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ABSTRACT

This guide is intended for use in helping high school and entry-level community college students in acquiring the practical science skills necessary to ensure successful completion of an associate-level allied health program. The guide was originally developed to provide an articulation model for high school students interested in entering the medical laboratory technology program at Columbus State Community College. Included in the guide are outlines for instructional units on the following topics: the practical sciences and health careers; science and the scientific method; basic laboratory procedures; measurement of matter; matter and energy; atomic structure; chemical formulas and bonding; water and organic compounds; basic chemical reactions; chemical solutions; acids and bases; acids and bases in solutions; structure and function of the cell; cellular activities; cell division; genetics; introduction to the human body; the framework of the human body; the human endocrine, reproductive, respiratory, cardiovascular, nervous, digestive, and excretory systems; interdependent systems of the body; and human relations in allied health and science careers. Recommendations for recruiting students, selecting instructors, planning programs, assessing and grading students, and selecting equipment and facilities are also provided. (MN)

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FOREWORD

Columbus State Community College (CSCC) has developed an excellent and extensive allied health program. Many of the students attempting to gain admission to the allied health program lack the necessary science background and thus are required to take remedial science courses before being accepted into the program. CSCC would like interested students to be able to more easily enter and be successful in the program.

To help ensure these improvements, CSCC requested articulation assistance from the National Center for Research in Vocational Education, which has experience in designing articulation plans and curriculum materials. This report presents the course objectives and outlines of the pre-tech articulation model developed by the National Center at CSCC's request.

The National Center wishes to express its sincere appreciation to CSCC for extending to us the opportunity to conduct this task, an addition to earlier technical assistance for secondary-postsecondary articulation in the Columbus area. Special thanks is extended to Mr. Michael Snider, Dean of Allied Health, for his assistance and direction in conducting the project, and to Mr. Jay Benedict, Instructor at CSCC, who was Mr. Snider's backup. Thanks are additionally extended to the eminently well-qualified members of the advisory panels, made up of Columbus Public Schools representatives Mr. Albert Acierno, Ms. Vernell Braxton, Ms. Jacqueline Cason, Ms. Lois Cooper, Ms. Jill Schrader, and Ms. Patty Walker, Ms. Pat Leithe of Eastland Vocational Center, CSCC representatives Ms. Julie Dudas,

Ms. Bev Geiger, and Mr. Bob Sanders, and Ms. Wilma Tompkins, State Supervisor of Health Occupations.

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Dr. James P. Long served as Project Director, Ms. Judith Goff as Program Associate, Ms. Constance R. Faddis as Program Assistant, and Dr. William L. Ashley as Research Specialist. The project was under the overall supervision of Mr. Harry N. Drier, Associate Director, Special Programs Division, and Dr. Mark Newton, Associate Director, Personnel Development and Field Services Division. Ms. Margaret Barbee, Ms. Monyeene Elliott, and Ms. Cheryl Salyers provided clerical support. Editing was performed by Ms. Elizabeth Martin of the National Center's editorial services.

We are pleased to have been able to serve the needs of CSCC and look forward to a continued relationship with the college.

Ray D. Ryan
Executive Director
National Center for Research
in Vocational Education

EXECUTIVE SUMMARY

This document reports the activities and results of an add-on task to the project titled Articulation Assistance for Columbus Technical Institute (now Columbus State Community College). The additional task was titled Pre-Tech for Allied Health. The purpose of the additional task was to develop an articulation model for use by high school students who plan to enter the Medical Laboratory Technology Program and other allied health programs at CSCC. Such a pre-tech course would give students a firm foundation in applied science upon which to build the technical skills they must attain in CSCC's allied health programs.

Several activities were carried out to develop the course. A literature search for an existing course was conducted. In order to establish a resource list, educational databases were reviewed and instructors were questioned. Textbook publishers were contacted to determine whether appropriate textbooks exist. The Principles of Technology, a physics pre-tech course developed by the Center for Occupational Research and Development (CORD), was studied as a resource.

Two advisory panels were named (see the appendix for list of participants). The first panel, consisting of CSCC allied health representatives and secondary vocational allied health representatives, met in April 1987 to determine what knowledge and skills a person should possess prior to being admitted to an allied health program. The panel recommended that an applied

biology course and an applied chemistry course be developed for this purpose.

The second advisory panel met in July 1987 to review and make recommendations for the draft course outlines that had been developed by project staff based on input received from the first advisory panel. The second panel was made up of secondary science personnel and the CSCC allied health personnel. They recommended that the two courses, applied biology and applied chemistry, be merged into one course. This recommendation was based on several factors: (1) the State of Ohio's Department of Education requires only 1 year of science for high school graduation; (2) students enrolling in the applied science course may have already taken one science course, making it very unlikely that they would take 2 years of applied science courses; and (3) the course resulting from the two merged courses would provide adequate science background for students seeking admission to CSCC's allied health program.

Recommendations were received from members of both panels concerning resources and textbooks available as well as suitable delivery methods. All recommendations are presented in the section titled "Recommendations for Implementation."

The task of the National Center was to establish course outlines and unit objectives. This is seen as a preliminary step in developing a complete pre-tech course curriculum when additional funding is available. Delivery method recommendations are offered for a fully developed course. Recommendations are also

provided for implementation of the course should no further funding become available for development.

Based upon suggestions from the advisory panels, the National Center project staff recommends primary marketing of this course, Principles of Practical Science for Allied Health Careers, to the 39 percent of high school students who enroll in a general course of study and do not know what they want to do after high school graduation. As a result of taking this course, students may be encouraged to enter the 2-year allied health program at CSCC. Principles of Practical Science for Allied Health Careers has potential value for all segments of high school students, but students must be properly informed about the course concepts and benefits.

The National Center also recommends that CSCC offer Principles of Practical Science for Allied Health Careers in summer school for incoming students who do not have a proper science background. The new course would replace CSCC's current Survey of Biology and Survey of Chemistry courses. The National Center stands ready to assist CSCC in course development and implementation.

INTRODUCTION

The Need

In 1977, the National Commission on Allied Health Education was created to conduct a study of allied health education in the United States. One of its recommendations is as follows:

Allied health administrators should establish links with local secondary school systems to inform students about allied health careers and requirements of educational programs and to encourage participation in work experience in health settings during the high school years. (National Commission, 1980, p. 212)

In order to inform and better prepare students for its allied health programs, Columbus State Community College (CSCC) established as a goal the development of a pre-tech articulation course for use by selected high school students who plan to enter the allied health programs at CSCC. CSCC has found that many students seeking admission to allied health associate degree programs lack the proper science background (i.e., chemistry and biology).

Many high school students avoid these subjects because they fear taking them. CSCC has discovered that it is becoming increasingly difficult for an allied health student to complete the 2-year associate degree program in a timely manner. Obviously, the student who enters the program without the proper science background must take remedial science courses and thereby lengthens the time needed to complete the total program. In addition, advancing technology has expanded the educational requirements and knowledge needed to complete the program.

Background

In a typical science classroom, the emphasis of the curriculum is on theory and seldom on the real-life application of the knowledge. Yager (1987) has suggested implementing a "Science for All" approach. This curriculum would not contain a sampling of science as known by scientists, but instead would emphasize "the nature of science, the applications of science, the history of science, and science-related careers" (p. 28).

The pre-tech course for allied health that is suggested in this report is designed to alleviate the problem at CSCC while incorporating Yager's suggestions. This pre-tech course emphasizes "hands on," reality-based learning experiences. For example, students can learn about the composition of blood by examining human blood samples under a microscope. This approach is based on considerable evidence that people learn best by direct experience. This applied pre-tech course for allied health and science careers, related to the real world and to real experiences, should be a valuable enhancement of the high school science curriculum.

Objective

The objective of the project is to develop course objectives and course outlines upon which a pre-tech course can be founded. This course could subsequently be implemented by (1) high schools in grades 10, 11, or 12 or (2) by CSCC as an "000"-level course (i.e., credit not applicable to college graduation requirements)

for high school or adult students interested in entering an allied health program.

Methodology

In order to determine whether a pre-tech course for allied health might already exist, project staff conducted an extensive literature search. No such course was found. The materials from Principles of Technology, a pre-tech course for physics developed by the Center for Occupational Research and Development (CORD), were examined to provide ideas on how to proceed.

Project staff investigated many other resources. Textbook publishers John Wiley & Sons, Inc.; Reston Publishing Company; and Charles E. Merrill Publishing Company were contacted concerning applicable current and upcoming textbooks. Educational databases such as VECM and DIALOG were reviewed. Secondary and postsecondary instructors were asked to recommend possible resources for use in a pre-tech course.

The CSCC allied health programs currently require two survey (i.e., remedial) courses for students who lack high school chemistry or biology, or who have taken such courses long ago, before admittance is granted to one of the allied health programs. CSCC hopes to eliminate or decrease enrollment in these survey courses through the development of a pre-tech course for high school students. Project staff also examined the survey courses closely for content to be covered in a pre-tech course.

Two advisory panels were named (see the appendix). Each panel was made up of representatives from the secondary schools

and from CSCC. The first panel convened on April 28, 1987. The task of this group was to identify the kinds of prerequisite knowledge and skills that should be expected of persons who apply for entry into the allied health program at CSCC. The group was also charged with identifying courses that would appropriately comprise the pre-tech program.

The major tasks of the second panel, which met on July 1, 1987, were to identify and discuss a tentative course outline for the applied science courses. This was achieved by critiquing the objectives and outlines drafted as a result of the suggestions of the first advisory panel pertaining to prerequisite knowledge and skills needed for allied health program entrance. Although the first panel operated under the premise of two separate courses, applied biology and applied chemistry, the second advisory panel's final recommendation was for one merged course. This decision was made primarily because the state of Ohio requires only 1 year of science for graduation, and the panel felt the second year of applied science would not be taken.

The remainder of this report presents the course outline for Principles of Practical Science for Allied Health Careers, as well as recommendations for its further development and implementation.

**PRINCIPLES OF PRACTICAL SCIENCE FOR ALLIED HEALTH CAREERS
A PRE-TECH COURSE OUTLINE FOR HIGH SCHOOL STUDENTS**

The pre-tech course, Principles of Practical Science for Allied Health Careers, covers 26 units of varying lengths. Units are designed to motivate students to learn relevant applied biological and chemical science concepts and skills that are essential for successful performance in an allied health or science technical career.

Skills taught in the units progress from the simple to the complex. Individual units are modular so that they may be selected and sequenced to meet the learning needs of specific students without requiring them to duplicate lessons they may have learned in earlier course work.

The remainder of this course outline lists the names of each unit and the related objectives in the recommended sequence for course implementation.

**Unit 1: Introduction to Practical Science
and Health Careers**

Unit Objective:

Upon completion of the unit, students will be able to identify the major allied health and science technical careers and will be able to explain in general terms how the careers differ from each other and from the medical and science professions.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o List the major allied health and science technical careers.

- o List the primary duties of the technician or technologist for selected allied health or science technical careers.
- o Explain the chief relationships and interactions with other relevant personnel for selected allied health or science technical careers.
- o Explain the reasons for the basic required education and training program, registry and/or certification process, and approximate salary range of selected allied health or science technical careers.
- o Describe the science and mathematics requirements necessary for entry into a college-level program in the selected allied health and science technical careers and/or for entry into practice.

Unit 2: Science and the Scientific Method

Unit Objective:

Upon completion of the unit, students will be able to discuss the investigative nature of science and describe the scientific method.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Define the term science.
- o List the steps that comprise the scientific method.
- o Explain each step of the scientific method.
- o Explain how the scientific method is used to solve problems.
- o Use the scientific method as exhibited in at least three discoveries and point out the steps of the scientific method as applied in each example.
- o Apply the scientific method to solve a science problem assigned/described by the instructor.

- o List the major divisions of science and describe the major content that each encompasses.
- o Discuss the limitations of science.

Unit 3: Basic Laboratory Procedures

Unit Objective:

Upon completion of the unit, students will be able to work safely in the laboratory with standard laboratory equipment.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Discuss and demonstrate the procedures needed to ensure personal safety.
- o Discuss and demonstrate the safety procedures for using equipment and chemicals.
- o Demonstrate the use of a triple beam accurate balance scale to determine the weights of objects.
- o Identify by name and purpose the standard pieces of basic chemistry laboratory glassware.

Unit 4: Measurement of Matter

Unit Objective:

Upon completion of the unit, students will be able to explain the basic principles of scientific measurement, define the basic systems of measurement, and demonstrate the use of various measurement devices and methods to solve practical problems specific to allied health and science occupations.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Identify metric measurements by their prefixes.

- o Convert quantities within the metric system.
- o Discuss the importance of the use of the International System of Units (SI) in allied health careers.
- o Compare length, mass, temperature, and volume measurements in both metric and English units.
- o Use a meter stick accurately to measure length, area, and volume of box-shaped objects and express the dimensions in both English and metric units.
- o Use the concept of simplifying algebraic expressions by replacing them with rational numbers.
- o Measure length, weight, area, volume, and density to be able to solve measurement problems for the unknown quantity, using basic algebraic concepts.
- o Explain the difference between weight and mass.
- o Explain how time is measured.
- o Describe the different methods of expressing temperature.

Unit 5: Matter and Energy

Unit Objective:

Upon completion of the unit, students will be able to discuss the basic principles of matter and energy and will be able to apply this knowledge in practical laboratory situations.

Specific Unit Objectives:

Upon completion of this unit the student will be able to do the following:

- o Explain the concept of matter and define the states of matter.
- o Recognize and explain the difference between a physical and chemical change.
- o Explain the concept of energy and its relationship to matter.

- o Explain what is meant by temperature.
- o Demonstrate accurate measurement of temperature.
- o Explain what is meant by pressure.
- o Demonstrate accurate measurement of pressure.
- o Explain what is meant by caloric content and how it differs from temperature.
- o Discuss and identify the different forms of energy.
- o Identify the major constituents of the electromagnetic spectrum.
- o Explain the relationships between and among temperature, pressure, and volume.
- o Define the term mixture.
- o Define the term compound.
- o Define the term element.

Unit 6: Atomic Structure

Unit Objective:

Upon completion of the unit, students will be able to discuss the basic order and structure by which elements combine and are organized into the periodic table.

Specific Unit Objectives:

Upon completion of this unit the student will be able to do the following:

- o Define the term atom.
- o Discuss basic atomic theory and the structure of the atom.
- o Explain why atoms are considered building blocks of matter.
- o Describe how electrons, protons, and neutrons are arranged in atoms.

- o Explain the meaning of the term isotope.
- o Discuss ionizing radiation, its different types, its biological effects, its uses in biology and the allied health and science fields, and the basics of dosage and safety in its use.
- o Explain the terms molecule, compound, valence, ion, and radical.
- o Explain the difference between ionic and covalent bonding.
- o Discuss how the properties of covalent and ionic compounds differ.
- o Explain the concepts of conservation of matter and energy.
- o Explain what is meant by energy levels.
- o Discuss the placement of electrons in energy levels.
- o Describe the electrical charges and weights of electrons, protons, and neutrons.
- o Use the periodic table to identify common elements by symbol and determine their atomic number and atomic weight.
- o Use the periodic table to classify an element as metal or nonmetal.
- o Use the periodic table to locate the transition elements.
- o Use the periodic table to identify the family and period of an element (i.e., the alkali metals, halogens, and noble gases) by its group designation and by specific name.
- o Use the periodic table to determine the number of outer shell electrons in an atom.

Unit 7: Chemical Formulas and Bonding

Unit Objective:

Upon completion of the unit, students will be able to explain generally how elements combine chemically to form compounds.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Explain the basic ways by which chemical compounds are formed.
- o Explain the processes of chemical bonding.
- o Define the term ionic bonding.
- o Define the term covalent bonding.
- o Identify a compound as ionic or covalent.
- o Explain the meaning of electron-dot formulas.
- o Describe polyatomic ions.
- o Write chemical formulas for various compounds, and identify the names of compounds from their chemical formulas.
- o Describe a polar covalent bond.
- o Use the periodic table to determine the formula weight of a compound.
- o Define the chemical term mole.
- o Explain the relationship between gram-formula weight and moles.
- o Explain the difference between normal and molar solutions.

Unit 8: Water and Organic Compounds

Unit Objective:

Upon completion of the unit, students will be able to discuss and demonstrate an appreciation of the importance, in allied health and science careers, of becoming highly knowledgeable about the common compounds of water and carbon.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Discuss the properties of water.
- o Discuss the importance of water as the basis of biological systems on earth.
- o Discuss whether a person could drown in his or her own fluid.
- o Identify carbon compounds by molecular structure.
- o Describe the structure of carbon and explain how the structure enables carbon to form so many compounds.
- o Explain the formation of hydrocarbons and list examples of such compounds.
- o Discuss the basic structure and function of carbohydrates.
- o Discuss the basic make-up and importance of proteins in nutrition.
- o Explain the role and properties of lipids and list examples of fats, oils, sterols, and steroids.
- o Demonstrate the structure of isomers by constructing models (using toothpicks and styrofoam balls).
- o Identify an alcohol, an acid, and an amine if given a pertinent formula.
- o Describe some of the properties that an alcohol, acid, and amine impart to an organic compound.
- o Describe a polymer.
- o Explain a polymerization reaction.
- o Identify some common polymers.
- o Discuss the importance of the use of polymers in the allied health field.

Unit 9: Basic Chemical Reactions

Unit Objective:

Upon completion of the unit, students will be able to explain what takes place in a chemical reaction and will be able to express the process using a chemical equation.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Identify the reactants in and products of a chemical reaction.
- o Explain the difference between exothermic and endothermic reactions.
- o Use chemical symbols to write chemical equations.
- o Explain why a chemical equation must be balanced.
- o Explain the basic concept involved in solving equations: that whatever operation is performed on one side of an equation must also be performed on the other side of the equation.
- o Balance chemical equations.
- o Identify the number of molecules and/or atoms represented in a chemical equation.
- o Identify the number of moles represented in a chemical equation.
- o Calculate the weight of reactants and products.

Unit 10: Chemical Solutions

Unit Objective:

Upon completion of the unit, students will be able to describe the characteristics of solutions and identify the components of a solution.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Explain the relationship of molecules in solid, liquid, and gaseous states.
- o Define the term solution.
- o Identify the solvent and solute in a solution.
- o Explain solubility.
- o Describe the effects that solute size, temperature, and pressure have on solubility.
- o Compare and contrast saturated, unsaturated, and super-saturated solutions.
- o Explain how solubility is affected by the polarity of the solute and solvent.
- o Prepare solutions of a given percent concentration and molar and normal concentration.
- o Define the term electrolyte.
- o Describe the process of ionization.
- o Explain the difference between weak and strong electrolytes.

Unit 11: Acids and Bases

Unit Objective:

Upon completion of the unit, students will be able to demonstrate basic knowledge of two important classifications of compounds--acids and bases--and will be able to identify each in simple laboratory experiments.

Specific Unit Objectives:

Upon completion of this unit the student will be able to do the following:

- o Describe an acid and its properties.

- o Describe a base and its properties.
- o Identify acids and bases by their properties.
- o Explain the difference between weak and strong acids and bases.
- o Explain pH and its general importance in living systems.
- o Demonstrate how pH is determined by performing simple lab experiments.

Unit 12: Acids and Bases in Solutions

Unit Objective:

Upon completion of the unit, students will be able to describe the characteristics of acids and bases in order to identify them in solutions.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Identify some acids and bases by reading their chemical formulas.
- o Identify acids in the human body.
- o Explain the properties of acids and bases.
- o Demonstrate in a laboratory setting how to identify acids and bases in solution using such indicators as litmus, etc.
- o Predict the ions that will form when various acids and bases are added to water.
- o Use chemical equations to demonstrate why acids and bases neutralize each other.
- o Discuss how to neutralize stomach acid by testing antacids with addition of acid.
- o Explain why an acid or base is considered to be strong or weak.

- o Demonstrate the relationship: if H^+ increases, pH decreases.

Unit 13: Structure and Function of the Cell

Unit Objective:

Upon completion of the unit, students will be able to discuss the cellular foundation of all living things, what is found within cells, and how each major part of a cell functions.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Describe how all living things consist of one or more cells.
- o Identify the structure and explain the function of the cell membrane.
- o Identify the structure and explain the functions of the cell cytoplasm.
- o Identify the structures and explain the function of the cellular organelles.
- o Identify the structure and explain the functions of nucleotides.
- o Discuss the differences in the nucleic acids DNA and RNA.

Unit 14: Cellular Activities

Unit Objective:

Upon completion of the unit, students will be able to discuss the basic activities of cells and the processes of conducting each activity.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Discuss the active and passive transport activities of the cell membrane and their differences.
- o Give examples of passive transport.
- o Give examples of active transport.
- o Explain the roles of DNA ribosomal and of RNA, mRNA, and tRNA.
- o Discuss the photosynthesis process for supplying energy for cellular activities.
- o Explain the biochemical pathways of cell respiration.

Unit 15: Cell Division

Unit Objective:

Upon completion of the unit, students will be able to explain the processes of cellular division.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Describe the asexual versus sexual method of cell reproduction.
- o Describe the structure and function of genes and chromosomes.
- o Discuss the process of mitosis, including the stages and events of each stage of mitosis.
- o Discuss the process of meiosis, including the stages and events of each stage of meiosis.
- o Describe the differences between mitosis and meiosis.

Unit 16: Genetics

Unit Objective:

Upon completion of the unit, students will be able to discuss the importance of studying genetic interactions in understanding the role of genes in heredity.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Explain the differences between sexual and asexual reproduction.
- o Discuss the determination of genotype and phenotype.
- o Describe the difference between pure and hybrid gene pairs.
- o Use Punnett Squares to evaluate and solve genetic problems.
- o Explain why humans are different from each other.
- o Explain some of the common genetic diseases and how they are genetically inherited.

Unit 17: Introduction to the Human Body

Unit Objective:

Upon completion of the unit, students will be able to demonstrate familiarity with the major components of the human body.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Identify the levels of cellular organization.
- o Identify the basic types of cells.

- o Identify the basic types of tissue.
- o Identify the main organ systems.

Unit 18: The Framework of the Human Body

Unit Objective:

Upon completion of the unit, students will be able to discuss the basic structure and function of the bones and muscles of the human body.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Name the major bones and muscles of the human body.
- o Discuss the general functions of bones in the human body.
- o Describe the basic structure of bones.
- o Discuss the function of basic body connective tissues.
- o Describe the basic function of muscles in the human body.
- o Describe the structure of the three basic kinds of muscle.
- o Describe how he or she is built.

Unit 19: The Human Endocrine System

Unit Objective:

Upon completion of the unit, students will be able to discuss the basic structure of the human endocrine system and the role it performs in regulating body chemistry.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Locate and identify the endocrine glands in the human body.
- o Describe the structure and functions of each endocrine gland.
- o Explain the functions of hormones in the body.
- o Describe how endocrine glands interact with each other and with other systems in the body.

Unit 20: The Human Reproductive System

Unit Objective:

Upon completion of the unit, students will be able to list the organs of the male and female reproductive systems and describe the functions of each organ in human reproduction.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o List and identify the organs of the male and female human reproductive systems.
- o Describe the function of the organs of human reproduction.
- o Describe the basic roles of hormones in the human reproductive process.
- o Explain the process of fertilization in humans.
- o Describe the development of the human embryo and fetus.

Unit 21: The Human Respiratory System

Unit Objective:

Upon completion of the unit, students will be able to discuss the basic structure and function of the organs of the human respiratory system.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Locate and identify the organs of the human respiratory system on a diagram of the human body.
- o Describe the function and mechanics of the organs of the respiratory system.
- o Explain the general mechanics of breathing at both the cellular and organ levels.
- o Discuss general conditions that affect breathing.

Unit 22: The Human Cardiovascular System

Unit Objective:

Upon completion of the unit, students will be able to discuss the basic structure and function of the human cardiovascular system.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Identify the basic structures of the human cardiovascular system.
- o Describe the basic functions of the human cardiovascular system.
- o List the structures of the human heart.

- o Explain the function of the structures that compose the human heart.
- o Trace the path of blood through the heart.
- o Trace the circulation of blood through the major parts of the human body.
- o Describe the structure of blood vessels, including arteries, capillaries, and veins.
- o Discuss the meaning of basic variations in blood pressure and describe how it is measured.
- o List the basic components of human blood.
- o Explain the function of each major blood component.
- o Prepare human blood smears for simple examination under a microscope.

Unit 23: The Human Nervous System

Unit Objective:

Upon completion of the unit, students will be able to discuss the basic structure and function of the human nervous system.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Describe the basic structure and functions of the central and peripheral nervous system in humans.
- o Explain what a neuron is and describe its basic parts.
- o Describe the basic chemistry of a nerve impulse.
- o Trace the path of a nerve impulse.
- o Describe the basic structure and functions of each part of the human brain.
- o Identify the functions of the sympathetic and para-sympathetic nervous systems.

Unit 24: The Human Digestive and Excretory Systems

Unit Objective:

Upon completion of the unit, students will be able to discuss the basic structures and functions of the human digestive and excretory systems.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o List the organs of the human body involved in the digestive process.
- o Describe the functions of the various parts of the digestive system by tracing the pathway of food.
- o Explain the chemical changes in food during digestion.
- o Identify the organs of the human body that perform excretory functions.
- o Describe the functions of the organs in the excretory system.

Unit 25: Interdependent Systems of the Body

Unit Objective:

Upon completion of the unit, students will be able to discuss the interactions and interdependence of the systems of the human body.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Discuss diseases, their prevention, and their treatment for each of the following systems--

endocrine

reproductive

respiratory
cardiovascular
nervous
skeletal
digestive
excretory

- o Address the question: what system can you do without?

Unit 26: Human Relations in Allied Health and Science Careers

Unit Objective:

Upon completion of the unit, students will be able to discuss the importance of effective interaction between people in allied health and technical science occupations.

Specific Unit Objectives:

Upon completion of this unit, the student will be able to do the following:

- o Define what is meant by human relations in the work world.
- o Explain what constitutes good communications skills.
- o Demonstrate good communication skills.
- o Demonstrate knowledge and appreciation of cross-cultural differences.
- o Demonstrate good listening skills.
- o Demonstrate the ability to read the nonverbal messages contained in body language and behavior.
- o Demonstrate the ability to keep emotions under appropriate control in the work (school) environment.
- o Discuss the importance of seeing a situation from others' points of view.

- o Avoid the use of emotionally and professionally negative statements and behavior.

RECOMMENDATIONS FOR IMPLEMENTATION

Recommendations for Recruitment of Students

- o Recruit students at grade level 10, 11, or 12.
- o Recruit only students who have completed 1 year of secondary-level general math or pre-algebra.
- o Give preference to students who have completed or are concurrently enrolled in algebra I.
- o Recruit only students who possess a minimum eighth-grade reading level.
- o Enlist the help of guidance counselors to inform students of course existence and benefits.
- o Recruit students from ninth grade physical science courses with the help of the physical science teachers.

Recommendations for Instructor Selection

- o Select instructors who are able to participate in an inservice course to learn how to teach an applied science course effectively.
- o Select instructors who meet state department of education certification requirements. Certification should preferably be in comprehensive science or biology.
- o Select instructors who are knowledgeable about the allied health field.
- o Select instructors who are able to present math concepts as they arise.
- o Select instructors who are able to present physics principles and concepts when necessary.

Recommendations for Program Planning

- o Offer the course in a comprehensive high school so that all students have an opportunity to take it.
- o Develop the course as a 1-year high school laboratory science course. It should meet 5 days a week for five to seven periods per week.

- o Offer the course as an alternative to biology in a student's course of study.
- o Stretch the course out into two high school courses, if desired, even though the advisory panel did not advise this.
- o Present individual units on their own, when required.
- o Fit the number of students enrolled in course to the availability of laboratory facilities.
- o Implement the course at CSCC as an "000"-level summer course for high school or adult students interested in entering allied health and science programs, if deemed appropriate, by assessment.

Recommendations for Assessment

- o Conduct a pre-assessment to determine students' existing knowledge.
- o Conduct a post-assessment to determine whether students have mastered material covered.
- o Design the post-assessment to be competency-based and at least partially practical.
- o Establish institutional grading standards for course completion.
- o Consider using a pass/fail system of grading.

Recommendation for Equipment and Facilities

In order to be able to conduct experiments properly in the laboratory, the following laboratory equipment is recommended for each lab station:

- o Microscope
- o Triple beam accurate balance scale
- o Gas burner
- o Electrical conductivity apparatus
- o Buret and clamp
- o Forceps

- o Meter stick
- o Ring stand
- o Funnel
- o Mortar and pestle
- o Thermometers--Celsius and Fahrenheit
- o Test tube clamp, holder, and rack

The following glassware is recommended for each laboratory station (use only heat-resistant glassware):

- o Test tubes with stoppers
- o Glass tubing
- o Beakers--various sizes
- o Graduated cylinders--various sizes
- o Flask
- o Volumetric flask
- o Stirring rod
- o Dropper
- o U-tube
- o Watch glass
- o Evaporating dish
- o Glass slides

It is recommended that both a classroom and laboratory be available for teaching this course. Ideally, supply one work station for every two students in the laboratory. A demonstration platform that can be viewed by the entire class should be available for student and teacher presentations.

Recommendation for Resource Material

The following list is a compilation of textbooks and other materials recommended by the members of the advisory panel. Because of the informal method used to gather this information, the bibliographic data is not always complete.

- o The Cell Biology Videodisc. Seattle, WA: Video-discovery, Inc.
- o Frenay and Mahoney. Understanding Medical Terminology.
- o The Human Body in Health and Disease. Harper & Rowe.
- o Integrated Basic Science. Costa Mesa, CA: Technicourse.
- o Kier, L., et al. Medical Assisting: Clinical and Administrative Competencies.
- o Langford. Integrated Sciences for Allied Health. Englewood Cliffs, NJ: Reston.
- o Miller - Allan, P. A. Introduction to the Health Professions. Monterey, CA: Wadsworth, 1984.
- o Moyer, R. H., and Bishop, J. E. General Science. Columbus, OH: Charles Merrill, 1986.
- o Safety-Isn't It Worth It? Fisher Scientific (film).
- o Walters, N. Basic Medical Laboratory Techniques.

Recommendations for Development and Delivery of the Pre-Tech Course

Should sufficient funds be available to develop the pre-tech curriculum materials, potential delivery methods could be as varied and extensive as those used in delivery of Principles of Technology. Suggestions for delivery for the present pre-tech include the following:

- o Develop a comprehensive student textbook, including laboratory instructions and worksheets.
- o Develop a teacher's guidebook, including demonstration instructions.
- o Develop video programs (a minimum of one per unit, but likely to be three or four for some units).

- o Develop a bank of test questions to be used as an aid to learning or as a practical method of assessment. A pre-test should be used to determine if a student already has the basic information to be covered in unit.
- o Sequence instruction by first explaining a new concept via video, after or while students read in text about it; follow with a demonstration conducted by the teacher or students; and finish with hands-on laboratory experience.

Should sufficient funds not be available to do any more with the pre-tech objectives and outline, it should still possible to teach Principles of Practical Science. This situation will require more work for the teacher, of course, than is required to present a fully developed course. Suggestions for delivery include all or some of the following:

- o Use the curriculum outline and supplement it with textbooks of the teacher's choice.
- o Use outside speakers: (1) bring CSCC allied health teachers to the high school and/or (2) bring allied health professionals to the high school to present various lessons and/or demonstrations.
- o Take students on site visits: (1) tour CSCC allied health facilities and receive a mini-lesson overview of its program, (2) tour an intensive care unit (ICU) to observe various parts of patient's bodies attached to monitors in order to better understand systems of the body, (3) observe an autopsy in a medical college lab, and/or (4) visit a health care facility to see the allied health roles in action.
- o Use a teacher-designed pre-test to determine students' knowledge of unit concepts in order to plan the depth of instruction. If student knowledge is sufficient, a unit may be eliminated.
- o Use a teacher-designed post-test to assess students' readiness to move on to another unit of instruction.
- o Use practical tests whenever possible.
- o Use teacher-designed hand-outs.

- o Use teacher-designed and conducted demonstrations.
- o Use student-designed and conducted demonstrations.
- o Explain the relevance of the unit concepts to practical situations.

Comments

This course is aimed primarily at the 39 percent of high school students who are uncertain about what they will do after graduation. These students are called the neglected majority. Based upon the National Longitudinal Study of the Class of 1980, CORD (n.d.) estimates that--

- o 34 percent of our high school students are taking college prep -- toward university
- o 27 percent are taking job training -- toward work
- o 39 percent are taking general courses -- toward ??

Many of the neglected majority could be recruited into allied health and science technical fields after exposure to Principles of Practical Science for Allied Health Careers. In addition to appealing to the neglected majority, the course could be beneficial to all segments of the student body. Some college-bound students are not interested in theoretical science but would benefit from an applied method of learning science. Students involved in job training could opt to take Principles of Practical Science for Allied Health Careers to meet their science requirement for graduation. The course could also be taken as a review course in a student's senior year.

REFERENCES

- Brockway, C. S.; Gardner, R.; and Howe, S. F. General Science. Newton, MA: Allyn & Bacon, 1985.
- Center for Occupational Research and Development. Model 2: Pre-Tech (handout). Waco, TX: CORD, n.d.
- Darlington, C. L., and Eigenfeld, N. D. The Chemical World. Boston, MA: Houghton Mifflin, 1977.
- Messer, M. B.; Hoag, R. A.; and Messer, A. H. Introductory Experimental Chemistry. Englewood Cliffs, NJ: Prentice-Hall, 1977.
- Moyer, R. H., and Bishop, J. E. General Science. Columbus, OH: Charles E. Merrill, 1986.
- National Commission on Allied Health Education. The Future of Allied Health Education. San Fransisco, CA: Jossey-Bass, 1980.
- Otto, J. H.; Julian, C. J.; Tether, J. E.; and Nassif, J. Z. Modern Health. New York, NY: Holt, Rinehart, & Winston, 1985.
- Parry, R. W.; Dietz, P. M.; Tellefsen, R. L.; and Steiner, L. E. Chemistry: Experimental Foundations. Englewood Cliffs, NJ: Prentice-Hall, 1975.
- Yager, Robert E. "Who Will Define 'Science for All'?" Education Week 6 (1987): 22, 28.

APPENDIX

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