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ABSTRACT

This booklet, one of a series developed by the Frederick County Board of Education, Frederick, Maryland, provides an instruction module for an individualized or flexible approach to 7th, 8th, and 9th grade science teaching. Subjects and activities in this series of booklets are designed to supplement a basic curriculum or to form a total curriculum, and relate to practical process oriented science instruction rather than theory or module building. Included in each booklet is a student section with an introduction, performance objectives, and science activities which can be performed individually or as a class, and a teacher section containing notes on the science activities, resource lists, and references. This booklet introduces students to chemistry and chemicals which exist in the average household. The estimated time for completing the activities in this module is two weeks. (SL)

AIDS TO INDIVIDUALIZE THE TEACHING OF SCIENCE

MINI-COURSE UNITS

BOARD OF EDUCATION OF FREDERICK COUNTY

1973

Frederick County Board of Education

Mini Courses for

Life, Earth, and Physical Sciences

Grades 7, 8, and 9

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1973

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FOREWORD

The contents represented in these modules of instruction, called mini courses, is an indication of our sincere desire to provide a more individualized and flexible approach to the teaching of science.

Data was accumulated during the school year relative to topics in life, earth, and physical science that were felt to be of greatest benefit to students. The final selection of topics for the development of these courses during the workshop was made from this information.

It is my hope that these short courses will be a vital aid in providing a more interesting and relevant science program for all middle and junior high school students.

Dr. Alfred Thackston, Jr.
Assistant Superintendent for Instruction

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HOUSEHOLD CHEMISTRY

Prepared by

Ross Foltz

CONTENTS

Estimated Teaching Time

2 weeks

HOUSEHOLD CHEMISTRY

INTRODUCTION:

In our homes, in the kitchen where we prepare our food, and in the basement where we store our garden supplies, are areas that we can think of as chemical laboratories.

All of the cooking ingredients in the kitchen are chemicals. Some, such as sugar, and salt, are single compounds; but most are mixtures of tens or even hundreds of different compounds. Making a cake or a loaf of bread involves chemical reactions, and cooking is nothing more than applied chemistry. We heat things to speed up reactions. We add ingredients in certain definite amounts just as we do in performing a chemical experiment. Housewives are scientists who develop new foods or cooking techniques and rely on chemistry to help solve their problems.

The most common type of household cleaner is soap. It can be made by boiling fat or vegetable oil with a solution of household lye (sodium hydroxide). Soapless detergents, which lessen the force of attraction between the molecules of water, permit them to spread through the clothing fibers and remove dirt more easily.

Gardeners and lawn and flower growers use many of the products of chemistry. Fertilizers supply plants with the minerals necessary for proper plant growth. The minerals contain the elements calcium, nitrogen, phosphorus and potassium. They also contain smaller amounts of the trace elements (S, Mg, Fe, Mn, B, Zn, Cu, Mo, and Cl). In most areas of the country, the soil contains enough of these trace elements for most plants.

Fertilizers are manufactured to contain the proper proportions of the elements needed by particular kinds of plants. For example, special fertilizers are made for grass, for roses, for flowering shrubs, and so on. These are sold under various brand names and often with the misleading name of "plant foods". Plants make their own food and the minerals they get from the soil are not considered by the scientist to be a food.

GENERAL OBJECTIVES:

1. To acquaint the student with some of the many chemical products found in the home that we use in our daily living.
2. To identify the chemical names and composition of these products.
3. To become aware of physical and chemical changes happening in the home and their importance in our everyday activities.

BEHAVIORAL OBJECTIVES:

When you complete this unit, you should be able to:

1. construct a list of 10 common chemical materials found in the home.
2. making sure of the above list, identify the formula or composition and then list the elements present.
3. classify these materials as elements, compounds, or mixtures.
4. give situations that involve changes, distinguish which are chemical and which are physical.

5. demonstrate which materials are acids or bases, giving three examples of each, using indicators.
6. identify some of the common elements, with their symbols, that you found in household products.
7. identify some physical and chemical properties you used to identify some household materials.

ACTIVITIES:

A. Materials Found in the Home
Make a list of ten or more materials, chemical in nature, that are stored and used in your home. Suggested areas to look are the kitchen, laundry, and garden supply storage. When listing materials, obtain the following information: common or trade name, ingredients with percent present.

B. Complete the above list with class discussion, and teacher's help.
1. With the above prepared list, classify the materials into the following groups:

MATERIAL	ELEMENT	COMPOUND	MIXTURE
1			
2			

2. Make a list of five common compounds from the above list, write the formula, and list the elements that make up the formula:

COMPOUND	FORMULA	ELEMENTS
1		
2		
3		

C. Do Some Reading (to aid in Activity B)

1. Pathways 1 - The Materials of Nature, Oxenhorn, pp.56-57, 108, 113, 114, 141, 142, 177-178.
2. Pathways 2 - Chemistry of Mixtures, Oxenhorn, pp. 1, 2, 8, 9, 40, 43, 44, 45, 54, 66, 102.
3. Pathways 3 - Chemistry of Metals, Oxenhorn, pp. 5-6, 41, 42, 147, 148, 150.
4. Physical Science, Brown and Anderson, Lippincott Co., pp. 157-158, 217-219.

D. Let's See What Makes Plants Grow

From fertilizer bags, which will be provided, list the elements present, with the percent of each available for plant use. Two general types of fertilizer bags will be provided:
a. a common lawn and garden fertilizer
b. a fertilizer that provides trace elements for the soil

E. LAB: What are Some Chemicals Found in the Kitchen?

Use Pathways Laboratory Workbook, Chemistry 1 - The Materials of Nature as a guide. Complete Laboratory Problem No. 10: What are Some Chemicals Found in the Kitchen?, pp.45-48.

You will be working in the lab, so remember: SAFETY FIRST!; handle all chemicals with care; Hydroclone Acid is a strong acid; household ammonia has a very pungent odor.

WEAR GOGGLES (Maryland State Law requires them when handling chemicals in the lab.)

F. LAB: To Observe Physical Changes in Substances

Complete problem 4-1, found in Properties of Matter, Lab-Inquiry Texts, Cambridge Book Company, page 99.

G. LAB: To Investigate a Chemical Change using Acids and Bases

We have performed some physical changes and observed why we called them physical changes. Now let's investigate other types of actions. Complete problem 4-2, found in Properties of Matter, Lab-Inquiry Texts, Cambridge Book Company, page 102.

H. Reading for Information and Review

Complete reference sheet 4-1, found in Properties of Matter, Lab-Inquiry Texts, Cambridge Book Company, pp. 100-101.

I. WORK SHEET

Self-Evaluation for Physical and Chemical Change Lab Experiences

1. Name three physical properties that make a silver spoon different from the copper on a copper clad (Revereware) pan:

   a._____ b._____ c._____

2. Name three physical properties that are the same for both sugar and salt:

   a._____ b._____ c._____

3. What physical property does the metal aluminum have that stainless steel does not have?_____

4. What chemical property does stainless steel have that iron does not have, and that makes stainless steel very useful in making cooking utensils, knives and forks?

   _____

5. When sugar dissolves in water, is it a physical or chemical change? Explain why.

6. Is the burning of gas in a gas stove a physical or a chemical change? Why?

7. Is the baking of a cake a physical or a chemical change? Explain.

8. A molecule of a simple sugar has a chemical formula $C_6H_{10}O_5$. How many and what kinds of atoms are in this molecule of sugar?

9. The chemical formula for baking soda is $NaHCO_3$.

   a. How many atoms of sodium are there in one molecule of baking soda?_____

   b. How many atoms of hydrogen? _____

   c. How many atoms of carbon? _____

   d. How many atoms of oxygen? _____

Upon completion of this worksheet, you are ready for group discussion. Check and clarify your answers.

J. WORKSHEET: CLASSIFICATION OF CHANGES

Classify as to physical or chemical change by marking P for physical and C for chemical before each statement:

action of baking powder in cake making

breaking an egg

baking a cake

grinding pepper

making a cup of milk from powdered skim milk

bleaching clothes with chlorox

cutting cabbage for cole slaw

mixing paint

peeling potatoes

frying an egg

souring of milk

fermentation of yeast in bread-making

plowing garden

plant using fertilizer for growth

Complete the list, then discuss your classification to verify your selection.

K. LAB: How Can We Identify Acids and Bases?

Complete Laboratory Problem No. 8 in Pathways Laboratory Workbook, Chemistry 2 - Chemistry of Mixtures.

CAUTION:
Keep in mind, safety first! You are using a strong acid (sulfuric acid) and a strong base (sodium hydroxide).

L. LAB: Making Soap (Optional)

In this lab, you will be making soap and testing its cleaning qualities.

We know that cleanliness is essential to good health. Of the cleaning agents found in the home, soap is the most common. Soap can be made by boiling a fat such as lard or olive oil with a solution of a strong base, such as lye (sodium hydroxide).

Materials

ethyl alcohol, 25 ml
olive oil, coconut oil, or lard
goggles
graduate, 100 ml
food coloring, 2 drops
5 M NaOH, 100 ml
beaker tongs
beaker, 600 ml

Procedure

1. Place 15 ml of olive oil, coconut oil, or lard in a 600 ml beaker, and add 100 ml of 5 M NaOH.
   CAUTION: NaOH CAN CAUSE BURNS.

2. Heat the contents of the 600 ml beaker for 30 minutes while stirring constantly.
   CAUTION: SPATTERING OCCURS WHEN BOILING POINT IN REACHED. IF THIS HAPPENS, TURN THE FLAME DOWN.

3. Add 1 or 2 drops of food coloring to give the soap color.

4. Permit the beaker and contents to sit overnight; note the appearance of the residue before you set the soap aside to cool.

Next Day:

5. Pour 25 ml of ethyl alcohol into the cooled beaker of soap mixture. Swirl the alcohol gently around the surface of the soap. Do this for 5 minutes. The alcohol will remove excess fluid from the soap.

6. Pour off and dispose of the alcohol.

7. Now see if the soap works. Remove a small amount of it with your hands. Find how well it lathers and removes dirt.

Interpretation

1. Suggest other fats that may be used in soap-making b ides the one you used today.

2. What may indicate to you that the substance you made is really soap?

3. Sodium hydroxide is the basic ingredient of drain cleaner. Why do you think we used it in making our soap?

M. LAB: How Can We Remove Tarnish from Silver without Rubbing?

Complete Laboratory Problem 9, in Pathways - Laboratory Workbook 3, Chemistry of Metals, pp. 39-42.

You will need a tarnished spoon, fork, ring, etc., from home to work with.

N. A Puzzling Review - A Time to Think

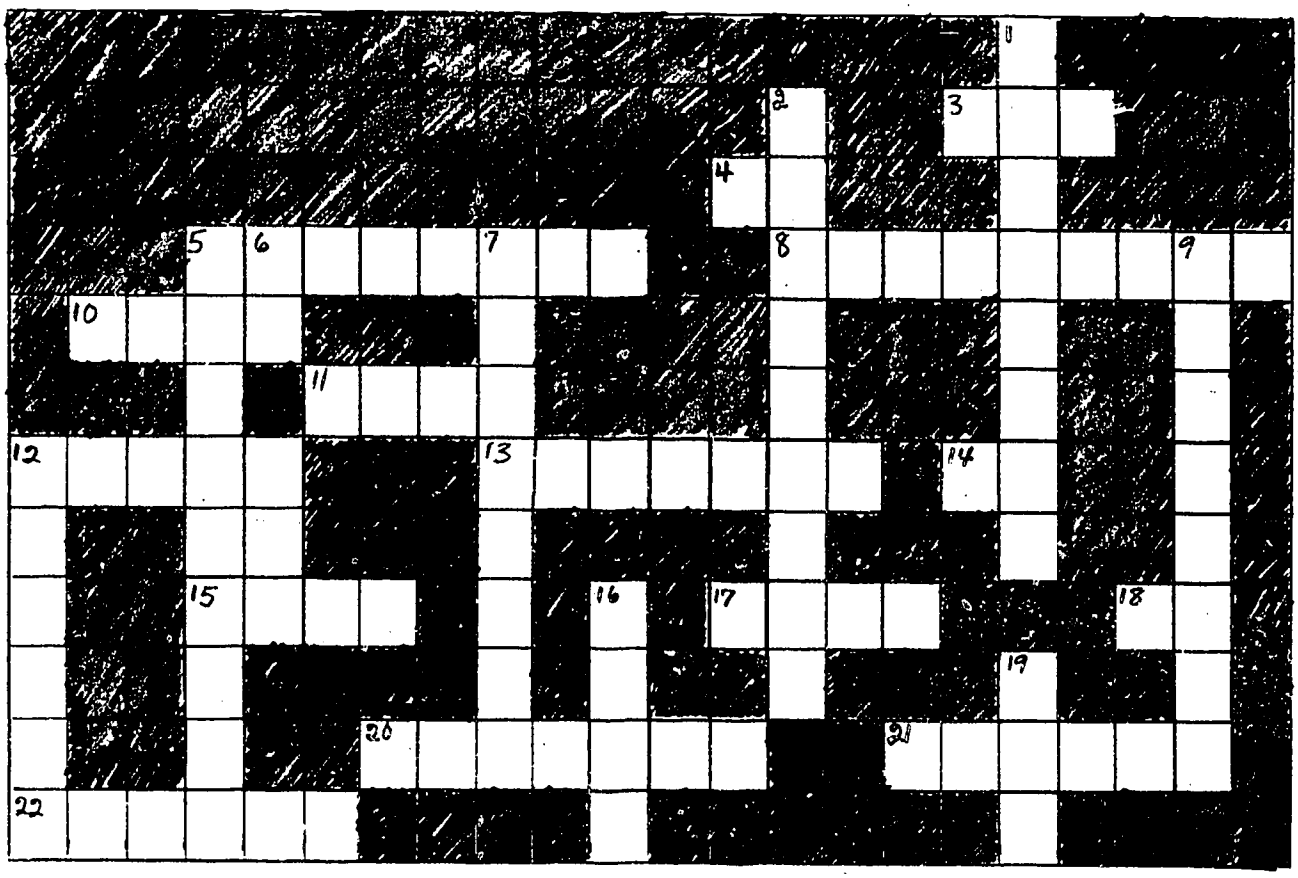
ACROSS

3 - common name for sodium hydroxide
4 - symbol for zinc
5 - breaking of glass is a _____ change
8 - a soapless cleaning agent for washing clothes
10 - smallest particle of an element
11 - opposite of acid - turns red litmus blue
12 - $C_{12}H_{22}O_{11}$
13 - inorganic solid found in nature
14 - symbol for iron
15 - sodium chloride's common name
17 - household material to clean face, hands, clothes
18 - symbol for magnesium
20 - element found in lime necessary for good bone structure
21 - gas in air necessary for life
22 - indicator that turns blue in a base and red in an acid

DOWN

1 - lightest element, found in water molecule
2 - materials used to determine acid or base by color change
5 - element needed for plant growth - symbol is K
6 - abbreviation for heavy material
7 - fermenting is a _____ change
9 - element making up 80% atmosphere needed for plant growth
12 - abbreviation for an element
16 - a compound that in solution will turn blue litmus red, or Phenolphthalein in solution will be clear

A PUZZLING REVIEW



M. RESEARCH ACTIVITY

A CHEMICAL INDICATOR (Optional)

(This activity may be done at home.)

Chemists recognize two large classes of compounds called acids and bases. These are soluble in water, and a particular solution may be acidic or alkaline (basic). When an acid and a base react chemically, the results are a compound belonging to a third class called a salt and water. Common table salt is one kind of salt. It is called sodium chloride (NaCl) and it is formed by allowing sodium hydroxide (NaOH), a base, to react with hydrochloric acid (HCl).

There are many kinds of acids, bases, and salts. A common household acid is vinegar. It contains acetic acid. A common household base is ammonia (ammonium hydroxide NH_4OH).

Some pigments, when in water solution, are very sensitive to acids and bases. They react to them by changes in color. One pigment of this kind is the purplish or bluish pigment found in "red" cabbage. Such pigments are called indicators.

Since the materials and equipment necessary for working with this indicator are easily obtainable, you can learn about acids and bases at the same time.

Materials and Equipment:

"red" cabbage
household ammonia
vinegar
small, smooth board
razor blade
four small fruit juice glasses
shot glass, or other small, clear glass container
small tea strainer
small pan, and a source of heat for heating water
teaspoon measure
two medicine droppers

Procedure:

1. Remove two or three leaves from the outside of a head of red cabbage. Select the thinnest portions of the leaves, and cut them up as finely as possible by placing them on a smooth board and cutting them into little bits with a razor blade.

2. Place the cut-up material in one of the fruit juice glasses. Heat a small quantity of water to boiling, and carefully pour enough water over the cabbage material to cover it. The less water you use, the better. Let the mixture stand for a few minutes, stirring it frequently. What happens? Allow all of the purple (or blue) pigment to go into solution that will do so.

3. Pour the colored solution into a second fruit juice glass. Pour it through a small tea strainer to hold back the solid cabbage material.

4. Pour a small quantity of ammonia into a third fruit juice glass, and a small quantity of vinegar into a fourth glass.

5. Put two teaspoonfuls of the colored solution into a shot glass or another small glass container. Add vinegar with a medicine dropper, drop at a time, to the solution. What happens? What color does the solution become? Stir the solution as you add the acid. When there is no further change, add ammonia, drop at a time, using the second medicine dropper. What happens? Why use the second medicine dropper? Again, stir as you add, until there is no further color change.

Is it possible, now, to reverse the color change by adding acid? Try it and see. If you succeed in reversing it, add ammonia and try to change it back the other way. Does it change again? How many times can you change the color back and forth? If you come finally to a point where a reversal is no longer possible, why do you think this has occurred?

Now replicate the experience, beginning with a new sample of the indicator. Are your results the same as before? Explain what you have observed in terms of equilibrium. What do you think was the original condition of the colored pigment solution? Neutral? Acid? Alkaline? Why?

Follow-up:

For this, you will need some additional equipment and materials:

test tube rack
nine small test tubes
tablespoon measure
pH paper
a third medicine dropper

Put a tablespoonful of water in each of nine test tubes in a test tube rack. Beginning at the left, add vinegar to the first four tubes as follows: (Use the same dropper that you used with the vinegar before.)

No. 1	20 drops	No. 3	10 drops
No. 2	15 drops	No. 4	5 drops

Do not add anything to the water in test tube No. 5. Continuing, then, from left to right, add ammonia to the remaining four tubes as follows: (Use the same dropper that you used with the ammonia before.)

No. 6	5 drops	No. 8	15 drops
No. 7	10 drops	No. 9	20 drops

Now you have a gradient of dilutions from left to right, ranging from very acid, through neutral, to very alkaline.

pH paper contains a pigment which, like that in red cabbage, changes color, becoming red with acid, blue with alkaline. Test your gradient of acidity and alkalinity with pH paper. Note color changes. Do you obtain a gradient of color? Are they reversible in the case of the paper?

Add a few drops of the cabbage pigment solution to each of the test tube dilutions. Use a third medicine dropper. Note all color changes, both kind and degree. Do you obtain a gradient of color? Why? What would you say as to the relative sensitivity of pH paper as compared to your cabbage pigment solution? Are both equally sensitive?

What practical use do indicators have? What is meant by pH? How is it related to what you have been doing?

EVALUATION:

When you have finished this unit, you will have had an evaluation on vocabulary as presented by the crossword puzzle. All of the lab activities have questions relating to the laboratory experiments which serve as a self-evaluation as well as a good review. See your teacher and you will be given an evaluating exercise.

Resources:

1. Physical Science, Anderson, Lippincott Co., 1972
2. Pathways, Oxenhorn, Globe Book Company, New York 10010
   - Chemistry 1 - The Materials of Nature
   - Chemistry 1 - Laboratory Work Book
   - Chemistry 2 - Chemistry of Mixtures
   - Chemistry 2 - Laboratory Work Book
   - Chemistry 3 - Chemistry of Metals
   - Chemistry 3 - Laboratory Work Book
3. Lab-Inquiry Text - Properties of Matter, Cambridge Book Co., New York
4. Fingerprinting Matter, Board of Education of Baltimore County, Towson, Md.

Notes on Activities:

A. A collection of empty containers which held the household materials are convenient to have - student may make this collection for class use. To make this list fairly accurate and complete, the students need class discussion and teacher's help.

C. Reading and diagrams in this activity will help student with Activity No. 2.

D. Local garden and lawn supply stores can supply this information. Students can bring in empty fertilizer sacks.

E. Follow experiment as written - add household ammonia to materials needed. Caution students on handling chemicals, particularly, hydrochloric acid, household ammonia. Dilute hydrochloric acid 1-3 before using.

F. When using Problems 4-1 - to observe physical change in substance - the use of coffee and tea will make the experiment more useful.

K. Materials used:
   oranges or grapefruit for lemons
   apples or peaches for tomatoes
   use white vinegar for nitric acid
   dilute sodium hydroxide - 5% solution
   dilute sulfuric acid - 1-6
   caution students on strong acid and base

L. This experiment requires 2 lab periods. Do not rush the heating - Close Supervision Necessary. OPTIONAL 5M NaOH SOL. (20g NaOH per 100 ml H_2O) Caution - This is a very strong base. Goggles for students.

M. You may want to use a larger beaker with students placing the objects they are cleaning in the larger beaker.

   Step 3-4 may be done in an aluminum pan - which does the cleaning.

N. The red cabbage pigment can be extracted with cold water, but more of it will go into solution if the water is hot.

   You may expand this laboratory experience to include other indicators, and to study the pH of various solutions in the environment: water in an aquarium, water from a marsh, water from a lake, water from a clean stream, water from a polluted stream, water it which soil samples have been allowed to stand.

Key to Crossword Puzzle

ACROSS

3 lye
4 Zn
5 physical
8 detergent
10 atom
11 base
12 sugar
13 mineral
14 Fe
15 salt
17 soap
18 Mg
20 calcium
21 oxygen
22 litmus

DOWN

2 indicator
5 potassium
6 Hm
7 chemical
9 nitrogen
12 symbol
16 acid
19 lye

Evaluation Form for Teachers

1. Name of the mini course _____

2. Was this unit appropriate to the level of your students?

3. Explain how this mini course was used with your students. (Individual, small group, or total class)

4. Identify the plus factors for this course.

5. List the changes that you would recommend for improvement.

7. Did you use any other valuable resources in teaching this unit? If so, please list.

PLEASE RETURN TO SCIENCE SUPERVISOR'S OFFICE AS SOON AS YOU COMPLETE THE COURSE.

ADDITIONAL SCIENCE MINI-COURSES

LIFE SCIENCE	Prepared by
A Study for the Birds	Terrence Best
Creepy Critters (Snakes)	Terrence Best
How's Your Plumbing?	Paul Cook
Guess Who's Been Here for Dinner	Paul Cook
Plants - The "Other" Living Things	Sharon Sheffield
Let's Look at You - The Human Organism	Sharon Sheffield
Classification: Why is There a Need?	Melvin Whitfield
Protist: The "Unseen" Kingdom	Melvin Whitfield

EARTH SCIENCE	
Coastline Development	Nelson Ford
Ocean Currents	John Fradiska
Features of the Ocean Floor (Ocean Floor Topography)	John Fradiska
Space and Its Problems	John Geist
Invertebrate Fossils: Clues to the Distant Past	John Geist
An Attempt towards Independent Study in Astronomy	John Geist

PHYSICAL SCIENCE	
Household Chemistry	Ross Foltz
Notions on Motions	Kenneth Howard
Environmental Chemistry	Fred Meyers