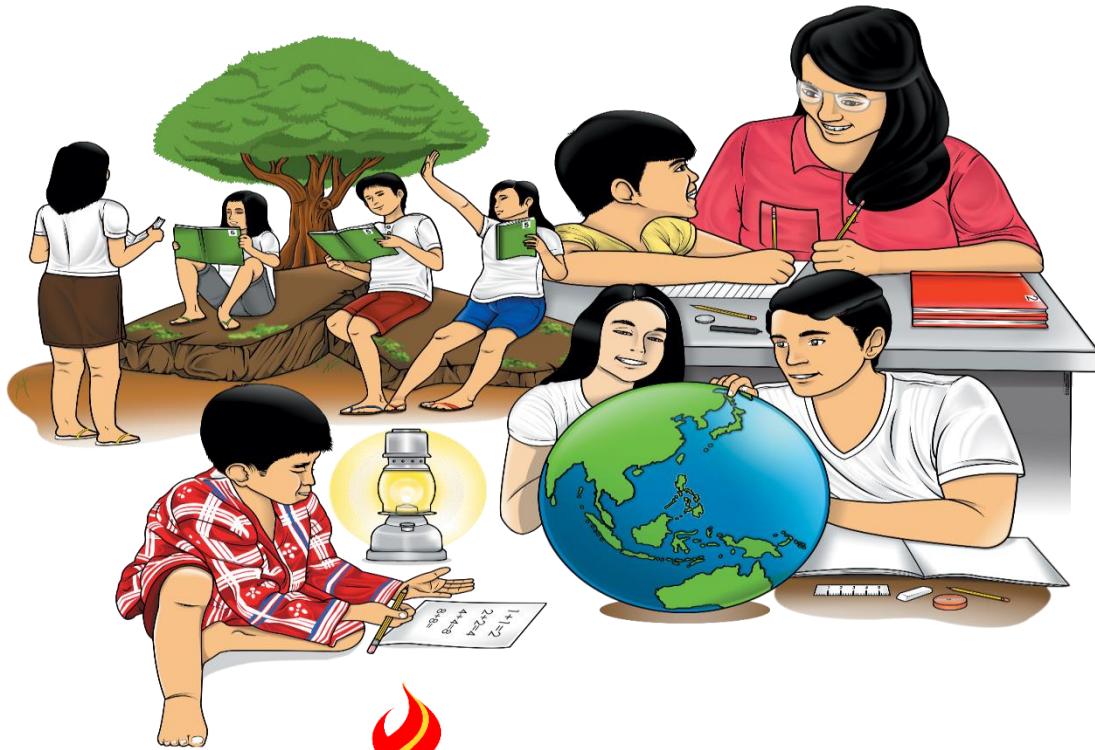


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Physical Science

Quarter 1 – Module 8: Understanding the Chemistry of Household Cleaning Products



Science – Grade 11/12
Alternative Delivery Mode
Quarter 1 – Module 8: Understanding the Chemistry of Household Cleaning Products
First Edition, 2020

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Senior High School

Physical Science

Quarter 1 – Module 8:

Understanding the Chemistry of Household Cleaning Products

This instructional material was collaboratively developed and reviewed by educators from public and private schools, colleges, and or/universities. We encourage teachers and other education stakeholders to email their feedback, comments, and recommendations to the Department of Education at action@deped.gov.ph.

We value your feedback and recommendations.

Introductory Message

For the facilitator:

Welcome to this Module on Understanding the Chemistry of Household Cleaning Products! This module particularly deals with the properties and mode of action of common cleaning products which are commonly found in households like cleaning agents, disinfectants, and soaps.

The Module has several parts that will require the learners to answer to determine their understanding of the concepts presented. Kindly assist them in the activities and remind them that these should be done in separate sheets of paper including the pre-test, self-check exercises, and post-test.

For the learner:

Welcome to this Module on *Understanding the Chemistry of Household Cleaning Products*. This module particularly deals with the properties and the mode of action of common consumer products that are found in your home like cleaning agents, disinfectants, and soaps.

This will help you have a wider view of the composition of common chemical household cleaning substances - a very essential knowledge that can help you maximize the use of the chemicals you utilize in cleaning your home. At the end of the module, you will gain better understanding of the chemical composition of household cleaning products that will help you appreciate its proper consumption at the same time, take the necessary precautionary steps in order to prevent harm, injury and fatality in your home during their use.

The module has activities and tests that you are required to answer. These should be done to help you deepen your understanding of the concepts. These should be answered in separate sheets of paper including the pre-test, self-check exercises, and post-test.



What I Need to Know

This module was designed and written with you in mind. It is here to help you master your understanding the chemistry of household cleaning products. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

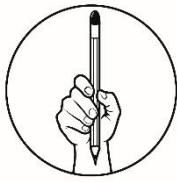
There are two lessons in this module that deal with the following:

- Lesson 1 - Properties and Mode of Action of Common Household Cleaning Products
Lesson 2 - Precautionary Measures in the Use of the Chemical Household Cleaning Products

OBJECTIVES:

After going through this module, you are expected to:

1. give the properties and mode of action of common household cleaning products;
2. explain the precautionary measures indicated in various cleaning products using the learners' knowledge on chemical elements; and
3. enumerate the importance of your knowledge on the chemistry of common household cleaning materials.



What I Know

Write T if the sentence is correct and F if the sentence is wrong. Write the chosen letter on a separate sheet of paper.

1. Chemicals can be both useful and potentially harmful depending on the use of the product and on the dose of the product used.
2. Bases taste sour.
3. The chemical properties of different substances make them suitable for cleaning hard surfaces, floors, upholstery, clothing, and other items.
4. A substance that is acidic does not mix with water.
5. Chlorine generally is the most common bleach used in household cleaning products.
6. Baking soda is the common name for Sodium Bicarbonate (NaHCO_3).
7. Bases are beneficial in removing hard-water deposits, discoloration from aluminum, brass, bronze, and copper and iron rust stains.
8. Hydrochloric Acids conduct electricity.
9. Lemons can pose a threat in households' health when not properly consumed.
10. The most common chemical found in silver jewelries cleaning liquids is boric acid.
11. Borax can be used as bread ingredient.
12. Dihydrogen Monoxide is an explosive liquid.
13. Ethanol is a primary ingredient in making alcoholic beverages.
14. Wear protective gears in handling household chemicals to prevent body harm.
15. Hydrochloric acid is used in cleaning swimming pools.

Lesson 1

Properties and Mode of Action of Common Household Cleaning Products



What's In

There are some students who find Chemistry as a difficult subject rather than as a useful branch of knowledge. Little they know that it will help them understand consumer products and common cleaning substances that they usually consume in their households. They are not fully aware of the components of some disinfectants, toilet cleaners, laundry and bath soaps, and even the compositions of bakery ingredients like baking soda, salts, and lemons. These components may be useful or harmful to them.

Many incidences of chemical deaths dealing with household products have been registered all over the world. One popular incident happened in a milk tea outlet on May 11, 2015 in Manila where three (3) fatalities were noted. After a chemical laboratory test, the Philippine National Police (PNP) identified the milk tea tested positive for Oxalic Acid, a poisonous, colorless substance.

This fatal incident could have been prevented if the people involved in the production of the milk tea are aware of the chemical properties of the liquids in their shop, and the corresponding precautionary measures in handling the chemicals. If they have understanding on the properties of the chemicals found in a household, they could have taken the appropriate action in order to prevent accidents, harm and death.



Notes to the Teacher

In the following exercise, the learner will need a partner to work on the THINK-PAIR-SHARE activity. This will help them recall the lessons they have taken the previous chapter about chemical compounds/substances, and their properties. The learners will identify these substances with their common names. After that, they will distinguish acids from bases.

Allow them to discuss the chemicals as they experience/encounter them in their homes.

ACTIVITY 1 THINK-PAIR-SHARE

CHEMICAL	COMMON NAME	ACIDIC, BASIC OR NEUTRAL?
1. Dihydrogen Monoxide		
2. Acetic Acid		
3. Sodium Hypochlorite		
4. Sodium Bicarbonate		
5. Hydrochloric Acid		
6. Sodium Hydroxide		
7. Potassium Hydroxide		
8. Ethanol		
9. Sodium Lauryl Sulphate		
10. Isopropanol		



What's New

- What is Chemistry?
- How can Chemistry ease one's life?
- Why is understanding of the chemical household cleaning solutions essential in the use of the cleaning products?

CHEMISTRY is the science that deals with the properties, composition, and structure of substances (defined as elements and compounds), the transformations they undergo, and the energy that is released or absorbed during these processes (Usselman, 2019). It is also concerned with the utilization of natural substances. Through the use of modern technology, artificial substances can also be created that expanded its scope and relevance.

Chemistry has different processes. Dating back from the beginning of civilization, these processes have been undertaken by man. Examples of these processes are cooking, fermentation, glass making, and metallurgy.

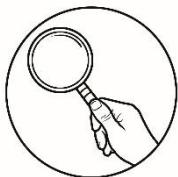
This 20th century, Chemistry has made man's daily living more advanced in health by curing diseases through molecular analysis and interpretations. Using the different processes of chemistry, man has changed and has improved his daily routines from complex to simple ones. Take for instance, washing of soiled clothes. Before, man has to use brush, wooden planks, and herbs to soften the dirt. Today, the use of appropriate laundry detergent and bleach help reduce the process of washing the clothes.

Another example of how Chemistry helps man live a more sustainable and healthy lifestyle, is in the maintenance of the cleanliness of the household. Imagine a house full of dirt, dust, stains and the dirt has invited the flies, mites, and cockroaches all over your rooms and kitchen. Cleaning the dirt with simple water and cloth alone will take a longer period of time and will require so much energy to completely do the job. The knowledge on chemical compounds and substances, their properties and their uses has

greatly helped to ease man's job on cleaning and in keeping the environment a safer place to live in.

In the review exercise, you were asked to identify the common names of the given substances, and to determine as to whether they are acidic or alkaline. Your knowledge of these concepts will help you better understand the properties and characteristics of the chemicals used in cleaning, their restrictions and their harmful effects to humans if mishandled or misused.

The definitions of usable concepts for you to better understand the properties of the chemicals in cleaning materials are given in the following pages.



What is It

Defining relevant concepts

An **acid** is classified as a compound with distinctive properties. An acidic substance is sour-tasting; reacts with litmus paper, bases and metals; conducts electricity; and has a pH of less than 7. An acid can be classified as strong or weak based on its reactivity, conductivity, and pH.

pH Scale – is used as a measure of how acidic or basic a substance is. This scale ranges from 0 to 14; a pH of 7 means the substance is neutral. An acidic substance measures lower on the pH scale. A substance with a pH value less than 7, is acidic.

Litmus paper strips are used as a general indicator to determine acidity. When dipped in or rubbed on an acidic substance, blue litmus paper turns red.

An **Alkali or chemical base** is a caustic substance. It is a substance that accepts hydrogen ions. It dissociates in water and is a good conductor of electricity. An alkali turns litmus paper blue.

Acids and bases are generally chemically active and can react in many other substances. Because of this characteristic, they are commonly found in household applications, especially as cleaners and as ingredients in cooking.

Activity 2

Understanding the properties of the chemical ingredients active in the following cleaning materials:

Directions: The table below shows the answers to the Think-Pair-Share exercise you have done. Candidly check your answers against the entries in the table.

CHEMICAL	COMMON NAME	ACIDIC, BASIC OR NEUTRAL?
1. Dihydrogen Monoxide	Water	Neutral
2. Acetic Acid	Vinegar essence	Acidic
3. Sodium Hypochlorite	Bleach	Basic
4. Sodium Bicarbonate	Baking soda	Basic
5. Hydrochloric Acid	Muriatic acid	Acidic
6. Sodium Hydroxide	Lye or caustic soda	Basic
7. Potassium Hydroxide	Caustic potash	Basic
8. Ethanol	Ethyl alcohol	Depends on the condition
9. Sodium Lauryl Sulphate	SLS	Acidic
10. Isopropanol	Isopropyl alcohol	Depends on the condition

1. **Sodium hypochlorite** appears as colorless or slightly yellow watery liquid with an odor of household bleach. It mixes with water. (USCG, 1999). It is used as a bleaching agent, laundry bleaching agent, disinfectant for glass, ceramics, and tiles.
2. **Sodium bicarbonate** appears as odorless white crystalline powder or lumps with slightly alkaline (bitter) taste. It is used to make many chemicals, as an ingredient in baking powder, effervescent salts and beverages, in fire extinguishers, cleaning compounds, and in human and veterinary pharmaceuticals. Workers that use sodium bicarbonate may breathe in mists or have direct skin contact. Sodium bicarbonate is a Generally Regarded as Safe (GRAS) chemical at levels found in consumer products, and has a low risk of toxicity in humans. It is a slight skin and eye irritant.
3. **Sodium hydroxide** room temperature is a white crystalline odorless solid that absorbs moisture from the air. It is a manufactured substance. When dissolved in water or neutralized with acid it liberates substantial heat, which may be sufficient to ignite combustible materials. Sodium hydroxide is very corrosive. It is generally used as a solid or a 50% solution. Other common names include caustic soda and lye. It is used to manufacture soaps, rayon, paper, explosives, dyestuffs, and petroleum products. It is also used in processing cotton fabric, laundering and bleaching, metal cleaning and processing, oxide coating, electroplating, and electrolytic extracting. It is commonly present in commercial drain

and oven cleaners. When inhaled, cough, sore throat, burning sensation and shortness of breath may be experienced.

4. **Boric acid** is a white crystalline solid with a density of 1.435 g/mL, melting point of 170.9 °C and boiling point of 300 °C. It is a weak inorganic acid with antiseptic properties, and is also called boracic acid or orthoboric acid. It is non-toxic with antibacterial properties, and it is mainly used as an antiseptic agent, acne treatment, preservative, insecticide, pH buffer, swimming pool chemical, flame retardant, and a precursor to many useful chemicals.
5. **Hydrochloric acid** is colorless - light yellow in appearance, has a pungent and irritating odor, has a pH level 0, with boiling point of 108.58°C @ 760 mm Hg (for 20.22% HCl in water) and melting point at -62.25°C (20.69% HCl in water), soluble in cold and hot water and diethyl ether, and it conducts electricity. Although it is highly corrosive, it is used to remove stains from metals. It can clean iron, copper, brass and other metals; however, one should dilute it by adding 9 parts of water to 1 part of the acid. One should not use it directly on metals as it is extremely powerful cleaning agent.
6. **Formaldehyde** is a liquid which is clear or water-white. The odor is irritating and pungent. It is soluble in water and up to 55 percent soluble in ether, acetone, benzene, and alcohol. Its melting point is -92.0 °C and its boiling point is 19.5° C. An aqueous solution of formaldehyde can be useful as a disinfectant as it kills most bacteria and fungi (including their spores).
7. **Sodium Lauryl Sulfate** appears as white to pale yellow paste or liquid with a mild odor, sinks and mixes with water, (USCG, 1999) naturally derived from coconut and/or palm kernel oil. It usually consists of a mixture of sodium alkyl sulfates, mainly the lauryl. SLS lowers surface tension of aqueous solutions and is used as fat emulsifier, wetting agent, and detergent in cosmetics, pharmaceuticals and toothpastes. It is also used in creams and pastes to properly disperse the ingredients and as research tool in protein biochemistry. SLS also has some microbicide activity. It is used in electrophoretic separation of proteins and lipids; wetting agent, detergent, especially in the textile industry.
8. **Ethanol** is a clear, colorless liquid rapidly absorbed from the gastrointestinal tract and distributed throughout the body. It has bactericidal activity and is used often as a topical disinfectant. It is widely used as a solvent and preservative in pharmaceutical preparations as well as serving as the primary ingredient in alcoholic beverages.

Activity 3

Identifying Common Household Cleaners

Directions: Take a tour at your house. List down at least five (5) examples of cleaning consumer products that are usually used in your household and write them down in the table below. Read the labels of the cleaning products and identify the active ingredient of each. Apply the cleaning substance on a dirty surface. Examine its effect on the surface, then identify the use of the active ingredient you identified in the substance.



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Assessment 2

Cleaning Substance	Active Ingredient	Use of Active Ingredient
1.		
2.		
3.		
4.		
5.		

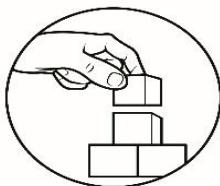
Answer the questions that follow using a separate sheet of paper. Discuss your answers with your teacher-facilitator.

1. What is the active ingredient used in each cleaning solution?
2. Use the following cleaning solution in cleaning the following surfaces and determine if it is sufficient to come up with an acceptable clean.
 - a. Bath soap in washing greasy pots
 - b. Borax in cleaning a goblet
 - c. Bleach in washing colored cloth
 - d. Hand soap in cleaning toilet bowls
3. Is there a particular chemical substance that is most appropriate to use in cleaning the following? Identify the chemical. Why?

a. oven	e. car
b. sink	f. white linen
c. garage	g. kitchen utensils
d. bathroom tiles/toilet bowl	h. window panes

Lesson 2

Precautionary Measures in the Use of Chemical Household Cleaning Products



What's More

The following is an article taken from the Philippine Daily Inquirer citing cleaning agents as one of the top causes of poisoning among children below 18 years old.

"Next to pharmaceuticals, PGH listed household cleaning agents as among the frequent causes of poisoning cases admitted to the hospital," Castillo said. The toxicologist told seminar participants that based on 2009 data from the National Poison Management and Control Center, 55 percent, or more than half, of poisoning patients were children.

Cited as the common causes of pediatric poisoning were silver jewelry cleaner, isopropyl and ethyl alcohol, pesticides, kerosene, bleaching agent sodium hypochlorite, button batteries, chlorine granules, muriatic acid and methamphetamines.

What could be done in order to reduce the incidence of poisoning among children that is caused by chemical cleaning agents?

To be able to answer the question, take a look at the table below that shows the common names of cleaning materials used in households, their active chemicals, product application and harmful effects if not properly handled. Study and analyze them carefully then answer **Assessment 3**.

Table of Common Household Cleaning Materials

Common Household Name	Active chemicals	Product Application	Harmful Effects
1. Bleach	Sodium hypochlorite	Used in washing laundry, removing stains	Ingestion can cause injury to esophagus, stomach irritation, and prolonged nausea and vomiting.
2. Boric acid	Boric acid	Used in products for insecticide.	Toxic if ingested or inhaled.
3. Borax	Sodium tetraborate decahydrate	Used as a multipurpose cleaner and bleach	Long exposure can cause respiratory irritation

4. Caustic soda	Sodium hydroxide	Used in products for cleaning, unblocking sinks, drains and even toilets. Highly corrosive alkali	Contact causes severe burns with redness, swelling, pain and blurred vision and blindness. Ingestion can burn lips, tongue, throat and stomach.
5. Formalin	40% solution of formaldehyde	Used as disinfectant or anti-bacterial agent	Can cause skin irritation; Toxic when inhaled
6. Detergent	Sodium Lauryl Sulfate & Sodium Laureth Sulfate/Sodium lauryl ether sulfate	Used in laundry detergents, dishwashing liquids;	Can cause eye, skin, or mouth irritation; injury and death when ingested; Poisonous when swallowed
7. Lye	Sodium hydroxide or potassium hydroxide	Used as oven cleaner	Can burn skin and eyes; cause severe tissue damage; and may be fatal if swallowed
8. Algicides	Calcium and sodium hypochlorite	Used as swimming pool disinfectant	If swallowed, the chemicals can burn the throat and cause death.
9. Air fresheners	Contain formaldehyde, petroleum distillates, p-dichlorobenzene and aerosol propellants.	Used to freshen cars, bathrooms, etc.	Can cause cancer and brain damage; irritate eyes, skin, and throat.

ASSESSMENT 3

Direction: Answer the following questions in a separate sheet of paper. Then discuss your answers with your teacher-facilitator.

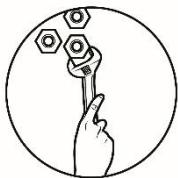
1. Based on the data given on the table, which cleaning material/s is/are
 - a. safe to use?
 - b. hazardous?
2. What active ingredients do air fresheners contain that may be hazardous to one's health?
3. Will you still use the above cleaning agents in your homes?
4. What precautionary measures can be done in order to prevent harm to one's body and avoid death in using the chemical cleaning agents? List down at least five.

Example: 1. In using air fresheners, read the labels carefully and determine whether there are no active ingredients like formaldehyde, petroleum distillates, p-dichlorobenzene and aerosol propellants.



What I Have Learned

1. The understanding of the chemical properties of common household cleaning agents/materials is essential before they are used.
2. Cleaning agents can be classified as acids or alkalis/bases, or neutral depending on the condition.
3. pH scale is used to measure how acidic or basic a chemical substance is. On a scale of 14, 7 is neutral and a with a pH value of less than 7, the material is acidic.
4. The following common household chemicals are acidic – acetic acid, hydrochloric acid, sodium lauryl sulfate, etc. and have pungent smell.
5. Water is a neutral solution.
6. Chemicals are used in manufacturing cleaning consumer products to lighten the process of cleaning varied surfaces.
7. Active chemical ingredients found in cleaning agents may have harmful effects to man.
8. The chemical household cleaning materials should be properly stored and kept away from children to avoid harm and poisoning.

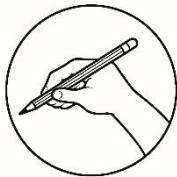


What I Can Do

Directions: One of the exits of a Senior High School student is to find a job. If you were in the following situation, what will be your decision? Justify. Write your answer on a separate sheet of paper.

Situation: You were hired as a Maintenance Officer in a prestigious hotel in the city, and one of your duties is to keep the linens in the hotel rooms without any smudge nor stain. However, you are allergic to bleaches. The hotel is the nearest work area to your home and it is just a stone's throw away. You do not have budget for transportation to transfer to another hotel, the nearest one takes a 2-hour travel from your home. You needed the job badly to sustain the medicines of your mother who is sick and bed-ridden.

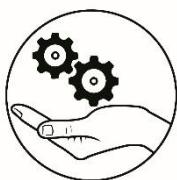
What will be your course of action? Explain briefly.



Assessment

Directions: Write **T** if the sentence is correct and **F** if the sentence is wrong. Write the chosen letter on a separate sheet of paper.

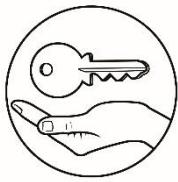
1. Chemicals can be both useful and potentially harmful depending on the use of the product and on the dose of the product used.
2. Bases taste sour.
3. The chemical properties of different substances make them suitable for cleaning hard surfaces, floors, upholstery, clothing, and other items.
4. A substance that is acidic does not mix with water.
5. Chlorine generally is the most common bleach used in household cleaning products.
6. Baking soda is the common name for Sodium Bicarbonate (NaHCO_3).
7. Bases are beneficial in removing hard-water deposits, discoloration from aluminum, brass, bronze, and copper and iron rust stains.
8. Hydrochloric Acids conduct electricity.
9. Lemons can pose a threat in households' health when not properly consumed.
10. The most common chemical found in silver jewelries cleaning liquids is boric acid.
11. Borax can be used as bread ingredient.
12. Dihydrogen Monoxide is an explosive liquid.
13. Ethanol is a primary ingredient in making alcoholic beverages.
14. Wear protective gears in handling household chemicals to prevent body harm.
15. Hydrochloric acid is used in cleaning swimming pools.



Additional Activities

Look around your community and search for organic materials which could be used to replace the function of the chemicals found in the cleaning consumer products you use in your household.

1. Bleach - _____
2. Sodium Lauryl Sulfate - _____
3. Hydrochloric acid - _____
4. Formaldehyde - _____
5. Boric Acid - _____



Answer Key

What I Know	Assessment	What's More	Answers may vary.	
1. T	1. T	7.	7.	15. T
2. F	2. F	8.	8.	14. T
3. T	3. T	9.	9.	13. F
4. F	4. F	10.	10.	12. F
5. T	5. T	11.	11.	11. F
6. T	6. T	12.	12.	10. F
7. F	7. F	13.	13.	9. F
8. F	8. F	14.	14.	8. F
9. F	9. F	15.	15.	7. F
10. F	10. F			6. T
11. F	11. F			5. T
12. F	12. F			4. F
13. F	13. F			3. T
14. T	14. T			2. F
15. T	15. T			1. T

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