DOCUMENT RESUME

ED 237 711 CE 037 713

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TITLE Chemistry for the Life Sciences. An Instructor Resource Guide. Appendix to a Final Report on the Paraprofessional Rurally Oriented Family Home Health Training Program.
INSTITUTION Baptist Coll. at Charleston, SC.
SPONS AGENCY Office of Vocational and Adult Education (ED), Washington, DC.
PUB DATE 83
CONTRACT 300-81-0436
NOTE 132p.; For related documents, see CE 037 711-718. Cover title varies.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC06 Plus Postage.
DESCRIPTORS *Allied Health Occupations Education; Associate Degrees; Behavioral Objectives; *Biological Sciences; Chemical Bonding; Chemical Reactions; *Chemistry; Classroom Techniques; Core Curriculum; *Family Health; Guidelines; Health Education; Health Personnel; Higher Education; Home Health Aides; *Home Programs; Hygiene; Instructional Materials; Laboratory Experiments; Learning Activities; Organic Chemistry; Paraprofessional Personnel; Program Implementation; Radiation; Radiation Biology; Resource Units; Rural Areas; *Rural Education; Structural Analysis (Science); Teaching Methods

ABSTRACT

This instructor's resource guide, one in a series of products from a project to develop an associate degree program for paraprofessional rural family health promoters, deals with teaching chemistry for the life sciences. Covered in the first section of the volume are the role of chemistry in rural health promotional training, general objectives and recommendations for the instructor, laboratory recommendations, and references and suggested course tests. A series of unit overviews dealing with the following topics are presented: matter and measurement; the composition of matter; chemical bonding; compounds and chemical change; gases and respiration; water; solutions; acids, bases, and salts; nuclear chemistry and radiation; organic chemistry; hydrocarbons; oxygen derivatives of hydrocarbons; fats; carbohydrates; and proteins. Also included are a series of laboratory experiments dealing with dentistry and metric measure, chemical reactions and factors that affect their rate, the Charles Law, hydrates, principles of acid and base neutralization, radioactivity, reactions of alcohol, aspirin and oil of wintergreen, determination of Vitamin C, and powdered milk versus whole milk. A discussion of methods and materials for use in student evaluation and a description of other materials in the Family Home Health Training Program series conclude the guide. (MN)

Rural Health Promotion ...

A SERIES OF MATERIALS SUPPORTING AN ASSOCIATE DEGREE

APPENDIX TO
A FINAL REPORT ON THE
PARAPROFESSIONAL RURALLY ORIENTED
FAMILY HOME HEALTH TRAINING PROGRAM

an instructor resource guide for
teaching a course in

CHEMISTRY FOR THE LIFE SCIENCES

developed for
the U.S. Department of Education
Office of Vocational and Adult Education
Contract No. 300-81-0436

AN INSTRUCTOR RESOURCE GUIDE
FOR TEACHING A COURSE IN

CHEMISTRY FOR LIFE SCIENCES

part of a Series of Materials Developed to Support
an Associate Degree in Rural Health Promotion

developed for
THE U. S. DEPARTMENT OF EDUCATION
OFFICE OF VOCATIONAL AND ADULT EDUCATION

developed by
THE PARAPROFESSIONAL RURALLY ORIENTED FAMILY HOME HEALTH
TRAINING PROGRAM
THE DIVISION OF NATURAL SCIENCES
THE BAPTIST COLLEGE AT CHARLESTON
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1983

The project which is the subject of this document was support in part by the U. S. Department of Education. However, the opinions expressed herein do not necessarily reflect the position or policy of the Department of Education.

This work was developed under contract, Contract No. 300-81-0436

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INTRODUCTION

RURAL HEALTH PROMOTION -
Definitions and Assumptions

The Associate Degree in Rural Health Promotion was developed out of concern for the health status of Americans in rural areas. Behind the development of such a paraprofessional degree lie certain definitions and assumptions about rural areas and the health problems they face. It is therefore appropriate to delineate some terms and concepts before describing the degree and its components in more detail. While this discussion will not attempt to comprehensively document the changing perceptions of rural issues, it summarizes the development of "mind-sets" which undergird the development of this project.

Probably the most difficult definition to make is of the term "rural". While we can easily quote dictionary definitions, there are important intrinsic and extrinsic connotations to the word "rural" which also need to be explored. The term rural carries with it tacit assumptions about population density, types of employment, character and structure of population centers, as well as the values and outlooks of the citizens. For example, RURAL is seen as:

country, not city
provincial, limited in perspective
unsophisticated
rustic
simple, leisurely paced life
religious
agricultural

William H. Friedland, in an article in The Journal of

Rural Sociology in 1982, suggests that if we base our definition of rural on the concept of this type of homogeneous culture, then we will find few rural areas left in the United States. This country has seen the development of an urban - rural continuum in terms of population densities which blurs any clear cut geographical definition, producing "fringe" areas with combination characteristics. So called "reverse" migration to lower density areas, as well as the effects of modern news and entertainment media, have resulted in "country" communities where many of the basic conditions of urban life are reproduced - culture, food, commodities, interests, etc.

These views of the changing character of rural populations are upheld by other studies in a variety of fields. Farms have become agribusinesses, with even small farms showing the impact of technological advances. Farm "managers" show the same life style illnesses of stress and overload as do urban managers. More importantly, while three out of five country residents in 1920 were engaged in farming, by 1970 this had changed to only one out of five - and is still dropping. Of the populations in rural areas, 24% of the whites and 11% of the blacks were recent arrivals - coming originally from urban areas. Yet total rural population size has changed little since 1920, while urban populations have often tripled.

Even population size definitions for "rural" vary from expert to expert. The Encyclopedia Britannica (1975 ed.) defines U.S. rural populations by default - by saying "rural" is "not urban", and "urban" means places of 2,500 or more and their fringes. A dictionary definition gives rural as "areas with less than 1,500 population". Obviously, the area's size as well as its population should be considered.

In the United States, 25% of the population lives on 90% of the land. For these "rural" areas, density varies from 200 per square mile near cities to one per ten square miles in the western mountains. In addition to density differences, the midwestern rural resident is still most likely to be involved in agriculture, the Appalachian rural populations organize their lives around the mining industries, and, in the Carolinas, rural populations often include high percentages of textile workers.

What characteristics DO occur consistently in rural areas? While individuals and special sub-populations may defy these trends, rural populations do seem to have:

* twice the poverty rate as cities
* more under and unemployed adults
* lower educational status
* higher percentages of children, elderly, and poor

The last item on the preceding list leads us into the specific health problems of the U.S. rural resident, for all three sub-populations - children, the elderly, and the poor - have more health needs than the average citizen. However, once again the specific health needs of rural areas are somewhat inconsistent with our preconceptions. While we picture the "country life" as leading to healthy longevity, the rural populations of America have more activity limiting chronic health conditions than do urban populations. Regardless of our vision of country life as providing healthier air, diets, and activity, rural citizens suffer from more heart conditions, more arthritis, more mental illness, more high blood pressure, and more visual impairment. Infant mortality rates are higher, alcohol use and the resultant drinking and driving mortalities are severe problems. In other words, the health issues associated with life style are more predominant in the country than in our "high pressure, polluted, unhealthy" cities. . .

These, and other health problems of the rural areas of our country, are made more distressing by the realities of non-urban health care. The following figures, taken from the report on Health Care in Rural America (U.S. Dept. of Agriculture Bulletin 428), show how rural areas provide for health care:

area type	medical personnel per 100,000 population
metropolitan	157
non-metro.	71
rural (near urban)	35
rural (far from urban)	37

The problem is not with acute care - hospitals are often equally accessible to the urban dweller, the suburban dweller and the rural resident (at least in terms of access time - "from my house to seeing the doctor"). It is precisely the type of life style oriented services, focusing on chronic and preventative care, which are needed by the rural resident which are not available. This is an age - old problem; as Hippocrates said, " Healing is a matter of time, but it is sometimes also a matter of opportunity."

Certainly one way of approaching these problems is to increase the numbers of traditional health professionals who serve rural areas. This has proved to be easier said than done; physicians and nurses are costly to train and costly to support, if not for the area they serve then for society as a whole. Moreover, the U.S. Surgeon General's Report on Healthy People states that major gains in the health status of Americans in general will not be made by increasing access to traditional treatment alone, but will also require enhanced emphasis on promotion of disease preventative life styles.

In this same vein, but focused on the needs of rural areas in particular, the Health Care in Rural America report suggests that communities train residents to serve as paraprofessionals in health care provision, from EMS(Emergency Medical Technician) services, to basic first aid, and on to health promotion and health education. Eva J. Salber and her co-workers in North Carolina addressed these needs by exploring the usefulness of "health facilitators" or "lay advisors". Their project sought to "promote good health and prevent illness rather than concentrating on the cure of illness alone" by using lay members of a community who have received "training in promotive health practices, prevention of disease, in early recognition of illness together with first aid measures."

In A Sociology of Health by Andrew C. Twaddle and Richard M. Hessler, the authors state that "...of all the strategies for improving medical care for the (rural) poor, the substantial increase in new nonphysician medical manpower is possibly the most important innovation..." Even in the areas of mental health (as discussed in Mental Health of Rural America ,NIMH and The Nonprofessional Revolution in Mental Health by Francine Sobey) paraprofessionals from rural communities have been used effectively. Part of the introduction to Sobey's book comments, "Nonprofessionals are utilized not simply because professional manpower is unavailable but rather to provide new services in innovative ways."

Although most of the training for such paraprofessionals, in both the mental and physical health areas, began as informal training programs, in both cases expanded programs soon became important. Twaddel and Hessler discuss the problem of insufficient training, both in terms of its impact on lay workers' competency and acceptance by existing professional care givers, as well as the impact on upward or outward mobility. They quote one paraprofessional as saying "I don't have a degree, so if I left here I may have to go ... back to business machines. I don't really feel secure. If something happens you have to try and get a job. You should at least get an associates degree in college." Nevertheless, Twaddel ends the section on Community Health Workers with these thoughts, "...the seed has been planted for changes in health manpower. If health care is to be made available to all as a right on the order of public education, then change must occur...The community health worker program has provided a model for the creation of a new occupational hierarchy."

These then are the components which shaped the development of the Associate of Natural Sciences in Rural Health Promotion:

1. the realities and myths of rural existence
2. the need for enhanced health care in rural areas based on chronic life style illnesses and on-going inadequate numbers of treatment professionals
3. the perceived and experienced strength of utilizing community paraprofessionals
4. the training insufficiencies defined by both professionals and the paraprofessionals themselves

The next sections summarize the specific philosophies and content of the Associate Degree in Health Promotion, followed by suggested uses, and then detailed course content. For other published materials on this project, please refer to the Supplementary Materials at the end of the course materials.

AN ASSOCIATE DEGREE IN
RURAL HEALTH PROMOTION

As an innovative approach to meeting the health needs of rural America, the Rural Health Promotion Associate Degree has been developed by the Baptist College at Charleston under Contract No. 300-81-0436 with the U. S. Department of Education, Office of Vocational and Adult Education. The curriculum and special courses developed under this contract do not reflect ideas that are new to health. Instead, they draw upon several <u>maturing</u> concepts: health promotion, paraprofessional preparation, and holistic principles. These concepts have been used to develop an integrated, state of the art, approach to personal and community health enhancement--the paraprofessional degree in health promotion.

First, the program represents the movement toward health promotion, as an equal partner with treatment, in improving the health status of Americans. The 1979 U. S. Surgeon General's Report on <u>Healthy People</u> explored in great detail the role health promotion and disease prevention will play in further expansion of the Nation's health care system. The <u>American Rural Health Newsletter</u> (April 1983), in looking at "Rural Health Care at the Crossroad", points out "the public's desire for comprehensive health and its growing interest in health promotion."

Secondly, this program reflects an increasing awareness of the usefulness of paraprofessionals in expanding the impact of health care systems. Health promotion is one of the few areas of health services which is relying more on "people power" than on sophisticated technology. Since the goals of health promotion always includes the empowerment of the individual to make decisions about his own health habits and environment, the use of paraprofessionals is particularly appropriate. Working under the guidance of treatment, health education, and public health specialists, the paraprofessional can extend the reach of existing health promotion programs in a variety of settings from medicine and psychology to industry and religion. In the introduction to <u>The Nonprofessional Revolution in Mental Health</u> (Sobey, 1970) Frank Riessman points out that

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"Nonprofessionals are utilized not simply because professional manpower is unavailable but rather to provide new services in innovative ways... It is noteworthy that their main function has not been to relieve professional staff to tasks requiring less than professional expertise. The major finding is that nonprofessionals are being trained for new service functions and roles, in many cases roles that were not previously being played at all."

The idea to use two year college programs to train such paraprofessionals is not new. The Mental Health of Rural America (Segal, 1973) evaluated projects which experimented with ways to meet rural mental health needs. The projects seen to have the greatest impact were two year college programs designed to prepare people to work as paraprofessionals in a wide range of community settings. The Rural Health Promotion Degree is different in the following respect. The two year program designed at the Baptist College reflects very specifically the current movement toward holistic principles of health. Rather than focusing preferentially on physical or mental health, the program provides formal educational experiences in studies relevant to the "whole" person.

The curriculum draws from a strong natural science base (33 credits) to build an understanding of both the biological and psychological aspects of human health. By including studies in religion and sociology, as well as written and spoken communication skills, it prepares the student for effective intervention in social and interpersonal settings. Then, to focus this basic knowledge on disease prevention/health promotion, the program includes specialized courses which provide understanding of health care organizations and issues, health promotion methods, fundamentals of paraprofessional care and a prevention/promotion practicum experience.

The Associate Degree in Rural Health Promotion was designed to fit comfortably into a traditional four year college's offerings or into any technical college which offers general Associate of Arts or Associate of Science degrees. At least one full year of the program is made up of courses which are commonly offered by psychology,

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science, sociology, mathematics, English, and religion departments. The specialized courses related to Health promotion and paraprofessional skills will often be useful to students in other disciplines who plan to work in settings which interface with health care providers. In addition, the degree's specialized content might be used to develop a minor in health promotion for baccalaureate students or to provide required courses to update existing allied health and related degrees.

The specific course content of the Associate Degree in Rural Health Promotion is listed in annotated form in the next section.

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SUGGESTED ACADEMIC CONTENT

Listed below are those courses suggested as required to earn an Associate Degree in Rural Health Promotion. The courses marked with an asterisk (*) are those which were specifically designed for the Health Promotion degree and are available as part of this set of materials. Whole prerequisites are not noted here for the specialized courses, specific prerequisites are in the detailed materials overviewing each course in the series.

English Composition and Rhetoric: Courses designed to improve students ability to express themselves accurately and effective in writing. (6 credits)

*Interpersonal Communication-Techniques and Styles: This course will teach techniques of good interpersonal communication include specific skills in listening, decision making, observation, assessment, interviewing, and group process. It will explore the effect of individual attitudes and beliefs on communication as well as cultural characteristics of communication and barriers to communication. (3 credits)

General College Mathematics: A course in general math skills with an emphasis on application. (3 credits) Or a more advanced course.

General Psychology: An introduction to concepts underlying the understinding of behavior. (3 credits)

Human Growth and Development: An overview of human development psychologically for conception through senescence, with an emphasis through adolescence. (3 credits)

Psychology of Adulthood and Aging: A study of development during adulthood. (3 credits)

Principles of Sociology: A focus on the ways sociology provides understanding of group behavior and human relations. (3 credits)

Introduction to Community Services: Introducing the organization, methods, settings of community social services. (3 credits)

Survey of New Testament: The content of the new testament. (3 credits) OR

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Introduction to Group Dynamics: Religious and psychological principles applied to interpersonal relationships and group functions. (3 credits)

Anatomy/Physiology: A study of human structure and function with emphasis on the body systems. (4 credits)

Microbiology: Study of micro-organisms with emphasis on normal and pathological conditions in man and environment. (4 credits)

*Epidemiology: A study of the inter-relationship among organisms, the environment, and man. The course develops an understanding of the history of disease, their signs, symptons, and prevention. It provides a working knowledge of the terms; morbidity, mortality, acute disease, and chronic disease. Basic data are presented concerning the application of demographics, community health care, and the epidemiologic study of the causal factors of disease. (3 credits)

Nutrition: Concepts of human nutrition applied to health and disease, world hunger, and personal nutrition. (3 credits)

*Concepts of Chemistry: Key principles needed in allied health and liberal arts. (4 credits)

*Health Care Organization and Issues: The purpose, functions, and administration of community health care services, public and private. A study of issues affecting health care utilization and delivery; consumerism, ethical issues, and future technology. (3 credits)

*Health Promotion Seminar: A cognitive presentation of the major areas of emphasis for health promotion - exercise, concern over what we put into our bodies (foods, alcohol, tobacco, and other drugs), and living in high stress environments--and concommitant presentation of the major techniques of personal responsibility and personal change. The course requires application of these concepts to develop experiential knowledge in behavior change. It will also develop critical consideration of emerging health promotion ideas in both professional sources and the popular media. (1 credit)

*Fundamentals of Paraprofessional Care I and II: Development and application of knowledge and paraprofessional skills in physical care, emotional support, personal hygiene, and safety/first aid. Acute and chronic conditions will be covered. Working knowledge of medical terminology and consumer oriented pharmacology. Laboratory experiences complement the lectures and include certification in Cardiopulmonary Resuscitation. (8 credits)

*Practicum in Health Promotion: Application of classroom knowledge in community based programs related to health promotion/disease prevention. During the first two weeks of the Semester and the last week of the Semester, this calss will meet 3 hours per week on campus to structure the students' practical experiences and discuss class assignments and requirements. The remainder of the semester the course will consist of 9-12 hours/week of experience in a community based program and one class meeting per week on campus. (3 credits)

Electives (3-6 credits); Electives are suggested from sociology, especially in the area of social institutions or rural concerns, and in health and physical education, especially in the area of fitness and aerobics and recreational exercise.

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USING THESE MATERIALS IN
TEACHING RURAL HEALTH PROMOTION

The Rural Health Promotion project materials include the seven course modules newly designed for this associate degree (see Suggested Academic Content), a project report, preliminary evaluation reports for both concept and courses, and a series of Focus Guides for use with existing care courses. Although designed to be used as a two year associate degree curriculum in a college setting, the individual courses can be used separately as they fit other academic needs.

All of the courses in this series were developed in a regular semester format for students who meet general admissions requirements for a four year college. It may be that a paraprofessional program such as Rural Health Promotion will attract students whose high school preparation has been less academic than traditional four year students. However, we feel it is preferable to meet any such deficiencies as they arise using existing college resources, rather than to structure the program and course content at a lower level. One specific reason for this is based in the nature of the activity for which these students are being prepared.

The health promotion paraprofessionals will need to function in their communities in a median position between the professional health care providers and lay recipients of such care. The credibility with which they function will be based in part on their ability to communicate with, and value the standards and expectations of, people on both ends of this care continuum. Interactions with the professional community may be tenuous at best in some settings. The existance of "watered down" courses in the program could contribute to a perception of the paraprofessional as "amateur." Indeed, other paraprofessional roles--such as the paramedics--have been effected by this attitude. Even nursing, now a profession in its own right, was once seen as "wasting our time educating a group of semi-professionals." (Jensen's History and Trends of Professional Nursing)

A second reason for dealing with deficiencies outside of this program is to clearly integrate the program academically into the parent institution, rather than having it exist with a separate level of expectations. Finally, students who have clearly and directly faced their own learning deficits should be better prepared to relate to the lay end of the professional-lay continuum with understanding and compassion.

It is expected that these courses may merely be a first approximation of what is needed in some academic settings. Each course includes state-of-the-art material at the time it was written and edited, including references and suggested support materials. Yet, health promotion is a rapidly growing field where excellent new materials are developing daily. We feel the objectives, concept outlines, and supplementary materials can be used either as specific delineation of a course or as general core concerns to be fleshed out according to other professional interests and directions.

Reports on the development of the curriculum for the Associate of Natural Sciences in Rural Health Promotion and the proto-type field testing and evaluation of both concept and courses are also available as part of this series of materials. The project report components may be useful for health education designers or administrators or for service providers as they plan directions in training and community services for the last part of the Twentieth Century. Even if this degree has only limited implementation, we feel the ideas and directions addressed in the project overall and in the courses specifically can serve as stimuli for discussion and decision making in a society with changing ideas of health, health care, and responsibility for health.

Finally, the Rural Health Focus Guides were developed to direct the thoughts of teachers in core areas (such as English, mathematics, sociology, etc.) without re-writing existing courses. These materials are listed separately in the Supplementary Materials section and may be interesting for educators who are concerned or curious about the interface between their area of expertise and changing concepts of community and personal health.

SPECIFIC COURSE MATERIALS

FOR

CHEMISTRY FOR LIFE SCIENCES

The Role of

CHEMISTRY FOR THE LIFE SCIENCES

in Rural Health Promotion Training

The entire inner status of the human organism, indeed every interaction the human makes with the outside world, is chemically mediated. From the thought processes themselves to muscle action, from digestion to the immune response, from the body's allergic reactions to the world to the impact we make on the world through technology - chemistry is the language that is used to describe life. The health promotion paraprofessional needs a good grasp of basic chemistry to be able to have a realistic and credible view of the "raw material" of health promotion and of the end "goals."

Chemistry undergirds any in-depth understnading of the academic and applied subjects which are of direct importance to the tasks of health promotion. Physiology, nutrition, microbiology, epidemiology, as well as the methods and means to prevent, intervene in, and treat diseases all are important when dealing with a person's life style and its impact on his health.

Just as important, an understanding of chemistry allows for informed consumer evaluation and choices - from health advertising "gimmicks" (don't put <u>chemicals</u> in your body!) to informed use of medical care. Not only does the paraprofessional need chemistry to explain that if we didn't eat "chemicals" we would never eat at all, the paraprofessional needs chemistry to explain the importance of trace elements, "balanced diet", and the importance of therapeutic drugs and regimes.

While a single introductory chemistry course does not prepare anyone to <u>do</u> even simple biochemistry or drug pharacology, it does prepare the student to understand

(and pass on that understanding) of the specificity of chemical interactions, where ever and why ever they occur.

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GENERAL OBJECTIVES FOR
A COURSE IN
CHEMISTRY FOR LIFE SCIENCES

Brief catalog discription: Chemistry for Life Sciences--4 semester hours

Key principles needed in allied health and liberal arts.

Objectives:

Unit I. *The student will be able to perform and illustrate measurements of length, volume, mass, temperature and density of the three states of matter in the metric system and be able to interconvert with the English systems.*

Unit II. *We must understand how the three principle sub-atomic particles are combined to make up atoms of all elements and how the elements can be systematically organized by electronic structure.*

Unit III. *Become able to take atomic electronic structure and predict how an element will change this structure to form compounds and to predict whether the compound will be ionic or covalent.*

Unit IV. *Become able to write balanced chemical equations and interpret the equation in terms of molecules and mass. Come to an understanding of the use or productions of energy in a chemical reactions.*

Unit V. *Come to an understanding of the relationship of the pysical properties of gases, volume, pressure, temperature, and mass.*

Unit VI. *To come to a knowledge and understanding of the major and often unique physical properties of water and how they affect living systems and their environment.*

Unit VII. *Understand and be able to use the principle that controls solubility and insolubility of solute in solvents. Describe the effectives of solutes upon the collegative properties of solvents.*

Unit VIII. *To understand the interrelationship of acids, bases, and salts and their effect on human life.*

Unit IX. *To gain the knowledge of the actual process of radioactive decay and the significance of half-life. Understand units of dosage and effects of radiation on health.*

Unit X. To understand the bonding and structure of the four classes to hydrocarbons; alkanes, alkenes, alkynes, and aromatic hydrocarbons.

Unit XI. Be able to identify the various classes of organic compounds that contain oxygen from both names and structure.

Unit XII. Be able to identify polyhalogenated hydrocarbons amines, and their compounds from both name and structure.

Unit XIII. Understand the classes of carbohydrates and recognize each class from structural formula.

Unit XIV. Recognize the structure of fats and oils and the relationship of fatty acids and glycerides.

Unit XV. To gain some understanding of the complex manner amino acids make up proteins.

GENERAL RECOMMENDATIONS FOR THE INSTRUCTOR

The course in Chemistry for the Life Sciences was designed to be taught in a 14-15 week semester setting, with weekly laboratory sessions in addition to lecture/discussion classes. The course is intended as a three credit science option for non-science majors. There are fifteen units of lecture/discussion material (determined more by conceptual grouping than number of semester weeks) and ten laboratory experiments. An introduction and recommendations regarding the laboratory classes are included in the next section of this resource guide.

Each of the lecture/discussion units has a general objective, a set of specific objectives, an instructor/student information sheet which includes a brief content outline. In the supplementary materials at the end of this guide are individual unit tests with their answer keys.

Both the content outlines and the objectives for each unit are intended for use as lecture references as well as distribution to the students in the class. A course in chemistry for students interested in health promotion needs to do the following things for the students:

1. prepare students to read articles and take part in discussions which have general chemical content.
2. prepare students to think about medical chemistry, treatment pharmacology, drug effects, synergistic effects.
3. provide a solid understanding of chemical structure, compounds, and chemical changes in

general (with ability to manipulate chemical equations of less importance).

4. make connections with health issues where basic chemistry helps in understanding the action of disease or therapy - e.g. water and humidity, solutions, osmosis, diffusion, humidity therapy, bood hemolysis, dialysis, buffers, body electrolytes, radiation as used in diagnosis and treatment, organic chemistry of the body physiology and specifically of foods, saturated vs. unsaturated fats, carbohydrates, animal and vegetable fats, proteins, drugs, alochols, and antiseptics.

Special focus should be given to these items and similar items as they occur in the classroom. Articles in the general press which are more clearly understood with a chemistry background OR information in advertisements which is impressive until you understand the chemistry, can be used by the instructor to challange the students. These could also be used as semester projects.

In order to facilite modification, individual comments, notes on classroom experiences and the like, the alternate pages in the unit over-views have been left blank for your convenience.

LABORATORY RECOMMENDATIONS.

The general purpose of a laboratory for nonscience students is to reinforce classroom lectures, review additional materials, teach basic skills and provide evaluation opportunities of behavioral and cognitive skills. For the health promotion paraprofessional, laboratory experiences in chemistry are important more for the understanding both of the chemistry and the techniques of chemistry than for skill attainment in the techniques. The health promotion paraprofessional is not going on to take further chemistry courses and will not use laboratory skills professionally. Yet knowledge of the specificity of actual chemical reactions and of the potential for precision work will be important when the health promotion paraprofessional speaks to or works with individuals and families around diagnostic testing, drug development, etc.

There are ten laboratory experiments suggested for this course. This leaves laboratory time free to be used for testing, for teaching laboratory safety, and for expansion into other areas depending on student and teacher interests. Additional laboratory experiments may be found in Experiments for Living Chemistry by David Ucko. (the complete reference is found in the next section)

The following outline suggests one format for the laboratory experiments included with this course:

Outline of A Typical Laboratory Period

I. Lecture - 20 minutes
   A. Brief discussion of the object of the laboratory

B. Review of theory and calculations

C. Discussion of procedure

D. Demonstration of techniques which are new

II. Perform the experiment - 90 minutes

III. Class review of results, problems - 10 minutes

One possible schedule for the order in which the experiments could be done is:

1. review of laboratory safety
2. "Density and Metric Measure"
3. "Chemical Reactions and Factors that Affect Rates"
4. QUIZ
5. "Charles Law"
6. "Hydrates"
7. "Principles of Acid-Base Neutralization"
8. QUIZ
9. "Radioactivity"
10. "Reactions of Alcohol"
11. "Aspirin and Oil of Wintergreen"
12. QUIZ
13. "Vitamin C"
14. "Powdered Milk vs. Whole Milk"
15. FINAL QUIZ

All of the Experiements listed above are outlined in detail at the end of the section of unit overviews. Each is in the form of a student handout which gives an overview of the theory, a step by step procedure, presentation of any calculations required, and a data sheet.

REFERENCES

Recommended Textbooks

Ucko, David A. Living Chemistry. New York: Academic Press. 1977.

Ucko, David A. and Barbara C. Ucko. Student Guide for Living Chemistry. New York: Academic Press. 1977.

Other References

Ucko, David A. Experiments for Living Chemistry. New York: Academic Press. 1977.

UNIT OVERVIEWS

CHEMISTRY FOR LIFE SCIENCES

Unit I

MATTER AND MEASUREMENT

Unit Objective

The student will be able to perform and illustrate measurements of length, volume, mass, temperature and density of the three states of matter in the metric system and be able to interconvert with the English systems.

Specific Objectives

The student will be able to:

1. Give the common metric prefixes, their symbols and meanings.
2. Understand the relationship between mass and weight.
3. Understand the relationships between pound, gram, milligram, and kilogram and interconvert between any and all.
4. Give the relationship between meter, foot, centimeter, millimeter, and kilometer and be able to interconvert between any.
5. Understanding the concept of volume and the relationships between quart, liter, milliliter, and cubic centimeter (cc).
6. Define and use the difference between mass (weight) and density.
7. Understand the relationship between temperature and heat energy.
8. Describe the differences between the Fahrenheit, Celsius, and Kelvin scales.
9. Compare the physical properties (shape, volume, mass, density, compressibility and effects of heat) of the three states of matter.

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.

2. Administer and discuss unit examination following completion of unit objective.

Content Outline

Central to all to all science, whether Chemistry, Biology, Medicine, or Physics, is the gathering of data (observation and measurements) organizing this data and drawing conclusions. This unit should present methods dealing quantitatively with the three physical states of matter and the units used (English and System International).

A. The Scientific Method

B. The Metric System

C. Mass

D. Length

E. Volume

F. Density

G. Temperature

H. Three States of Matter

Student Assignments:

1. Readings: Living Chemistry- pgs. 1-17 (section 1.1-1.8) exercise 1-18

2. Laboratory: Experiment- " Density and Metric Measure"

Unit II

THE COMPOSITION OF MATTER

Unit Objective

We must understand how the three principle sub-atomic particles are combined to make up atoms of all elements and how the elements can be systematically organized by electronic structure.

Specific Objectives

The student will be able to:

1. Reproduce from memory the following table:

Particle	Charge	Retalive Mass (amu)	Symbol
Proton	+1	1	p
Neutron	0	1	n
Electrons	-1	0	e

2. State the meaning of atomic number.
3. Relate atomic mass units to grams.
4. State that in a neutral atom that the number of electrons equal the number of protons and that the mass number equals the number of protons plus the number of neutrons.
5. Define the term isotope and give example.
6. Explain atomic weight as given on periodic chart.
7. Explain the concept of electron energy levels.
8. Draw a simple diagram to represent the structure of any atom given atomic number and atomic mass.
9. Explain the electronic organization of the periodic chart.
10. Distinguish between a group and a period.
11. By use of periodic chart identify metals and nonmetals.
12. Compare physical properties and electronics structure of metals and nonmetals.

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.

2. Administer and discuss unit examination following completion of unit objective.

Content Outline

The particle nature of matter is the key to understanding many of the physical and some of the chemical behaviors of matter. The atom is the basic unit of elemental matter and the subunit of molecular matter, therefore, its makeup must be understood.

A. The Atom

B. Charge

C. Atomic Number

D. Atomic Mass

E. The Structure of Atoms

F. Isotopes

G. Elements

H. Atomic Weight

I. The Periodic Table

J. Properties of the Elements

Student Assignment:

1. Readings: Living Chemistry-pgs. 19-36 (section 2.1-2.10)
exercises 2-11d,21,& 24

Unit III

CHEMICAL BONDING

Unit Objective

Become able to take atomic electronic structure and predict how an element will change this structure to form compounds and to predict whether the compound will be ionic or covalent.

Specific Objectives

The student will be able to:

1. Write the Lewis dot structure for the A group elements.
2. Define electron pair bond.
3. Show how single, double, and triple electron pair bonds can be formed.
4. Define the concept of electronegativity.
5. Define and give an example of a polar covalent bond.
6. Use the concept of electronegativity and the octet rule to decide whether a bond is ionic or covalent.
7. Write the formula of ionic compounds using elemental ions and common polyatomic ions.
8. Be able to name binary ionic compounds and compounds using polyatomic ions.

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline
2. Administer and discuss unit examination following completion of unit objective.

Content Outline

Understanding the need for each element to have a valence shell as found in noble gas elements is necessary to understand the formations of compounds. After all, we biological species are composed of many compounds.

A. The Chemical Bond

B. Covalent Bonding

C. The Molecule

D. Lewis Symbols

E. Diatomic Molecules

F. Polar Covalent Compounds

G. Valence

H. Naming Covalent Compounds

I. Ions

J. Charges of Ions

K. Ionic Bonds

L. Writing Formulas of Ionic Compounds

M. Polyatomic Ions

Student Assignment:

1. Readings: Living Chemistry-pgs. 38-56 (section 3.1-3.13) exercises 1-24

Unit IV

COMPOUNDS AND CHEMICAL CHANGES

Unit Objective

Become able to write balanced chemical equations and interpret the equation in terms of molecules and mass. Come to an understanding of the use or productions of energy in a chemical reactions.

Specific Objectives

The student will be able to:

1. Be able to determine formula weight and molecular weight of compounds and elements.
2. Determine per cent composition by element of a compounds.
3. Define what is meant by a mole and give an example.
4. Determine the number of moles of a substance when given grams.
5. Determine the number of grams of a substance when given the number of moles.
6. State the law of conservation of mass and give an example.
7. Write a formula equation from a word equation.
8. Balance a formula equation.
9. Interpret the balanced equation on a molecule level.
10. Interpret the balanced equation in terms of grams.
11. Name the four major types of inorganic reactions: combination, decomposition, single replacement, and double replacement.
12. Give an example of each type of reaction mentioned in objective 11.
13. Recognize an oxidation-reductions reactions.

14. Define endothermic, exothermic, and law of conservations of energy.

15. Define Dynamic equilibrium.

16. Discuss how constration, temperature, particle size and catalyst effect the rate of reaction.

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.
2. Administer and discuss unit examination following completion of unit objective.

Content Outline

Within our own bodies chemical reactions, such as respira-respiration and digestion are taking place all the time. Plants are absorbing carbon dioxide from the atmosphere and producing oxygen in a series of reactions known as photosynthesis. Gasoline is reacting with oxygen to run automobiles. Metals are reacting with oxygen to form rust. Chemical reactions are what's happening in the world.

A. Formula or Molecular Weight of Compounds

B. Percentage Compositions

C. The Mole

D. Compounds vs. Mixtures

E. Chemical Reactions

F. Balancing Chemical Equations

G. Interpreting Equations

H. Types of Reactions

I. Oxidation-Reduction Reactions

J. Energy and Chemical Reactions

K. Reversibility of Reactions

L. Rate of a Reaction

Student Assignment:

1. Readings: Living Chemistry-pgs. 58-80 (section 4.1-4.13) exercises 1-19
2. Laboratory: Experiment-"Chemical Reactions and Factors That Affect Their Rate"

Unit V

GASES AND RESPIRATION

Unit Objective

Come to an understanding of the relationship of the physical properties of gases, volume, pressure, temperature, and mass.

Specific Objectives

The student will be able to:

1. Discuss the four major points of the kinetic theory of gases.
2. Explain the process of diffusion and relative rates of different molecules.
3. Explain the effect of temperature upon the particle of a gas (kinetic energy).
4. Explain gas pressure and the relationship of mm Hg to atm. to torr.
5. Understand and calculate with Boyles Law.
6. Understand the action of respiration and an iron lung.
7. Explain and calculate the relationship of pressure and temperature at constant volume.
8. Be able to calculate with Charles's Law.
9. Understand the relationship of STP and mole.
10. Explain Dalton's Law of partial pressure.
11. Explain the concept behind oxygen hypertherpay

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.
2. Administer and discuss unit examination following completion of unit objective.

Content Outline

The behavior or gases in the atmosphere under varying conditions, greatly affect our environment. Gas molecules pass in and out of our lungs constantly and medical treatments, as oxygen therapy, depend on gas properties.

A. Kinetic Molecular Theory

B. Diffusion

C. Temperature

D. Pressure

E. The Gas Law: pressure and volume

F. Breathing

G. The Gas Laws: pressure and temperature

H. The Gas Laws: volume and temperature

I. The Gas Laws: the quantity of gas

J. Air and partial pressure

K. Respiration

L. Oxygen Therapy

Student Assignment:

1. Readings: Living Chemistry-pgs. 82-102 (sections 5.1-5.12) exercises 1-12, 14-19
2. Laboratory: Experiment-"Charles Law"

Unit VI

WATER

Unit Objective

To come to a knowledge and understanding of the major and often unique physical properties of water and how they affect living systems and their environment.

Specific Objectives

The student will be able to:

1. Draw the physical and electronic structure of water.
2. Understand the hydrogen bond.
3. Explain vapor pressure and evaporation.
4. Understand the relationship of heat capacity and specific heat.
5. Be able to relate boiling point and heat of vaporization and melting point and heat of fusion.
6. Define andrelate density and specific gravity.
7. Explain surface tension, capillary action and menisius.
8. Know the two factors that control liquid pressure and discuss Pascal's Law.
9. Understand humidity, atomization, nebulization and aersol.

Unit VI

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.
2. Administer and discuss unit examination following completion of unit objective.

Content Outline

Water is the most important chemical in this biological world. The transport of vital chemicals in living systems and the activity of cells take place in an aqueous systems.

A. The Structure of Water

B. Kinetic Theory of Liquids and Solids

C. Evaporation

D. The Calorie and Specific Heat

E. Heat and the States of Water

F. Density and Specific Gravity

G. Surface Tension

H. Viscosity

I. Water Pressure

J. Water of Hydration

K. Water Purification

L. Water Balance

M. Humidity Therapy

Student Assignment:

1. Readings: Living Chemistry-pgs. 104-125 (sections 6.1-6.9,6.12,6.13) exercises 1-6,9-16
2. Laboratory:Experiment-"Hydrates"

Unit VII

SOLUTIONS

Unit Objective

Understand and be able to use the principle that controls solubility and insolubility of solute in solvents. Describe the effectives of solutes upon the collegetive properties of solvents.

Specific Objectives

The student will be able to:

1. Define solute, solvent, solution, alloy, and saturation.

2. Explain and give examples of the statement "Like dissolves Like".

3. List the factors that effect the solubility of gases in liquids.

4. Calculate the percent by weight-volume, by weight-weight and by volume-volume given the necessary information.

5. Calculate the parts per million (ppm) given the necessary information.

6. Prepare a dilute solution from a concentrated solution.

7. Describe the process of osmosis and diffusion.

8. Define what is meant by osmotic pressure.

9. Define the terms hypertonic, hypotonic and isotonic solution.

10. Describe the conditions of crenation and hemolysis and tell why they occur.

11. Discuss the process of dialysis and hemodialysis.

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline
2. Administer and discuss unit examination following completion of unit objective.

Content Outline

A large number of medical problems and household problems deal with solution chemistry. Some examples are diabetes mellitus, gallstones, glaucoma, prostate, kidney stones, and hyperacidity. We also need to understand solution chemistry when cleaning clothes, floors, dishes, bricks, as well as painting our homes.

A. Types of Solutions

B. The Process of Dissolving

C. Solubility of Solids

D. Saturation

E. The Solubility of Liquids and Gases

F. Concentration of Solutions-percentage

G. Molarity

H. Dilution of Solutions

I. Osmosis

J. Osmosis and the Blood

K. Colloids

L. Dialysis

Student Assignment:

1. Readings: <u>Living Chemistry</u>-pgs.127-150 (sections 7.1-7.12)
2. Laboratory:Experiment"Principles of Acid-Base Neutralization"

Unit VIII

ACIDS, BASES AND SALTS

Unit Objective

To understand the interrelationship of acids, bases, and salts and their effect on human life.

Specific Objectives

The student will be able to:

1. Write an equation to show the ionizations of water.
2. Define an acid chemically.
3. List some common identifying properties of acids.
4. Define a base chemically.
5. List some common identifying properties of base.
6. Define pH, based on hydrogen ion concentration.
7. State the relationship between hydrogen ion concentrations and hydroxide ion concentration at any pH.
8. Explain acid-base neutralization and salt formation.
9. Explain weak acid and weak base.
10. Explain how a salt solution may be acidic or basic.
11. State what is meant by strong electrolyte and weak electrolytes.
12. Define what is meant by buffer actions.
13. Define the terms acidosis and alkalosis.

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.

2. Administer and discuss unit examination following completion of unit objective.

Content Outline

The balance of acid, base and salts is critical to all biological life and these substances are often the major ingredient in home chemicals.

A. Acids

B. Properties of Acids

C. Bases

D. Properties of Bases

E. The pH of Acids and Bases

F. Measurement of pH

G. Neutralization and Titration

H. Normality

I. Salts and Hydrolysis

J. Body Electrolytes

K. Buffers

L. Acidosis and Alkalosis

Student Assignment:

1. Readings: Living Chemistry-pgs.152-174
   (sections 8.1-8.7,8.9-8.11)
   exercises 1-5,7-9,11,12,14,22,23,24

2. Laboratory: Experiment "Principles of Acid-Base Neutralization"

Unit IX

NUCLEAR CHEMISTRY AND RADIATION

Unit Objective

To gain the knowledge of the actual process of radioactive decay and the significance of half-life. Understand units of dosage and effects of radiation on health.

Specific Objectives

The student will be able to:

1. Explain what is meant by radioactivity.
2. Name the three types of nuclear radiation.
3. State the charge and mass of each type.
4. Complete a nuclear equation, given the starting isotopes and the particles emitted.
5. Explain the term half-life.
6. Calculate the amount of isotope remaining after a given time period, when given its' half-life.
7. Compare the energy of the various types of electromagnetic radiation.
8. Name four devices used to detect radiation and explain what each is used for.
9. Define curie, roentgen, rad, rem, dose equivalent and LD 30/50.
10. Explain teletherapy, brachytherapy, and radiopharmacentical therapy.
11. Explain the relationship between rem and rad.
12. Give the symptoms of radiation sickness.

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.

2. Administer and discuss unit examination following completion of unit objectives.

Content Outline

Nuclear radiation is not only important in the diagnosis and treatment of human diseases,but the effect of radiation upon life in the nuclear age is a social, political, economic,as well as a health issue.

A. Radioactivity

B. Nuclear Reactions

C. Natural Radioactivity

D. Artificial Radioactivity

E. Half-life

F. Nuclear Energy

G. X-ray Radiation and Photography

H. Detection of Radiation

I. Units of Radiation

J. Radioisotopes in diagnosis

K. Radiation Therapy and Cancer

L. Effects of Radiation

M. Radiation Safety

Student Assignment:

1. Readings: Living Chemistry-pgs. 176-203 (section 9.1,9.2,9.5,9.7-9.13) execises 1-4, 8-16

2. Laboratory: Experiment "Radioactivity"

Unit X

ORGANIC CHEMISTRY - HYDROCARBONS

Unit Objective

To understand the bonding and structure of the four classes of hydrocarbons; alkanes, alkenes, alkynes, and aromatic hydrocarbons.

Specific Objectives

The student will be able to:

1. State whether a compound is organic or inorganic when given its chemical formula or physical properties.
2. Write the electron dot formula of carbon and methane.
3. Define and give an example of tetrahedral structure.
4. Understand and use condensed structural formula.
5. Name the first ten members of the alkane family.
6. Draw and name the first five alkyl groups.
7. Draw and name the isomers of the first six members of alkane hydrocarbons.
8. Show how carbon can form double and triple bonds.
9. Name the first six alkene and alkynes.
10. Explain "cis" and "trans".
11. Define unsaturation.
12. Explain the bonding in benzene.
13. Define and give an example of polynuclear hydrocarbons.
14. Compare the physical properties of alkanes, alkenes, alkynes and aromatic hydrocarbons.

INSTRUCTOR & STUDENT INFORMATION

Recommendation for the Instructor:

1. Lecture based on specific objectives and content outline.

2. Administer and discuss unit examination following completion of unit objective.

Content Outline

Organic chemistry has its name because of its association with life and living things. The hydrocarbons are the building skelton for the more complex vital compounds of life.

A. The Carbon Atom

B. Alkanes

C. Alkyl Groups

D. Isomers

E. Reactions of Alkanes

F. Alkenes

G. Reactions of Alkenes

H. Alkynes

I. Cycloalkanes

J. Aromatic Hydrocarbons-benzene

K. Properties of Benzene

L. Polynuclear Atomatic Hydrocarbons

Student Assignment:

1. Readings: Living Chemistry-pgs. 205-231
(sections 10.1-10.12)
exercises 1-5,7-29

Unit XI

OXYGEN DERIVATIVES OF THE HYDROCARBONS

Unit Objectives

Be able to identify the various classes of organic compounds that contain oxygen from both names and structure.

Specific Objectives

The student will be able to:

1. Explain the meaning of functional group.
2. Identify an alcohol from its structure.
3. Name the first five alcohols by their common and IUPAC names.
4. Identify primary, secondary, and tertiary alcohols from their structures.
5. Write general equations to illustrate the oxidation and dehydration reactions of alcohols.
6. Identify an ether and epoxide from its structure.
7. Name simple ethers by their common and IUPAC names.
8. Identify aldehydes from their structure.
9. Name the first five aldehydes by their common and IUPAC name.
10. Write a general equation to illustrate oxidation reactions of aldehydes.
11. Identify ketones from their structural formula.
12. Name the first five ketones by their common and IUPAC names.
13. Identify carboxylic acids from their structural formula.
14. Name the first five acids by their common and IUPAC names.
15. Write general equations to illustrate the neutralizations and esterfication reactions of acids.

16. Identify esters from their structural formula.

17. Name up to five carbon esters by their common and IUPAC names.

18. Write general equations from hydrolysis and soponifications reactions of esters.

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.

2. Administer and discuss unit examination following completion of unit objective.

Content Outline

The oxygen atom appears in a number of classes of compounds. There classes of compounds are important as drugs, antiseptics, and food.

A. Functional Groups

B. Alcohols

C. Examples of Alcohols

D. Reactions of Alcohols

E. Ethers

F. Reactions of Ethers

G. Aldehydes

H. Reactions of Aldehydes

I. Ketones

J. Acids

K. Reactions of Acids

L. Esters

M. Reactions of Esters

Student Assignments:

1. Readings Living Chemistry-pgs. 233-260
(section 11.1-11.12)
exercises- 2,3,6,7,9,10,12,
14,18,21,24,27

2. Laboratory:Experiment"Alcohol and Their Reactions"

Unit XII

OTHER ORGANIC DERIVATIVES

Unit Objective

Be able to identify polycholoronated hydrocarbons amines, and their compounds from both name and structure.

Specific Objectives

The student will be able to:

1. Write the formula and name the halogenated methanes.
2. Give an example of one medically important organohalogen compound.
3. Identify thiol, thioether, thiolketone, thioacid, sulfoxide, sulfonic acid and sulfone from their structural formula.
4. Identify amines from their structural formula.
5. State whether an amine is primary, secondary, or tertiary, when given its structural formula.
6. Name the amines contains up to six carbons.
7. Illustrate the basic properties of amines and name the salts.
8. Identify the amide functional group from its structural formula.
9. Illustrate the hydrolysis reactions of amides.
10. Give an example of at least two heterocyclic nitrogen compounds and tell their biological importance.

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.
2. Administer and discuss unit examination following completion of unit objective.

Content Outline

Halogenated organic compounds have some most valuable properties as well as some of the most dangerous. Many sulfur and nitrogen compounds are valuable drugs as well as being found in proteins.

A. Halogen Derivatives

B. Sulfur Derivatives

C. Nitrogen Derivatives-amines

D. Reactions of Amines

E. Nitrogen Derivatives-amines

F. Heterocyclic Nitrogen

G. Nitrogen Derivatives-alkaloids

H. Other Nitrogen Derivatives

Student Assignment:

1. Readings: Living Chemistry-pgs. 262-286 (sections 12.1-12.7) exercises 1-16
2. Laboratory: Experiment "Aspirin and Oil of Wintergreen"

Unit XIII

CARBOHYDRATES

Unit Objective

Understand the classes of carbohydrates and recognize each class from structural formula.

Specific Objectives

The student will be able to:

1. Define and give examples of monosaccharide.
2. Define aldose and ketose.
3. Recognize open form, Fisher formula and Haworth formula of monosaccharide.
4. Give an example of alpha structure and beta structure.
5. Explain why glucose and galactose will give a positive Benedicts test and fructose will not.
6. Define disaccharide and give an example; maltose, lactose, and sucrose.
7. Define polysaccharide.
8. Explain the difference in structure of starch, glycogen and cellulose.

Unit XIII

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.

2. Administer and discuss unit examination following completion of unit objective.

Content Outline

The sun's energy is stored in carbohydrates and our body must have this energy. Sugars, starches, cellulose, glycogen, and heparin are all carbohydrates and are very important compounds to life.

A. Classification of carbohydrates

B. Monosaccharrides

C. Open and Closed Forms of Monosaccharides

D. Glucose

E. Other Hexoses-Galactose and Fructose

F. Disaccharides

G. Polysaccharides

Student Assignment:

1. Readings: Living Chemistry-pgs 296-314
(sections 13.1-13.8)
exercise 1,2,3,7,9,12,
13,16,17,4

2. Laboratory:Experiment "Determination of Vitamin C in Fruit Juices and Fruit Drinks"

Unit XIV

FATS

Unit Objective

Recognize the structure of fats and oils and the relationship of fatty acids and glycerides.

Specific Objectives

The student will be able to:

1. Define and give an example of a fatty acid.
2. Identify the prostoglandins as cyclic fatty acid.
3. Explain the detergent action of salts of fatty acids.
4. Identify waxes as esters of fatty acids and high molecular alcohols.
5. Identify triglycerides as a triester formed from glycerol and three fatty acids.
6. Be able to explain why vegetable fats are oils and animal fats are solid.
7. Explain iodine number and saponifications number as related to fats.
8. Give the composition of a depot lipid.

INSTRUCTOR & STUDENT INFORMATION

Recommendation for the Instructor:

1. Lecture based on specific objectives and content outline.

2. Administer and discuss unit examination following completion of unit objective.

Content Outline

Fats are found in both plant and animal tissue. Vegetable fats include oils and waxes. With todays concerns for polyunsaturated and low gycerides, the study of fats is essential.

A. Fatty Acids

B. Soaps and Detergents

C. Waxes

D. Fats and Oils

E. Properties of Fats and Oils

F. Body Fats

Student Assignment:

1. Readings: Living Chemistry-pgs. 320-332
(section15.1-15.9)
exercises-2,5,6,9-13,15-17

2. Laboratory: Experiment "Determination of Vitamin C in Fruit Juices and Fruit Drinks"

Unit XV

PROTEINS

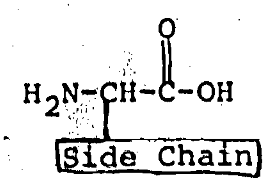
Unit Objective

To gain some understanding of the complex manner amino acids make up proteins.

Specific Objectives

The student will be able to:

1. Give the general formula of an alpha amino acid as



2. List the common sides chain and give general structures.
3. Explain zwetterion and isollective point.
4. Show how two amino acids react to from the peptide bond.
5. Explain how hydrogen bonding forms the secondary structure of protein.
6. Tell what forms tertiary and quarternay structure of proteins.
7. Define what is meant by denaturation of proteins and list three ways it can occur.

INSTRUCTOR & STUDENT INFORMATION

Recommendations for the Instructor:

1. Lecture based on specific objectives and content outline.

2. Administer and discuss unit examination following completion of unit objective.

Content Outline

Proteins have many complex functions in the body to include; catalyzing reactions, defending the body against disease, aiding digestion, transporting oxygen, genetic function, as well as, being the musculature tissue of the body.

A. The Amino Acids

B. Properties of Amino Acids

C. Primary Structure of Proteins

D. Secondary Structure of Proteins

E. Tertiary and Quaternary Structure of Proteins

F. Examples of Protein Structure

Student Assignment:

1. Readings: Living Chemistry-pgs. 344-362 (sections 15.1-15.9) exercises- 1-17

2. Laboratory: Experiment "Powered Milk vs. Whole Milk"

LABORATORY EXPERIMENTS

CHEMISTRY FOR LIFE SCIENCES

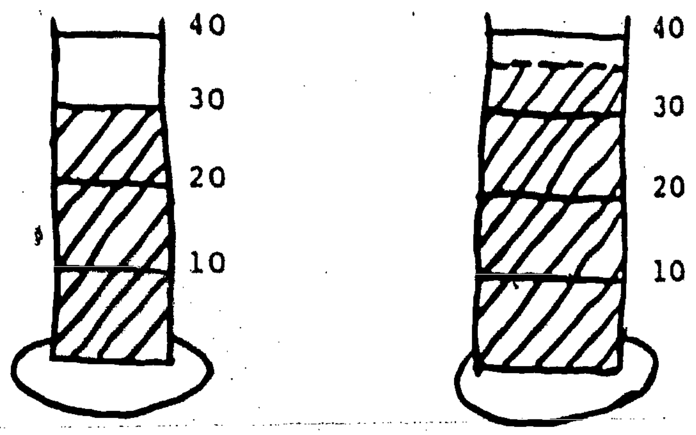
DENSITY AND METRIC MEASURE

Theory:

Density is defined as weight per unit volume. (D = wt/vol.). In the English system this is often expressed as pounds per cubic inch, tons per cubic yard, or pounds per gallon. In the metric system, the densities of the solids and liquids are usually expressed as grams per millimeter or grams per cubic centimeter (1 ml = 1 cm^3).

To obtain the density, the volume and weight of a given quantity of the substance must be measured. The density is then calculated by dividing the weight by the volume. A convenient method of determining the volume of a solid (regardless of its shape) is to submerge the solid in a measured quantity of water in a graduated cylinder. The increase in volume, due to the rise in the water level, gives the volume of the solid.

Example:



PROCEDURE: H_2O only, Vol. = 30.0 ml H_2O + solid; vol. = 37.5 ml

Volume of solid = 37.5 - 30.0 = 7.5 ml

To Metric Measure:

1. Fill a one quart container with water to the filling mark and measure in a 1 ℓ (1000 ml) graduate cylinger.

2. Fill a one ounce container with water and measure the amount in a 50 ml graduate cylinder.

3. Draw 10 cc of water into syringe and measure in a 10 ml graduate cylinder.

4. Using a 10 cm ruler measure the width of this page in cm and inches.

5. Using a meter stick measure the width of the lab desk in feet and meters.

6. Take a 1 lb. weight and measure its mass in grams on a triple beam balance.

Weigh two steel balls to the nearest 0.1 g. (this sample is referred to as the Known). Add a few ml of H_2O to a 10 or 50 ml graduated cylinder and record this volume to the nearest 0.1 ml on the Data Sheet. Carefully let the steel balls slide down the side of the graduated cylinder. (Be careful not to knock the bottom out OR let any water splash out of the cylinder). Record this volume on the data sheet Take four steel balls and determine their weight and volume in the above manner. The four steel balls weighed, must be the same 4 steel balls added to the graduated cylinder. The density of the 2 and the 4 steel balls should be approximately the same. If they are, proceed with the UNKNOWN; if not, call the instructor.

From the side shelf, obtain a sample of one of the unknowns and record the unknown number. Determine the weight and volume of this unknown sample exactly as you did the KNOWN. Record these values Take another sample of the same unknown and repeat the above procedure. If the densities obtained for these two unknown samples are not approximately the same, the procedure should be carefully repeated a third time. Using the reference table below, list the metal(s) which you believe to be your UNKNOWN.

Reference Table:

	Density, g/ml
Aluminum	2.702
Copper	8.92
Iron	7.86
Lead	11.343
Magnesium	1.74
Nichrome	8.17
Stainless Steel	7.75
Tin, Gray	5.75
Tin, White	7.28
Wood's metal	9.7
Zinc	7.14

Data Sheet

1. ________ ml ________ l

2. ________ ml

3. ________ ml

4. ________ cm ________ inches

5. ________ ft. ________ meters

6. ________ g

KNOWN:

	2 steel balls	4 steel balls
1. Weight (g)	________	________
2. Volume of: H_2O + balls (ml)	________	________
3. Volume of: H_2O only (ml)	________	________
4. The volume of H_2O displaced (#2 answer of #3)	________	________
5. Density (wt/vol) (divide #1 by #4)	________	________

UNKNOWN:

Unknown number ________ The unknown is ________

	Detemination 1	Detemination 2
Weight	________	________
Vól. H_2O + Unk.	________	________
Vol. H_2O only	________	________
Density (wt./vol.)	________	________

CHEMICAL REACTIONS AND FACTORS THAT AFFECT THEIR RATE

A. Reaction Types

1. Combination (addition)

$A + B \longrightarrow C$

$2\ Mg = O_2 \longrightarrow 2\ MgO$ + Light + Heat

Take a small piece of magnesium ribbon, hold it with crucible tongs and light it carefully over a bunsen burner. Warning do not look directly at the burning magnesium. Describe the magnesium before (1) and after the reaction (2).

2. Decomposition

$D \longrightarrow E + F$

$KClO_4 \longrightarrow KCl + 2O_2$

Place a small quantity of $KClO_4$ (potassium perchlorate) in a test tube and heat until molten over a bunsen burner. Note changes in the tube (gas escaping, etc..) and test for escaping oxygen with a glowing splint. Explain test. (3)

3. Displacement (substitution)

$AD + C \longrightarrow AC + B$

$CuSO_4 + Zn \longrightarrow ZnSO_4 + Cu$

Place a small strip of Zinc (gray-silver) into a test tube containing a solution of copper sulfate (blue). Note the change in color of the metal (4) and of the solution (5). Explain any change (6).

4. Double Displacement

$A - B + C - D \longrightarrow A - C + B - D$

$AgNO_3 + NaCl \longrightarrow \frac{AgCl}{white} + NaNO_3$

To a small amount (3-5ml) of silver nitrate solution in a test tube add dropwise sodium chloride solution. Describe how you know a reaction took place(7).

B. Factors that Affect the Rate of Reaction

The rate of a chemical reaction is controlled by three factors. These are : (1) Rate of collision of reacting molecules, (2) Energy of colliding molecules and (3) Do the reacting parts of the molecules collide.

1. Catalyst

A catalyst is an agent which alters the rate of a chemcial reaction without undergoing change itself. A catalyst lowers the amount of energy colliding particles must have to react. Therefore, more collisions will have this amount of energy and more collisions will result in a reaction.

Place some (5-6ml) hydrogen peroxide (H_2O_2) into a Test tube. It will very slowly decompose to give off bubbles of oxygen gas. Add to this a very small amount (several grains) of manganese dioxide (MnO_2) and describe the difference in the rate of evolution of oxygen (8). Use glowing splint to confirm bubbles as oxygen.

$$2\,H_2O_2 \xrightarrow{MnO_2} 2H_2O \pm O_2\uparrow$$

2. Solvent

The presence of a solvent greatly increases the rate of reaction between two solids. The mobility of ions or molecules in solids are greatly restricted, therefore, the number of collisions are very low. The results rate of reaction is accordingly also low. By adding a solvent the solids go into solution and the ions or molecules become much more mobile. The rate of collisions increases and accordingly the rate of reaction increases.

Grind together in a mortar small and about equal amounts of potassium aluminum sulfur ($KAl\ (SO_4)$) and sodium Bicarbonate ($NaHCO_3$). Transfer to a small flask and test with a glowing splint (9). Add a small amount of water and test with a glowing splint again (10).

$$H^+ + HCO^-_3 \rightarrow H_2O + CO_2\uparrow$$

(from $KAl\ (SO_4)_2$)

3. Surface

The smaller the size of solid particles, the greater the surface, exposed for collisions between reactants.

Take an iron nail, hold it with crucible tongs, and place one end in the flame of a bunsen burner. Next take a small amount of powdered iron and sprinkle it into the flame of a bunsen burner held at an angle. Compare the rate of oxidation (burning) of the two types of iron (11).

$$4\ Fe + 3O_2 \longrightarrow 2\ Fe_2O_3$$

In the powdered state the rate of oxidation of the iron is greatly enhanced. Dust explosions are the result of their factor.

4. Concentration

The concentrated a solution, the more crowded the reacting substances are. This crowding greatly increases the number of collisions between reacting substances. Since collisions are necessary for reactions, the more collisions per unit time, the more reactions, per unit time.

Take two clean test tubes, to one add 5 ml of 3 molar hydrocholoric while to the other add 1 ml of 3 molar hydrochloric acid and 9 ml of water. This makes test tube two have 0.3 molar hydrochloric in it. To both solutions add a small piece of magnesium ribbons and compare the rates of reactions in the two tubes (12).

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2\uparrow$$

~~5. Temperature~~

An increase in temperature effects the rate of reaction in two ways. One the movement of molecules are increased and therefore the number of collisions are increased. Two the energy content of the reactants are increased and therefore the number of collisions that result in a reaction increases.

Slowly, warm the test tube from 4 containing the magnesium with the 0.3 molar acid and observe how heating affects the rate of reaction (13).

CHARLES' LAW

Theory:

Charles' Law states that the volume of a gas varies directly with the absolute temperature, provided the pressure remains constant. The absolute (or Kelvin) temperature is found by adding 273° to the centigrade temperature i.e., °K = °C + 273. One can conclude from Charles' Law that if the temperature increases, so does the volume; also, if the temperature decreases the volume decreases. Mathematically, Charles' Law may be written:

$$V - T \qquad (1)$$

or

$$V = kT \qquad (2)$$

where k is the proportionality constant. Hence, if a gas occupies an inital volume V_1 at some initial temperature T_1, then according to this law,

$$\frac{V_1}{T_1} = k \qquad (3)$$

If the temperature of this same gas is changed to T_2, then the volume will change to some value V_2 and again applying this relationship.

$$\frac{V_2}{T_2} = k \qquad (4)$$

Combining equations (3) and (4) above gives:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \qquad (5)$$

The purpose of this experiment is to measure the decrease in a definite volume of a gas on cooling and to compare this experimentally determined value with the theoretical value by the use of Charles' Law.

Procedure:

Tightly fit a dry, empty 250 ml Erlenmeyer flask with a one hole rubber stopper containing a glass tube about 8 cm long. Clamp the flask in a 1000 ml beaker and add enough water to the beaker to cover the flask up to its neck. Boil the water for at least fifteen minutes, after which time it may be assumed that the air in the flask is the temperature of the boiling water. This temperature should be recorded as T_1. (Do not be particularly disturbed if your thermometer does not record this temperature as exactly 100°C.)

Press a finger firmly over the end of the tube and quickly lift the flask out of the beaker and immerse it completely in a pneumatic trough filled with cool water. Making sure that the tip of the glass tube is under the water, remove the finger, and hold the flask under the water until the flask has cooled to the temperature of the waster (at least 5 minutes). Record the temperature of the cooling water as T_2. This temperature represents the temperature to which the air in the flask on cooling from T_1 to T_2. (Note that no allowance is made for the cooling water). To obtain this decrease in volume, tip the flask so that the water level in the flask is the same as the water level in the trough. By so doing, this insures that the pressure in the flask and the pressure of the laboratory are the same. Close the end of the tube by placing your finger over it, set the flask on the desk and mark with a label the level of the lower edge of the stopper.

Remover the stopper and carefully measure in a graduated cylinder the volume of water in the flask, which can be reocrded in the line (c) of the data sheet. Now fill the flask with water and push the stopper in to the mark made with the label. Be sure that the tube is filled and that there are no air bubbles trapped below the stopper. Carefully measure this volume in a graduated cyliner. This volum represents the original volume of air in the flask and should be labeled as V_1. The volume of air in the flask after cooling from T_1 to T_2 is labeled V_2 and can be found by subracting the value in line (c) in the data sheet from the value labeled V_1, i.e., $V_2 = V_1 - (c)$.

Calculations:

Taking your values of V_1, T_1, and T_2, calculate by Charles' Law the correct value of V_2, and record this on line (f). Compare this with the experimental value of V_2 listed on line (e). The percentage error may be calculated using the following equation:

$$\% \text{ error} = \frac{\text{Theoretical value} - \text{Experimental value}}{\text{Theoretical Value}} \times 100\%$$

If your error is greater than 5%, the experiment should be repeated.

NAME ____________________

DATE ____________________

Data Sheet

(a) Temperature of the hot flask, T_1 in K. ____________

(b) Temperature of the cooled flask, T_2 in K. ____________

(c) Amount of contraction on cooling, in ml. ____________

(d) Total volume of air at original temperature V_1 in ml. ____________

(e) Measured volume of air at cooled temperature V_2, or V_1 - (c). ____________

(f) Calcualted volume of air at T_2, in ml. ____________

(g) Experimental error, (f) - (e), in ml. ____________

(h) Percentage error $\frac{(g)}{(f)}$ X 100%. ____________

HYDRATES

Many inorganic salts form crystalline complexes that contains water molecules, water of hydration, as part of their crystalline structure. Such complexes are known as hydrates. Each hydrate has a definite composition: a certain number of water molecules combined with each formula unit of the salt. Hydrates are named by naming the salt and adding the word hydrate preceded by a prefix to indicate the number of water molecules.

$$\text{Magnesium sulfate heptahydrate} = MgSO_4 \cdot 7H_2O$$

Hydrate formulas consist of the formula for the salt followed by a dot, then a coefficient indicating the number of water molecules, and then the formula for water.

Heating causes most hydrates to lose the water of hydration.

$$MgSO_4 \cdot 7H_2O \xrightarrow{heat} MgSO_4 + 7H_2O$$

The reaction is reversed when water is added to the anhydrous compound are different.

If a hydrate loses its water spontaneously to the atmosphere it is known as efflorescent. Compounds that absorb water from the atmosphere are said to be hydroscopic. Hydroscopic compounds that absorb water from the atmosphere beyond the hydrate stage to produce a solution are called deliquescent compounds.

Procedure

A. Place a few pellets of sodium hydroxide (strong, base, care!) on a watch glass. Describe the appearance of the solid at the beginning of the experiment (1) and note the change after one hour (2).

B. Place a few crystals of cobalt (II) chloride hexahydrate, $CoCl_2 \cdot 6H_2O$, in a clean dry test tube and observe the color of the crystal (3). Heat the test tube gently over a flame until the crystal color changes (4). Allow the tube to cool and add one drop of water and observe the color (5).

C. Heat a clean crucible and cover for 5 minutes on a clay triangle supported on an iron ring, with a clean blue flame. Allow to cool for 5 minutes and weigh (6). Place approximately 3g of Copper (II) sulfate hydrate into the crucible, cover and reweigh (7). Heat moderately for 20 minutes over a medium flame (crucible should not become red). Cool for five minutes and weigh (8). Calculate the percent of water in the hydrate (9).

A. 1. Initial Observation ____________________

2. Final Observation ____________________

3. Classify NaOH ____________________

B. 4. Color or $CoCl_2 \cdot 6H_2O$ ____________________

5. Color of $CoCl_2$ ____________________

6. Color after adding H_2O ____________________

C. 7. Mass of Crucible and cover ____________________

8. Mass of Crucible, Cover, and hydrate ____________________

9. Mass of hydrate (8-7) ____________________

10. Mass of Crucible, Cover, and anhydrous ____________________

11. Mass of Water (10-8) ____________________

12. Percentage of water

$$\%H_2O = \frac{\text{mass } H_2O \text{ (11)}}{\text{mass Hydrate (8)}} \times 100$$ ____________________

PRINCIPLES OF ACID-BASE NEUTRALIZATION: A COMPARISON OF ANTACIDS

Theory:

Many products are commercially avaiable for relief of upset stomach or the "queezy" feeling. These antacids are commonly called bases and are sually carbonate (CO_3^{-2}) or hydroxide (OH^-) compounds. These bases, which are H^+ acceptors, react with acids (H^+ donors) to produce water and a salt. This process is called neutralization.

Examples:

$$\underset{\text{base}}{Mg(OH)_2} + \underset{\text{acid}}{2HCl} \longrightarrow \underset{\text{water}}{2H_2O} + \underset{\text{salt}}{MgCl_2}$$

$$OH^- + H^+ \longrightarrow H_2O$$

$$Na_2CO_3 + 2HCl \longrightarrow H_2CO_3 + 2NaCl$$

$$H_2O + CO_2 \uparrow$$

$$CO_3^{-2} + 2H^+ \longrightarrow H_2O + CO_2$$

In the case of carbonate, the indiscreet "belch" that often indicates relief from indigestion is due to CO_2 gas.

Indicators are compounds that change color with the acidity or basicity (pH) of the solution. The pH of a solution is a measure of the H^+ concentration; pH= 7.0 (neutral; pH $>$ 7 (basic); pH $<$ 7 (acidic). The following table gives the colors of indicators in acidic and basic solutions.

Indicator	Acid Color	Basic color
Methyl orange	red	yellow
Methyl red	red	yellow
Bromthymel Blue	yellow	blue
Phenolphthalein	colorless	red

The indicator used in this experiment, methyl red or orange, change color in the approximate pH (acid) range as that found in the stomach.

PROCEDURE:

Obtain from the instructor one tablet of Tums, Rolaid, Phillips, and weight each of these tablets to the nearest 0.1g. Record these weights on the answer sheet. Grind each of these tables separately with a mortar and pestle, place the resulting powders in 5 beakers, and add 50-100 ml. of water and 5 drops of methyl red or orange indicator to each of the beakers. Stir for a few minutes to "dissolve" the tablets. (The solutions will appear to be chalky, except for the alkaseltzer.) (The solubilities of some of these antacids places a time restriction on the interprelation of the results).

Fill a 50 ml. buret with 1.0M CHl and titrate (add acid to base until a red color appears.) In some cases the titration may have to be continued until the solution assumes a pale pink color.

At the conclusion of the laboratory period, compare your data with that of fellow students to determine which is the "best" and which is the "worst" antacid.

ANSWER SHEET: Antacids

Type of Antacid	Weight	Volume of Acid Added	ML / Gram
Tums	______	______________	____
Rolaids	______	______________	____
Phillips	______	______________	____
Di-gel	______	______________	____

Best Antacid (s) ______________________

Worst Antacid (s) ______________________

RADIOACTIVITY

Theory:

It is not farfected to state that the future of our civilization is bound to the atomic nucleus. Either we shall use its energy to abolish want on earth and to reach other planets, or we will use it to destroy ourselves. A radioactive atom consists of an unstable nucleus seeking to gain stability generally by the emission of alpha, beta, or gamma radiation.

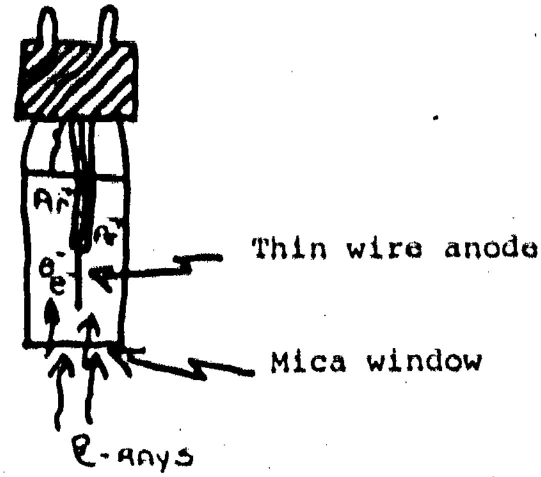
Alpha particles are identical to helium nuclei and generally have energies between 4 and 9 MeV. (MeV refers to million electron volts. As a point of reference, the ionization energy of a hydrogen atom is 13.6 Mev.) Due to the relatively large size of these particles, they have great ionizing power and low penetrating power.

Beta particles are negatively charged particles indentical to electrons except that they originate in the nucleus. They generally have energies of 0.1 to 4 MeV and have moderate penetrating power.

Gamma rays are electromagnetic radiation as are x-rays, light, radio waves, etc. They have energies in the range 0.1 to 10 MeV and, being uncharged, have very high penetrating power. Unlike alpha and beta particles, which lose their energy as a result of many collisions, gamma rays are completely stopped in one or two interactions.

Exposure to radiation can be reduced by two simple ways; (1) the amount of radiation arriving at a given point decreases rapidly as the source of radiation is moved further away from the given point (inverse square law); (2) placing matter of high atomic weight in the path of the radiation.

In this experiment a Geiger-Mueller counter will be used to detect radiation. This counter words most efficiently in detecting beta particles because most alpha particles can not even penetrate the thin window of the G-M tube and most gamma rays pass right through the tube without interacting with any of the detecting gas. The detecting gas in the G-M tube is usually He or Ar. The following figure shows the counting arrangement for an end-window G-M tube:



As a beta ray enters the G-M tube, it ionizes the gas; i.e., forms positive ions and electrons. The positive ions travel to the negatively-charged out walls of the tube, while the electrons produced in the original collision and those produced by secondary ionization travel to the anode wire. The resulting electrical pulse is registered on the scale of the G-M counter and one beta particle has thus been counted.

^{137}Cs - ^{137m}Ba generator (Demonstration) !

$^{137}Cs^{+}$ and $^{137m}Ba^{+2}$ ions are placed on an ion-exchange column containing a zirconium phosphate resin. $^{137}Cs^{+}$ will stick to this resin while $^{137m}Ba^{+2}$ can be washed off the resin with 1M HCl. ^{137}Cs decays by beta emission to ^{137m}Ba, followed by decay by gamma emission to ^{137m}Ba, a stable isotope. The detection of gamma ray from ^{137m}Ba is used to demonstrate radioactive decay and half life. The half life, of an isotope is the time necessary for the count rate to drop by one-half. Since ^{137m}Ba with a half-life of 2.6 minutes will be eluted from the column with 1M HCl, the student will be able to observe the very fast drop in the count rate. ^{137}Cs with a 30 year half life will remain behind on the column.

PROCEDURE:

Your instructor will distribute to you a G-M Survey Meter and explain how it operates. If this counter is battery operated, please remember to turn the meter completely off after finishing the lab.

Using a beta source supplied by your instructor, set the scale of your counter so that the needle is registering in the last half of the scale. This improves the accuracy of the reading. Check the effect of distance on the count rate by moving the G-M tube back from the radioactive source to distances of 1,2,4,8,12,34, and 36 inches, and record the count rate reading both in mr/hr and in cpm.

Take a background count by removing the radioactive sources away from the G-M tube and record this value. Since this background reflects the natural amount of radiation in the room and in your body, this value should be subtracted from each of the above reading.

On graph paper, plot the true activity (mr/hr) on the verticla axis vs the distance from the source to the G-M tube on the horizontal axis. Draw a smooth line through data points to indicate correlation.

In order to check the shielding abilities of several substances, take readings as pieces of cardboard, wood, glass, brick, aluminum, and lead are placed between the sample and the G-M tube. It is best for comparison purposes if the pieces are of similar thickness. List the various absorbers according to their ability to stop radiation. Is there any correlation between the absorber's density (g/cc) and its ability to block radiation? The following density data may be used: pb(11.34), Al (2.7), glass (2.4), brick (1.4), and wood (0.85), cardboard (0.69), and air (0.0018).

NAME ________________

DATE ________________

Data Sheet

Effect of Distance on the Count Rate

Distance (inches)	Count Rate MR/HR	Counts/Minute
Background		
1		
2		
4		
8		
12		
24		
36		

Shielding

Absorber	Count Rate Mr/Hr	Counts/Minute
Lead		
Aluminum		
Glass		
Brick		
Wood		
Cardboard		
Air		

ALCOHOLS AND THEIR REACTIONS

Alcohols are the family of organic compounds where an OH group is bonded to carbon that has four single bonds (sp^3). Alcohols undergo a variety of different reactions. The purpose of this experiment is to investigate several of these through the use of 1-propanol ($CH_3CH_2CH_2OH$).

I. Esterification:

Alcohols react with carboxylic (organic) acids to form esters. This reaction can be followed by the changing odor of the solution of acid in alcohol. Alcohols have a fairly sharp penetrating odor (check yours), while most carboxylic acids have foul odors (check with care). Esters on the other hand have quite pleasant fruity odors. The reaction is a fairly slow one so we must heat it at <u>least one hour</u>.

$$CH_3-CH_2-CH_2-OH + CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[\Delta]{H^+} CH_3-CH_2-CH_2-O-\underset{\underset{O}{\|}}{C}-CH_2-CH_2-CH_3 + H_2O$$

1-propanol + butanoic acid $\rightarrow$ n-propyl butanoate

II. Oxidation:

Alcohols undergo low levels of oxidation first to carbonyl compounds (aldehydes and ketones) and further oxidation to carboxylic acids.

$$CH_3-CH_2-CH_2-OH \xrightarrow{Cu} CH_3-CH_2-\overset{O}{\overset{\|}{C}}-H \quad \xrightarrow{Ag^+}$$

1-propanol

$$CH_3-CH_2-CH_2-OH \xrightarrow{K_2Cr_2O_4} CH_3-CH_2-\overset{O}{\overset{\|}{C}}-OH$$

1-propanol — propanoic acid

The oxidation of alcohols to aldehydes must be carefully controlled. For this reaction hot copper wire is the best oxidant. To test for any aldehyde formed, we will use the Tollen's test. This test is based on the reaction of silver ions with aldehydes to give carboxylic acids and free silver metal. The free silver will be observed as a fine block percipitation of a "silver minor" on the bottom of the test tube.

The chromate ion oxideizes alcohols very rapidly. The reaction can be easily followed by the change in color of the chromate solution. The chromate ion gives an orange color in solution while the reduced form Cr^{+++} GIVEN A DIRTY GREEN COLOR IN SOLUTION.

III. Acids:

Alcohols are very weak acids and only react as acids with extremely strong bases. We will react 1-propanol with the strong base amide ion ($:NH_2^{\ominus}$).

$$CH_3-CH_2-CH_2-O-H + :NH_2^{\ominus} \rightarrow CH_3-CH_2-CH_2-O:^{\ominus} + NH_3\uparrow$$

1-propanol amide ion $\rightarrow$ 1-propoxide ammonia

This reaction can be observed with the visual evolution of ammonia (NH_3) and with the careful detection of the ammonia odor.

PROCEDURE:

I. Esterification:

In a long test tube mix 5 ml of 1-propanol (check odor, 1) and 2 ml of buanoic acid (check odor, 2) with 2-3 drops of concentrated sulfuric acid (H_2SO_4). Suspend the tube in a hot water bath for 1 hour. It may be necessary to add water to the bath during the hour. At the end of the one hour heating period check the odor of the solution (3).

II. Oxidation:

Place 5 ml of 1-propanol in a small test tube. Heat a piece of copper wire in which a loop has been formed, to redness and plunge while hot into the propanol. Repeat at least 10 times. Check to see if you can detect any difference in the odor of the solution. (4)

To this solution add 5 ml of Tollen's solution and allow to set at room temperature for five minutes. If no visible reaction has occurred at the end of five minutes warm in the water bath for five minutes. (5)

To 10 ml of a warm solution of 0.1 molar $K_2Cr_2O_4$ add dropwise 1-propanol with shaking. Observe all color changes. (6)

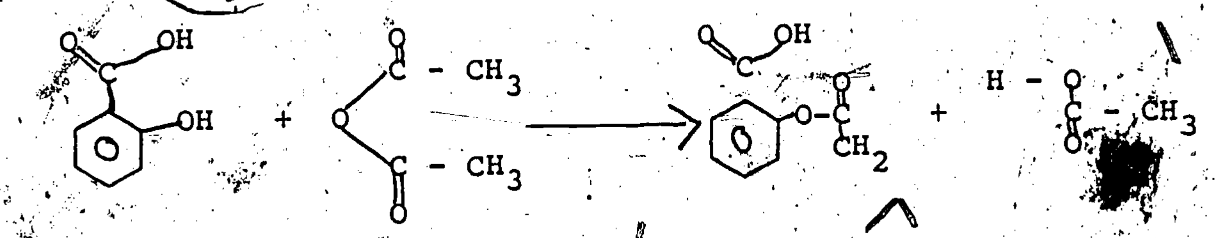
III. Acid:

In a clean dry test tube put 5 ml of 1-propanol. Carefully sprinkle a small amount of sodium amide into the propanol with a dry spatual. Observe any evolution of gases and carefully smell the opening of the tube.

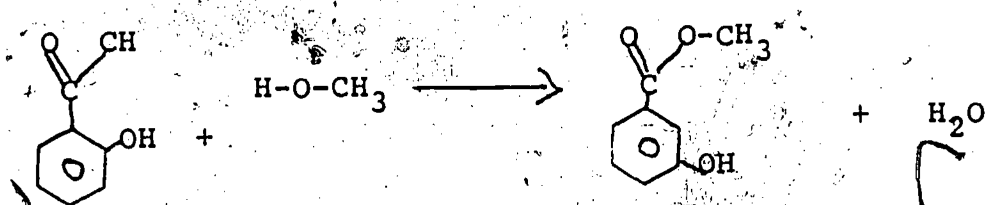
ASPIRIN AND OIL OF WINTERGREEN

Headaches and bodyaches are two ailments that may be treated by two different esters prepared from the same starting material, salicylic acid. This is a difunctional compound possessing both an organic acid grouping (carboxyl group) and a phenol grouping. The headache pill is acetylsalicylic acid (aspirin) which is usually made by reaction of the phenol group of salicylic acid with acetic anhydride. The bodyache medicine, used in liniments for sore muscles, is methyl salicylate (oil of wintergreen). This compound is also used in perfumery and in very small quantities for flavoring candies, etc. It is made by reaction of methyl alcohol with the acid group of the salicylic acid. Both of the reactions use sulfuric acid as a catalyst and to tie up water formed in the reaction. A catalyst is a substance that changes the rate of a chemical reaction without being permanently changed itself.

The formulas of the compounds and the reactions are indicated below:



Salicylic acid + acetic anhydride → aspirin (acetylsalicylic Acid) + Acetic acid



Salicylic acid + methyl alcohol → oil of winter-green (methyl salicylate) + water [illegible]URES:

This experiment requires careful attention to the precaution and the other parts of the procedure. The aspirin that you prepare may not be completely free of starting materials so should not be used.

1. Precautions

   a. Acetic anhydride is very irritating to the skin and eyes. If spilled on your skin it should be washed off with plenty of water. Use with adequate ventilation.

   b. Concentrated sulfuric acid is extremely irritating to the skin and eyes. If spilled on you, wipe it off, then wash immediately with copious quantities of water and notify the instructor. It also reacts violently with water and is destructive of clothing.

   c. Methyl alcohol is a flammable liquid. Breathing tha vapor of this compound for short periods, even in low concentration, is dangerous. Swallowing small quantities can cause blindness or death. Use with adequate ventilation.

2. Preparation of Aspirin

PROCEDURES:

Mix together in a test tube 2 ml of acetic anhydride and 1 gram of salicylic acid. Add two drops of concentrated sulfuric acid and stir the mixture vigorously with a glass rod while you warm it in a hot-water bath. When the solid dissolves, set the tube aside to cool. If no crystals appear after the tube has cooled to room temperature, scratch the inner wall of the tube with your water, stir, and collect the solid on a filter. Rinse the solid on the filter with small portions of water letting the water filter through. Press most of the water from the solid between two pieces of paper towel or a few filter paper circles. The product is acetylsalicylic acid (aspirin)

TURN IN YOUR PRODUCT TO THE INSTRUCTOR

3. Preparation of Wintergreen

PROCEDURE:

Place approximately 0.5 grams of salicylic acid in a clean, dry test tube and dissolve it in 3 ml. of methyl alcohol. When all the solid has dissolved, slowly add 10 drops of concentrated sulfuric acid, dropwise, swirling the contents of the tube after the addition of each drop. Place the tube in a beaker of hot water (about 60-70) for 5 minutes and then pour its contents into 20 ml of hot water contained in a small beaker. Cautiously note the color. What compound is responsible for it? (name) ______________ ______________ describe it. ______________ ______________.

TURN IN YOUR PRODUCT TO THE INSTRUCTOR

DETERMINATION OF VITAMIN C IN FRUIT JUICES AND FRUIT DRINKS

Theory:

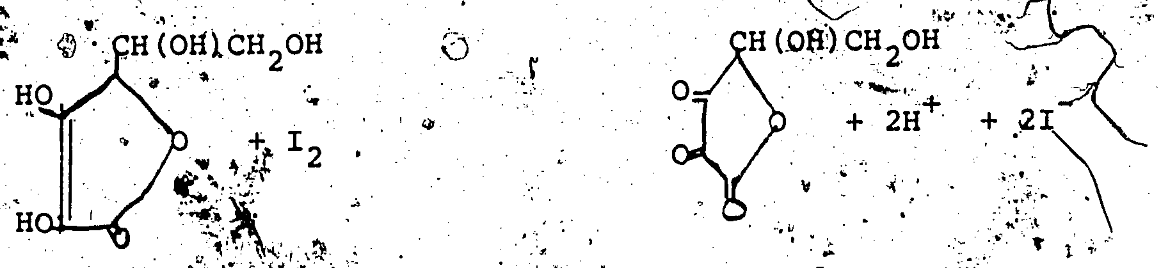
In this experiment, the vitamin C content of a fruit, vegetable, or juice can be determined using ordinary household supplies.

The chemistry involved is a variation of a standard titrametric method, the oxidation of Vitamin C (ascorbic acid) by iodine to dehydroascorbic acid.

The titration end point is signaled by the formation of the classic starch-iodine blue complex upon addition of excess I_2. Other ascorbic acid analyses are known, but none lends itself so readily to "house-holding" as this.

1. The method outlined below is limited in application to fruits and vegetables. It is not suitable for urine analysis, dairy products, and so on--apparently because the iodine is reduced by proteins in these samples.

2. This type of experiment can be used to determine the effect of iron; aluminum and copper utensils: effects of air; vitamin content of the food service salad bar, etc.



Ascorbic Acid Dehydroascorbic Acid

Titration procedures

1. Crush a 100 mg tablet of vitamin C and dissolve it in 100 ml of water. (There will be a slight powdery residue from the tablet, most likely a kaolin binder used to hold the tablet together; this is of no concern). Transfer a 10 ml portion (which contains 10 mg of vitamin C) to the Erlenmeyer flask for titration. Add 2 to 3 ml of starch indicator solution and titrate with iodine by adding the iodine dropwise (with stirring), counting drops, until the whole mixture just turns purple/blue/grey. The iodine solution can then be expressed as equivalent to a certain number of milligrams of vitamin C per drop.

(See Calculation 1)

2. Now analyse the juices by: adding one ounce of juice and 10 ml H_2O to a 5 ml water flask along with a 3 ml of starch indicator. Add the iodine dropwise until the color change occurs.
Repeat at least twice.

Sample Calculations:

1. A 10 ml vitamin C sample required 27 drops of iodine. The vitamin C equivalent is:

$$\frac{\text{10 mg vit. C (in 10 ml)}}{\text{27 drops}} = \frac{\text{0.37 mg vit. C}}{\text{1 drop}}$$

2. A 1 ounce orange juice sample (reconstituted, frozen) took 54 drops so the vitamin C content of a 6-ounce glass is:

$$\frac{\text{0.37 mg vit. C}}{\text{1 drop}} \times \frac{\text{54 drops}}{\text{1 ounce}} \times \frac{\text{6 ounces}}{\text{1 serving}} = \text{120 mg Vit. C/serv.}$$

3. One sixth of an orange took 31 drops. What is the vitamin C content of one orange?

$$\frac{\text{31 drops}}{\text{1/6 orange}} \times \frac{\text{0.37 mg Vit. C}}{\text{1 drop}} = \text{69 mg Vit. C/orange}$$

Data Sheet

Fruit Juice	Volume of Juice	Drops of Iodine	Vitamin C Equiv./ounce

Calculations

1. Vitamin C tablet (standard)

$$\frac{\text{10 mg Vit. C (in 10 ml)}}{\text{\_\_\_\_\_\_ drops iodine}} = \text{\_\_\_\_\_\_} \frac{\text{mg. Vit. C}}{\text{1 drop iodine}}$$

2. Vitamin C equivalent/ounce

$$\frac{\text{mg Vit. C}}{\text{1 drop iodine}} \times \text{\_\_\_\_\_\_ drops iodine} = \text{\_\_\_\_\_\_} \frac{\text{mg Vit. C}}{\text{ounce juice}}$$

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Theory:

Low fat dry milk is used to reduce the amount of fat intake into the body for one reason or another. This experiment has as its purpose to determine if it does have the casein and all other proteins present and has very little fat as compared to whole milk. One half of the class will use the powdered milk while the other will use whole milk. After following the instructions and collecting your data, compare your results with the other half of the class.

Procedure:

1. Litmus Test: Test the reaction of the milk to red and blue litmus paper. Is it acid, base or neutral?

2. Separation of casein and fat: Place 50 ml of milk in a beaker, and add an equal volume of water. With a bulb piept add 10% aceitc acid, a drop at a time, stirring the milk after the addition of each drop, until a flocculent precipitate is formed. This precipitate is casein, the chief protein in milk, mixed with fat. It is important to add the acid slowly and to look for the appearance of the casein "curds" after each drop; you can easily add too much acid, in which case the casein will not separate out. Ordinarily 50 ml of sweet milk will require from 40-60 drops of 10% acetic acid, and sour milk will require less. When a satisfactory "curding" has been produced, let the mixture stand until the casein settles to the bottom of the beaker and then filter through fluted filter paper first the decanting fluid and then the casein upon the filter paper. Keep the filtrate for a later experiment.

When the filtration is complete, lift the filter paper containing casein from the funnel, open, and lay it out flat upon several thicknesses of paper towel. Dry the casein mixture by applying paper towels to the top of the cake and pressing it until most of the water has absorbed. Now transfer the casin, (a fat) to a dry beaker, cover with alcohol, and stir with a glass rod for several minutes. The treatment with alcohol completes the removal of water. Filter and press the casein mixture a second time to remove the alcohol and water. Remove the cake to a beaker, and add the least amount of ether that will cover the material (not over 10 ml.). (Caution: Do not permit the ether to be near a burning flame since ether vapors will readily ignite and produce dangerous fires.) Stir the mixture of ether, casein, and fat with a glass stirring rod for about 5 minutes and then filter, collecting the ether filtrate upon a large tared watch glass. Open the filter paper and allow the ether to evaporate. The material remaining upon the filter paper is practically pure casein. Test it for protein by the Buiret test.

The Buiret Test:

Place 2 ml of an albumin solution in a test tube and make it alkaline with a few drops of NaOH solution. Add a few drops of dilute copper sulfate (1%). Note the color.

Any compound having two or more peptide bonds in a close approximation will give this test. Thus any soluble protein can be counted on to give a Buiret Test.

Test isolated casein by putting a small amount in a test tube with 5 ml of H_2O.

NO. 2 (continued)

Place the watch glass containing the ether filtrate in a favorable place for drying and allow the ether to evaporate. When dry, examine the residue, noting its greasy appearance and weigh. The substance is the fat of the milk.

3. Separation of Lactose: After adding acetic acid and filtering to remove casein and fat, the filtrate obtained in step 2 is used for this experiment. Place this filtrate in a beaker and heat to boiling. This will coagulate the lacetalbumin and lactoglobulin, other proteins of the milk. Cool and filter. Test this filtrate for sugar by adding 8 drops to 5 ml of Benedict's solution and heating. A brown precipita[illegible]s that sugar is present. To the remaining filtrate [illegible]0 ml of saturated lead acetate solution. This will remove the last traces of proteins. Filter about 3 to 5 ml of thick, syrupy solution remains. Set this beaker aside in your desk, and examine at the next laboratory period. Crystals of lactose or milk sugar will be found.

NAME ____________

SECTION ____________

DATE ____________

1. ____________ milk was used.

2. The reaction of milk to red litmus was ____________ and blue litmus was ____________.

3. The casein was separated from solution by bringing the milk to an acidity at which casein is ____________ (soluble or insoluble)

   Casein is a ____________ (carbohydrate, protein, fat). This was proved by treating with ____________ grams of fat was isolated.

4. In the filtrate from the casein there remained the sugar, ____________, and the protein, ____________. The proteins were partly removed by ____________. and complete removal of the proteins was finally effected by adding ____________. That the filtrate contained a reducing sugar was shown by a positive ____________ test. More crystals or lactose finally obtained?

5. Write a description of the difference in powdered milk and whole milk.

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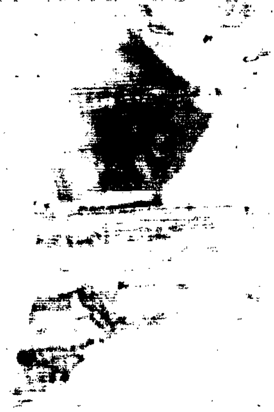
SUPPLMENTARY MATERIALS



METHODS AND MATERIALS FOR STUDENT EVALUATION

The evaluation materials compiled here were based on the specific unit objectives and on the use of the text:

Uko, David A. Living Chemistry. New York: Academic Press, 1977

If another text is chosen, many of the evalution questions would still be relevant, based as they are on the objectives of the course.

In general, the tests are middle cognitive level, with short answer, fill in the blanks, some multiple choice and several discussions in slightly more depth. Answer Keys are provided just after each test. It was felt that the middle cognitive level was most appropriate for the type of student expected and the intent of the course.

An instructor could use some of the items noted in the General Recommendations to design higher cognitive level items or to develop special topics for reports or projects.

In addition, recently developed materials are available in chemistry to teach and test using computer assisted learning. These might be another method of testing, particularly if the instructor favors criterion referenced testing.

Unit I

Examination

Write the letter that corresponds to the correct answer in the blank beside the question number.

_____ 1. Which of the following is longer.
a. 10 millimeters
b. 10 meters
c. 10 kilometers
d. 10 centimeters
e. 10 decimeters

_____ 2. If a person had a mass of 63.5 kg upon earth and traveled to the moon where gravity is one-sixth of earth's, their mass would be?
a. 10.6 kg
b. 63.5 kg
c. 381 kg
d. 21.2 kg
3. 190.5 kg

_____ 3. One pound is approximately?
a. 500 g
b. 900 g
c. 450 g
d. 2.2 kg
e. 250 g

_____ 4. One and one-half (1.5) meter is the same as?
a. 150 cm
b. 300 cm
c. 3 km
d. 15 km
e. 150 mm

_____ 5. One quart is slightly smaller than?
a. 100 ml
b. 1 ℓ
c. 500 ml
d. 250 cc
e. 2 ℓ

_____ 6. If lead had a density of 11 grams/cc then a 10 cc piece would have a mass of?
a. 110 g
b. 1.1 g
c. 5.5 g
d. 220 g
e. 11 g

_____ 7. Water freezes at 0° and boils at 100° on which scale?
a. Mercury
b. Fahrenhiet
c. Kelvin
d. Metric
e. Celsius

____ 8. If a definite mass of a substance has a definite volume, shape, density and cannot be compressed, it is?
a. gas
b. liquid
c. plasama
d. solid

____ 9. Five milliliters of a solution is the same as ________ cc?
a. 50
b. 10
c. 15
d. 2.5
e. 5

____ 10. The state of matter which diffuses readily is?
a. gas
b. liquid
c. solid
d. fluid
e. crystal

Unit II

EXAMINATION

Write the letter that corresponds to the correct answer in the blank beside the question number.

_____ 1. The smallest particle of an element that can exist either alone or in combination with other particles of the same element is the?
a. electron
b. proton
c. neutron
d. atom
e. isotope

_____ 2. The electronic field formed by the electrons about the nucleus of an atom is responsible for its?
a. mass
b. weight
c. density
d. positive nature
e. volume

_____ 3. In an electrically neutral atom the number of protons equals the number of?
a. neutrons
b. electrons
c. positrons
d. gamma rays
e. neutrons and electrons

_____ 4. An element consists of atoms all of which have nuclei containing the same number of?
a. neutrons
b. electrons
c. protons
d. beta particle
e. neutrons plus protons

_____ 5. If an atom has 12 protons, 14 neutrons and 12 electrons its mass would be?
a. 12
b. 24
c. 26
d. 38
e. 60

_____ 6. Isotopes of a given element have?
a. same mass
b. same atomic number
c. same nuclear structure
d. atomic weight

_____ 7. All elements of a group have the same number
a. of protons
b. of electrons in outershell.
c. neutrons
d. isotopes

____ 8. The element with mass of 39 and atomic number of 19 is?

a. Ca
b. Ar
c. K
d. Na
e. Cd

____ 9. Nonmetals are?

a. good conductors of electricity
b. solids at room temperature
c. good heat conductors
d. are brittle if solids

____ 10. Nonmetals tend to have more than ____ electrons in their outmost shell.

a. 1
b. 2
c. 3
d. 4
e. 5

Unit III

EXAMINATION

Write the letter corresponding to the correct answer in the blank besides the question number.

_____ 1. The correct Lewis dot structure for nitrogen is?
a. :N··
b. ·Ṅ·
c. ·N̈·
d. N

_____ 2. The most electronnegative of the following is?
a. O
b. Si
c. Li
d. Ba

_____ 3. If Lithium (Li) and nitrogen (N) reacted the correct formula would be?
a. LiN
b. Li_2N
c. Li_3N
d. LiN_3

_____ 4 A negative charge species is an?
a. cation
b. anion
c. radical
d. molecule

_____ 5. The smallest unit formed by covalent bonding of atoms is?
a. compound
b. cation
c. anion
d. molecule

_____ 6. The name of the following compound, Na_3N is?
a. nitrogen sodide
b. sodium oxide
c. sodium nitride
d. Nitrate of sodium

_____ 7. Ionic compounds form when electrons are?
a. shared equally
b. shared unequally
c. transferred
d. combined with protons

_____ 8. The symbol for the phosphate ion is?

a. PO_4^{-3}

b. PO_3^{-3}

c. P^{-3}

d. $P_2O_3^{-2}$

_____ 9. The formula for sodium carbonate is?

a. $NaHCO_3$

b. Na_2CO_3

c. Na_2CO_2

d. $NaHCO_2$

_____ 10. Which of the following bonds is the most polar?

a. H—OH

b. H—NH_2

c. H—Cl

d. H—BH_3

EXAMINATION

Write the letter corresponding to the correct answer in the blank besides the question number.

_____ 1. The gram molecular weight of $CaCO_3$ is?

a. 50 g
b. 100 g
c. 60
d. 40g

_____ 2. The percent of oxygen in $CaCO_3$ is?

a. 48%
b. 40%
c. 12%
d. 20%

_____ 3. Fifty grams of $CaCO_3$ is __________ moles.

a. 0.25
b. 0.5
c. 1.0
d. 24.5

_____ 4. You need 0.25 mole of H_2SO_4, how many grams would be needed?

a. 98 g
b. 49 g
c. 9.8
d. 24.5

_____ 5. One hundred fourteen grams of octane (C_8H_{18}) reacted exactly with 200 grams of oxygen to yield __________ total grams of CO_2 and H_2O.

a. 114 g
b. 314 g
c. 580 g
d. 290 g

_____ 6. In the equation below the coefficient need for KI is?

$$PbSO_4 + \_\_KI \rightarrow PbI_2 + K_2SO_4$$

a. 1
b. 2
c. 4
d. 6

_____ 7. Consider the reaction of antiacid $CaCO_3$ with stomach acid HCl. $CaCO_3 + 2HCl \quad CaCl_2 + H_2CO_3$. How many molecules of acid will two molecules of antiacid neutralize?

a. 2
b. 1
c. 3
d. 4

_____ 8. The equation in question 6 is an example of?
a. decomposition
b. combination
c. single replacement
d. double replacement

_____ 9. In the following reaction iron is:

$$2Fe_2O_3 + 3C \rightarrow 4Fe^\circ + 3CO_2$$

a. decomposed
b. oxidized
c. reduced
d. combined

_____ 10. The burning of coal (carbon) is an?
a. endothermic
b. isothermic
c. puerdothermic
d. eothermic

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EXAMINATION

Write the letter corresponding to the correct answer in the blank besides the question number.

_____ 1. Hydrogen chloride (HCl) will diffuse approximately _______ times slower than helium (He).
a. 1
b. 2
c. 3
d. 4

_____ 2. One atmosphere of pressure is equivalent to _____ torr. of Hg.
a. 32
b. 76
c. 760
d. 380

_____ 3. At constant volume an increase in temperature of a gas will result in a __________ of pressure.
a. increase
b. decrease
c. no change

_____ 4. A 22.4 l canister of CO_2 is 1 atm. of pressure and 273° K contains __________ grams.
a. 22 gm
b. 44 g
c. 440 g
d. 4400 g

_____ 5. A 3 liter ballon at 20° C is cooled to 10° C and the size of the balloon becomes.
a. 4.5 l
b. 6 l
c. 1.5 l
d. 2.5 l

_____ 6. An increase in temperature results in gas molecules
a. expanding
b. moving slower
c. contracting
d. moving faster

_____ 7. The following gases are mixed: nitrogen (200 torr), oxygen (350 torr) and argon (150 torr). What is the total pressure of the mixture?
a. 350 torr
b. 700 torr
c. 1050 torr
d. 1400 torr

_____ 8. A decrease in volume of a quanity of a gas results in a __________ in pressure.
a. increase
b. decrease
c. no change

EXAMINATION

Using your own words, briefly answer the following. Use illustrations when appropriate.

1. Explain how hydrogen bonding can occur.

2. Explain how water, a liquid, can have a vapor pressure.

3. Why is so much heat needed to boil water?

4. How can water exist as an liquid and solid state at 0° C.?

5. Explain surface tension.

6. Why is blood more viscosous than water?

7. Discuss the two factors that effect a liquid's pressure.

8. Describe humidity therapy.

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EXAMINATION

Fill in the blank with the missing word. You may use the bottom of the test for any calculation necessary.

1. A solution of two solids is a ______________________.

2. A 5 (w/v)% saline solution contains ______________gm of soldium chloride per liter of solution.

3. A solution that has undissovled solute in it is said to be ______________________.

4. Decreasing the temperature will generally ____________ the solubility of a gas in a liquid.

5. A 1000 ml solution that contains 0.001 gm of solute is ____________ ppm.

6. ________ml of 15% solution should be diluted to 500 ml to have 5% solution.

7. In the process of osmosis, _______________ diffuses through a membrane from a solution of low concentration to a solution of high concentration.

8. The process by which blood is purified in a kidney machine is known as _______________.

9. Placing red cells in a hypotonic solution results in ____________________.

10. The osmotic pressure of a solution depends on the ____________ of particles, ions, or molecules of solute.

EXAMINATION

Fill in the blank with the missing word.

1. An acid is a substance that ______________ the hydrogen ion concentration of water.

2. The ____________ of an acid depends on how completely it is ionized in solution.

3. When a base dissolves in water, the relative number of OH^- ions become ________________ than the number of H^+ ions.

4. Solutions of base have _______________ feeling.

5. A solution with a pH 2 is _________ times more acidic than one with a pH 4.

6. At pH 7 the hydroxide concentration is ____________ the hydrogen ion concentration.

7. When an acid reacts with a base, it forms water plus an ionic compound, a ______________.

8. When dissovled in water, some salts react with the water in a process called _____________________.

9. The sour taste of citrus fruit is due to citric ____ _________________.

10. The salt of a weak acid dissolves in water to make the solution ___________________.

EXAMINATION

Fill in the blank with the missing word or symbol.

1. The type of radiation that can pass through concrete is ______________________.

2. Complete $^{59}_{27}Co$ $\quad$ $^{55}_{25}Mn$ + ______________________.

3. The half life of $^{90}_{38}Sr$ is 28 years. If 60 mg is initially present, ________________ mg will be present at the end of 56 years.

4. The type of radiation given off in nuclear decay, that yields an electron is called ________________.

5. X-rays are ____________ in energy than ultraviolet light.

6. Geiger-Muller counters can detect ________________ radiation.

7. A dose of radiation actually absorbed is expressed using ______________________.

8. The unit of radiation that you would use to describe activity would be ______________________.

9. The first sign of radiation sickness is ________________.

10. Radioisotopes behaves chemically ________________ the same element in its stable form.

Unit X

EXAMINATION

Fill in the blank with the correct structure or with the correct answer.

1. The structure of 1-butyne is ______________________.

2. The name of $CH_3-CH_2-CH-CH$ is ______________________.
$\qquad\qquad\qquad\qquad\qquad\quad | $
$\qquad\qquad\qquad\qquad\qquad\; CH_3$

3. The structure of cis - 3 - pentene is ______________

4. Complete the following $CH_3-CH_2-CH=CH_2+H_2 \longrightarrow$

5. Which of the following is not an isomer hexane__________.

a.
$$\begin{array}{c} \qquad\qquad\quad CH_3 \\ \qquad\qquad\quad | \\ CH_3-CH_2-C-CH_3 \\ \qquad\qquad\quad | \\ \qquad\qquad\quad CH3 \end{array}$$

b.
$$\begin{array}{l} CH_3-CH_2-CH-CH_3 \\ \qquad\qquad\quad\; | \\ \qquad\qquad\quad CH_2-CH_3 \end{array}$$

c.
$$\begin{array}{l} CH_3-CH-CH-CH_3 \\ \qquad\quad | \quad\;\; | \\ \qquad\; CH_3 \; CH_3 \end{array}$$

d. $CH_3-CH=CH-CH_2-CH_2-CH_3$

6. Complete the following  + HCl $\longrightarrow$ ______________

7. Draw an example of a polynuclear hydrocarbon ___________

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8. Draw the structure ethyl chloride ______________.

9. Give the structure of cyclopentane ______________.

10. Which of the following is not organic? ______________.

a. $H\overset{\overset{O}{\|}}{C}-H$ b. CH_3-CH_2OH

c. $NaC\equiv N$ d. $CH_3-\overset{\overset{O}{\|}}{C}-OK$

EXAMINATION

In the first blank following the structure write the principle functional group of the structure and in the second blank write the name of the compound.

$CH_3-CH_2-O-\overset{O}{\overset{\|}{C}}-CH_3$ 1. ____________ 2. ____________

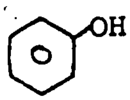
$CH_3-CH_2-O-CH_2-CH_2-CH_3$ 3. ____________ 4. ____________

$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-H$ 5. ____________ 6. ____________

$CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-OH$ 7. ____________ 8. ____________

$CH_3-\overset{OH}{\overset{|}{C}}H-CH_3$ 9. ____________ 10. ____________

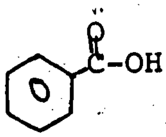
$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$ 11. ____________ 12. ____________



13. ____________ 14. ____________

15. Complete $CH_3-CH_2-CH_2OH \xrightarrow{\text{strong oxidation}}$

16. Complete $CH_3-\underset{CH_3}{\underset{|}{C}}H-\overset{O}{\overset{\|}{C}}-H + Cu^{+2} \xrightarrow[H_2O]{OH^-}$

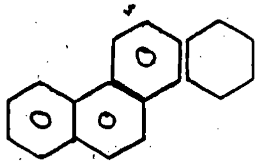
17.  + NaOH $\longrightarrow$

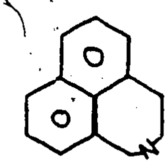
18. Give an example o saponification.

EXAMINATION

Fill in the blank with the correct structure.

1. Give an example of a halogenated hydrocarbon ________________________________
2. Give an example of a thiol ________________
3. Give an example of a secondary amine ______________________________.
4. Give the structure of amiline ____.
5. Give an example of an amide ________________.
6. Circle which of the following is an alkaloid?

a. 



7. Give the structure of a thioether:

8-9. Illustrate and briefly explain how an amide react different from an amine with acid.

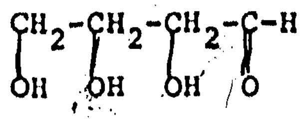
10. Give an example of PCB ________________.

Unit XIII

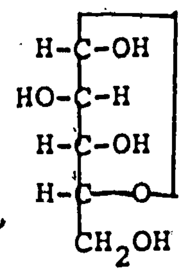
EXAMINATION

Fill in the blank on the first six questions. Give brief answers and illustrate structure for question 7 through 10.

1. The following structure is called a ______________.

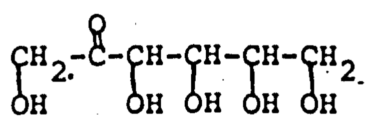


2. The ring in the following structure has been formed by a functional group ______________.



3. The representation of the formula given in the previous question is a ______________ formula.

4. The conversion between alpha and beta forms of monosaccharide is called ______________.

5-6. Fructose  is an example of a ______________ and ______________ give a positive Benedicts test.

7. Give an example of a disaccharide.

8. Why is maltose a better infant food than lactose or milk sugar?

9. What is the difference in starch and cellulose?

10. How does glycogen differ from starch?

EXAMINATION

Use brief discussion, with illustration to answer the following.

1. Explain the importance of iodine number.

2. Explain the term polyunsaturated.

3. Give an example of a triglyceride.

4. How does a wax differ from a fat?

5. How are soaps formed from glyceride?

6. What difference in the physical property of fats does double bonds in the fatty acid make?

7. How do prostaglahdins differ from other fatty acids?

EXAMINATION

Use brief discussion and structure to answer the following:

1. Explain what is meant by alpha amino acid.

2. Give the structure of glutamic acid.

3. Explain the structure of a zwitterion.

4. Illustrate the function group serves as a peptide bond.

5. Explain how the secondary structure of proteins are formed.

6. Explain how alcohols denature proteins.

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ANSWERS

Unit I

1. c	4. a	7. e	10. a
2. b	5. b	8. d	
3. c	6. a	9. e	

Unit II

1. d	4. c	7. b	10. c
2. e	5. c	8. c	
3. b	6. b	9. d	

Unit III

1. c	4. b	7. c	10. c
2. a	5. d	8. a	
3. c	6. c	9. b	

Unit IV

1. b	4. d	7. a	10. d
2. a	5. b	8. d	
3. b	6. b	9. c	

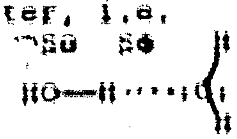
Unit V

1. c	4. b	7. b
2. c	5. c	8. a
3. a	6. d	

ANSWERS

Unit VI

1. Oxygen being much more electronegative than hydrogen draws the shared pair towards its nuclei. Hydrogen having lost electron density can now accept electron density from one of the nonbonding pairs of the oxygen of another water, i.e.

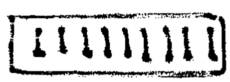


2. Within any system there is a distribution of energy among molecules. Some have enough to escape the liquid phase into the vapor. This escape is opposed by the pressure of the molecules already in the atmosphere (atmospheric pressure).

3. Enough energy must be added to each water molecule so it can overcome the molecule-molecule attraction of depole-depole and hydrogen bonding.

4. Water molecules in the liquid have a random arrangement and extra energy must be removed to get them into the orderly arrange of a crystal structure, but the temperature remains the same.

5. Water molecules are highly attracted to one another. the molecules on the surface are pulled inward only.



6. Large molecules or cells have a resistance to slide past and over one another.

7. The two factors that the pressure of a liquid are height and density. Both factors are directly related to the pull of gravity.

8. Humidity therapy involves the additions of water to the gas being breathed by the patient.

ANSWERS

Unit VII

1. alloy
2. 5 gm
3. saturated
4. increase
5. 1 ppm
6. 166 ml
7. solvent
8. dialysis
9. crenation
10. number

Unit VIII

1. increases
2. strenght
3. greater
4. slippery
5. 100
6. the same as
7. salt
8. hydrolysis
9. acid
10. basic

Unit IX

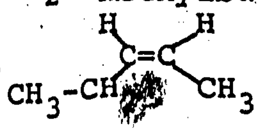
1. gama ray or 8 ray
2. $^{4}_{2}He$
3. .15 mg
4. beta or B
5. higher-greater 8 curie
6. beta
7. RAD
8. curie
9. drop in white blood cell
10. the same as

ANSWERS

Unit X

1. $CH_3-CH_2-C\equiv CH$

2. 2- methylbutane (esopentane)

3. 

4. $CH_3-CH_2-CH_2-CH_3$

5. d

6. N.R.

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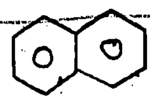
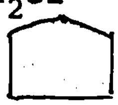
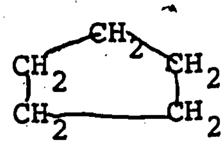
7.  plus numerous others

8. CH_3-CH_2Cl

9.  or 

10. C

ANSWERS

Unit XI

1. ester
2. ethyl ethanoate or ethylacetate
3. ether
4. ethylpropylether or ethoxypropane
5. aldehyde
6. propanal or propionaldehyde
7. acid

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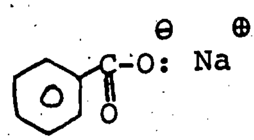
8. batanoic acid or butryic acid
9. alcohol
10. 2-propanol or isopropyl alcohol
11. ketone
12. 2-butanone or methyl ethyl ketone
13. phenol
14. phenol
15. $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-OH$
16. $CH_3-\underset{CH_3}{\underset{|}{CH}}-\overset{O}{\overset{\|}{C}}-OH$
17. 
18. $R-\overset{O}{\overset{\|}{C}}-OR' + NaOH \longrightarrow R-\overset{O}{\overset{\|}{C}}-ONa + HOR'$

Plus numerous others

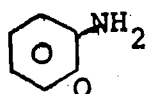
ANSWERS

Unit XII

1. CH_3-CH_2-Cl plus numerous others

2. CH_3-CH_2-SH plus numerous others

3. $CH_3-\underset{H}{\underset{|}{N}}-CH$ plus numerous others

4. 

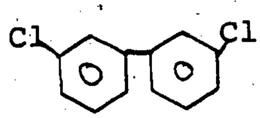
5. $R-\overset{O}{\overset{\|}{C}}-NH_2$ plus numerous others

6. b

7. CH_3-S-CH_3 plus numerous others

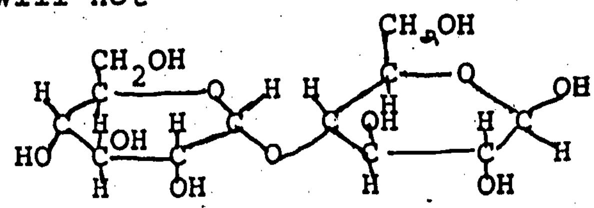
8. $R-\overset{O}{\overset{\|}{C}}-NH_2 + H^+ \longrightarrow$ N.R

9. $R-NH_2 + H^+ \quad R-NH_3^{\oplus}$ water soluble salt

10.  plus numerous others

ANSWERS

Unit XIII

1. Aldose
2. Hemiacetal
3. Fisher
4. Mutarotation
5. Ketose
6. will not
7.  Maltose or one of many others

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8. Maltose has two glucose units while other dissacharides have only one.

9. Starch is a polymer of alpha glucose while cellulose is a polymer of beta glucose.

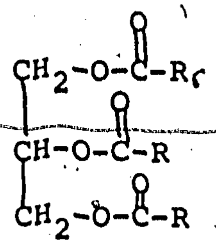
10. Glycogen is a polymer of 5000 monosaccharides, while starch is a polymer of 1000 monosaccharides.

ANSWERS

Unit XIV

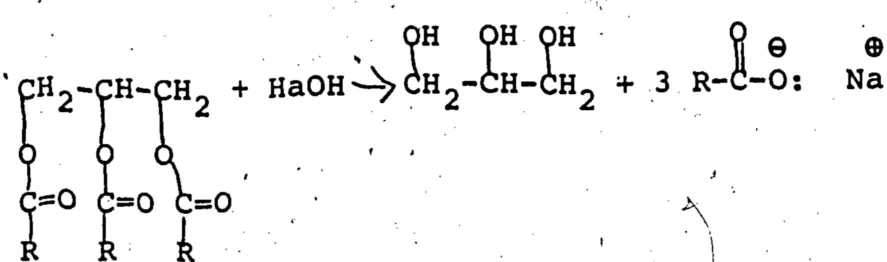
1. Iodine number measures the degree of unsaturation. The higher the iodine number the more unsaturation (double bonds)

2. Unsaturation is a term indicating carbon-carbon double (pi) bonds. The bonds are more reactive than carbon-carbon single (sigma) bonds. Poly means many.

3. 

   Plus numerous others

4. Fats are triesters of the trihydric alcohol glycerine, while waxes are monoester of high molecular weight monohydric alcohols.

5. 

   The reaction of the ester functional group of fats with base yields glycerine and the salt of fatty acids (soap)

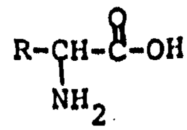
6. Saturated fatty acids make for solid fats. The more double bonds the softer the fat unit, they become oils.

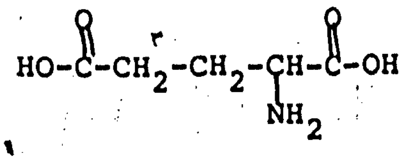
7. The fatty acids in prostagtandins have carbon ring system in their chains.

ANSWERS

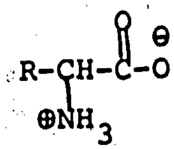
Unit XV

1. The amino group (NH_2) is bonded to the carbon next in the chain (number two) to the carbon of the acid functional group. i.e.

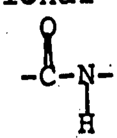


2. 

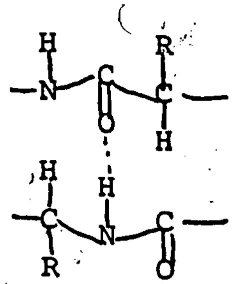
3. Doubly charged molecules, molecules that contain both a cation portion and anion portion are zwitterion.



4. The amide funtional group the primary strucutre of proteins.



5. The secondary structure of proteins result from hydrogen bonding between adjacent chains.



6. Denaturation is the disorganization of protein structure. Alcohols do it by breaking the hydrogen bonds of the secondary structure.

OTHER MATERIALS IN THIS SERIES

The U. S. Department of Education contracted with the Baptist College at Charleston to produce the following products, which are now available as part of the Rural Health Promotion Series supporting an associate degree in rural health.

1. A Final Project Report , including summary information about the design of the 2 year degree; conceptual, developmental, and applications issues; and a compilation and analysis of preliminary qualitative evaluation of the program components (by professionals in the health care field) and the programs goals (by rural residents and care providers).

2-8. A series of seven courses designed to meet the needs of this two year degree including:

Interpersonal Communications: skills in listening, sharing information, observation, and assessment, with special focus on cultural concerns, verbal and non-verbal messages.

Epidemiology: inter-relations of disease development and prevention in a public health model of host, agent, and environment; specially focused at the sophomore level.

Concepts of Chemistry: an up-dating of traditional chemistry concepts for allied health.

Health Care Organization and Issues: An overview of community health care systems, with special focus on issues such as financial support, ethical dilemmas, changing services and technologies, and future directions, including computers in intervention, treatment and education.

Health Promotion Seminar: A hands-on personal experience in behavior change around life-style issues, including up to date data and consideration of popular media ideas of health promotion.

Fundamentals of Paraprofessional Care I and Fundamentals of Paraprofessional Care II: A sequence of two courses designed to produce a person educated in major health issues and responses, with special skill development in physical care, emotional support, personal hygiene, safety and first aid (including Cardio-Pulmonary Resusitation).

Each of the instructor resource guides for teaching one of the above courses includes overview material on the total project (to provide perspective for content and methodological elements) as well as context of the course in the overall curriculum.

9. Rural Health Focus Guides for Core Content of the Health Promotion Associate Degree: This document is the work of professional educators in fields which make up the curricular core of the associate degree. The focus guides are the result of thoughtful consideration by these teachers regarding how their subject area relates to the necessary knowledge and competencies of a community paraprofessional in health promotion. All of the authors of the focus guides attended a workshop on health promotion which brought together core faculty, health educators, rural health sociologists, rural health care

providers, and rural health care recipients. The focus guides are the product of their individual approaches to the relevance of their subject matter to the overall degree; each gives ideas for highlighting particularly useful areas of a core course without in any way compromising the existing goals and expectations applied to all students who take these courses. Bound together in one volume, the focus guides cover the areas of

Freshman English,
general college mathematics,
general psychology,
human growth and development,
psychology of adulthood and aging,
introductory sociology,
social service systems,
New Testament religion,
interpersonal communications skills,
group dynamics,
anatomy and physiology,
microbiology,
introductory allied health chemistry.

The nine products listed above are in the ERIC system; copies are also housed with the contractor (the Baptist College of Charleston, Charleston, S.C.) and with the funding agency (the U. S. Department of Education, Office of Vocational and Adult Education, Washington, D.C.)