harm human tissue only after repeated exposure?
 - harm human tissue after one or more exposures but the damage is reversible and tissue can be restored?
 - readily undergo combustion?
 - explode if heated?
 - Cause long term negative effects in humans?
13. What symbol can you design for a product that contains a strong sensitizer?

Risk/Benefit Assessment

14. Explain the concept of Risk-Benefit assessment.
15. Give an example of a decision relevant to your life involving risks and benefits.
16. Give an example of the Risk-Benefit assessment for a household product of your choice. Explain both the risk and the benefit of the household product.

Task 4: Learn More About Household Product Labels

For Task 4 your team will work together to analyze a typical label on a household product.

The labels of household products containing hazardous substances must include at least the following information:

1. **Brand Name**
2. **Common and/or Chemical Name**
 - A list of the common names of the hazardous ingredients; if a hazardous substance has no common name, the chemical name will be listed.
3. **Amount of Contents**
4. **Signal Word**
 - One of the signal words must appear on all hazardous substances.
5. **Instructions for Safe Handling and Use**
 - Warnings about how to use the product and where to avoid use of the product.
6. **Name and Address of Manufacturer, Distributor, Packer or Seller**
 - Contact the manufacturer about any questions concerning the product.
7. **Description of Hazard and Precaution**
 - A description of the principal hazard involved in using the product. In this case, the product causes burns and is "corrosive" to the skin and eyes, and to the gastrointestinal system if swallowed. A statement of what to do to avoid the hazard such as precautions to wear gloves or eye protection, or to provide adequate ventilation.
8. **First Aid Instructions, When Necessary or Appropriate**
 - On some hazardous products antidotes are provided in case of accidental poisoning. In the event of a poison emergency, **always** call for emergency services of the Regional Poison Center.

Your team will work together to look at the next sample label from a household chemical. Find, circle, and label all 8 parts of the required label components on this [®]Easy-Off label. Use the numbers 1-8 along the left side to label these sections on the [®]Easy-Off label.

References: <http://www.cpsc.gov/businfo/fhsa.pdf>
<http://pasture.ecn.purdue.edu/~epados/waste/src/readhaz.htm>

Circle and label the 8 required label components on the left hand side of this page.

Front Label

America's #1 Oven Cleaner
® EASY - OFF
Heavy Duty Original Oven Cleaner
CUTS THROUGH TOUGH BAKED ON FOOD AND GREASE
KEEP OUT OF REACH OF CHILDREN

DANGER:
CAUSES BURNS TO SKIN AND EYES ON CONTACT. HARMFUL IF
SWALLOWED CONTENTS UNDER PRESSURE.
READ PRECAUTIONS ON BACK

NET WT. 16 OZ
(1 LB.) 453 G

Back Label

® EASY-OFF HEAVY DUTY OVEN CLEANER
EFFECTIVELY CLEANS WARM OR COLD OVENS! IDEAL FOR CLEANING
OVENS, BROILERS, BARBEQUE GRILLS & STAINLESS STEEL
SURFACES.

READ WARNINGS, PRECAUTIONS AND ENTIRE LABEL BEFORE USE.
**NOTE: FOLLOW DIRECTIONS ON SAFETY CAP TO REMOVE IT. DO NOT
USE KNIFE OR OTHER TOOL TO PRY CAP. DOING SO MAY PUNCTURE
CONTAINER. NOTE: PLACE BOTH THUMBS DIRECTLY BELOW THE WORD
"HERE" LOCATED ON THE TOP OF CAP. PUSH CAP UPWARDS WITH
BOTH THUMBS.**

PRECAUTIONS: Recommended for use ONLY on porcelain enamel, iron, stainless steel,
ceramic and glass surfaces. Avoid excessive use on glass. Do not use on exterior oven
surfaces, aluminum, chrome, baked enamel. Do not use on self-cleaning or continuous-
cleaning ovens. Avoid spraying oven pilot light. Keep off all electrical connections such as
heating element, thermostat, bulb receptacles. Light switch. Do not puncture or incinerate
container, expose to heat or store at temperature above 120°F. Never leave can on stove or
near source of heat. Avoid freezing.

Back Label
continued

DIRECTIONS: SHAKE CAN WELL AND FREQUENTLY.

Wear long rubber gloves. Do not get this on skin clothing, or in eyes.

FAST CLEANING: 1) Preheat oven to 200°F. Once preheated, turn oven off before applying [®]EASY-OFF Oven Cleaner. 2) Wear long rubber gloves when using. 3) **Liberally spread newspaper under oven door and surrounding area to protect floor. For ease of application remove oven racks and clean separately.** 4) Hold can upright pointed away from face. Spray surfaces from a distance of 9 - 12 inches. Make sure pointing arrow is aligned with black dot. Spray top of oven first, then spray sides and bottom. 5) After application, close oven door. 6) Allow foam to work 5 -10 minutes then wipe clean with wet cloth or sponge, rinsing frequently. For heavily soiled areas, allow to work longer. 7) After use, rinse spray button thoroughly and drain excess water. Replace cap promptly.

KEEP OUT OF REACH OF CHILDREN

DANGER: Contains sodium hydroxide (LYE)

WILL BURN SKIN AND EYES. Avoid contact with skin, eyes, mucous membranes and clothing.

HARMFUL IF SWALLOWED. Do not ingest. **AVOID BREATHING SPRAY MIST. WEAR LONG RUBBER GLOVES WHEN USING.**

FIRST AID: SKIN - rinse immediately and remove contaminated clothing, wash thoroughly with soap and water and continue flushing with water for at least 10 minutes. If discomfort persists, call a physician immediately.

EYES - rinse immediately, and remove any contact lenses and continue flushing with water for at least 15 minutes. If discomfort persists, call a physician immediately.

IF SWALLOWED DO NOT INDUCE VOMITING - rinse mouth thoroughly with water, drink water or milk. Call a physician immediately.

Important Facts:

Encourage your local authorities to establish a program to recycle this can.

This can is made from an average of 25% recycled steel (10% post consumer).

Questions? Comments? Call 1-800-228-4722

Distributed by: Rickett Benckiser Inc.

Parsippany, NJ, 07054-0224. Made in the U.S.A.

Visit us at www.easyoff.us

Task 5: Record Information from Household Product Labels

Now your Research Team is to apply your new knowledge by finding and recording the information available on Household Products Labels. Read the precautionary statements on the labels of 10 household products that your Chief Chemical Investigator has made available in the classroom. Record label information on the chart provided on the next two pages.

Not all chemicals found in the home are classified as "hazardous". If, however, according to Federal Law, the household product is found to be hazardous, "signal words" will define the level of the hazard.

Remember, the Federal Hazardous Substance Act does not regulate all chemical products that could be found in a home. Pesticides, foods, drugs, and cosmetics are all regulated by other federal laws.

Remember, only hazardous substances are required to comply with the labeling regulated by Federal Hazardous Substance Act (FHSA).

When the front of the chart is complete, answer the questions on the back regarding the chemicals you identified.



Task 5: Chart for Recording Information from Household Product Labels

Hazardous Substance? Yes or No	Brand Name of Product	Common or Chemical Name of Ingredient(s)	Write chemical formulas	Signal Words	Description of Hazardous Properties	Route of Exposure
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Task 5: Questions to answer concerning the chemicals identified on household product labels

1. Write the names and formulas of any organic compounds.
2. Write the names and empirical formulas of any ionic compound.
3. Write the names and structural formulas of polar covalent compounds.
4. Write the names and structural formulas of nonpolar covalent compounds.
5. Which active ingredients did you find that could be classified as acids?
6. Which active ingredients did you find that could be classified as bases?
7. Petroleum distillates are found in several WD40, metal polishes, and "Goo Gone". Petroleum is another name for crude oil. Distillation is a process to physically separate the components of a mixture. What is the physical property of these components on which the separation technique is based?
8. Aqueous ammonia solution is a common cleaning product used to degrease surfaces. What intermolecular force is responsible for the dissolving of ammonia in water?
9. Draw a particle diagram representing 3 molecules of ammonia dissolved in 6 molecules of water. Indicate on the diagram the intermolecular force mentioned in your answer to question #7. Be sure to draw the proper orientation of the molecules attracted by intermolecular forces.
10. In the automotive product "Heet", methyl alcohol is used as a gas line antifreeze and water remover. Why would water in the gas line be attracted to the methyl alcohol? (Remember the gas line is full of the hydrocarbon gasoline.) Identify the intermolecular force responsible for this attraction.
11. Why does the addition of antifreeze keep your radiator in your car from freezing in cold weather?

County Coroner's Autopsy Report



Name of Deceased: Janette Williams
Sex: Female Approx. Age: 26 Height: 5'6"
Weight: 145 lbs Blood Type: O positive

Known Health Condition

Asthma requiring medication, but otherwise deceased was known to be in good health.

Physical Description of the Body

The body of the deceased had blood pooling beneath the skin of the right hip and back of the head, supporting a hard fall to the floor. Red scratch marks were evident on her throat. Skin cells were found under the fingernails of her right hand. The throat area was swollen and red. The eyes showed signs of severe irritation with excess redness and tearing. Nostrils evidenced signs of extreme rhinorrhea, i.e., runny nose.

Autopsy Report

There was no trauma to the esophagus or stomach, indicating no ingestion of a toxic substance. The heart and surrounding blood vessels collapsed due to hypotension (low blood pressure). Some signs of necrosis (holes) in the cell layers inside of the nose and lungs. Trachea severely burned. Impaired Respiratory System, marked by lung damage. Pulmonary Edema was found in lungs, evidenced by accumulations of fluid and swelling.

Blood Chemistry

Acidosis of the blood was found, with a lower pH instead of the normal pH of 7.41. Lactic acid concentration in excess of normal was found in the blood and is a sign of inadequate mitochondrial oxygenation, a condition resulting from insufficient oxygen supply. Prescription drugs for the treatment of asthma were detected in the blood.

Conclusive Cause of Death **Asphyxiation caused by Respiratory Failure**

Mucus in lungs caused impaired gas exchange and led to respiratory failure. The asphyxiation was due to a deficient supply of oxygen. The deceased's lungs were already compromised due to her condition of asthma. The irritation of the trachea and lining of the lungs is consistent with a toxic chemical inhalation. Thus death resulted from choking on a poisonous gas.

Signature: _____
Teresa Gonzales

Date: _____
7-29-2006

Forensic Specialist's Report



Analysis of tagged suspicious chemicals found at the site of the death of Janette Williams

- Item #1 Empty unmarked bottle found next to deceased. This was found to be a #1 recyclable plastic made of Polyethylene Terephthalate, or PET. The label on the bottle had been removed. Chemical analysis of the trace remains of liquid in the bottle revealed an aqueous solution of sodium hypochlorite.
- Item #2 The white powder by the kitchen sink was analyzed to be sodium bicarbonate.
- Item #3 Ant Traps contained a mixture of sodium tetraborate pentahydrate and boric acid.
- Item #4 Thick white liquid in bathroom sink was found to be an aqueous suspension of calcium carbonate.
- Item #5 The toilet bowl was found to contain an acidic cleanser, with hydrochloric acid still remaining in the toilet bowl.
- Item #6 The bucket of liquid was analyzed and found to be local tap water.
- Item # 7 The Super Washing Soda found next to the washing machine contained sodium carbonate.
- Item #8 The metal cleaner used on the chrome of the car contained petroleum distillates.
- Item #9 Two automotive products had been recently used by the deceased. The gallon of antifreeze/coolant contained ethylene glycol (1,2-dihydroxy alcohol or 1,2-ethanediol). A small container of gas line antifreeze and water remover was found to contain methyl alcohol (methanol).

Murray Jones

Forensic Specialist Signature: _____

7-29-2006

Date: _____

Task 7:
Final Report from the Chemical Investigators



Date _____

Team Members Names

2. Hypothesize a scenario that created the environmental health issue in the home of Janette Williams.

3. Which hazardous chemical agents do you think lead to the death of Janette Williams.

4. What warning signs are normally displayed on the labels of the chemicals used by Janette Williams, which, if noticed, could have prevented this incident?



5. Recommendations of Chemical Investigation Team for future consumers.

For Your Information:

Household chemicals account for approximately 50% annually of all instances of reported poisonings. The majority of these poisonings occur to children under 6 years of age.

The Top Ten Poison Exposures in Children under 5.

1. Cosmetics and Personal Care Products
2. Household Cleaning Products
3. Foreign Bodies and Toys
4. Topical Preparations (ointments, creams, gels, and lotions)
5. Analgesics (pain relievers)
6. Plants
7. Cold and Cough Medications
8. Arts / Crafts / Office Supplies
9. Vitamins
10. Pesticides

Reprinted from:

<http://www.maripoisoncenter.com/education/materials/Top%20Ten%2012.2.04.pdf>

Factual Data #1:

Five-year cumulative data (1988-1992) from the American Association of Poison Controls Centers' National Data Collection System revealed 27,788 exposures to chlorine. Of these exposures, the outcome was categorized in 21,437 cases; 40 resulted in a major effect, 2091 resulted in a moderate effect, 17,024 resulted in a minor effect, and 2099 had no effect. Three fatalities occurred.

Reprinted from: <http://www.emedicine.com/emerg/topic851.htm>

Factual Data #2

Following Hurricane Katrina, many residents of South Louisiana returned home to find that their water-damaged properties would require cleaning and disinfecting. Hence, there was a concern about health effects resulting from exposure to bleach mixtures. Over a six-month period, sixty-five individuals statewide called health authorities to report health concerns resulting from exposure to a bleach/ammonia or bleach/acid mixture. The most commonly reported symptoms included cough/choke, throat irritation and shortness of breath. Most of the reported cases (74%) required no hospitalization.

Reprinted from: <http://www.dhh.louisiana.gov/offices/publications/pubs-205/marapr06DontMixWithBleach.pdf>

Teacher Information

Home Sweet Home? The Mysterious Death of Janette Williams



For Teacher Information only! Do not reveal the solution to students. Let them discover this.

Mysterious Death Solved (several scenarios possible):

Janette had an unmarked bottle of chlorine bleach in her hands. She was cleaning the toilet with an acidic toilet bowl cleaner, and evidently added some bleach thinking she would better remove any stains. Noxious fumes of chlorine gas were generated, and she perhaps ran out of the small bathroom, twisting the bathroom rug as she exited. Janette collapsed on the floor in the middle of the kitchen, dropping the unmarked bottle of bleach. The toilet bowl still had excess acid in it from the toilet bowl cleaner. Janette must have gasped for breath and scratched her throat as she lost consciousness.

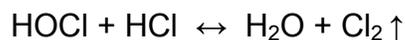
What is the balanced chemical reaction for the dangerous reaction of chlorine bleach and hydrochloric acid, as found in Lysol[®] Toilet Bowl Cleaner?

The main compound in chlorine bleach is “sodium hypochlorite (NaOCl)”. This compound becomes hypochlorous acid (HOCl) by hydrolysis:



Actually the chlorine in the bleach exists as hypochlorous acid. This compound is so oxidative that it has a property of bleaching and sterilization. Gaseous chlorine is generated when hypochlorous acid is mixed with hydrochloric acid. Hydrochloric acid is used in acidic toilet cleaner.

When the hypochlorous acid from the sodium hypochlorite comes into contact with the acidic toilet bowl cleaner, chlorine gas is generated.



Hypochlorous acid also generates gaseous chlorine in the presence of not only hydrochloric acid but also other acids, such as acetic acid (CH₃COOH, vinegar).

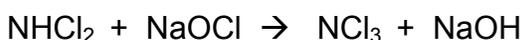
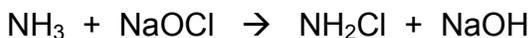


There are other scenarios that are feasible, like using Whink[®] to remove rust stains and bleach to whiten the toilet. This too would have created the chlorine gas. Lime-A-Way is also an acidic cleaner which would generate chlorine gas when mixed with bleach. Any acidic household chemical would react with bleach to generate chlorine gas.

Another dangerous combination is chlorine bleach and household ammonia, which would generate poisonous fumes of chloramines. These are perhaps even more dangerous, but the scenario does not support this hypothesis. The toilet bowl had excess acidic toilet bowl cleanser used, evidenced by the acidic conditions analyzed by the forensic scientist.

What is the balanced chemical equation for the volatile reaction of chlorine bleach and ammonia?

The reactions are:



Nitrogen trichloride is a yellow oil: m.p.= -40 C; b.p. = 71 C

NCl_3 is very toxic as are all the other nitrogen hydrochlorides.

NCl_3 is explosive when exposed to sunlight.

Moral of the Story

1. Do not mix chlorine bleach with any other household cleaners.
2. Read the labels of household products.
3. Never transfer chemicals into unmarked containers.

Learning Context

Subject Area(s): Chemistry (also applicable to Biology) Grades 9-12

Overall Purpose: Students will investigate the safe use of hazardous household products.

Learning Objectives: Students will...

- Classify household products as hazardous or non-hazardous
- Identify hazardous substances in household products
- Explain the requirements in the precautionary statements found on household product labels
- Interpret results from chemical and medical analyses to analyze the toxic substance involved in a death
- Evaluate risks and benefits associated with the use of household products

Prerequisite Knowledge and Skills: Students should have...

- Knowledge of chemical structure
- Write empirical and structural formulas
- Skill to write compounds when given their name
- Knowledge of classes of compounds based on bonding

- Knowledge of classes of organic compounds
- Knowledge of classification of acids and bases

Note to teacher; the only essential topic to be discussed before this activity is writing, naming, and classifying chemicals. If bonding, organic chemistry, or acids and bases are not yet taught, the students will still be successful with the lesson. However, the Teacher will need to remove some of the questions on Task 5.

Procedure

Classroom Timeline (40 minute class periods):

Day 1

- Give Pretest (10 min.)
- Introduce mystery and read Police Report (10 min.)
- Task 1: Process Official Police Report (5 min.)
- Task 2: Background information about the toxicity of household chemical products (Individuals review one of the four topics to learn) (15 min.)

Day 2

- Jigsaw sharing of information for Topics 1-4 (15 min.)
- Task 3; Check for Understanding (10 min.)
- Task 4: Learn More About Household Product Labels (5 min)
- Task 5: Record information from household product labels (10 min.)

Day 3

- Continue and finish Task 5: Recording information from household product labels. Answer questions for Task 5 (20 min)
- Task 6: Evaluate Information from household product labels (15 min)
- Class discussion as to what we now know. (5 min.)

Day 4

- Read Coroner's Report (5 min.)
- Read Forensic Specialist's Report (5 min.)
- Team analysis of death of Janette Williams (15 min.)
- Task 7: Write Final Report from the Chemical Investigators (15 min.)

Day 5

- Give presentations (optional) (30 min)
- Post-test (10 min)

Equipment and Supplies:

Copies to make;

You will need one copy of Topic #1, Topic #2, Topic #3, and Topic #4 for each team of students. You will need one copy of all of the other handouts for each student. See specifics in the Day by Day Instructions below.

Note; Student handouts need to be given out incrementally on each day. The final handouts will give away the solution to the mystery.

Day 1 handouts:

- Pretest
- Police Report
- Task 1; Process Official Police Report
- Task 2; Background information about the toxicity of household chemical products

Day 2 handouts:

- Task 3; Check For Understanding
- Task 4; Learn More About Household Product Labels
- Task 5; Record information from household product labels

Day 3 handouts:

- Task 6; Evaluate Information from household product labels

Day 4 Handouts:

- Coroner's Report
- Forensic Specialist's Report
- Task 7; Final Report from the Chemical Investigators

Day 5 Handouts:

- For Your Information
- Post-test

The teacher could bring in a variety of household products. Be sure to include ammonia solution, an acidic toilet bowl cleaner, and bleach. See the chart below for suggested products. This activity could be introduced in class with only a few products present. The rest of the labels could be interpreted at home with authentic products in the home of the student.

Alternative option: use the labels from the 34 suggested household products typed and presented in Appendix B.

Chart of suggested household products.

The chart below shows abbreviated labels from the 34 suggested household products. These particular household products contain a variety of hazardous chemicals. The names of these chemicals should be recognizable to first year chemistry students. An asterisk before the product name (*) indicates that the product is listed in the Household Products Data Base at the National Institutes of Health, National Library of Medicine website <http://householdproducts.nlm.nih.gov/index.htm>

Product Name	Signal Word	Ingredients
Products likely to be found in the Garage or Basement		
*WD 40 [®]	Danger	Petroleum Distillates
Heet [®]	Danger	Methyl alcohol
Goop [®]	Non-hazardous	Water, isoparafins
*Prestone [®] Antifreeze	Warning	Ethylene glycol
Pic [®] Ant Control Systems	Caution	Sodium Tetraborate Pentahydrate
*Brasso [®] Metal Polish	Danger	Petroleum Distillates and Silica
Mr. Metal [®]	non-hazardous?	ammonia
Whink [®] Rust Stain Remover	Danger	Hydrofluoric acid
Products likely to be found in the Kitchen		
Lysol [®]	Warning, Flammable	ethanol
*Lime-A -Way [®]	Danger	Sulfamic acid
*Windex [®] MultiTask with Vinegar	Non-hazardous	Vinegar and water (not written on label)
*Easy Off [®] Heavy Duty Oven Cleaner	Danger	Sodium hydroxide (lye)
*Parsons [®] Ammonia	Caution	Ammonium hydroxide
Ivory [®] Dishwashing Liquid	Non-hazardous	Biodegradable surfactants (anionic and nonionic)
Fit [®] Fruit and Vegetable Wash	Non-hazardous	Water, glycerol, ethyl alcohol
*Windex [®] Original with Ammonia-D	Non-hazardous	Ammonia and water (not written on label)
Fruit Fresh [®]	Non-hazardous	Dextrose, ascorbic acid, silicon dioxide, citric acid
Arm and Hammer [®] Pure Baking Soda	Non-hazardous	Sodium bicarbonate
Dial [®] Hand Sanitizer	Non-hazardous	Ethyl alcohol
*Goo Gone [®]	Danger	Petroleum distillates
Cascade [®]	Caution	Sodium carbonate, sodium silicate
*Soft Scrub [®]	Caution	Calcium carbonate and detergents

Product Name	Signal Word	Ingredients
Products likely to be found in the Laundry		
ENOZ [®] Moth Balls	Warning	Naphthalene
*Arm and Hammer [®] Super Washing Soda	Caution	Sodium Carbonate
RIT [®] White Wash	Caution	Sodium Hydrosulfite Sodium carbonate anhydrous
*Clorox [®] Regular Bleach	Danger	Sodium hypochlorite
*Clorox [®] Oxi Magic	Caution	Hydrogen peroxide
*Bounce [®] Fabric Softener	Non-hazardous	biodegradable cationic softeners isopropyl alcohol
Products likely to be found in the Bathroom		
Pure and Natural [®] Bath Bar	Non-hazardous	Soap
*Lysol [®] Power Toilet Bowl Cleaner	Danger	Hydrochloric acid
*Draino [®] Clog Remover	Danger	Sodium hydroxide sodium hypochlorite sodium silicate
Crest [®] toothpaste	Warning	Sodium fluoride
Sani Flush [®]	Danger	Sodium bisulfate
Lysol [®] Basin Tub and Tile Cleaner	Caution	Octyl decyl dimethyl ammonium chloride

Detailed Instructions for Implementing the Activity

Day 1

1. Give Pretest
2. Group students in cooperative learning teams called Teams of Chemical Investigators. Four students per team is optimal for this activity. Reinforce expectations for Team work.
3. Introduce the activity as a mystery that the students will solve as Chemical Investigators.
4. Introduce yourself as the Chief Chemical Investigator, and the class as the Association of High School Chemical Investigators.
5. Provide the following handouts for every student:
 - **Request for Assistance**
 - **Your responsibilities as a Chemical Investigator**
 - **Official Police Report (3 pages)**
 - **Task 1: Process Official Police Report**
 - **Task 2: Research Background Information About Household Chemical Products.**

6. Read out loud the Request for Assistance by Forensic Specialist Murray Jones.
7. Review responsibilities of Chemical Investigators.
8. Read the Official Police Report. Assign reading parts to different students.
9. Do **Task 1: Process Official Police Report** in teams; Have individual teams process the Police Report.
10. Introduce **Task 2: Research Background Information About Chemical Products**.
11. Do Task 2 as jigsaw activity. See appendix A for information on the Jigsaw strategy. Provide **Topic #1, Topic #2, Topic #3, and Topic #4** Background Information, as one packet per team. The team will choose which student researches which of the Topics 1-4. You might place the materials for each Topic in the four corners of the room and allow students to move to the corner where other students from other teams will be studying the same Topic. Copying each topic on a different color of paper will make distribution easier.

Alternative option: Instead of providing students with the handouts, provide time for the students to do their own Internet research using these designated websites:

TOPIC #1

What is Toxicology? What does toxicology have to do with Janette Williams?

<http://www.niehs.nih.gov/external/faq/clean.htm>

<http://www.epa.gov/kidshometour/toxic.htm>

http://www.msmr.org/LAB_Notes_Toxicology.pdf

(selected parts dealing with toxicology only)

TOPIC #2

How can a household product be harmful?

(Exposure, Routes of Entry, and Dose-Response)

<http://www.niehs.nih.gov/external/faq/clean.htm>

<http://www.epa.gov/kidshometour/exposure.htm>

<http://www.epa.gov/kidshometour/accident.htm>

http://www.msmr.org/LAB_Notes_Toxicology.pdf

(selected parts dealing with exposure and routes of entry only)

TOPIC #3

What information is found on the label of household products?

<http://www.epa.gov/kidshometour/labels.htm>

<http://pasture.ecn.purdue.edu/~epados/waste/src/readhaz.htm>

http://www.euphoricorganics.com/taking_action/green_clean_hazard_label.html

TOPIC #4

Are household chemical products good or bad for us?

(Risk / Benefit Assessment)

http://www.msmr.org/LAB_Notes_Toxicology.pdf

(selected parts dealing with risk/benefit or risk assessment only)

http://www.euphoricorganics.com/taking_action/green_clean_hazard.html

<http://pmep.cce.cornell.edu/issues/risk-fifra-891.html>

Day 2

1. Students start the day in their Teams with the sharing of information from the 4 Topics. (See Appendix A for Jigsaw strategies)
2. Provide copies of handouts to each student:
 - **Task 3: Check for Understanding**
 - **Certification Questions for Task 3**
 - **Task 4: Learn More About Household Product Labels** (3 pages)
 - **Task 5: Record information from Household Product Labels** (3 pages)
3. Do Task 3 in teams; Check for understanding one of two ways;
 - Orally ask one question of each student in each team. Do not ask a question concerning the research they personally did.
 - Give all the students on each team a printed handout of the questions, and give time to answer in class.
4. Do Task 4 in teams; Learning More about Household Product Labels. Read the handout and discuss in teams. This could be done for homework, with additional internet sources provided.
5. Bring household products that you collected at your home into the classroom. Explain to students that this investigation will focus on household (and garage) cleaning products, and will not consider pesticides, prescriptions, and over-the-counter medications.
6. Do Task 5 individually; Recording Information from Household Product Labels. This task will require you to move actively among the students and give assistance as the Chief Chemical Investigator. This step could be started in class and finished for homework using the products in the student's homes.

Day 3

1. Finish Task 5 by answering questions. (Note; the appropriateness of these questions depends on the content covered in your class. The teacher may want to select only the questions for Task 5 that are relevant to the sequence taught in the course.)
2. Provide copies of **Task 6: Evaluation Information from Household Product Labels** (two pages) to each student.
3. Do Task 6 in teams; Evaluate Information from household product labels
4. Class discussion as to what we now know

Day 4

1. Provide handouts to each student:
 - **County Coroners' Autopsy Report** (two pages)
 - **Task 7: Final Report from the Chemical Investigators** (two pages)
2. Read the Coroner's Report, either out loud to the class or individually in teams.
3. Read the Forensic Specialist's Report either out loud or individually in teams.
4. Do Task 7 (in teams); Final Report form Chemical Investigators.

Day 5 +

1. (Optional) Oral presentations by each team.
2. Provide a copy of **For Your Information** to students
3. Give Post-Test

Many extension of this lesson are possible, and some ideas for further investigations are listed in the Teachers Notes.

Sample Answers for Student Handouts

Task 1: Process Official Police Report

1. In your research group, list what you currently know about the death of Janette Williams.

She was healthy prior to death.

She was in immediate contact with a lot of different chemicals.

She died quickly so that she could not phone 911.

The rumpled rug suggests that Jane tripped or was moving fast through the doorway.

Janette worked on her own car.

Janette was a gardener, involved with fertilizers and pesticides.

Many other statements taken from the reading.

Be careful about quick conclusions.

Keep to the facts!

2. Brainstorm specific conditions in the home of Janette Williams that might lead to the death of a healthy person.

Janette could have been electrocuted (vacuum cleaner out).

Janette could have been exposed to toxic chemicals.

A chemical could have brought on a deadly asthma attack.

Many other statements taken from the reading.

3. What information do you need to continue your investigation?

What specific chemicals were in use at the time of death?

What are the ingredients of those household products?

Which ingredients might be toxic?

What asthma medicine was Janette taking?

Could this medicine interact with chemicals in the home?

What does the autopsy report say about Janette's physiology at the time of death?

Sample Answers for Student Handouts

Certification Questions for Task 3

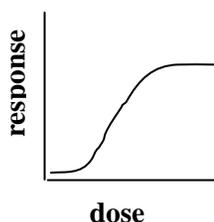
Toxicology

1. What is meant by toxicology? Toxicology is the study of the qualitative and quantitative effects of chemicals on living systems.
2. Give an example of the saying "the dose makes the poison". In other words, what is a substance that is beneficial in certain quantities but harmful in larger quantities?
NaCl, Vitamin D, carrots
3. What does it mean that the LD₅₀ of botulinus toxin is 0.00001 mg/kg?
50 % of the exposed population would die if a dose of 0.00001 mg/kg was administered.
4. Name several factors that determine the level of toxicity?
Dose, concentration, chemical properties, frequency of exposure, length of exposure, exposure pathway, age and sex of individual are all factors that contribute to toxicity.
5. How is the study of toxicology related to the death of Janette Williams?
The chemical environment because of her cleaning might have caused her death. This would be both a qualitative and a quantitative response.

Exposure, Routes of Entry, and Dose-Response

6. What are three routes for exposure to a chemical?
Skin (dermal), Lung (inhalation), Oral (gut)
7. What other factors determine the response to exposure of a chemical?
How and where, how long, how much, how strong or toxic?
8. Do you think all routes of exposure are equivalent for a specific toxin? Explain.
The lung is the quickest route of a toxin into the blood stream, where it will travel to all other parts of the body. But the nature of the toxin will determine the most probable route of exposure. For example, elemental mercury on your skin or ingested is not as toxic as mercury in a compound being ingested.
9. What is the first thing that you do if...
 - a. You splash a harmful chemical on the skin of your arm? Rinse with water
 - b. A harmful chemical mist irritates your eyes? Rinse sufficiently with water
 - c. The smell of a noxious gas makes you feel dizzy? Get away from the gas immediately

10. Sketch the shape of a dose-response curve. What does this shape imply?



Household Product Labels

11. Name and rank the 4 signal words found on labels of hazardous household products?
Most severe... DANGER.....WARNING.....CAUTIONleast severe

12. What term describes the property of a hazardous substance if it can
- destroy human tissue by means of a chemical reaction and severely burn skin or eyes? Corrosive
 - harm human tissue only after repeated exposure? Sensitizer
 - harm human tissue after one or more exposures but the damage is reversible and tissue can be restored? Irritant
 - readily undergo combustion? Flammable
 - explode if heated? Generates Pressure
 - Cause long term negative effects in humans? Toxic

13. What symbol can you design for a product that contains a strong sensitizer?
Student's choice for answer

Risk/Benefit Assessment

14. Explain the concept of Risk-Benefit assessment.

We make choices that involve thinking through the relative potential harm versus the potential good that could come by our decision. Use of chemicals in our lives involves this assessment.

15. Give an example of a decision relevant to your life involving risks and benefits.

Drinking cow's milk has many beneficial vitamins and minerals. However, the hormones given to cows that get into the milk have been shown to promote an early onset of puberty.

16. Give an example of the Risk-Benefit assessment for a household product of your choice. Explain both the risk and the benefit of the household product.

Household Product;	Bleach, Sodium hypochlorite
Risks;	Strong corrosive- burns eyes, skin and lungs. Causes respiratory tract damage. May cause pulmonary edema if ingested
Benefits;	Kills germs Whitens dirty laundry

Sample Answers for Student Handouts

Task 5:

Questions to answer concerning the chemicals identified on household labels

1. Write the names and formulas of any organic compounds.

Methanol or methyl alcohol CH_3OH
ethylene glycol $\text{CH}_2\text{OHCH}_2\text{OH}$
ethanol or ethyl alcohol $\text{CH}_3\text{CH}_2\text{OH}$
glycerol or glycerin $\text{CH}_2\text{OHCHOHCH}_2\text{OH}$
isopropyl alcohol $\text{CH}_3\text{CHOHCH}_3$

2. Write the names and empirical formulas of any ionic compound.

Sodium terra borate pentahydrate $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$
Sodium hydroxide NaOH
Sodium bicarbonate NaHCO_3
Sodium carbonate Na_2CO_3
Sodium silicate or waterglass Na_2SiO_3
Calcium carbonate CaCO_3
Sodium hydrosulfite NaHSO_3
Sodium hypochlorite NaOCl
Sodium fluoride NaF
Sodium bisulfate NaHSO_4

3. Write the names and structural formulas of polar covalent compounds.

Water H_2O
Ammonia NH_3 or ammonium hydroxide NH_4OH
Hydrofluoric acid HF
Vinegar $\text{HC}_2\text{H}_3\text{O}_2$
Dextrose $\text{C}_6\text{H}_{12}\text{O}_6$
Ascorbic acid $\text{C}_6\text{H}_8\text{O}_6$
Citric acid $\text{C}_6\text{H}_8\text{O}_7$
Hydrogen peroxide H_2O_2
Hydrochloric acid HCl

4. Write the names and structural formulas of nonpolar covalent compounds.

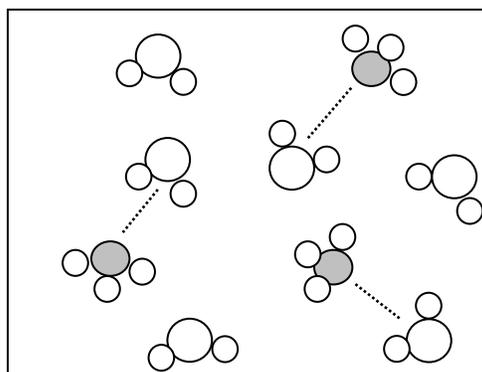
Silica (i.e. silicon dioxide) SiO_2
Naphthalene C_{10}H_8

5. Which active ingredients did you find that could be classified as acids?

Hydrofluoric acid HF
Sulfamic acid H_3NSO_3
Vinegar $\text{HC}_2\text{H}_3\text{O}_2$
Ascorbic acid $\text{C}_6\text{H}_8\text{O}_6$
Citric acid $\text{C}_6\text{H}_8\text{O}_7$
Hydrochloric acid HCl

6. Which active ingredients did you find that could be classified as bases?
 Ammonia or ammonium hydroxide NH_3 or NH_4OH
 Sodium hydroxide NaOH
7. Petroleum distillates are found in several WD40, metal polishes, and "Goo Gone". Petroleum is another name for crude oil. Distillation is a process to physically separate the components of a mixture. What is the physical property of these components on which the separation technique is based?
 Boiling points
8. Aqueous ammonia solution is a common cleaning product used to degrease surfaces. What intermolecular force is responsible for the dissolving of ammonia in water?
 Hydrogen bonds
9. Draw a particle diagram representing 3 molecules of ammonia dissolved in 6 molecules of water. Indicate on the diagram the intermolecular force mentioned in your answer to question #7. Be sure to draw the proper orientation of the molecules attracted by intermolecular forces.

Answer



10. In the automotive product "Heet", methyl alcohol is used as a gas line antifreeze and water remover. Why would water in the gas line be attracted to the methyl alcohol? (Remember the gas line is full of the hydrocarbon gasoline.) Identify the intermolecular force responsible for this attraction.
 Water and methanol are both polar molecules, and likes dissolve likes.
 Hydrogen bonds
11. Why does the addition of antifreeze keep your radiator in your car from freezing in cold weather?
 When a solute is added to a solvent, the freezing point of the solvent is lowered. So instead of water freezing at 0°C , the antifreeze-water solution will freeze below 0°C . The more antifreeze you add, the lower the freezing point goes.

Sample Answers for Student Handouts

Task 6: Evaluate Information from Household Product Labels

Each team member has read the labels of 10 household products. Now as a team you will reflect on this information. First discuss each question within your team. Then answer each question individually on your paper.

Questions for Reflection:

1. If the 10 products you evaluated were found in your home, which room of your house would contain the most hazardous substances? What precautions would you take to insure the safety of your family?

The room with the most hazardous products is probably the kitchen or bathroom, depending on individual practices of storage of chemicals. Student responses will vary.

2. Which signal word was most commonly found? Which description of hazardous properties was most commonly found? What does this suggest?

Danger... Poison

This suggests that many of the chemicals are in the highest risk category.

3. Consider the signal words used on labels. Design a symbol that could be used as an icon for each signal word.

Danger / Poison

Warning

Caution.

Student art work will vary..

4. Which products refer to specific warnings for children? Why do you think this warning is added?

Responses will vary. Children are more at risk with toxic chemicals because of their small size.

5. Consider the hazardous substance that generates a gas when decomposed or heated. Explain, in terms of kinetic molecular theory, why this is a risk.

When a gas is generated in a sealed container, the pressure increases until an explosion occurs. This is because a gas occupies almost 1000 times more volume than a liquid or solid.

6. Why do manufacturers use such small print when the warning is required to protect consumers?

Manufacturers are intent on selling their product, not creating an environment of fear of contaminants.

7. If a household substance is used incorrectly, do you think the manufacturer should be held responsible for the consequences? Give reasons for your perspective.

Answers will vary.

Sample Answers for Student Handouts

Task 7: Final Report from the Chemical Investigators

Team Members Names

1. Hypothesize a scenario that created the environmental health issue in the home of Jane Smith.

Jane was cleaning up a storm. For some reason she had bleach poured into a water bottle. The toilet already had an acidic toilet bowl cleanser in it. Perhaps when Jane saw the brown stains, the idea of bleach occurred to her. The chlorine gas generated from the combination of bleach and acid would cause Jane to quickly leave the small, closed up bathroom. Perhaps in her haste she twisted the rug in the hall. Jane might have had immediate respiratory failure because she did not even have time to call 911.

2. Which hazardous chemical agents do you think lead to the death of Jane Smith. Somehow, while cleaning the bathroom, the two chemicals mixed, which generated the toxic gas, chlorine. Perhaps Jane was trying to get those brown stains out of the toilet. Mixing the acidic toilet bowl cleaner and the whitening power of the bleach almost sounds good.....until one reads the specific caution of the back of the bleach bottle. Jane did not have this warning available because she was storing bleach in a unmarked bottle.

3. What warning signs are normally displayed on the labels of the chemicals used by Jane Smith, which, if noticed, could have prevented this incident?

The bleach bottle would have a precautionary statement similar to this (written exactly as found on the bottle):

PRECAUTIONARY STATEMENTS: HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER: CORROSIVE

May cause severe irritation or damage to eyes and skin. Harmful if swallowed. Protect eyes when handling. For prolonged use, wear gloves. Wash after contact with product. Avoid breathing vapors and use only in a well-ventilated areas.

Do Not use or mix with other household chemicals, such as toilet bowl cleaners, rust removers, acids, or products containing ammonia. To do so will release hazardous, irritating gases.

4. Recommendations of Chemical Investigation Team for future consumers.

Read the label.

Do not pour any chemical into an unmarked container.

Follow the precautions cited on the label.

Assessment Plan

Formative Assessment:

See Task 3, Task 5, and Task 6

Pre-test and Post-test Questions:

A 10 question pre-test and post-test is provided.

Alternative Summative Assessment Options:

The oral presentations could be expanded to become a summative assessment

Possible Extensions for Students

1. Design Your Own Toxicology Lab. Choose a household chemical and create a dilution series that you predict will influence a response in your organism. Consider using daphnia (bottled spring water works the best, avoid distilled or tap water), any fast growing seed (like radish or lettuce), brine shrimp (ask a fish store), or California black worms (ask a bait shop). Students can design the experiment, determining the independent variable, the dependent variable, and the controlled variables. Students will determine how they will measure a response to the dose used with the organism.
2. Learn more about MSDS. Possible website for students to use include;
<http://hazcom.elearning.dol.gov/HazCom/Lesson05/> An interactive lesson by the Mine Safety and Health Administration.
http://www.nasaexplores.com/show_912_teacher_st.php?id=030108104806
and http://media.nasaexplores.com/lessons/01-041/9-12_1.pdf
These two sites include teacher lesson plans and students lessons on MSDS. The site is on the NASA Explores website. The site is visually appealing and interactive, geared for students 9-12 grades.
3. Investigate the pH's of various household chemicals Then do a serial dilution of an acidic and a basic household product and measure pH changes using pH paper, pH meters or universal indicator.
4. Use the website <http://householdproducts.nlm.nih.gov/> to investigate specific household products and the chemicals that are contained. MSDS sheets are included on site. This household products database is sponsored by the National Library of Medicine with the National Institute of Health. At this site you can browse by product name, ingredients, or MSDS.

5. Use different ratios of antifreeze and water to investigate freezing point depression and boiling point elevation. This can be easily done using the antifreeze testers. This is a syringe that contains 5 colored plastic balls that float at different densities of the antifreeze solution. The number of balls floating indicates the antifreeze level of protection for your car. The syringe actually has the freezing and boiling points for the various proportions of aqueous ethylene glycol solutions. No actual freezing necessary due to the plastic balls indicating densities and hence relative concentrations.
6. Research possible "Healthy Cleaning Alternatives" in conjunction with a Green Chemistry Theme. The goal is to use chemicals that do no harm for human use and do no harm when disposed in the environment.
7. Explore the actual chemistry of household products. Find and explain the following reactions:
 - bleach with ammonia
 - bleach with acids
 - Oven cleaners containing NaOH
 - Oxi Magic with H_2O_2
 - Drano with NaOH
 - Dial Hand Sanitizer with ethyl alcohol
 - Rust Remover containing HF
 - Any other household product
8. The students could conduct a home survey of household products. They could create a chart to record the data they find most important. Suggestions could be made at home to reduce the risk of toxic exposure. Categories of Household Products could be the room the products are stored in, or the application of the home product, such as automotive products and personal care products.

Resources

Cited Sources, Teacher Background Resources, and Suggested Student Resources

These websites are helpful for providing background information or extensions for teachers or students.

Environmental Health Sciences in General

<http://www.niehs.nih.gov/> Website for the National Institute for Environmental Health Sciences at the National Institutes of Health. You will find the selection “Environmental Health Info” and then “Environmental Health Sciences Education” useful.

<http://www.nlm.nih.gov/> National Library of Medicine with the National Institute of Health provides a vast selection of Resources. Select Environmental Health and Toxicology and then continue to explore.

<http://sis.nlm.nih.gov/enviro.html> National Library of Medicine’s portal for Environmental Health and Technology

<http://www.epa.gov/> Website of the United States Environmental Protection Agency. Educational Resources available.

Household Chemicals

<http://householdproducts.nlm.nih.gov/> Website providing a household products database, sponsored by the National Library of Medicine with the National Institutes of Health. You can search household chemicals by product name or ingredients.

<http://www.clevelandclinic.org/health/health-info/docs/3300/3354.asp?index=11397> A flyer printed by The Cleveland Clinic Health Information Center entitled, Household Chemicals; What’s In My House? Lists potentially dangerous chemicals found in every room of your house, and suggests safety tips.

<http://www.clevelandclinic.org/health/health-info/docs/3300/3353.asp?index=11398> Household chemicals chart listing products and hazardous ingredients for the flyer What’s In My House?

<http://www.clevelandclinic.org/health/health-info/docs/3300/3352.asp?index=11396> Household Chemicals; The Basics, discusses meaning of toxic substance and signal words on labels.

<http://www.epa.gov/kidshometour/> Kid-friendly and interactive site for learning about household chemicals. You can go room to room through a house and click on household hazards. Puzzles and test questions included. Sponsored by the EPA

<http://www.purdue.edu/dp/envirosoft/housewaste/house/mainmenu.htm> Hazardous Products in the Home, with an interactive virtual house, a list of products found in the home, and a very useful glossary of products with hazards from A to Z.

<http://www.checnet.org/healthhouse/virtualhouse/index.asp> Children's Health Environmental Coalition, an interactive virtual house that kids can navigate for toxic household products.

http://www.pueblo.gsa.gov/cic_text/housing/cleansafe/cleansafe.htm Site discusses being Clean and Safe in the 21st Century. Labels are explained. Site provides information, facts, and strategies about using household cleaning products effectively and safely.

Toxicology in General

<http://toxtown.nlm.nih.gov/> National Library of Medicine's interactive website for Environmental Health concerns and toxic chemicals where you live, work, and play.

<http://www.aapcc.org/> American Association of Poison Control Centers. Follow the link to Poisoning Data - TESS (Toxic Exposure Surveillance System). Click Annual Reports. This report is a demographic profile of exposure cases by generic category of substances and products. Here you can find how many people were injured or killed in 2004 by misuse of various substances.

<http://sis.nlm.nih.gov/enviro/toxtutor.html> National Library of Medicine site that has three tutorial lessons on toxicology

http://www.msrmr.org/LAB_Notes_Toxicology.pdf

Massachusetts Society for Medical Research has a great handout on toxicology in general. This handout can be ordered

Toxicology Labs

<http://ei.cornell.edu/toxicology/bioassays/> A Cornell University site dedicated to environmental inquiry and authentic scientific research for High School students. Site contains excellent ideas for inquiry labs in toxicology. See Research Challenges.

http://www.toxicology.org/AI/FA/toxenrich_dose.pdf Find the Toxic Dose Lab from SOT, Society of Toxicology.

<http://coep.pharmacy.arizona.edu/> Southwest Environmental Health Sciences Center maintains this site with great lesson ideas. Click on to Lesson Plans and Activities, then check out Basic Tox Labs or California Blackworms.

Information on Labels on Household Chemicals

<http://www.epa.gov/opptintr/labeling/pubs/rtlf/home.pdf> Flyer; Read the Label First! Protect Your Household, published by the Environmental Protection Agency and available for free with request. Order flyer online at www.epa.gov/nscep, National Service Center for Environmental Publications, document 740F00004, phone 1-800-490-9198. Also ask about Document 735E04002, Use Household Pesticides and Chemicals Safely: Read The Label First! (Bookmark with magnifying Fresnel lens), and Document 735F02015, Why Read Labels?.

http://www.euphoricorganics.com/taking_action/green_clean_hazard_label.html

Labeled and Unlabeled Household Products, Links to A Dozen Hazardous Household Chemicals.

<http://pasture.ecn.purdue.edu/~epados/waste/src/readhaz.htm> Purdue University website with good label reading ideas

<http://www.terrificscience.org/healthrich/pdf/10-14/SafetyInfo.pdf#search=%22signal%20words%20poison%22> Terrific Science has a flyer on “Stop, Read, and Heed” the labels found on household products.

Risk Assessment and Risk/Benefit

http://www.msmr.org/LAB_Notes_Toxicology.pdf See sections on Risk/Benefit

<http://pmep.cce.cornell.edu/issues/risk-fifra-891.html> This is a Cornell University website for describing the four steps in EPA's risk assessment process: hazard identification, dose/response assessment, exposure assessment, and risk characterization.

<http://www.toxicology.org/AI/News/news-riskassess.asp> Society of Toxicology website on “Risk Assessment: What’s It All About?”

Chemistry and Biology of Chlorine Gas and Chloramines

http://www.science-education.org/classroom_activities/chlorine_compound/chloramines.html
Chemistry of forming chloramines which are produced from bleach reacting with ammonia

http://www.chemistryquestion.com/English/Questions/ChemistryInDailyLife/3c_bleach_cleaner.html chemistry behind mixing bleach and acid

<http://www.newton.dep.anl.gov/askasci/chem00/chem00776.htm> Ask A Scientist Archive with correct equations for mixing bleach and ammonia

New York State Learning Standards and Performance Indicators

Standard 4

III. Moles/Stoichiometry

- III.1 A compound is a substance composed of two or more different elements that are chemically combined in a fixed proportion. A chemical compound can be broken down by chemical means. A chemical compound can be represented by a specific chemical formula and assigned a name based on the IUPAC system. (3.1cc)
- III.2 Types of chemical formulas include empirical, molecular and structural. (3.1ee)
- III.3 The empirical formula of a compound is the simplest whole-number ratio of atoms of the elements in a compound. It may be different from the molecular formula, which is the actual ratio of atoms in a molecule of that compound. (33.d)

IV. Chemical Bonding

- IV.2 Two major categories of compounds are ionic and molecular (covalent) compounds. (5.2g)
- IV.13 Metals tend to react with nonmetals to form ionic compounds. Nonmetals tend to react with other nonmetals to form molecular (covalent) compounds. Ionic compounds containing polyatomic ions have both ionic and covalent bonding. (5.2h)

V. Physical Behavior of Matter

- V.1 Matter is classified as a pure substance or as a mixture of substances. (3.1q)
- V.3 A pure substance (element or compound) has a constant composition and constant properties throughout a given sample, and from sample to sample. (3.1r)
- V.5 Mixtures are composed of two or more different substances that can be separated by physical means. When different substances are mixed together, a homogeneous or heterogeneous mixture is formed. (3.1s)
- V.8 A solution is a homogeneous mixture of solute dissolved in a solvent. The solubility of a solute in a given amount of solvent is dependent on the temperature, the pressure, and the chemical natures of the solute and solvent. (3.1oo)
- V.17 Kinetic molecular theory describes the relationships of pressure, volume, temperature, velocity, and frequency among gas molecules. (3.4c)

VII. Organic Chemistry

- VII.1 Organic compounds contain carbon atoms which bond to one another in chain, rings, and networks to form a variety of structures. Organic compounds can be named using the IUPAC system. (3.1ff)
- VII.3 Organic acids, alcohols, esters, aldehyde, ketones, ethers, halides, amines, and amino acids are categories of organic molecules that differ in their structures. Functional groups impart distinctive physical and chemical properties to organic compounds. (3.1hh)

Appendix A

Jigsaw

Jigsaw is most effective for learning activities that include questions that are challenging, do not have answers that can be found in text books, have multiple answers, are open-ended, require interpretation, and/or encourage students to offer opinions.

Because traditional reviewing for examinations, especially essay exams or Part C questions, can be tedious, *Jigsaw* for review provides an effective alternative. Classes may only need the teacher to provide the review questions. They may be able to take over from there. The teacher can guide the class through the whole review process without uttering a word during the 45-minute period once the class has experience with *Jigsaw*.

To implement this strategy, write five or six good essay questions that cover the material on which the students will be tested. You can use questions you develop yourself, tests from previous years as sources or questions in test banks or resource guides. Make copies for each student. Hand them out at the beginning of class. Break up the class into groups of equal numbers of youngsters. They may self-select. Each group answers a different one of the questions. These are the expert groups. An example is:

1 1	2 2	3 3	4 4
1 1	2 2	3 3	4 4
1 1	2 2	3 3	4 4

A group may use notes, textbooks, review guides, and whatever other sources are available, including you. The group constructs a model answer to the question. All members are responsible for learning that answer. Each will have to teach the answer to other students. During this segment, the teacher monitors the progress of each group. Generally this segment of the period lasts about twenty minutes.

When all groups have completed their answers or after the twenty minutes, students reconfigure groups to form jigsaw groups. One member of each expert group separates from other members of the same group to join one member from each of the other groups. An example is:

1 2	1 2	1 2	1 2	1 2	1 2
3 4	3 4	3 4	3 4	3 4	3 4

In turn, the members of every jigsaw group go over every question and answer. The expert for each question reads that question, answers it and any questions jigsaw group members have.

As the teacher, you circulate as students work in expert groups. You can stay with one group and correct misconceptions for the whole class during jigsaw group time or hop from group to group listening to one or two answers. Try it--you'll like it!

Appendix B

Labels for the 34 Suggested Household Products

The suggested 34 Household Products to be used in this lesson are selected because of the recognizable chemicals used as active ingredients. To purchase all of these chemicals would cost about \$100. Many of these chemicals, or similar products, might be found in your own home. You could consider bringing these into the classroom to give the students the experience of reading real labels. However, even though direct experience with the actual labels would be more authentic, there are situations where making these chemicals available would not be possible.

If you are looking for a way to simplify this learning activity, two chemicals are essential for this mysterious death; bleach and an acidic toilet bowl cleaner. This combination created the chlorine gas poisoning that is described in the Coroner's Report. A basic toilet bowl cleaner could also be used, and the toxic gas generated would then be chloramines.

If the use of real household products is not feasible, Appendix B contains simplified typed labels of the suggested 34 household products.

<p>WD-40®</p> <p>Stops Squeaks Cleans And Protects Loosens Rusted Parts Frees Sticky Mechanisms Drives Out Moisture</p> <p>DANGER: FLAMMABLE. CONTENTS UNDER PRESSURE; HARMFUL OR FATAL IF SWALLOWED.</p> <p>KEEP OUT OF REACH OF CHILDREN. SEE OTHER CAUTIONS ON BACK</p>	<p>DANGER: CONTENTS ARE FLAMMABLE: Keep spray away from heat, sparks, pilot lights, open flames, etc. Unplug electrical tools, motors and appliances before spraying or bringing the can near any source of electricity.</p> <p>BREATHING HAZARD: Use only in a well-ventilated area. So not breathe vapor or spray mist. DELIBERATE OR DIRECT INHALATION OF VAPOR OR SPRAY MIST MAY BE HARMFUL OR FATAL.</p> <p>CONTENTS UNDER PRESSURE: Do not store above 120°F. Do not place can on hot surfaces or in direct sunlight; Heat may cuase can to burst violently. Do not puncture, crush, or incinerate (burn) can, even when empty.</p> <p>CONTAINS PETROLEUM DISTILLATES.</p>
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<p>Multi-Purpose</p> <p>BRASSO®</p> <p>Metal Polish Cleans & Polishes BRASS Plus Pewter Chrome Copper Stainless</p> <p>KEEP OUT OF REACH OF CHILDREN DANGER: HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. EYE AND SKIN IRRITANT. COMBUSTIBLE Read precautions on back</p>	<p>BRASSO Multipurpose METAL POLISH</p> <p>KEEP OUT OF REACH OF CHILDREN DANGER: HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. EYE AND SKIN IRRITANT.</p> <p>DO NOT ingest. DO NOT inhale. DO NOT get in eyes, on skin, or on clothing. Keep away from heat, sparks and open flames. Keep container closed.</p> <p>Contains Petroleum Distillates and Silica.</p>
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<p>Lysol® Disinfectant Spray</p> <p>Kills viruses, bacteria, mold & mildew</p> <p>Kills 99.9% of Germs in 30 seconds Eliminates odors Original scent</p> <p>KEEP OUT OF REACH OF CHILDREN Warning: Read Precautions on First Aid on Back Panel</p> <p>Active Ingredients: Dimethyl Benzyl Ammonium Saccharinate, Ethanol</p>	<p>Disinfects: On environmental surfaces, LYSOL® Brand Disinfectant Spray is tuberculocidal and kills bacteria, viruses and fungi.</p> <p>Precautionary Statements: Hazards to Humans and Domestic Animals. WARNING; Causes eye irritation. Do not spray in eyes, on skin or on clothing. Physical Hazards; FLAMMABLE: Contents under pressure. Keep away from hear, sparks, and open flames. Do not puncture or incinerate container. Exposure to temperatures above 130°F may cause bursting.</p>
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Cleans and Disinfects

CLOROX®

Regular BLEACH

KEEP OUT OF REACH OF CHILDREN

DANGER: CORROSIVE

Active Ingredients:

Sodium Hypochlorite 6.0%

Other Ingredients 94%

CLOROX® REGULAR BLEACH

Precautionary Statements: HAZARDS TO HUMANS AND DOMESTIC ANIMALS.

DANGER: CORROSIVE

May cause severe irritation or damage to eyes and skin. Harmful if swallowed. Protect eyes when handling. For prolonged use, wear gloves. Wash after contact with product. Avoid breathing vapors and use only in a well-ventilated area. Product contains a strong oxidizer. Always flush drains before and after use. If swallowed, call poison control center or doctor for advice.

Do not use or mix with other household chemicals, such as toilet bowl cleaners, rust removers, acids, or products containing ammonia. To do so will release hazardous, irritating gases. Prolonged contact with metal may cause pitting and discoloration.

FRUIT AND VEGETABLE WASH

FIT®

100% from Natural sources

Get your fruits
and vegetables cleaner with

FIT®

Removes 98% more chemicals and wax than water alone! Rinses away, leaving the taste nature intended.

DIRECTIONS: Use FIT® on ALL fresh produce.

1. Spray to cover produce
2. Rub for about 20 seconds
3. Rinse under water.

Ingredients: Purified Water, Oleic Acid (from vegetable sources), Glycerol (from vegetable sources), Ethyl Alcohol (from corn), Potassium Hydrate (from Basic Minerals), Baking Soda (from Basic Minerals), Citric Acid (from Cornstarch and Molasses), and Distilled Grapefruit Oil.

ARM AND HAMMER®

THE STANDARD OF
PURITY

PURE
Baking Soda

For Baking, Cleaning, and Deodorizing

For a Fresher Cleaner Home

Use This Sink-Side Shaker for:

- ✓ Cleaning Down To The Shine!
- ✓ Soaking Away Grime!
- ✓ Cleaning Produce Naturally!

Not For Antacid Use

Pure Baking Soda

Nutrition Facts

Calories 0
Total Fat 0g
Sodium 150 mg
Total Carb. 0g
Protein 0g

INGREDIENT: Sodium Bicarbonate

**Mr.
Metal®**

Cleans, Shines & Protects

ALL METAL

INSTANTLY

No Rubbing – No Buffing

SILVER, BRASS, COPPER, & MORE

**Mr.
Metal®**

Clean, shine, and protect all metal surfaces instantly. Mr. Metal's advanced formula quickly and easily dissolves tarnish on contact. Contains no abrasives, so there is no hard rubbing or buffing. Just wipe on and wipe off.

If product gets in eyes, wash with plenty of water, Keep out of reach of children. **Contains Ammonia.**

<p style="text-align: center;">PLUS SCOPE</p> <p style="text-align: center;">Minty Fresh Liquid Gel</p> <p style="text-align: center;">CREST[®]</p> <p style="text-align: center;">FLUORIDE ANTICAVITY TOOTHPASTE</p>	<p>Drug Facts</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 60%;">Active Ingredient</td> <td style="width: 40%;">Purpose</td> </tr> <tr> <td>Sodium fluoride 0.243%.....</td> <td>Anti-cavity toothpaste</td> </tr> </table> <p>Warnings</p> <p>Keep out of reach of children under 6 years of age. If more than used for brushing is accidentally swallowed, get medical help or contact a Poison Control Center right away.</p> <p>Inactive Ingredients: sorbitol, water, hydrated silica, alcohol (1.4%) sodium lauryl sulfate, trisodium phosphate, flavor, glycerin, cellulose gum, sodium phosphate, sodium saccharin, sodium benzoate, benzoic acid, blue 1, yellow 5</p>	Active Ingredient	Purpose	Sodium fluoride 0.243%.....	Anti-cavity toothpaste
Active Ingredient	Purpose				
Sodium fluoride 0.243%.....	Anti-cavity toothpaste				

<p style="text-align: center;">MULTI-PURPOSE</p> <p style="text-align: center;">GOOP[®]</p> <p style="text-align: center;">HAND CLEANER</p>	<p style="text-align: center;">REMOVES STAINS FROM WASHABLE CLOTHING</p> <p>Goop contains an exclusive SPOT OUT FORMULA not found in any other hand cleaner, detergent, spot remover, or pre-soak.</p> <p>Goop quickly and safely removes grease, paint, ink, tar, industrial soils, etc. from hands and washable clothing.</p> <p>Premium ingredients make it safe for use on children's hands.</p> <p style="text-align: center;">NON-TOXIC • BIODEGRADABLE • AVOID EYE CONTACT •</p> <p>CONTENTS: Isoparaffins, Water, Oleic Acid, Nonoxinol-10, Triethanolamine, Glycerine, BHT</p>
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Whink[®]

RUST STAIN REMOVER

FOR ALL COLORFAST FABRICS
WHITE SINKS AND WHITE TOILET BOWLS

Not a general purpose rust remover. Read
precautions and directions before using.
Do not use this product if you do not
intend to follow the directions.

DANGER: MAY BE FATAL OR CAUSE
PERMANENT DAMAGE. CAUSES SEVERE
BURNS WHICH MAY NOT BE IMMEDIATELY
PAINFUL OR VISIBLE. VAPOR HARMFUL.
CONTAINS HYDROFLUORIC ACID. KEEP OUT
OF REACH OF CHILDREN. Use only with heavy duty
household rubber gloves. Read back panel for additional
precautions and directions.

DANGER – POISON

AVOID CONTACT WITH SKIN OR EYES. SO
NOT TASTE, SWALLOW, OR BREATHE.

ANTIDIOTE: Medical care required.
PHYSICIAN ALERT: Specific antidotal
treatment may be required. Emergency information
– call (800)229-6036.

Windex[®]

Original

Streak-Free Shine!

GAS CLEANER WITH
AMMONIA-D

KEEP OUT OF REACH OF CHILDREN AND PETS.

Note: Unplug electrical appliances before use.
Contains no phosphorous. Not recommended for
use on wood or other varnished surfaces. Spot test
other surfaces before using. Do not use or mix with
other household cleaners.

ENOZ[®]

OLD FASHIONED MOTH BALLS

Kills Clothes Moths, Eggs, and Larva in
Air-Tight Containers and Storage Closets.
This product can treat up to 43.7 cu. Ft.

Active Ingredient: NAPHTHALENE 99.95%
KEEP OUR OF THE REACH OF CHILDREN

WARNING

See back panel for additional precautionary statements

Precautionary Statements:
Hazardous to human and domestic animals.

WARNING: May be fatal if inhaled. Do not breathe vapors. Avoid contact with skin, eyes, or clothing. Remove contaminated clothing and wash clothing before reuse. Harmful if swallowed. Wash thoroughly with soap and water after handling.

PHYSICAL OR CHEMICAL HAZARDS:

Combustible.
Do not use or store near heat or open fire.

Dial[®]

ANTIBACTERIAL

Hand Sanitizer

KILLS 99.99% OF GERMS INSTANTLY!

Light Citrus Scent

Drug Facts

Active Ingredient	Purpose
Ethyl Alcohol 62%.....	Antibacterial

Uses

•hand sanitizer to help reduce bacteria on the skin that may cause disease

<p><i>New Formula</i></p> <p>Rich in Vitamin C</p> <p>Fruit Fresh[®]</p> <p>Produce Protection</p> <p>Stops Browning Protects Flavor</p>	<p><u>Nutritional Facts</u> Serving Size ¼ tsp (1g) Servings Per Container 141</p> <p>Calories 5 Total Fat 0g Sodium 0 mg Total Carbohydrate 1g Protein 0g Vitamin C 230%</p> <hr/> <p>Ingredients: Dextrose, Ascorbic Acid, (Vitamin C) Citric Acid, Silicon Dioxide (Anti-caking).</p>
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<p>40oz VALUE SIZE</p> <p>Sani- Flush[®]</p> <p>TOILET BOWL CLEANER</p> <p>CRYSTALS</p> <p>Dissolves Stains with Bubbling Action</p> <p>KEEP OUT OF REACH OF CHILDREN DANGER: CORROSIVE. Read precautions on back.</p>	<p>SANI-FLUSH[®] Toilet Bowl Cleaner with “blue bubbling action” is specially formulated to dissolve hard water and rust stains to leave your bowl sparkling clean.</p> <p>KEEP OUT OF REACH OF CHILDREN.</p> <p>DANGER: CORROSIVE. MAY CAUSE IRREVERSIBLE EYE DAMAGE. IRRITATING TO SKIN. Avoid contact with eyes, skin, and clothing. Avoid breathing dust. Wash hands with soap and water after handling. DO NOT mix with any other cleansers or chemicals as harmful fumes may result. Store in a dry place away from children. DO NOT reuse empty container. Contains sodium bisulfate.</p>
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<h1 style="margin: 0;">GOO GONE[®]</h1> <p style="margin: 10px 0;">Removes Grease, Gum, Stickers, Crayon, Tape</p> <p style="margin: 10px 0;">Citrus Power</p> <p style="margin: 10px 0;">DANGER: COMBUSTIBLE. HARMFUL IF SWALLOWED. See Back Panel</p>	<p>Citrus Power and Scientific Technology combine to defeat the toughest stains.</p>
	<p>KEEP OUT OF REACH OF CHILDREN Contains petroleum distillates. If swallowed, do not induce vomiting. Call physician immediately. Avoid prolonged contact with skin. Use in well-ventilated area. Do not use near heat, sparks, or flames.</p>

<h2 style="margin: 0;">pure & natural[®]</h2> <p style="margin: 5px 0;">bath bar dermatologist tested</p> <p style="margin: 20px 0;">hypoallergenic</p>	<h2 style="margin: 0;">pure & natural[®]</h2> <p style="margin: 5px 0;">bath bar dermatologist tested hypoallergenic</p> <p style="margin: 10px 0;">Formulated with pure ingredients. Gentle enough for all-family use, even babies.</p> <p style="margin: 10px 0;">INGREDIENTS: SOAP, WATER, GLYCERINE, SORBITOL, SODIUM CHLORIDE, FRAGRANCE, TITANIUM DIOXIDE</p>
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NEW! EASY TWIST OFF CAP!

HEET[®]

Gas-Line Antifreeze and Water Remover

The #1 Brand for

- Fast Cold Weather Starts
- Year-Round Water Removal

DANGER: MAY BE FATAL OR CAUSE BLINDNESS OF SWALLOWED. FLAMMABLE. VAPOR HARMFUL.
Read cautions on back panel.

HEET[®]

Use with gasoling engines. DO NOT use with 2-cycle gasoline or diesel engines; use Iso-HEET instead.

DANGER: POISON. CONTAINS METHYL ALCOHOL. Cannot be made non-poisonous. Avoid contact with eyes and skin. Use only in well-ventilated area. Keep away from heat or open flames.
KEEP OUT OF REACH OF CHILDREN.

Rit[®]

laundry treatment

White-Wash[®]

Stain Remover and Whitener
For Non-Bleachable Whites

CAUTION! EYE IRRITANT. HARMFUL IF SWALLOWED.
Read precautions on back.

Rit[®] White-Wash[®]

For white fabrics only

Safely removes or lightens stains, and whitens non-bleachable white fabrics.

CAUTION! EYE IRRITANT. HARMFUL IF SWALLOWED. Avoid Contact With Eyes. Wash Thoroughly After Handling.

CONTAINS: Sodium Hydrosulfite, Sodium Carbonate Anhydrous. **Do Not Combine With Any Bleach Product. KEEP OUT OF REACH OF CHILDREN**

<p style="text-align: center;">PIC[®]</p> <p style="text-align: center;">KILLS ANTS</p> <p style="text-align: center;">ANT CONTROL SYSTEMS</p> <p>Active Ingredients:</p> <table border="0"> <tr> <td>Sodium Tetraborate Pentahydrate</td> <td style="text-align: right;">5%</td> </tr> <tr> <td>Ortho Boric Acid</td> <td style="text-align: right;">4%</td> </tr> <tr> <td>Inert</td> <td style="text-align: right;">91%</td> </tr> </table> <p>CAUTION KEEP OUT OF REACH OF CHILDREN READ OTHER CAUTIONS ON BACK PANEL</p>	Sodium Tetraborate Pentahydrate	5%	Ortho Boric Acid	4%	Inert	91%	<p style="text-align: center;">Pic[®] ANT CONTROL SYSTEMS</p> <p>PRECAUTIONARY STATEMENTS: Harmful if the content from the inside of this ant cup are swallowed. Wash thoroughly with soap and water after handling the ant cups.</p> <p>CAUTION: Keep out of reach of children and domestic animals.</p> <p>HOW THE SYSTEM WORKS: The ants you see are worker food providers to the Queen Mother and the larvae residing in the nest. The worker ants feed the colony and then themselves. Thus, the entire colony is destroyed.</p>
Sodium Tetraborate Pentahydrate	5%						
Ortho Boric Acid	4%						
Inert	91%						

<p style="text-align: center;">IVORY[®] <i>ULTRA</i></p> <p style="text-align: center;">Concentrated Dishwashing Liquid</p> <p><i>Classic Scent</i></p> <p>MILD ON HANDS. HARD ON GREASE.</p>	<p>Ivory[®] does not remove the natural oils in your skin and is specifically formulated to provide tough grease cleaning.</p> <p>Ultra Ivory[®] contains biodegradable surfactants (anionic and nonionic) Contains no phosphate.</p> <p>Keep out of reach of children. If Ultra Ivory gets in eyes, rinse thoroughly with water. If swallowed drink a glass of water to dilute.</p>
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<p style="text-align: center;">Bounce[®]</p> <p style="text-align: center;">Fabric Softener Sheets</p> <p style="text-align: center;">Free of dyes and perfumes</p>	<p>Usage; Add a new sheet on top of clothes at start of drying. Discard after each dryer cycle.</p> <p>www.BounceEverywhere.com</p> <p>Ingredients: contains biodegradable cationic softeners.</p>
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<p>AMERICA'S #1 OVEN CLEANER!</p> <h1>EASY-OFF®</h1> <h2>HEAVY DUTY ORIGINAL OVEN CLEANER</h2> <p>CUTS THROUGH TOUGH BAKED-ON FOOD AND GREASE</p> <p>KEEP OUT OF REACH OF CHILDREN.</p> <p>DANGER: CAUSES BURNS TO SKIN AND EYES ON CONTACT. HARMFUL IF SWALLOWED. CONTENTS UNDER PRESSURE. READ PRECAUTIONS ON BACK</p>	<h2>EASY-OFF® HEAVY DUTY OVEN CLEANER</h2> <p>Effectively cleans warm or cold ovens! Ideal for cleaning ovens, broilers, barbeque grills, & stainless steel surfaces.</p> <p>READ WARNINGS, PRECAUTIONS AND ENTIRE LABEL BEFORE USE. NOTE: FOLLOW DIRECTIONS ON SAFETY CAP TO REMOVE IT. DO NOT USE KNIFE OR OTHER TOOL TO PRY CAP. DOING SO MAY PUNCTURE CONTAINER.</p> <p>KEEP OUT OF REACH OF CHILDREN.</p> <p>DANGER: Contains sodium hydroxide (LYE). WILL BURN SKIN AND EYES. Avoid contact with skin, eyes, mucous membranes, and clothing. HARMFUL IF SWALLOWED. Do not ingest. AVOID BREATHING SPRAY MIST. WEAR RUBBER GLOVES WHEN USING.</p>
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<p>Mix with ANY COLOR ANTIFREEZE</p> <h1>Prestone®</h1> <p>Trusted quality since 1237</p> <h2>Extended Life Antifreeze / Coolant</h2> <p>UP TO 150,000 mil/5 year protection</p> <p>WARNING: HARMFUL OR FATAL IF SWALLOWED. Read warnings on back label.</p>	<h2>Prestone® Antifreeze / Coolant</h2> <p><i>When disposing of used antifreeze / coolant: Follow local laws and regulations. If required, dispose at facilities licensed to accept household hazardous waste. If permitted, dispose in sanitary sewer systems. Do not discard into storm sewers, septic systems, or onto the ground.</i></p> <p>Warning: Contains ethylene glycol, diethylene glycol, sodium 2-ethyl hexanoate and sodium neodecanoate.</p> <p>Precautionary Measures: Do not drink antifreeze or solution. Do not breathe mist or vapors. Avoid prolonged exposure. Avoid skin and eye contact.</p> <p>Ethylene glycol causes birth defects in laboratory animals. Solution is poisonous to animals. KEEP OUT OF REACH OF CHILDREN.</p>
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<p style="text-align: center;">Lysol® BRAND FOAMING Disinfectant Basin Tub and Tile Cleaner Removes Soap Scum FOAMING ACTION</p> <p>ACTIVE INGREDIENTS octyl decyl dimethyl ammonium chloride 0.050% KEEP OUT OF REACH OF CHILDREN. CAUTION: SEE BACK PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS</p>	<p style="text-align: center;">Lysol® BRAND FOAMING Disinfectant Basin Tub and Tile Cleaner</p> <p>PRECAUTIONARY STATEMENTS: HAZARDS TO HUMANS AND DOMESTIC ANIMALS. CAUTION: MAY CAUSE EYE IRRITATION. AVOID CONTACT WITH EYES OR SKIN. KEEP OUT OF REACH OF CHILDREN.</p> <p>PHYSICAL OR CHEMICAL HAZARDS: Contents under pressure. Do not use or store near heat or open flame Do not puncture or incinerate container. Exposure to temperatures above 120oF or in sun or discarding can in fire or incinerator may cause bursting.</p>
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<p>Powerful Cleaning Plus Shine Shield</p> <p style="text-align: center;">Cascade® Dishwasher Detergent</p> <p>CAUTION: IRRITANT. HARMFUL IF SWALLOWED. MAY IRRITATE EYES OR SKIN. KEEP OUT OF REACH OF CHILDREN.</p>	<p>CAUTION: Do not get in eyes. Do not get on skin or clothing.</p> <p>KEEP OUT OF REACH OF CHILDREN.</p> <p>FIRST AID TREATMENT: Contains sodium carbonate, sodium silicate, and enzymes. If swallowed. Give a glassful of water or milk and call a Poison Center or doctor immediately. Do not induce vomiting. If in eyes, rinse with water for 15 minutes. If on skin, rinse well with water.</p>
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<p>IMPROVES LIQUID LAUNDRY DETERGENT PERFORMANCE UP TO 40%</p> <p>ARM & HAMMER®</p> <p>THE STANDARD OF PURITY</p> <p>All Natural Super Washing Soda</p> <p>DETERGENT BOOSTER AND HOUSEHOLD CLEANER</p> <p>CAUTION: MAY BE HARMFUL IF SWALLOWED. MAY IRRITATE EYES. SEE CAUTIONS ON SIDE PANEL</p>	<p>Super Washing Soda is a natural detergent booster and freshener</p> <p>It works in two ways:</p> <ol style="list-style-type: none"> 1. It increases your detergents cleaning power to get out ground-in dirt and stains and cuts through greasy soils. 2. It helps neutralize and eliminate odors, not cover them up with perfumes. <p>CAUTION: Contains Sodium Carbonate. Avoid contact with eyes. If contact is made, flush with water for 15 minutes. If swallowed, give water or milk. Contact a physician.</p> <p>KEEP OUT OF REACH OF CHILDREN.</p>
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<p style="text-align: right;">Sudsy</p> <p>Parsons' Ammonia</p> <p>All-Purpose Cleaner For Tough Jobs</p> <p>CAUTION: HARMFUL IF SWALLOWED. IRRITANT. Read precautions on back label.</p>	<p>PARSONS' SUDSY AMMONIA THE ORIGINAL ALL-PURPOSE CLEANER</p> <p>Daily Clean-up for Kitchen and Bathroom</p> <p>DO NOT USE TO SOAK ALUMINUM PANS.</p> <hr/> <p>KEEP OUT OF REACH OF CHILDREN. CAUTION: DO NOT MIX WITH OTHER HOUSEHOLD PRODUCTS SUCH AS CHLORINE-TYPE BLEACHES, TOILET BOWL, WALL OR TILE CLEANERS. Avoid contact with eyes and prolonged contact with skin. Do not take internally. Avoid inhalation of vapors. Use in well ventilated area.</p> <hr/> <p>INGREDIENTS: AMMONIA HYDROXIDE SOLUTION, ANIONIC SURFACTANT, NONIONIC SURFACTANT, SALTS (INERT).</p>
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**Tough on
Soap Scum**

**Soft
Scrub®
Original
Cleanser**

CAUTION: EYE IRRITANT. READ BACK PANEL CAREFULLY

Soft Scrub®

CUTS THROUGH GREASE AND SOAP SCUM
WITHOUT HARSH SCRATCHING!

Use All Over the House!

CAUTION: EYE IRRITANT. Contains calcium carbonate and detergents.

KEEP OUT OF REACH OF CHILDREN

ADVANCED FORMULA!

**LIME-
A-WAY®
CLEANER**

Rust • Calcium • Lime

Effectively Removes Stains From a Variety of
Surfaces Inside and Outside the Home.

KEEP OUT OF THE REACH OF CHILDREN.

DANGER: HARMFUL IF SWALLOWED.

CAUSES EYE AND SKIN INJURY. Read other
precautions on back panel carefully.

LIME-A Way® Cleaner easily removes stains
caused by the natural minerals in your water.
LIME-A-WAY effectively cleans even the
toughest hard-stains you might have thought
were permanent.

Precautionary Statements: KEEP OUT OF
THE REACH OF CHILDREN. DANGER:
CORROSIVE. CAUSES EYE AND SKIN
DAMAGE. HARMFUL IF SWALLOWED.
VAPOR MAY BE HARMFUL. DO NOT get in
eyes, on skin, or on clothing. DO NOT ingest. DO
NOT breathe vapor or mist. DO NOT mix with
bleach or other household chemicals as harmful
fumes may result. Use in well-ventilated area. Wear
rubber gloves and eye protection.

Ingredients: Contains sulfamic acid.

<p>OPENS DRAINS FAST</p> <p style="text-align: center;">Draino[®] CLOG REMOVER</p> <p>DANGER: KEEP OUT OF REACH OF CHILDREN. CAN CAUSE BURNS ON CONTACT. HARMFUL IF SWALLOWED. READ BACK LABEL CAREFULLY.</p>	<p style="text-align: center;">Safe on Metal & Plastic Pipes!</p> <p>DANGER: KEEP OUT OF REACH OF CHILDREN. HARMFUL IF SWALLOWED. MAY BURN EYES, SKIN, MUCOUS MEMBRANES ON CONTACT. Do not use or mix DRANO[®] Clog Remover with any other cleaners or chemicals, as hazardous fumes or a violent reaction may result. If gasses are released, leave area immediately – ventilate if possible.</p> <p>Contains sodium hydroxide, sodium hypochlorite, and sodium silicate</p>
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<p style="text-align: right;">WOW! Removes Wine, Tea, Juice, Pet Stains and More!</p> <p style="text-align: center;">Clorox[®] Oxi Magic[™] Multi-Purpose Stain Remover</p> <p>CAUTION: EYE IRRITANT. READ BACK PANEL CAREFULLY</p>	<p style="text-align: center;">CLOROX[®] OXI MAGIC[™]</p> <ul style="list-style-type: none"> • Chlorine free • Safe on colored fabrics and surfaces <p>CAUTION: EYE IRRITANT. Avoid eye contact and prolonged skin contact. KEEP OUT OF REACH OF CHILDREN.</p> <p>CONTAINS: Hydrogen peroxide, isopropyl alcohol, surfactant and fragrance. Contains no phosphorus.</p>
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Lysol[®]
BRAND
DISINFECTANT

POWER
Toilet Bowl Cleaner

Kills Germs
Removes Rust and Mineral Stains

ACTIVE INGREDIENT:

Hydrogen Chloride 9.5%
Other Ingredients 90.5%

KEEP OUT OF REACH OF CHILDREN.

DANGER: SEE BACK PANEL FOR ADDITIONAL
PRECAUTIONARY STATEMENTS.

DIRECTIONS FOR USE: It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Read the entire label before using product.

Lysol[®] Brand Disinfectant Power Toilet Bowl Cleaner has been specifically formulated for use only in toilets. It should not be used or placed on toilet bowl lids, vanities, sinks, bathtubs, cabinets, counter tops, rugs, etc. Clean up spills and drips immediately. *Do not use with chlorine bleach or any other chemical products.* This product contains no phosphates and is germicidal when used as directed but differs in composition from other LYSOL[®] Brand products.

PRECAUTIONARY STATEMENTS:

Hazards to Humans and Domestic Animals.

DANGER: CORROSIVE – produces chemical burns. Contains Hydrochloric Acid. Do not get in eyes, on skin, or on clothing. May be harmful or fatal if swallowed. Do not breathe vapor or fumes. Keep out of reach of children. Fumes are corrosive to metal.

AMMONIA-FREE
STREAK-FREE SHINE!

Windex[®]

Multi
with **Task**
vinegar

Cuts Grease, Cleans Glass and More!

**KEEP OUT OF REACH OF CHILDREN
AND PETS.**

Note: Unplug electrical appliances before use. Contains no phosphorous. Not recommended for use on wood or other varnished surfaces. Spot test other surfaces before using. Do not use or mix with other household cleaners.