DOCUMENT RESUME

ED 064 083 SE 013 653

TITLE	Science: Introduction to Chemistry, Organic Chemistry, Qualitative Analysis, Introduction to Biochemistry. Authorized Course of Instruction for the Quinmester Program.
INSTITUTION	Dade County Public Schools, Miami, Fla.
PUB DATE	71
NOTE	78p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Chemical Analysis; *Chemistry; Instruction; *Objectives; *Organic Chemistry; Secondary School Science; *Teaching Guides; Units of Study (Subject Fields)
IDENTIFIERS	*Quinmester Program

ABSTRACT

Performance objectives are stated for each of the secondary school units included in this package of instructional guides prepared for the Dade County Florida Quinmester Program. All four units are concerned with chemistry: "Introduction of Chemistry," "Organic Chemistry," "Qualitative Analysis," and "Introduction to Biochemistry." Lists of texts, films, filmstrips, and other instructional aids are included in each package. A course outline summarizing the content of the units, numerous suggestions for experiments, activities, and projects are given. A master sheet showing the relationship of each suggested activity to the objectives of the package is appended to each booklet. (TS)

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

DADE COUNTY PUBLIC SCHOOLS

Science· INTRODUCTION TO CHEMISTRY 5316.01

DIVISION OF INSTRUCTION•1971

INTRODUCTION TO CHEMISTRY

5316.01

SCIENCE

(Experimental)

Written by Chemistry Advisory Committee
First Revision by J. Buffaloe

for the

DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida
1971

Published by the Dade County School Board

Copies of this publication may be obtained through

Textbook Services
2210 S.W. Third Street
Miami, Florida 33135

Price: $.75

TABLE OF CONTENTS

COURSE DESCRIPTION:

Introduction to Chemistry is suggested as the first course for Chemistry I or Nursing Chemistry. The investigative approach is used and as many laboratory experiments and teacher demonstrations as possible should be included. Through laboratory and class work, students should become skilled in applying a scientific approach to the explanation of scientific phenomena, recognizing and using laboratory equipment, and using the periodic table to predict physical and chemical properties of the elements. The study of the periodic table should culminate in a study of atomic structure.

COURSE ENROLLMENT GUIDELINES:

There are no prerequisites for this course. Students should have average or above average ability to be successful. The student who plans to continue in chemistry should take Scientific Mathematics.

STATE ADOPTED TEXT BOOKS:

1. O'Connor, Davis, Haenisch, MacNab, and McClellan. Chemistry: Experiments and Principles. Atlanta: Raytheon Education Company, 1968.

2. Choppin and Jaffe. Chemistry: Science of Matter, Energy and Change. Morristown, New Jersey: Silver Burdett Co., 1965.

3. Greenstone, Sutman, and Hollingworth. Concepts in Chemistry. New York: Harcourt, Brace and World, Inc., 1966.

4. Metcalfe, Williams, and Castka. Modern Chemistry. New York: Holt, Rinehart and Winston, Inc., 1966.

OBJECTIVES:

1. Given a problem, the student will solve it using the scientific approach. The student will

   a. Distinguish between an observation and an interpretation,
   b. Record data,
   c. Recognize regularities, and
   d. Hypothesize.

2. Students will recognize and use correctly the following pieces of laboratory equipment according to the specifications of each: balance, thermometer, graduated cylinder, gas burner, pipette, buret, and filter paper.

3. Given the atomic number and mass number of an atom the student will state the number of protons, neutrons, and electrons in the atom.

4. The student will select from a list of substances those that are elements, compounds, and mixtures.

5. Given a list of symbols and formulas, the student will separate them into two lists putting only symbols in one and only formulas in the second.

6. Given a list of names of pure chemicals, the student will select those which represent molecules and state which atoms compose each chemical.

7. Given a periodic table, the student will construct the "stair step" line which separates the metals from the nonmetals.

8. Given a periodic table, the student will, within a family and a period, cite the trends in size, formation of ions, chemical activities, and types of bonds formed.

9. Given a periodic table and a table of common ions and their names, the student will write formulas for various compounds.

10. Given a periodic table and a table of common ions and their names, the student will write names of various compounds.

11. Given the atomic number and the atomic orbital chart, the student will write the s, p, d, f electron configuration of the first 30 elements.

COURSE OUTLINE:

I. Investigative Approach to Scientific Phenomena

II. Atomic Theory

III. Periodic Table

A. Metals and non-metals

B. Similarities of families and periods (chemical and physical)

1. Size of atoms

2. Formation of ions

a. Ionization energy

b. Electronegativity (mention only for Nursing Chemistry)

3. Chemical activity and types of bonds formed

C. Simple formula writing and nomenclature

IV. Atomic Structure (Limit discussion in nursing chemistry. Students should have the information necessary for an understanding of bonding in a later course.)

A. Particles in the nucleus

B. s, p, d, f configurations

EXPERIMENTS:

Castka, Metcalfe, and Williams, Exercises and Experiments in Chemistry, New York: Holt, Rinehart and Winston, 1966.

1. Laboratory Procedures- use of burner, glass manipulations, the balance, handling of solids, measuring liquids, filtration, assembling apparatus, precision, etc. (p. 119)

2. Mixtures and compounds (pp. 129-130)

3. Physical and Chemical Changes (pp. 131-132)

4. Group II metals and Their Compounds (pp. 263-64)

Cotton and Lynch. Chemistry an Investigative Approach. New York: Houghton, Mifflin and Co., 1968.

5. The Behavior of Solids on Warming (pp. 5-6)

6. Melting Temperature (pp. 8-10)

7. Combustion of a Candle (pp. 16-18)

Davis, MacNab, Haenisah, McClellan, and O'Connor. Laboratory Manual for Chemistry: Experiments and Principles. Atlanta: Raytheon Education Co., 1968.

8. Observation of a Candle (p. 1)

9. Observing Evidence of Interaction (p. 2)

10. Searching for Regularity (pp. 3-5)

11. Weighing an Ojbect Immersed in Two Different Liquids (pp. 6-7)

Ellis and Toon. Laboratory Experiments for Foundations of Chemistry. New York: Holt, Rinehart, and Winston. 1968.

12. Introducing the Laboratory Program (pp. 1-12)

13. Analysis of a Mixture (pp. 13-16)

14. Development of a Scientific Model (pp. 17-18)

15. Measurement: The Basis of Quantitative Chemistry (pp. 19-29)

Ferguson, Schmuckler, and Siegelman. Investigating Matter, Energy, and Change. Morristown, New Jersey: Silver Burdett Co., 1966.

16. Observation and Experiment: Recognizing Chemical Change (p. 3)

17. Chlorine, Bromine, and Iodine (pp. 105-111)

18. Atomic Theory and Chemical Periodicity (pp.125-127)

Geffner, Lauren. Experimental Chemistry and Workbook. New York: Amsco Publications, 1968.

19. Laboratory Techniques (pp. 1-8)

Greenstone. Concepts in Chemistry - Laboratory Manual. Atlanta: Harcourt, Brace, and World. 1966.

20. Introduction to the Nature of Matter (pp. 17-22)

21. Relationships Within the Halogen Family (p. 120)

Pimentel, George C. (ed). Chemistry: An Experimental Science. Laboratory Manual. San Francisco: W. H. Freeman and Co., 1963.

22. Reactions Between Ions in Aqueous Solutions (p.34)

23. Reactions Between Ions in Solution (p. 59)

Smith, William T. Jr., Laboratory Manual for College Chemistry. New York: Harper and Row, Publishers, 1966.

24. Changes; Substances (pp. 25-26)

25. Density (p. 13)

26. Elementary Laboratory Methods (pp. 1-[illegible]

27. Percent Composition of a Compounds and Relative Atomic Weights (pp. 17-18)

Curriculum Bulletin 8-D. Chemistry 2, Advanced Placement Course Outline and Manual of Laboratory Activities. Dade County, Florida: Board of Public Instruction, 1966.

28. A Comparison of Chlorine, Bromine, and Iodine (pp. 170-172)

DEMONSTRATIONS:

Alyea and Dutton. Tested Demonstrations in Chemistry. Easton, Penn.: Div. of Chemical Education of the American Chemical Society, 1962.

1. Group I - Alkali Metals (p. 27)
2. Group II - Alkaline Earth Metals (p. 29)
3. Aluminum - The Rare Earth Metals (pp. 31 and 95)
4. Boron and Silicon (pp. 33, 95)
5. Carbon and Its Inorganic Compounds (pp. 35, 96)
6. Nitrogen Chemistry (pp. 37, 98)
7. The Phosphorus Family (pp. 39, 100)
8. Group VI - The Sulfur Family (pp. 41, 101)
9. The Halogens (pp. 43, 102)
10. Metals of Groups IV through VIII (pp. 45, 103)
11. Group I - The Alkali Metals - The Copper Group (p. 93)
12. Group II - Earth Metals- The Zinc Group (p. 94)

DADE COUNTY 16 mm FILMS

1. Aristole and the Scientific Method
   AV#1-12492, 14', C.

2. "A" is for Atom
   AV#1-10790, 16', C.

3. Atomic Energy
   AV#1-01940, 10', B and W.

4. Chemical Families
   AV#1-10819, 21', C.

5. Physical and Chemical Change
   AV#1-30341, 28', B and W.

6. Preface to Chemistry
   AV# 1-10888, 16', B and W.

7. Using the Laboratory
   AV#1-10905, 11', C.

Educators' Guide to Free Films 29th Edition 1969

8. Fun with Metals (Am Society for Metals)
   30'

9. How Metals Behave
   30', C.

FILMSTRIPS 10800 SERIES ENCYCLOPEDIA BRITANNICA FILMS INC.

1. Determination of a Formula

2. Experiments with Atomic Particles

3. Ionization

4. Introduction to Chemistry Lab Parts 1 and 2

5. Size of Molecules

FILM LOOPS

Encyclopedia Britannica

1. Decanting and Washing a Residue, #80457,C.
2. Density, #80602, C.
3. Filtering, #80455, C.
4. Using a Burette, #80456, C.
5. Weighing Triple Beam Balance, #80452, C.
6. Weighing Procedure, # 80451, C.
7. Volume, #80603, C.

EALING CORPORATION CAMBRIDGE, MASS.

8. Measuring Techniques, Part I and 2 #81-000 and 81-001, C.
9. Weighing Techniques, Part I and 2 #81-002 and 81-003, C.
10. Handling Solids and Liquids, #84-0017, C.
11. The Bunsen Burner, #84-0025, C.
12. Heating Solids, #84-0033, C.
13. Heating Liquids, #84-0041, C.
14. Use of Pipette, #84-0090,C.
15. Working Glass, #84-0108, C.
16. Definite Proportions, #84-0165, C.
17. Combining Volumes, #84-0173, C.
18. Conservation of Mass, #80-3254, C.
19. Mass of an Atom, #80-3353, C.

20. The Melting Point of a Pure Substance, 80-3411, C.

21. Rutherford Scattering, #80-3965, C.

22. Thomson Model of the Atom, #80-3957, C.

DADE COUNTY TRANSPARENCIES

1. Chemistry Laboratory Techniques, AV#2-00164, B & W.

2. Periodic Table of the Elements, AV#2-00143, C.

Transparency masters are available from the multi-media center at the Lindsey Hopkins Building. If specific transparencies are requested, up to 200 per school year can be made at no cost.

REPORTS

1. Historical background and development of

   a. Scientific approach (include some classical problems and their solutions)
   b. Atomic theory
   c. Three atomic models ("plum pudding", planetary, and quantum mechanical)
   d. Periodic table

2. An explanation of the properties of the metalloids.

3. List and explain the similarities and trends in any family or period on the periodic table.

4. Types of bonds and conditions necessary for their formation

5. Relationship between atomic structure and

   a. Ionization energy
   b. Electronegativity
   c. Bond type
   d. Metallic properties
   e. Chemical activity

6. Explanation of the emission of light by excited chemicals

7. Variation in properties of isotopes

8. How is the mass number determined?

9. What is the relationship between mass number and the gram atomic mass?

PROJECTS

1. Prepare models of atoms showing size

2. Develop a list of properties and methods to test them which would identify chemicals as elements, compounds, and mixtures.

3. Predict trends in compounds or elements based on atomic structure -- test to show correctness of prediction

4. Glass work: make a T or Y tube

5. Analyze canal water for specific ions such as Cl^- and Hg_2^{2}

6. Flame test for cations

7. Test various factors which affect

   a. Crystal growth
   b. Fermentation of alcohol
   c. Conductance of electricity by a solution
   d. A metal or metalloid.

8. Devise various methods to separate mixtures

SAMPLE PROBLEMS

1. Complete the following table.

Element	Atomic No.	# protons	# Electrons	#Neutrons	Mass No.
Al	13	___	___	___	27
Ca	___	___	20	20	___
C	___	6	___	6	___
K^{+}	19	___	___	___	39
O^{-2}	8	___	___	___	16
O^{-2}	___	___	___	___	17

2. All of the following particles have the same number of electrons except for one. Choose the one.

   K^{+1}, S^{-2}, Ca^{+2}, Cl^{-}, Ar, Al^{+3}

3. Write the formula for the following compounds.

   a. Potassium phosphate
   b. Magnesium bromide
   c. Aluminum sulfite
   d. Tin (IV) stannic oxalate

4. What are the changes on ions made from the following atoms? Use the periodic table only.

   Ba, As, Br, Al, In

5. Nitrogen forms five compounds with oxygen in which 1.00 gram of nitrogen combines with 0.572, 1.14, 1.73, 2.28, and 2.85 grams of oxtgen respectively. Use this data to illustrate or explain the law of simple multiple proportion.

6. A student reacted hydrogen gas and oxygen gas to produce water. In the first trial 0.56 grams of hydrogen gas and 4.48 grams of oxygen gas reacted. In the second trial 0.42 grams of hydrogen gas and 3.36 grams of oxygen gas reacted. Use the numbers provided to show that the compound produced was the same.

DISCUSSION QUESTIONS

1. How could you prove that water is a compound rather than an element?

2. How could you prove that air is a mixture rather than an element?

3. Write the names of the following substances: CO, Co, FeS, $CuSO_3$, $NaNO_3$, K_3PO_4, etc.

4. What does a formula tell you?

5. How and why (based on structure) are metals and nonmetals different?

6. Compare and contrast ions and the inert gases they imitate both structurally and chemically.

7. Is there a similarity in atomic structure that would explain trends in families on the periodic table?

8. What is a scientific model? What is the purpose of a scientific model?

9. Is it ever wise to discard data?

10. Why do the ionization energies of Be and N not follow the trend in the 2nd period?

11. What conditions must be present when a covalent bond is formed? Ionic bond?

12. What basic characteristics of an atom determine its properties?

SOURCES OF SPEAKERS AND FIELD TRIPS

Such activities at this point in a chemistry course should create interest, inform students of career opportunities, and allow the student to see chemists at work. Below are listed organizations and businesses which will, by appointment, provide tours of their facilities or send speakers to the schools.

1. Dade County Medical Association
   2 Southeast 13 Street

2. East Coast District Dental Society
   2 Southeast 13 Street

3. South Florida Veterinary Medical Association
   Dr. Eli Gersten, 6100 South Dixie Highway, Miami.

4. Southeast Florida Pharmaceutical Association,
   Mr. Ben Saks, 2337 Southwest 4 Street.

5. City of Miami Water Plants, Director of Department of Water and Sewers.

6. Dade County Air and Water Pollution Control
   Mr. Peter Baljet, 864 Northwest 23 Street.

7. Dade County Department of Public Health, Director, Division of Health Education, 1350 Northwest 14 Street.

8. American Society for Metals, Dr. H.A.B. Wiseman, University of Miami.

9. American Institute of Industrial Engineers, Inc., Mr. R.B. Levin, Standard Chemical Co., P.O. Box 667, Northwest Station, 33147.

10. University of Miami School of Medicine.

11. Dade Reagents Inc., 1851 Delaware Parkway, Miami.

REFERENCES

1. Alberty, Robert A. and Daniels, Farrington, Physical Chemistry. New York: John Wiley and Sons, Inc., 1955.

2. Barrow, Gordon M.; Kenney, Malcolm E.; Lassila, Gean D.; Little, Robert L.; and Thompson, Warren E. Chemical Bonding from Understanding Chemistry. New York: W.A. Benjamin Inc., 1967.

3. Castle, Metcalfe, and Williams. Laboratory Experiments in Chemistry. New York: Holt, Rinehart, and Winston, 1966.

4. Mahan, Bruce H. College Chemistry. Reading, Mass.: Addison and Wesley Publishing Co., 1969.

5. Mariella, Raymond. Chemistry of Life Processes. New York: Harcourt, Brace, and World, 1968.

6. O'Connor, Paul R.; Davis, Joseph E. Jr.; Haenisch, Edward L.; MacNab, W. Keith; and McClellan, A.L. Lab Manual for Chemistry Experiments and Principles. Atlanta: Raytheon Education Co., 1968.

7. Pauling, Linus. The Nature of the Chemical Bond. Ithaca, New York: Cornell University Press, 1960.

8. Pimentel, George C. (ed). Chemistry: an Experimental Science. San Francisco: W.H. Freeman and Co., 1963.

9. Plane, Robert A. and Sienko, Michell J. Chemistry (2nd ed). New York: McGraw-Hill, 1961.

10. Ryschkewitsch, George E. Chemical Bonding and the Geometry of Molecules. New York: Reinhold Publishing Corp., 1963.

11. Sebera, Donald K. Electronic Structure and Chemical Bonding. New York: Blaisdell Publishing Co., 1964.

12. Semat, Henry and White, Harvey E. Atomic Age Physics. New York: Holt, Rinehart, and Winston, Inc., 1963.

13. Sienko, M. J. Stoichiometry and Structure. Freshman Chemistry Problems and How to Solve Them. New York: W.S. Benjamin, 1964.

14. Sisler, Harry H. Electronic Structure Properties and the Periodic Law. New York: Reinhold Publishing Corp., 1965.

15. Smith, William T. and Wood, Jesse H. Laboratory Manual for College Chemistry. New York: Harper and Row Publishers, 1966.

16. White, Emil H. Chemical Background for Biological Sciences. Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1964.

17. White, Harvey E. Modern College Physics. Princeton, New Jersey: D. van Nostrand Co. Inc., 1962.

18. Vaczek, Louis. The Enjoyment of Chemistry. New York: Viking Press, 1964.

MASTER SHEET - INTRODUCTION TO CHEMISTRY

Objectives	Experiments	Textbooks	References	Films	Film Loops	Demonstrations	Film Strips	Trans-parencies
1	8, 9, 5, 6, 10, 11, 14, 25, 26, 27.	1 pp.1-14 2 pp.6-12 4 pp.1-5	1 p.3 8 pp.1-16 18 pp.25-34	1,6	16 17 18 20			
2	1, 2, 3, 8, 9, 10, 11, 12, 15, 16 19, 24		3 pp.172-173 6 Appendix 9	7	1-15		4	1
3		1 pp.125-137 2 pp.199, 200,204. 3 pp.31-34 4 pp.41-46	5 pp.3-5 17 pp.167-169 9 pp.23-46 18 pp.82-83 16 pp.4,5 8 pp.85-90	3,2			2	
4	2, 7, 13	1 pp.27-29 2 pp.12-19 3 pp.15-18 4 pp.28-34	4 pp.1-11 5 pp.2,3 8 pp.21-32 18 pp.61-65	5				
5 and 6		1 pp.25-30 2 pp.15,16, 18 3 pp.15-18 4 pp.29-32	5 pp.2,3 8 pp.21-32 18 pp.51-56					
7 and 8	4, 17, 18, 22, 23, 21, 28	1 pp.103-120 2 pp.171-183 3 pp.71-91 4 pp.64-78	14 pp.41-61 103,115 9 pp.46-49& 77-89 18 pp.104-130 16 pp.14-21 15 pp.21-22 8 pp.90-106	4,8, 9	19	1-12	3,5	2
9 and 10		1 pp.29-3. 2 pp.128-141 3 pp.15-18 4 pp.97-100	15 p.37 18 pp.88-92 8 pp.78-82 13 pp.143-152 5 pp.17-19				1	
11		1 pp.147-165 2 pp.245-257 3 pp.42-46& 83 4 pp.51-63	8 pp.252-272 16 pp.8-14 18 pp.105-125 7 pp.28-57 1 pp.536-573 11 pp.33-61 12 pp.55-63 17 pp.502-510 14 pp.1-35 10 pp.1-30 5 pp.5-15 2 pp.1-42 4 pp.29-30		21 22			

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

DADE COUNTY PUBLIC SCHOOLS

Science: ORGANIC CHEMISTRY 5317.65

DIVISION OF INSTRUCTION • 1971

ORGANIC CHEMISTRY
5317.65
SCIENCE

(Experimental)

Written by Jacqueline Buffaloe and Cindy LaPerche
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
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ORGANIC CHEMISTRY

COURSE DESCRIPTION

This course is intended for the student who is ready for first year college material. It partially prepares the student for the Advanced Placement Test. Laboratory work concerning the preparation and reactions of representative compounds from the functional groups will be an integral part of the course. Guidelines for activities in the Advanced Placement courses are in the current edition of Advanced Placement Course Descriptions available at each high school.

ENROLLMENT GUIDELINES

Students should have successfully completed Scientific Mathematics, Introduction to Chemistry, Reactions of Atoms and Molecules, The Dynamic Nature of Atoms and Molecules, and Energy of Atoms and Molecules or show readiness as a result of testing. It is suggested that the student be advanced in mathematics.

STATE ADOPTED TEXTS

1. Choppin and Jaffee. Chemistry: Science of Matter, Energy and Change. Morristown, New Jersey: Silver Burdett Co., 1965.

2. Greenstone, Sutman, and Hollingworth. Concepts in Chemistry. New York: Harcourt, Brace, and World, 1966.

3. Mahan, Bruce. College Chemistry. Reading, Massachusetts: Addison-Wesley, 1966.

4. Metcalfe, Williams, and Castka. Modern Chemistry. New York: Holt, Rinehart, and Winston, Inc., 1966.

5. O'Connor, Davis, Haenisch, McNab, and McClellan. Chemistry: Experiments and Principles. Atlanta: Raytheon Education Company, 1968.

PERFORMANCE OBJECTIVES

1. Given the formulas of an organic compound and an inorganic compound, the student will apply the information inferred from the bonding types to justify the

   (a) solubility of the compounds in common solvents,

   (b) relative melting points of the compounds, and

   (c) products of combustion.

2. Given a list of formulas for organic compounds, the student will organize them in order of increasing melting points and solubilities in water.

3. Given a list of formulas of organic compounds, the student will select those which represent resonance structures, and those which represent paramagnetic structures.

4. Given molecular formulas of compounds containing coordinate covalent bonds, multiple bonds, hybrid bonds, and bonds which resonate, the student will illustrate by using Lewis electron dot and orbital diagrams.

5. Given a structural formula for any one of the following types of compounds:

   (a) aliphatic hydrocarbons
   (b) alcohols
   (c) ethers
   (d) aldehydes
   (e) ketones
   (f) organic acids
   (g) esters
   (h) aromatic hydrocarbons

   the student will state the International Union of Chemistry name and common name.

6. Given a general formula for any of the types of compounds listed in Objective 5, the student will compare the melting points, solubilities in water, and chemical activities of two specific compounds which agree with the general formula when

   (a) the compounds have carbon chains of different lengths,
   (b) one compound is branched and the other has a straight carbon chain,
   (c) the compounds are isomers, and
   (d) one of the compounds is halogen substituted.

PERFORMANCE OBJECTIVES

7. Given the name of any of the functional groups listed in Objective 5, the student will write an equation showing a specific chemical from that group participating in any of the types of reactions listed below:

   (a) oxidation
   (b) reduction
   (c) addition
   (d) substitution
   (e) acid-base
   (f) polymerization
   (g) dehydration

8. Given the structural formula for any compound from the functional groups listed in Objective 5, the student will write equations showing two different methods of preparation.

COURSE OUTLINE

I. Introduction to Organic Chemistry

A. Definition of organic chemistry

B. Importance of organic chemistry

C. Elements most commonly found in organic compounds

D. Basic differences in organic and inorganic chemistry
1. Distinguishing bond types
a) Covalent bond
b) Ionic bond
2. Combustion
3. Stability toward heat
4. Solubility
5. Activity of molecular species

II. Types of Bonds in Organic Compounds

A. Covalent bonds
1. Coordinate covalent
2. Percent ionic character or polarity
3. Resonance structures
4. Hybridization
5. Paramagnetic structures
6. Multiple covalent bonds

B. Ionic bonds

C. Hydrogen bonds

D. van der Waals forces

III. Nomenclature, Physical and Chemical Properties, Typical Reactions, Methods of Preparation, Types of Isomers Formed, and Uses for

A. Aliphatic hydrocarbons

B. Alcohols

C. Ethers

D. Aldehydes and ketones

E. Carboxylic acids

F. Esters

G. Aromatic hydrocarbons

EXPERIMENTS

Adams, Roger and Johnson, John R. Laboratory Experiments in Organic Chemistry. New York: McMillan, 1959.

1. Determination of Melting Points (Exp. 3, pp. 67-73)
2. Reactions of Hydrocarbons (Exp. 9, pp. 147-159)
3. Ethylene (Exp. 10a, pp. 159-165)
4. Acetylene (Ethyne) (Exp. 12, pp. 181-184)
5. Ethanol (Ethyl Alcohol) (Exp. 13, pp. 185-187)
6. Reactions of Alcohol (Exp. 14, pp. 189-193)
7. n-Butyl Acetate (Exp. 17, pp. 219-221)
8. Fats and Fatty Oils (Soap) (Exp. 18, pp. 223-225)
9. Formaldehyde-Test Reactions for Aldehydes (Exp. 22a, pp. 239-243)
10. Carbonyl Reactions of Aldehydes and Ketones (Exp. 24, pp. 251-257)
11. Iodoform (Exp. 25, p. 259)
12. Reactions of Primary, Secondary, and Tertiary Amines (Exp. 25, pp. 323-325)

Barrett, Richard L. and Price, Jack. Chemistry: A Modern Course Laboratory Manual. Columbus, Ohio: Charles E. Merrill Books, Inc., 1965.

13. Hydrocarbons (Exp. 37, pp. 83-85)
14. Esters (Exp. 39, pp. 89-90)

Castka, Joseph F.; Metcalfe, H. Clark and Williams, John E. Exercises and Experiments in Chemistry. New York: Holt, Rinehart and Winston, 1966.

15. Solution and Molecular Polarity (Exp. 20, pp. 167-169)
16. Conductivity of Solutions (Exp. 24, pp. 181-183)
17. Hydrocarbons (Exp. 36, pp. 221-225)
18. Hydrocarbon Substitution Products (Exp. 37, pp. 227-230)

Chemistry 2: Advanced Placement Course Outline and Manual of Laboratory Activities. Curriculum Bulletin 8-D. Dade County Public Schools, 1966.

19. Some Elementary Experiments in Organic Chemistry (pp. 152-157)
20. Hydrocarbon Substitution Products (pp. 158-159)
21. Organic Reactions (pp. 160-161)

Ferguson, Harold; Schmuckler, Joseph and Siegelman, Irwin. Investigating Matter, Energy and Change. Morristown, New Jersey: Silver Burdett Co., 1966.

22. Organic Synthesis I (Exp. 32, p. 203)
23. Organic Synthesis II (Exp. 32, p. 204)
24. Ester Hydrolysis (Exp. 33, pp. 204-205)
25. Giant Molecules I (Exp. 34, p. 205)
26. Giant Molecules II (Exp. 34, p. 206)

EXPERIMENTS

Fieser, Louis F. Organic Experiments, second edition. Lexington, Massachusetts: Raytheon Education Company, 1968.

Garrett, Albert B. Semimicro Laboratory Experiments and Projects for a First Course in Modern Chemistry. New York: Ginn and Company, 1963.

27. Some Reactions of Organic Compounds (pp. 129-133)
28. Use of Molecular Models (pp. 126-127)
29. Saponification; Soap; Detergents (pp. 142-143)
30. Coal Tar and Some Aromatics (pp. 145-148)
31. Polymers (pp. 156-158)

Geffner, Lauren. Experimental Chemistry and Workbook. New York: Amsco Publications, 1968.

32. Molecular Models of Some Organic Compounds (Exp. 47, pp. 193-199)
33. Reactions of Functional Organic Groups (Exp. 48, pp. 199-203)
34. A Study of Isomers (Exp. 49, pp. 203-207)
35. Esters (Exp. 50, pp. 207-211)

Greenstone, Arthur W. Concepts in Chemistry Laboratory Manual. Atlanta, Georgia: Harcourt, Brace, and World, 1966.

36. Molecular Polarity (Exp. 54, pp. 92-95)
37. Carbon Compounds--Molecular Models (Exp. 55, pp. 152-155)
38. The Hydrocarbons (Exp. 55, pp. 155-156)
39. Some Hydrocarbon Substitution Compounds (Exp. 56, pp. 157-159)
40. Esterification and Saponification (Exp. 57, pp. 159-161)

Helmkamp, George K. and Johnson, Harry W. Jr. Selected Experiments in Organic Chemistry, second edition. San Francisco: W. H. Freeman and Co., 1968.

41. Melting Points (Exp. 1A-1B, pp. 1-6)
42. Synthesis of n-Amyl Acetate (Exp. 6C, pp. 56-57)
43. Competitive Sn Reactions: n-Butyl Alcohol and tertiary-Butyl Alcohol (Exp. 7A and 7B, pp. 59-61)
44. Carbon to Carbon Double Bonds (Exp. 8A, pp. 69-70)
45. Organic Halides (Exp. 8B, pp. 71-74)
46. Alcohols and Ethers (Exp. 8C, pp. 75-77)
47. Elimination Reactions (Preparation of Alkenes) (Exp. 9A, 9B, 9C, 9D, pp. 77-84)
48. Synthesis of Cyclohexene (Exp. 10A, pp. 85-87)
49. Characteristics of Products (Exp. 10B, pp. 87-88)
50. Stereochemistry (Exp. 12A, pp. 98-99)
51. Conjugate Addition (Exp. 14F, pp. 116-118)
52. Reactions of Functional Groups: Carbonyl Compounds and Amines (Exp. 19, pp. 159-162)
53. Identification of a General Unknown (Exp. 20A, pp. 164-167)
54. Generalizations on Solubilities (Appendix I, p. 175)

EXPERIMENTS

Mariella, Raymond. Chemistry of Life Processes--Selected Laboratory Experiments. New York: Harcourt, Brace, and World, Inc., 1968.

55. Molecular Models: Isomerism (Exp. 20-25, pp. 51-57)
56. Preparation of Ethylene (Ethene) (Exp. 26, pp. 59-60)
57. Preparation of Acetylene (Ethyne) (Exp. 27, p. 61)
58. Alkanes, Alkenes, and Aromatic Hydrocarbons (Exp. 28, pp. 62-64)
59. Preparation of Ethyl Alcohol by Fermentation (Exp. 29, p. 64)
60. Iodoform (Exp. 30, p. 65)
61. Oxidation (Exp. 31, p. 66)
62. Special Oxidation (Exp. 32, p. 66)
63. Ketone Production (Exp. 33, p. 70)
64. Properties of Organic Acids (Exp. 34, pp. 73-74)
65. Esters (Exp. 35, p. 75)
66. Ethers (Exp. 36, p. 77)

Pimentel, George C., ed. Chemistry: An Experimental Science--Laboratory Manual. San Francisco: W. H. Freeman and Co., 1963.

67. Investigation of Some of the Properties of a Pair of Cistrans Isomers (Exp. 26, pp. 69-71)
68. Some Reactions of Hydrocarbons and of Alcohols (Exp. 28, pp. 75-77)
69. The Preparation of Some Derivitives of Organic Acids (Exp. 29, pp. 78-79)

Smith, Wm. T. and Wood, Jesse H. Laboratory Manual for College Chemistry.

70. Alcohols (Exp. 47, p. 208)
71. Ethers and Esters (Exp. 48, pp. 209-212)

Sturchio, Malcolm et al. Techniques of Chemistry. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1966.

72. Ethyl Alcohol (pp. 109-111)

Weaver, Elbert C. Scientific Experiments in Chemistry. New York: Holt, Rinehart and Winston, Inc., 1966.

73. Preparation of DDT (pp. 66-68)
74. Synthesis of a Dye (pp. 68-70)
75. Preparation of Esters (pp. 71-72)
76. Soap (pp. 72-73)
77. Rate of Hydrolysis of an Ester (pp. 74-76)
78. Interfacial Polymerization (pp. 77-79)

DEMONSTRATIONS

Alyea, Hubert N. and Dutton, Frederick B. Tested Demonstrations in General Chemistry. Easton, Pennsylvania: Journal of Chemical Education, 1962.

1. Carbon and Its Inorganic Compounds (p. 35)
2. Comparison of EtOH and Me_2O (p. 105)
3. Spot Test for Isomers (p. 105)
4. Distinguishing Isomers (p. 105)
5. Substitution and Addition (p. 105)
6. Free Redicals (p. 105)
7. Distillation of Petroleum (p. 106)
8. Cracking Petroleum (p. 106)
9. Oxidation of Hydrocarbons (p. 106)
10. Substituted Hydrocarbons (p. 106)
11. Ring Compounds (p. 106)
12. Plant Foods and Plant Products (p. 107)
13. Animal Foods and Products (p. 107)
14. Industrial Products (pp. 108-112)
15. Organic Preparations (pp. 112-113)

Greenstone, Arthur W. Concepts in Chemistry Laboratory Manual. Atlanta: Harcourt, Brace, and World, 1966.

16. The Conductivity of Chemical Compounds (Exp. 28, p. 90)

PROJECTS

1. Devise a method to identify a pure organic unknown.

2. Synthesize, purify, and identify by the formation of a derivative an unsaturated aldehyde or ketone or any other choice of compound desired.

3. Devise an experimental method to determine whether an organic compound has a resonance structure.

4. Experimentally determine the effect of various factors (pH, temperature, etc.) on the rate of alcohol production by fermentation.

5. Produce organic chemicals used for medical or cosmetic purposes (soap, toothpaste, aspirin, etc.).

6. Devise experimental methods used to separate various organic materials.

REPORTS

1. Explain the similarities and differences of the chemistry of carbon and its family members.

2. Explain the physical and chemical properties of a specific organic compound which has resonance or paramagnetic structures.

3. Describe methods by which chemicals dissolve.

4. Discuss factors which determine solubility in common solvents.

5. Explain the differences in solubilities and melting points of
   (a) homologous series of chemicals
   (b) isomers of various types, etc.

FIELD TRIPS

1. Key Pharmaceuticals, Inc.
   51 N.W. 176 Street
   625-0426
   625-2411

2. Sandoz-Wander, Inc.
   Crop Protection Dept. 248-4671
   381 North Krome Avenue, Homestead
   Experimental Farm 247-7865
   18900 S. W. 280 Street, Homestead

RELATED PROBLEMS

1. Determine the composition of the vapor above a mixture of carbon tetrachloride and toluene at 85 degrees C. using Raoult's Law. (Note to teacher: use 2 components for which a liquid-vapor composition diagram is available. Compare the composition to the actual composition of the vapor. Is the solution "ideal"?)

2. If a mixture of bromobenzene and water were subjected to steam distillation under diminished pressure, at 100 mm pressure, what would be the temperature of distillation and the weight composition of the distillate? Compare the results with the composition at 760 mm pressure.

3. Compound B has a distribution coefficient of 15 between benzene and water. How many extractions will be needed to extract 95% of B from an aqueous benzene solution of B containing 6 grams of B in 100 ml of water and 100 ml of benzene?

4. What quantity of each of the following agents would be required to combine with 1 gram of water: metallic Na? $MgSO_4$? $CaCl_2$ (change to $CaCl_2$-$4H_2O$)?

5. Determine the theoretical yield in grams for ethyl-methyl ether made by the reaction below when 6.9 grams of metallic sodium, 46 grams of absolute alcohol, and 49.7 grams of methyl iodide were reacted. Assume 15 grams of the ether was actually made. Determine the % yield.

$$C_2H_5OH + Na + CH_3I \rightarrow C_2H_5\text{-}O\text{-}CH_3 + NaI + 1/3\ H_2$$

6. Calculate the number of moles of H_2SO_4 in 50.0 ml of concentrated acid having an assay of 96% and specific gravity of 1.8355.

DADE COUNTY 16 mm FILMS

1. Carbon and Its Compounds
AV#1-01968, 10', BW

2. Synthesis of an Organic Compound (No. 4163)
AV#1-10890, 20', C

3. Mechanism of an Organic Reaction (No. 4166)
AV#1-10979, 20', C

FILMS FROM OTHER SOURCES

4. Science of Soap
Encyclopedia Britannica Films, Inc.
1150 Wilmette Ave., Wilmette, Ill.
1948, 10', BW, rent (668.1)

5. Waiting Harvest (Coal Tar Products)
United States Steel Co.
525 William Penn Place, Pittsburgh, Pa.
1954, 23', C, free

6. World That Nature Forgot
Modern Talking Picture Service, Inc.
45 Rockefeller Plaza, New York, New York
1955, 30', C, free

FILMSTRIPS

1. Covalent Bond
Discusses covalent bonds, describes bond energies, multiple bonds, the phenomena of resonance, molecules and polymers, and shapes of molecules. From the Atomic Diagrams Series.
1964, 31 frames, C

2. Organic Chemistry
Chemical Principles--A Series. 40 frames.

3. The Chemistry of Carbon and Silicon
From the High School Physical Science (1965-66FOM) Series L. C.,
42 frames, C

FILMSTRIPS

4. Hydrocarbons
   Chemistry, Set 4--A series

5. Organic Chemistry
   From the High School Science Club Series. 41 frames, C

MODELS

1. Molecular Model, Set "B", C 86, Museum of Science, AV#6-00026. Different colored balls, springs, wooden rods are used to represent atoms in molecular models.

SUGGESTED DISCUSSION QUESTIONS

1. How does the structure and type of bonds in a compound determine its solubility?

2. The melting point of carbon tetrachloride is below room temperature and that of sodium chloride is over 700 degrees C. The C-Cl bond energy is about 80 kcal/mole and the lattice energy of NaCl is 104.5 kcal/mole. The size of one unit of CCl_4 is much greater than one unit of NaCl and size increases the van der Waals forces. Explain the lack of correlation in the above facts and why the melting point difference exists using bond types as a basis.

3. How could you separate an aqueous solution of salt and alcohol? There are methods other than distillation.

4. The catalytic combustion of ammonia produces NO (g) and H_2O (g). What similarities and differences do you find in this reaction and the combustion of CH_4 (methane gas)? Consider:
   (a) change in oxidation states
   (b) activation energy
   (c) ΔH

SUGGESTED DISCUSSION QUESTIONS

5. How can you predict the formation of H-bonds, resonance structures, polar structures, multiple bonds?
   (a) Can a set of rules be followed? Construct and test a set.
   (b) What type of information will be needed?
   (c) What properties would these structural characteristics give the chemical?
   (d) Illustrate the usefulness of your set of rules by naming and writing a Lewis dot and orbital representation of each type of compound predicted.

6. What trend in melting points and solubilities exists in the homologous series? Explain the reason for this trend.

7. Is it possible to form a covalent bond by sharing an uneven number of electrons?

8. Describe the electronic structure of benzene. How does it react toward H_2, Br_2, HBr, and H_2SO_4?

9. What elements would be in a compound before it would form coordinate covalent bonds?

10. What is a "fat" and how is it "saponified"?

11. Write chemical equations, using structural formulas when appropriate, for the following:
    a. saponification of stearin, $(C_{17}H_{35}COO)_3C_3H_5$
    b. addition polymerization (in general)
    c. condensation polymerization (in general)
    d. any esterification reaction
    e. oxidation of ethanol by acidic dichromate solution to form acetaldehyde

12. Using chemical equations, outline a sequence of reactions that describes synthesis of formaldehyde starting from coal and water (you may use any catalyst and reagent).

13. What reasons can be suggested for diminished stability of bonding when a propane chain is closed to form cyclopropane?

14. Predict the products of a reaction between sodium hydroxide and chlorobenzene, and explain.

15. What kind of product would you expect to form when water is removed from a mixture of glycol and dicarboxylic acid?

REFERENCES

1. Crockford, H. D. and Knight, Samuel B. Fundamentals of Physical Chemistry. New York: John Wiley and Sons, Inc., 1959.

2. Daniels, Farrington and Alberty, Robert A. Physical Chemistry. New York: John Wiley and Sons, Inc., 1959.

3. Degering, Edward F., ed. Organic Chemistry. College Outline Series, Barnes and Noble, 1969.

4. Fieser, Louis F. Organic Experiments, 2nd ed. Lexington, Massachusetts: Raytheon Education Co., 1968.

5. Hine, Jack. Physical Organic Chemistry. New York: McGraw Hill Book Co., Inc., 1956.

6. Mariella, Raymond and Blau, Rose A. Chemistry of Life Processes. New York: Harcourt, Brace, and World, Inc., 1968.

7. Pauling, Linus. Nature of the Chemical Bond. Ithica, New York: Cornell University Press, 1964.

8. Pimentel, George C., ed. Chemistry: An Experimental Science. San Francisco: W. H. Freeman and Co., 1963.

9. Ryschkewitsch, George E. Chemical Bonding and the Geometry of Molecules. New York: Reinhold Publishing Corp., 1963.

10. Sanderson, Robert T. Teaching Chemistry with Models. Princeton, New Jersey: D. Van Nostrand Co., Inc., 1962.

11. Sebera, Donald K. Electronic Structure and Chemical Bonding. New York: Blaisdell Publishing Co., 1964.

12. Shriner, Ralph L. The Systematic Identification of Organic Compounds, 4th ed. New York: John Wiley and Sons, Inc., 1959.

13. Sienko, M. J. and Plane, Mitchell S. Chemistry. New York: McGraw-Hill Book Co., 1966.

14. Vanderwerf, Calvin A. Acids, Bases, and the Chemistry of the Covalent Bond. New York: Reinhold Publishing Corp., 1962.

15. White, Emil H. Chemical Background for the Biological Sciences. Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1964.

MASTER SHEET - ORGANIC CHEMISTRY

Objectives	Laboratory Experiments	State Adopted Texts	Demonstrations	Films	Filmstrips
1	1, 15, 16, 19, 27, 28, 32, 36, 37, 41	5 pp.329-337,357,359 2 pp.57,92-100,102-110, 131, 182-183,205-206 4 pp.194-196,202-211,288	1, 16,	1	2, 3, 5
2	1, 15, 16, 19, 36, 41, 54	5 pp329-337,347-352, 181-189 1 pp.258,278-284, 2 pp.92-100,131,102-110 4 pp.91-92			
3	32, 37, 49	1 p. 609 2 pp.109-110 4 pp.86,271-272 5 p.361			1
4	32, 37	1 pp.268-269,271-272, 274-280,609 2 pp.101,109-110,550,580 4 pp.93,269,271-272 5 pp.179-189,330			1
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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

QUALITATIVE ANALYSIS

5316.61

SCIENCE
(Experimental)

DADE COUNTY PUBLIC SCHOOLS

DIVISION OF INSTRUCTION • 1971

QUALITATIVE ANALYSIS

5316.61

SCIENCE

(Experimental)

Written by J. Buffaloe and J. Mayer

for the

DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida
1971

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Miami, Florida 33135

Price: $.75

TABLE OF CONTENTS

QUALITATIVE ANALYSIS

COURSE DESCRIPTION:

Students will conduct laboratory investigations to identify metallic and non-metallic ions present in solutions. The ions studied will depend on the availability of materials and teacher decision. Students will do spot tests for various ions, as well as qualitatively analyze known and unknown samples of mixtures of ions. A review of basic concepts of equilibrium including calculations will be a part of the course. A large percentage of the work will be done in the laboratory.

ENROLLMENT GUIDELINES:

Students should have successfully completed Scientific Mathematics, Introductory Chemistry, Reactions of Atoms and Molecules, and the Dynamic Nature of Atoms and Molecules or show readiness indicated by a test score. This course is intended as an elective for second year chemistry students and Nursing Chemistry students.

STATE ADOPTED TEXTS:

1. O'Connor, Davis, Haenisch, McNab, and McClellan. Chemistry: Experiments and Principles. Atlanta: Raytheon Education Company, 1968.

2. Choppin and Jaffe. Chemistry: Science of Matter Energy and Change. Morristown, New Jersey: Silver Burdett Co., 1965.

3. Mahan, Bruce. College Chemistry. Reading, Mass.: Addison-Wesley, 1966.

4. Greenstone, Sutman, and Hollingworth. Concepts in Chemistry. New York: Harcourt, Brace and World, Inc., 1966.

5. Metcalfe, Williams, and Castka. Modern Chemistry. New York: Holt, Rinehart and Winston, Inc., 1966.

PERFORMANCE OBJECTIVES

1. Given the equilibrium constant the student will calculate

   (1) the concentration of an ion needed to precipitate a compound.
   (2) the solubility of a specific chemical.
   (3) the pH, pOH, and hydrogen ion concentration of a solution.

2. Given a mixture of two sulfides, one from metallic group II and one from metallic group III, the student will devise a method of separating them based on a knowledge of pH.

3. Given a list of confirmatory tests and the solubilities of various compounds containing the cations from metallic group I, the student will construct a flow chart.

4. Given solutions containing a single cation or anion the student will identify each ion to be studied by the use of confirmatory tests.

5. Given a composite unknown of ions from metallic groups I, II, and III, the student will follow a flow chart and make confirmatory tests to identify the unknown.

6. Given a composite unknown of ions in non-metallic groups I, II, and III, the student will follow a flow chart and make confirmatory tests to identify the unknown.

7. The student will show by laboratory demonstration his ability to correctly use filter paper, a pipette, a suction filter assembly, a centrifuge, acid-base indicators, and reagent bottles.

8. The student will apply proper laboratory techniques to avoid contamination of reagents and hazardous laboratory situations.

COURSE OUTLINE

I. Review of basic concepts of equilibrium
   A. Use Ka, Ksp, Kw, Kb, and K for redox reactions in calculations of concentration of hydrogen and other ions, solubilities, and pH.

   B. Use equilibrium constants in the separation of precipitates by
      1. Variations in pH.
      2. Variations in the concentration of an ion.

II. Activity of metallic ions of groups I through V

   A. Confirmation tests for various ions used

   B. Known of each separate group

   C. Unknown of each separate group

   D. Unknown composite of groups I, II, and III

   E. Total composite (if time permits)

III. Activity of non-metallic ions of groups I, II, and III

   A. Conformation tests for various ions used

   B. Known of each separate group

   C. Unknown of each separate group

   D. Known composite of groups I, II, and III.

   E. Unknown composite of groups I, II, and III.

IV. Identification of organic groups (if time permits)

Suggestions:

1. Some selection of ions must be made since time will not permit the study of all ions in all groups.

2. Please note that most of the compounds that contain heavy metals are poisonous and should not be pipetted by mouth.

3. Care should be taken in the use of H_2S since it is very toxic. Ammonium sulfide can be used rather than H_2S.

4. All arsenic compounds should be eliminated from the laboratory investigations.

EXPERIMENTS

Due to the nature of this subject, many laboratory procedures in the form of confirmatory tests and flow charts will be found in the materials referred to as references.

Castka, Metcalfe, and Williams. Exercises and Experiments in Chemistry. New York: Holt, Rinehart, and Winston, 1966.

1. Aluminum and Its Compounds (pp. 283-286)
2. Borax Bead Tests (pp.287-288)
3. Cobalt Nitrate Tests (pp. 279-280)
4. Complex Ions of Copper and Silver (pp. 275-276)
5. Equilibrium and Complex Ions (pp. 243-246)
6. Flame Tests (pp. 261-262)
7. Hydrogen Sulfide and Qualitative Analysis (pp. 299-302)
8. Hydronium Ion Concentration, pH (pp. 193-194)
9. Identification of Salts (pp. 315-317)
10. Oxidation and Reduction of Iron Compounds (pp.273-274)
11. Separation of Lead, Silver and Mercury Ions (pp. 281-282)
12. Separation of Metallic Ions (pp. 289-290)
13. Solubility Product Constant (pp. 239-240)
14. Sulfite and Sulfate Ions (pp. 303-306)

Davis, MacNab, McClellan, and O'Connor. Laboratory Manual for Chemistry: Experiments and Principles. Atlanta: Raytheon Education Co., 1968.

15. Analyzing for Anions (pp. 59-60)
16. Determination of Hydrogen Ion Concentration Using Indicators (p. 84)

17. Introduction to Qualitative Analysis (pp. 53-54)
18. Qualitative Analysis Relative Solubilities (pp. 55-56)
19. Qualitative Analysis: Ag^{+}, Hg_2^{+2}, Pb^{+2} (p. 58)

Ferguson, Schmuckler, and Sigelman. Investigating Matter, Energy, and Change. Morristown, New Jersey: Silver Burdett Co. 1966.

20. Coordination Compound Synthesis (pp. 201-202)
21. Safety in Lab and First Aid in Lab (p. VI)
22. Solubility and Solubility Products (pp. 163-168)
23. Some Chemistry of Copper (p. 202)

Geffner, Lauren. Experimental Chemistry - Laboratory Manual. New York: Amsco Publication, 1968.

24. Principles of Qualitative Analysis: Anions (pp. 187-192)
25. Principles of Qualitative Analysis: Cations (pp. 183-186)

Greenstone, Concepts in Chemistry - Laboratory Manual. Atlanta: Harcourt, Brace, and World, 1968.

26. Aluminum and Its Compounds (pp. 142-144)
27. Compounds of Calcium (pp. 136-137)
28. Ionization Constant for Weak Acids and Bases (pp. 88-89)
29. Iron and Its Compounds (pp. 139-141)
30. Preparation and Properties of Hydrogen Sulfide (pp. 123-125)
31. Reactions of Sulfur With Metals (p. 122)

Mariella, Raymond. Chemistry of Life Processes - Selected Lab Experiments. New York: Harcourt, Brace, and World, Inc., 1968.

32. Color Range of Indicators (pp. 84-86)
33. Formation of Complex Ions with Ammonia (pp. 48-50)
34. Volume of Liquids (pp. 17-23)
35. Laboratory Safety (pp. 1-2)
36. Laboratory Equipment (pp. 3-8)
37. Water (pp. 25-30)

Pimentel, George C. (ed). Chemistry: An Experimental Science, Laboratory Manual. San Francisco: W.H. Freeman and Co., 1963.

38. Development of a Scheme for the Analysis of an Unknown Containing Various Anions (pp. 92-94)
39. Development of a Scheme of Qualitative Analysis Using Reagents Labeled A, B, and C (p. 86)
40. Qualitative Analysis of Ag^{+}, Hg_2^{+2}, and Pb^{+2} (p. 89)
41. Some Metals of the Second Column Qualitative Analysis (pp. 87-88)

Smith, William T. and Wood, Jesse H. Laboratory Manual for College Chemistry 3rd ed. New York: Harper and Row, 1966.

42. Carbonate and Carbon Dioxide (pp. 159-162)
43. Semimicro Qualitative Analysis (pp. 163-195)
44. Solubility Product Constant (pp. 107-110)
45. Sulfur (pp. 143-148)

Weaver, Elbert C. Scientific Experiments in Chemistry. New York: Holt, Rinehart, and Winston, Inc., 1966.

46. Reducing Action of Hydrogen Sulfide (pp.111-114)
47. Tests to Identify Ions (pp. 92-94)

Curriculum Bulletin 8-D. Chemistry 2 Advanced Placement Course Outline and Manual of Laboratory Activities. Dade County, Florida: Board of Public Instruction, 1966.

48. Amphoterism (pp. 103-104)
49. Analysis of Group I Metals (pp. 173-175)
50. Equilibrium and Complex Ions (pp. 100-102)
51. Hydronium ion concentration and pH (pp. 84-86)
52. Hydrogen Sulfide and Hydrosulfuric Acid (pp.74-76)
53. Solubility Product Constant (pp. 116-118)
54. Spectroscopy (pp. 183-185)

DEMONSTRATIONS

Alyea and Dutton. Tested Demonstrations in Chemistry. Easton, Penn.: Division of Chemical Education of the American Chemical Society, 1962.

1. Cupric Tetra Amine (p. 28)
2. H. Analytical (p. 30)
3. Aluminum Hydroxide (p. 31)
4. Analysis for Aluminum (p. 32)
5. Borax Beads (p. 33)
6. Carbonates (p. 36)
7. The Phosphorus Family Analytical (p.40)
8. Colored Sulfides (p. 40)
9. Sulfides (p.40)
10. Starch Test (p. 44)
11. Silver Group Tests (p. 44)
12. Analysis of Lead Ions (p. 45)
13. Iron Analytical (p. 46)
14. Cobalt Complex (p. 46)
15. Nickel Analytical (p. 46)

DADE COUNTY 16 mm FILMS

1. Acid-Base Indicators
   AV#1-10799, 19', C

2. Acids, Bases, Salts
   AV#1-10974, 21' C

3. Catalysis
   AV#1-10809, 16' C

4. Colloidal State
   AV#1-10933, 16' C

5. Using the Lab
   AV#1-105592, 11', C

6. Sulfur and Its Compounds
   AV#1-10937, 14' C

7. Standard Solutions and Titration
   AV#1-10926, 21', BW

8. Solutions
AV#1-10928, 16' C

9. Oxidation and Reduction
AV#1-01934, 11' BW

10. Nitric Acid
AV#1-10887, 15', C

11. Molecular Spectroscopy
AV#1-10869, 22' C

12. Introduction to Reaction Kinetics
AV#1-10859, 13' C

13. Ionic Equilibrium
AV#1-10930, 16' C

14. Equilibrium
AV#1-10829, 22', C

TRANSPARENCIES FROM DADE COUNTY

Up to 200 transparencies may be requested per school from the Dade County Multimedia Center per year for no charge.

	Transparency No.	No. of Cells	Name
1.	3	7	An Ionic Reaction
2.	5	6	Evidence of Hydrogen Bonding
3.	14	3	Ionization Reactions in Water-Liquid Solutions
4.	15	4	Ionization Reaction in Gas
5.	17	3	Sizes of Atoms
6.	18	6	Ionic Compound LiF
7.	19	6	Ionic Compound MgO
8.	20	4	Covalent Compound N_2 Molecule

	Transparency No.	No. of Cells	Name
9.	21	5	Covalent Compound NH_3
10.	22	4	Covalent Bonding, Ethane Ethyne, Ethylene
11.	24	5	Atomic Structure and X-ray Spectrometer
12.	34	7	Reactions That Go to Completion
13.	37	10	Rates of Reactions - Catalysis
14.	38	4	Factors Affecting Reaction Rates
15.	43	4	Chemical Equilibrium Part I
16.	44	2	Chemical Equilibrium Part II
17.	45	5	Common Ion Effect
18.	49	8	Periodic Table and Atomic Structure

PROJECTS AND REPORTS

1. Make a voltaic cell

2. Design simple electroplating cell

3. Determine eutectic point of NaCl

4. Design chart that shows amount of antifreeze-ethylene glycol - needed to prevent freezing (at $-10^{0}C$) in some standard car radiator.

5. Set up and demonstrate an ion exchange resin (water softener)

6. Produce a polymer (nylon) from raw materials (Adipic acid and 1-6 hexaminediamine)

7. Electrolysis of NaCl (careful)

8. Rutherford's experiment

9. Half life and decay curve

10. How steel is made from Fe_2O_3

11. Reactions in non-aqueous solvents

12. Organic qualitative analysis
Adams, Roger and Johnson, John. Lab Experiments in Organic Chemistry. New York: MacMillan Co. 1959. (pp. 133-143)

Degering, Ed. F. College Outline Series Organic Chemistry. New York: Barnes and Noble. 1963 (pp. 324-383)

13. Analysis of an alloy, Item 6 on References (pp 290-292)

14. Paper, column and thin-layer chromatography

15. Helmkamp, George and Johnson, Harry W. Jr. Selected Experiments in Organic Chemistry. San Francisco: W.H. Freeman and Co. 1968. pp.24-34.

16. Use of a pH meter

17. Types of and information given by spectroscopy

18. Electrochemical means of separating and identifying chemicals

FILM STRIPS (available from Cenco)

1. Solutions, Suspensions, and Colloids
   59151-6, C

2. Acids, Bases, and Salts
   59175-1, C

3. The Halogens
   59175-$, C

4. Sulphur and Nitrogen
   59175-6, C

5. Paper Chromatography
   70112-1, C

6. Paper Electrophoresis
   70112-2, C

7. Thin Layer Chromatography
   70112-3, C

FILM LOOPS (available from Ealing)

1. Handling Solids and Liquids
   84-0017, C

2. Heating Liquids
   84-0041, C

3. Oxidation and Reduction: The Halogens
   84-0140, C

4. Oxidation and Reduction: Electrolytic Cells
   84-0157, C

5. Equilibrium: Solutions and Precipitates
   84-0215, C

6. Equilibrium: LeChatelier's Principle
   84-0223, C

7. Reaction Rates
   84-0231, C

8. Production of Sodium by Electrolysis
   80-3940, C

SUGGESTED DISCUSSION QUESTIONS

1. What is the general plan for separation of ions in a solution into groups?

2. What are equivalent weights and why are they important in qualitative analysis?

3. What two types of bonding exist in complexions?

4. What type of particles form complex ions?

5. If too much concentrated HCl is added to the precipitating Group I metallic ions, which ion might not precipitate?

6. Name two compounds other than HCl that could be used to precipitate Group I.

7. Could sulfuric acid be used to precipitate Group I?

8. A colorless solution containing elements of Group II metallic ions, on treatment with H_2S yielded a yellow precipitate. This precipitate was completely soluble in ammonium sulfide solution. What elements might be present?

9. A greenish-colored Group II solution gave a black precipitate with H_2S which was extracted with ammonium sulfide and the remaining solid was found to be soluble in 3M nitric acid. The ammonium sulfide extract produced an orange precipitate when acidified. What elements are probably present? Probably absent?

10. To a colorless solution containing only elements in Group III, NaOH solution is added slowly. A precipitate forms, but on further addition of NaOH it dissolves. What elements are absent? What elements are present?

11. Why should one make a sodium and potassium flame test on the original sample rather than on the solution after magnesium is removed?

12. If antimony nitrate is placed in water, why does a solid form if all nitrates are soluble in water? How can the solid be dissolved?

SPEAKERS AND FIELD TRIPS

1. Key Pharmaceutical (30 people at a time), Mr. Friedland.

2. Dade Reagents, David Plout.

3. City of Miami Water Plant, Director of Water and Sewers, 665-7471.

4. University of Miami School of Medicine, Director of Public Relations, 1477 N. W. 12th Avenue, 350-6256.

5. Southeast Florida Pharmaceutical Association, Mr. Ben Saks, 2337 S. W. 4th Street.

6. Dade County Medical Association, 2 S.E. 13th Street, 371-2601.

7. American Society of Medical Technologist, Mrs. Anna Rundell, 2213 Red Road, Coral Gables.

PROBLEMS:

1. Calculate the OH^- ion concentration in a 0.1 M solution of ammonia. $K = 1.8 \times 10^{-5}$.

   Repeat the calculation above if the solution also contained 1 mole of ammonium chloride per liter.

   What is the hydrogen ion concentration in each case and what is the pH?

2. What concentration of $C_2O_4^{-2}$ is necessary to just precipitate CaC_2O_4 from a saturated solution of $CaSO_4$? Ksp of $CASO_4$ is 2.3×10^{-4} and the Ksp of CaC_2O_4 is 2.6×10^{-9}.

3. The Ksp of FeS is 3.7×10^{-19}. Calculate the maximum quantity of Fe (mg per 100 ml) which will remain unprecipitated by H_2S in a 0.3 M HCl solution.

4. The Ksp of AgCl is 1.2×10^{-10}. If, to a saturated solution, we add sufficient KCl to make the latter 0.1 M, to what extent will the concentration of silver ions be reduced?

5. Calculate the hydrogen ion concentration in a 0.1 M solution of ammonium chloride.

6. Calculate the percentage hydrolysis in a solution (0.1M) of Na_2S. Kof HS^- is 1.2×10^{-15}.

7. How many milliliters of concentrated sulfuric acid is needed to prepare a 3 M (1 liter) solution? Specify Gravity 1.84 and Assay of 96%. Repeat for a 5 N solution.

8. The Ksp of CdS is 3.6×10^{-29}. What pH will the solution have to be to dissolve the chemical? The solution is saturated with H_2S.

9. Calculate the weight of $(CdSO_4)_3 \cdot (H_2O)_8$ needed to prepare 250 ml of .1 M solution.

10. Determine the equilibrium constant for a reaction in a standard cell at 25° C when Zn is reacting with Cu^{+2} and copper is being plated out.

REFERENCES

1. Alberty, Robert A. and Daniels, Farrington. Physical Chemistry. New York: John Wiley and Sons, Inc., 1955.

2. Barrett, Richard and Price, Jack. Chemistry a Modern Course, Columbus, Ohio: Charles E. Merrill Books, Inc., 1965.

3. Barrow, Kenney, Lassiter, Litle, and Thompson. Chemical Equilibria from Understanding Chemistry, Volume IV. New York: W. A. Benjamin, 1967.

4. Brumblay, Ray W. Qualitative Analysis of College Outline Series. New York: Barnes and Noble, 1968.

5. Carnell and Reusch. A Programmed Course in General Chemistry Molecular Equilibrium. Philadelphia: W. B. Saunders Co., 1963.

6. Curtman, Louis J. Introduction to Semi-micro Qualitative Chemical Analysis. New York: MacMillan Co., 1957.

7. Lingane, James J. Analytical Chemistry of Selected Metallic Elements. New York: Reinhold Publishing Corp. 1966.

8. Pauling, Linus. Nature of the Chemical Bond. Ithaca, New York: Cornell University Press, 1960.

9. Pimentel, George C. (ed) Chemistry: an Experimental Science. San Francisco: W. H. Freeman and Co., 1963.

10. Plane, Robert A. and Sinko, Michell J. Chemistry (2nd ed). New York: McGraw Hill, 1961.

11. Schaum, Daniel. Schaum's Outline of Theory and Problems for Students of College Chemistry (3rd ed). New York: Schaum Publishing Co. 1956.

MASTER SHEET - QUALITATIVE ANALYSIS

Objectives	Text Books	References	Experiments	Demonstrations	Films	Film Strips	Film Loops	Transparencies
1	1 pp. 238-245 258-261 220-225 2 pp. 346-408 3 pp. 178-185 191-211 251-253 4 pp. 224-228 274-277 293-296 5 pp. 354-374 233-239 283-385	1 pp. 460-481 3 pp. 1-120 4 pp. 1-48 5 All 6 pp. 15-22, 41-119 9 pp. 163-195 392-398 10 pp. 269-287 310, 349-383 11 pp. 112-139 14 pp. 373-425 483-510	8, 13, 44, 20, 22	1,2,3	1,2,3, 9,13, 14	1	3 - 8	1-10, 12-17
2	4 pp. 398-403 533	1 p. 32 4 pp. 44-45, 86-88, 63-66	7, 13, 30, 46, 52, 53			2		
3		4 pp. 55, 56 173-174 7 pp. 60-65 78-84 95-101	4, 5, 11, 17 18, 19, 33, 39, 40, 49		10			
4		2 pp. 93-94 105-116 4 pp. 50-57 68-152 6 pp. 129-203 241-252 292-299 7 pp. 1-133 8 pp. 543-599 10 pp. 424-468	1, 2, 3, 4, 5, 6, 18, 23, 24, 25, 26, 27, 29, 31, 41, 45, 47, 48, 50, 54	1-15	6, 12, 11	3, 4		11, 18
5	1 pp. 394-404 536-548 584-585 577 565-566 3 pp. 504-596 4 pp. 539-548 5 pp. 436-462 417-419 432 499-502	2 pp. 105-116 4 pp. 50-118 6 pp. 252-290 8 pp. 543-559 10 pp. 424-468 544-546	6, 9, 12, 25, 43, 46	1-15	12	5, 6, 7		11, 18
6	3 pp. 487,504 4 pp. 441-448 473 5 pp. 428,518 520,521 245	2 pp. 101-105 4 pp. 126-157 6 pp. 299-345 10 pp. 405-408 531-546 562-563	9, 14, 15, 24, 38					
7	5 p. 231	44 pp. 52, 53 6 pp. 221-240	16, 28, 32, 34, 35, 36, 37, 51			5, 7, 8		
8		6 pp. 221-240	21		5			1, 12

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

DADE COUNTY PUBLIC SCHOOLS

Science: INTRODUCTION TO BIOCHEMISTRY 5316.60

DIVISION OF INSTRUCTION • 1971

INTRODUCTION TO BIOCHEMISTRY

5316.60

SCIENCE
(Experimental)

Written by Joe Adams and Sam Viviano
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Fla.
1971

Published by the Dade County School Board

Copies of this publication may be obtained through

Textbook Services
2210 S.W. Third Street
Miami, Florida 33135

Price: $.75

TABLE OF CONTENTS

INTRODUCTION TO BIOCHEMISTRY

COURSE DESCRIPTION:

Topics to be studied in this course include biochemical evolution, the chemistry of photosynthesis, respiration and digestion, reaction sequences involving the urogenital system, circulatory system, and nervous system, and recent experiments in biochemistry. It should be especially useful to those students planning a medical or para-medical career, or to those interested in any phase of biology or chemistry as a career.

ENROLLMENT GUIDELINES:

It is strongly suggested that the student have a prior scientific orientation as a minimum requirement, and has completed successfully an elementary course in chemistry, or its equivalent.

TEXTBOOK REFERENCE LIST

*1. Biological Science Curriculum Study. Biological Science: Molecules to Man. (blue version) 2nd. ed. Boston: Houghton Mifflin Company, 1968.

*2. Biological Science Curriculum Study. Biological Science Interaction of Experiments and Ideas. 2nd. ed. Englewood Cliffs, New Jersey: Prentice Hall Inc., 1970.

3. Weisz, Paul. B. The Science of Biology. New York: McGraw-Hill Book Company, Inc., 1963.

* State adopted

PERFORMANCE OBJECTIVES

The student will:

1. Given a set of atomic models, construct molecules believed present in the primitive atmosphere of the earth.

2. Given structural representations of each, identify representative amino acids, carbohydrates, fats, polypeptides, and nitrogen bases.

3. Given possible pathways of cyclic and non-cyclic electron transfer, differentiate each.

4. Generalize from data the effect of the light and dark reactions of photosynthesis.

5. Measure the effect of varying light intensity on the rate of oxygen production during photosynthesis.

6. Analyze chromatographically the pigments present in green plants.

7. Contrast fermentation and glycolysis with respect to reactants and products.

8. Predict the outcomes of the addition to the blood of various chemicals on the buffer systems of the blood.

9. Identify the hydrogen pathway as the energy transport mechanism in respiration.

10. Given various hormonal influences, predict their effect on the respiratory rate.

11. Integrate the function of various hormones and enzymes in the digestive process.

12. Given unknown foodstuffs, analyze them as carbohydrate, fat, protein, mineral or vitamin.

13. Apply enzymes to various foodstuffs, thereby determining enzyme specificity.

14. Discover possible disruptions of homeostasis from data obtained by urinalysis.

15. Describe the effects of various compounds on isolated heart musculature.

16. Classify various blood types according to their phenotypes.

17. Discuss critically the significance of blood cholesterol levels.

18. Differentiate biochemical effects in the sympathetic and parasympathetic nervous systems.

Optional

19. Deduce the effect of a cholinesterase inhibitor.

20. Formulate a hypothesis for the behavior of chemical mutagenic agents.

21. Propose reasons for the feasibility or non-feasibility of the synthesis of life.

COURSE OUTLINE

I. Biochemical Evolution

A. Original molecules formed on primitive earth--H_2, H_2O, CH_4, NH_3, CO_2 and HCN as strong probabilities.

B. Structures and general properties of compounds formed from these gases.
1. Amino acids
2. Sugars
3. Glycerin
4. Fatty Acids
5. Nitrogen bases

C. More complex molecules
1. Nucleic acids and nucleotides
2. Polysaccharides
3. Proteins
4. Fats and lipids

D. Specialized molecules--structure and mode of formation
1. DNA and RNA
2. Energy carriers, especially ATP
3. Chlorophyll
4. Coenzymes
5. Enzymes

II. The Chemistry of Photosynthesis

A. Cyclic and non-cyclic electron transfer
1. Photoexcitation
2. Photoionization

B. Photolysis and CO_2 fixation, light and dark reactions
1. Water as a source of oxygen--experimental evidence
2. CO_2 fixation--formation of carbohydrate

C. The significance of PGAL

D. The Calvin Cycle

III. The Chemistry of Respiration

A. Anerobic respiration
1. Fermentation
2. Glycolysis

B. Aerobic respiration
1. Buffer systems of the blood and their influence on respiratory rate
2. Respiratory pathways for carbohydrate, fat and protein
a. Mechanism of weight loss in a high protein diet
b. The citric acid cycle; significance of acetyl coenzyme A
c. The hydrogen pathway; the cytochromes; DPN and TPN (Or NADP and NADP.H)
3. Comparative energy yield; aerobic and anerobic pathways
4. Hormonal influences on respiratory rate
5. Tests of basal metabolism
a. Basal metabolic rate
b. Protein-bound iodide

IV. The Chemistry of Digestion

A. Action of enzymes and sites of production
1. Salivary enzymes
2. Conversion of pepsin, trypsin and chymotrypsin
3. Pancreatic enzymes
4. Enterokinase-formation of trypsin

B. Action of hormones
1. Gastrin
2. Secretins
3. Cholecystokinin

C. Other digestive juices
1. Mucoid substances and their function
2. Bile--emulsification
3. HCL--pH reduction, activation or pepsinogen

D. Stepwise decomposition of foodstuffs with their associated enzymes
1. Polysaccharide--Discaccharide--Monosaccharide
2. Protein--Polypeptide--Dipeptide--Amino acid
3. Bulk fat--colloidal fat--fatty acids and glycerol

V. Chemistry of the Urogenital System

A. Kidney function with respect to the homeostatic regulation of glucose concentration
1. Hormonal influence
2. Tubular reabsorption
3. The renal threshold--diabetes mellitus

B. Ornithine cycle--Formation of urea

C. Significance of the chemistry of urinalysis
   1. Presence of protein
   2. Presence of carbohydrate
   3. Ketonuria
   4. Phenylketonuria
   5. pH and crystal production

VI. Chemistry of the Circulatory System

A. Substances affecting the heart and blood vessels
   1. Vasoconstrictors and vasodilators
   2. Cardiac accelerators and depressants

B. Chemistry of the blood
   1. Significance of the blood glucose level
   2. Non-protein nitrogen level
   3. Chemistry of coagulation
   4. Antigen--antibody reactions
      a. Blood typing
      b. Vaccines
         1. Active immunity
         2. Passive immunity
   5. Buffered systems of the blood
   6. Significance of the cholesterol determination

VII. Chemistry of the Nervous System

A. Physical chemistry of neurological transmission

B. Effects of neurohormones

C. Cholinosterase inhibitors

D. Antagonistic activity of parasympathetic and sympathetic nervous system

VIII. Recent Experiments in Biochemistry

A. Bacterial transformation and its implications

B. Mutagenic agents

C. Efforts to synthesize life

EXPERIMENTS

Weisz, Paul. The Science of Biology Laboratory Manual, 3rd. ed. New York: McGraw-Hill Book Co., 1967.

1. Minerals and Carbohydrates (pp. 51-56)
2. Lipids and Pigments (pp. 57-61)
3. Proteins and Nucleic Acids (pp. 61-67)
4. Enzymes and Enzyme Activity (pp. 68-73)
5. Photosynthesis (pp. 171-175)
6. Respiration (pp. 167-170)
7. Nutrition in Animals: Digestion (pp. 162-166)
8. Breathing and Gas Exchange (pp. 189-194)
9. Gas Exchange and Excretion (pp. 195-199)

Biological Science Curriculum Study. Biological Science: Molecules to Man. 2nd ed. Boston: Houghton Mifflin Company, 1968.

10. Investigating the Formation of Coacervates (pp. 132-133)
11. Investigating the Work of Simple Catalysts (pp. 143-145)
12. Investigating Photosynthesis (pp. 168-171)
13. Investigating Chlorophyll Pigments (pp. 187-188)
14. Investigating Chemical Breakdown of Sugar (pp. 203-206)
15. Investigating the Action of Hormones on Frog Reproduction (pp. 327-331)
16. Chemical Control of Capillary Diameter (pp. 490-491)
17. Investigating Rates of Oxygen Consumption (pp. 502-503)
18. Investigating Carbon Dioxide Production in Man (pp. 514-516)
19. Investigating Digestion (pp. 519-521)
20. Investigating Chemical Receptors (pp. 592-593)
21. Investigating Contraction in Smooth and Cardiac Muscle (pp. 617-618)

DEMONSTRATIONS

Biological Science Curriculum Study. Biological Science: Molecules to Man. 2nd. ed. Boston: Houghton Mifflin Co., 1968.

1. Investigating the Composition of Water--(Electrolysis) (pp. 114-115)
2. The pH of Biological Substances (Use pH meter) (p. 122)
3. Fermentation (This demonstration may be modified to include fractional distillation, whereby the alcohol produced is purified) (pp. 150-151)
4. Investigating Hormonal Regulation of Secondary Sex Characteristics (pp. 564-565)

Todd and Sanford, Clinical Diagnosis by Laboratory Methods or Hepler, Opal E., Manual of Clinical Laboratory Methods.

5. Urinalysis (Significance of color, pH, specific gravity, absence or presence of sugar, acetone, albumin, various crystals)
6. Quantitative estimation of glucose in blood and other biological fluids. (Use photoelectric colorimeter)

Todd and Sanford, Clinical Diagnosis by Laboratory Methods. W. B. Saunders Co., 1947.

7. Blood typing and the Rh factor (pp. 335-346)

PROJECTS

1. Recent studies of blood cholesterol levels correlated with cardiovascular disease.
   Mutagenic agents.
   Recent studies of the effect of diet on psychomotor illness.
4. Organic pollutants in our atmosphere and their biological significance.
5. History of the basal metabolism test.
6. Phenylketonuria and its significance.
7. Cause and significance of urinary crystals.
8. Recent theories of enzyme activity.
9. Bacterial transformation and its possible implications.
10. Is cancer due to a biochemical lesion?

RELATED PROBLEMS

The student may:

1. Make a list of the various chemical components and their structural arrangements of important biochemical substances.
2. Distill some of the products of fermentation and determine alcohol content by specific gravity, using hydrometers.
3. Figure the chi square problem on the number of chloroplasts in various kinds of leaves.
4. Conduct a laboratory study on the effect of acid, base, or saline solutions on the growth rate of bacteria or other organisms.
5. Qualitatively analyze a set of unknown chemical substances.

FIELD TRIPS

1. Baptist Hospital Clinical Laboratories
2. Dade Reagents
3. Jackson Memorial Hospital
4. Veterans Administration Hospital
5. University of Miami Medical School

DADE COUNTY 16mm FILMS

1. Ionic Equilibrium (Coronet)
   AV# 1-10930
2. The Synthesis of an Organic Compound (No. 4163)
   AV# 1-10890
3. Reproductive Hormones (AIBS) Pt. 5
   AV# 1-30454
4. Respiration (AIBS) Pt. 4, #4
   AV# 1-30434
5. Chlorophyll (Photosynthesis) (AIBS) Pt. 3, #4
   AV# 1-30628

FILM STRIPS (Available From McGraw Hill)

1. Biochemistry of Vitamin Action--PSP 1-559
2. Pumps in the Living Cell--PSP 1-555
3. Hormones--FOM---PSP 1-551
4. Biochemistry of Enzyme Action--PSP 1-564
5. Sugar Metabolism--PSP 1-548
6. The Genetic Code--PSP 1-563

FILM LOOPS

1. Chromatography and Chlorophyll
   Ealing Film Loops 81-5854
2. Measuring the Rate of Photosynthesis
   Ealing Film Loops 81-563

MASTER SHEET - INTRODUCTION TO BIOCHEMISTRY

Objectives	Experiments	Student Text Reference	General Reference	Films	Film Loops	Reports	Demonstrations	Speakers	Slides or Film Strips	Field Trips
1	10	1 pp.107-136	3 pp.229-232			7	1			
2	3, 14	1 pp.215-243	3 pp.65-93 2 pp.207-222	4		4			6	
3		1 pp.183-185 791-794	3 pp.340-343	5	2					
4	5	1 pp.163-191	3 pp.340-341 2 pp.178-184							
5	12	1 pp.187-199	2 pp.181-184							
6	13	1 pp.377-388	3 pp.335-337 2 p.208		1					
7	14	1 pp.150-153	3 pp.407-409 2 pp.25-26						5	
8	8	1pp.485-497	3 pp.502-507 2 pp.24-25	1						
9	6	1 pp.194-211	3 pp.395-421	4		8				
10	18	1 pp.595-603	3 pp.501-519 2 pp.44-89	3		5			3	5
11	19, 7	1 pp.518-537	3 pp.355-366 2 pp.40-43			6			3	4
12	1, 2	1 pp.518-521	3 pp.354-380						1	
13	4	1 pp.527-531	3 pp.458-461						4	
14		1 pp.538-552	3 pp.519-523			3	5		2	1
15	21	1 pp.612-626	3 pp.512-519							
16		1 pp.398-401	3 p.503				7			2
17		1 pp.485-498	3 p.76			1				3
18	16	1 pp.594-602	3 pp.524-538							
19 through 21. May be done as optional projects listed 2, 8, 9, 10										