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ABSTRACT

Presented is the third part of the K-12 unified science materials used in the public schools of Anne Arundel County, Maryland. Detailed descriptions are presented for the roles of students and teachers, purposes of bibliography, major concepts in unified science, processes of inquiry, scheme and model for scientific literacy, and program rationale, design, and strategies. Proficiency levels 13-21 are incorporated together with 75 proficiency level objectives. Each objective is analyzed into a number of educational objective statements. Three sequences of course learning are further provided for students after completion of the work of proficiency levels 1-21. Course names, rationale for course study, unit descriptions, and prerequistes are entered in the descriptive sheet of each course offering. The course content, partly selected from other science curriculum improvement projects, is related to the fields of physical sciences, chemistry, biological sciences, physics, geology, oceanography, zoology, environmental studies, geomorphology, and botany. Applications of scientific principles are stressed. Included are a list of elementary projects, kits, and materials and bibliographies of selected elementary, secondary, and professional readings. (CC)

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Unified Science Approach K-12

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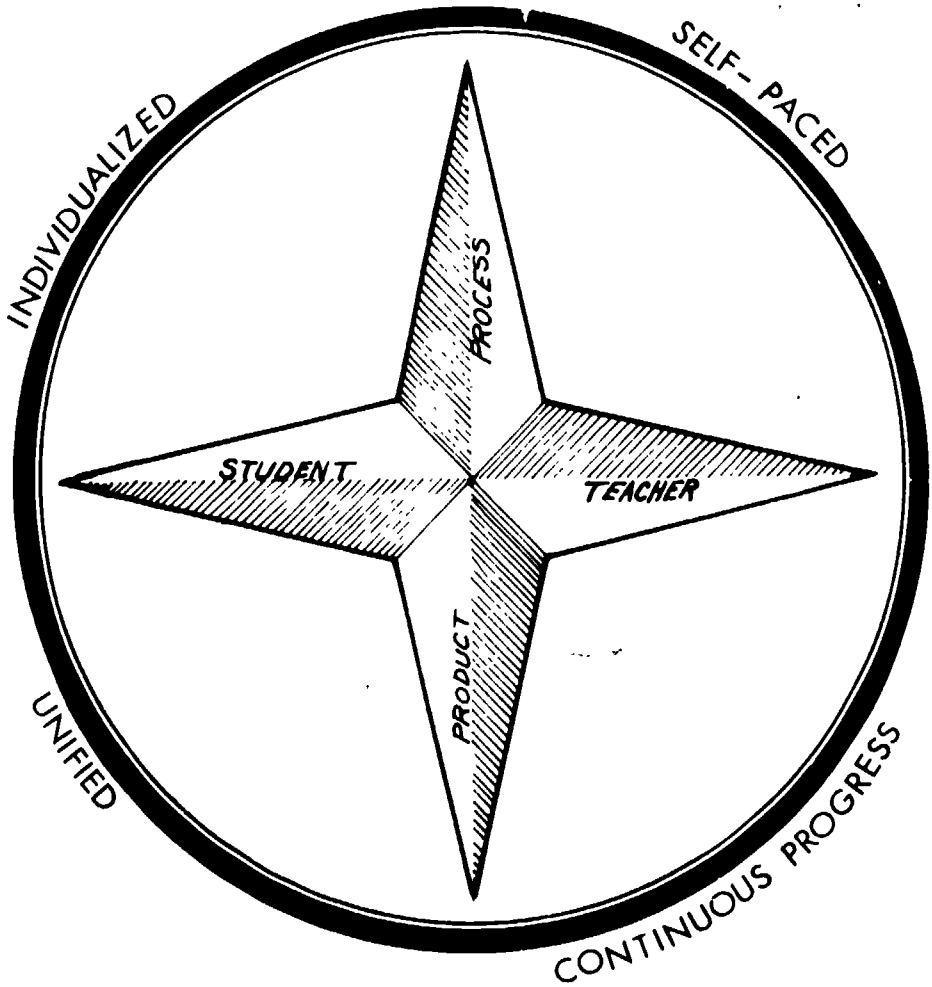

Anne Arundel County
Annapolis, Maryland

PROFICIENCY LEVELS XIII–XXI
& SEMESTER COURSES

SE 015 823

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Taxonomy of Objectives

Proficiency Level No 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No. III, V

Proficiency Level Objective Statement: No. 1

The student will quantify specific characteristics of matter to the limit of accuracy of the instruments.

Educational Objective Statements:

1. The student will describe the historical development of the metric system in terms of its base ten structure, nomenclature and the establishment of its standards.
2. The student will convert metric units of length, volume and mass to larger and smaller metric units.
3. The student will measure the dimensions of several objects to the limit of accuracy of the instrument.
4. The student will determine the mass of several objects using a double pan balance.
5. The student will contrast his calculated volume of a regularly shaped object with the volume given by the water displacement method.
6. The student will determine the volume of a liquid by using a graduated cylinder.
7. The student will summarize the main points of the arguments for and against the conversion of the United States to the metric system.

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TABLE OF CONTENTS

DEFINITIONS

Implementation Team:	Those individuals designated to give support to and work with personnel in schools where program implementation is occurring by interpreting the program and assisting in the achievement of program objectives.
Individualization:	The method by which each student is engaged in the achievement of objectives through involvement in experiences (ranging from tutorial to large group situations) that are uniquely appropriate to his learning style and which require active participation (mentally and/or physically) as he progresses as far and as rapidly as his interests or abilities permit.
Instructional Team:	Those individuals involved in implementing the program at the school level, including teachers, administrators, supervisors and implementation team members when team members are engaged in activities with school personnel.
Inquiry:	A method of discovery of knowledge by which the student observes, hypothesizes, analyzes, experiments, interprets, and predicts.
Learning Package:	A unit of related content and activities organized for mastery of a stated problem or question. The learning package includes: specific cognitive and affective objectives with appropriate criterion measures; instructional strategies; necessary personnel; and suggested supplies, materials, equipment and facilities.
Major Unifying Concepts:	Major science concepts which are interrelated and interdependent ideas crossing discipline boundaries and demonstrating the interrelationships among the sciences.
Process:	Specific mental or operational skills that transform random cognitive or affective knowledge in such a way so as to integrate it into a meaningful structure.
Product:	The concepts, facts, theories, and laws of natural phenomena.
Proficiency Level:	A specified area of content and process to be mastered. Rather than use age or grade levels, the content and processes are determined by determining a child's math skills, reading level, communicative skills, and psychomotor skills that are characteristic of children at various age levels.

DEFINITIONS

Proficiency Level Objective: A measurable statement of the student's performance by which his acquisition of process and content relating to the proficiency level may be evaluated.

Scientific Literacy: A scientifically literate person is one that knows and can apply the fundamental concepts and principles of science; understands the investigative nature of science; and has an appreciative attitude towards the role of science and the scientist in a modern society.

Self-Instructional Activities: Activities designed so that the student would work more or less independently through a step-by-step sequence toward achievement of the objective, or in which the student is required to devise his own strategies for achievement of the objective.

Spiral: A recurring topic ever expanding in complexity.

Unified Science: An organizational and instructional approach which emphasizes a universal scheme of concepts permeating all science disciplines, and, in practice, builds upon interrelationships among science disciplines.

Educational Objective: A concise statement of the goals or end product achieved from a learning experience. The objective involves procedures, conditions, and criteria of acceptable performance, and includes cognitive, affective, and psychomotor skills.

RATIONALE OF UNIFIED SCIENCE

The trend in science education today is not to think in terms of separate artificial barriers for each field of science, but to point out scientific principles common to all

The unified science curriculum identifies major unifying concepts which permeate all of the science disciplines These major concepts interrelate with principles of knowledge in each science area The scientific principles in the disciplines then become the subconcepts which make up the broad body of knowledge or content which the student needs to acquire

An education in science produces both the knowledge of basic scientific principles and command of the process by which they have been evolved. To accomplish this twofold purpose The Anne Arundel County Unified Science Approach unites the processes of science with the products of scientific endeavor to produce the scientifically literate person This goal of scientific literacy is reflected in the program's structural design feature of nine statements of scientific literacy.

Since students learn in different ways and at different rates, the program consists of a series of proficiency level objectives which each student accomplishes at his own pace

PROGRAM DESIGN

The core of the program is organized around a series of twenty-one proficiency levels which are subdivided into proficiency level objectives Each proficiency level objective unifies the process and the content of the life sciences, the physical sciences, and the earth sciences There are educational objectives to measure learning experiences for each proficiency level objective In determining what should be learned in each of these levels, student's cognitive, affective, and psychomotor development was considered. Although the program is designed to facilitate continuous progress in learning from K-12, the proficiency levels have been correlated to suggested grade levels to assist the teacher in the transitional and introductory phases Upon completing the proficiency levels, specialized semester courses are available to students in terms of their interests, needs, and future plans

PROGRAM STRATEGIES

1 A K-12 development of unified science provides for coherency and continuity of learning

2 Science is presented as an inquiry process through which skills, information, and scientific literacy are developed

3 A combination of the process of learning and the products of scientific knowledge provide a true learning situation

4. The individualized nature of the program offers the student an opportunity to progress at his own pace

5 The program is designed to offer choices and options to meet individual student needs

6 Concepts are developed through direct experiences with science materials.

7 Instructional materials and strategies which are incorporated into the program permit movement toward a high degree of individualization

ROLE OF THE STUDENT

The student will perform all kinds of activities (ranging from independent study to large group situations) which are uniquely appropriate to his learning style. This will permit him to progress continuously in content and process at a pace related to his abilities and interests.

ROLE OF THE TEACHER

The teacher will be a diagnostician of individual needs, a prescriber of appropriate materials and activities, and a facilitator of student achievement of educational objectives.

PURPOSE OF THE BIBLIOGRAPHY

The selected bibliography includes the following:

1. Suggested professional readings related to the philosophy and goals of the program:
2. Elementary textbooks which can supplement and enrich the program:
3. Secondary textbooks which can supplement or are a part of the program.

MAJOR UNIFYING CONCEPTS

I Matter is composed of units called fundamental particles. These units of matter are thought to have certain structures and properties. Units of matter can be classified into hierarchies of organizational levels.

II Living and non-living things in our biosphere interrelate in such a way that they tend to establish a balance in nature.

III. The behavior of one unit of matter may be altered by the presence of other units of matter. These interactions may be orderly or random.

IV. Units of matter, in the presence of energy, may be rearranged in such a way that the properties of a system undergo some change to give a new set of properties with the sum of energy and matter remaining constant as the system tends toward an equilibrium state.

V. Natural phenomena can be measured, described quantitatively, and/or predicted statistically.

PROCESSES OF INQUIRY

Observing

Classifying

Space/time relationships

Using numbers

Communicating

Measuring

Predicting

Inferring

Formulating hypotheses

Controlling variables

Experimenting

Defining operationally

Formulating models

Interpreting data

SCHEME FOR SCIENTIFIC LITERACY

The scientifically literate person:

1. should acquire knowledge which can be used to explain, predict, understand, and control natural phenomena.

2. should recognize that the meaning of sc[illegible]e [illegible]nds as much on its inquiry process as on its conceptual scheme and his abil[illegible] in the processes of science and to apply these processes in appropriate everyd[illegible]uations.

3. should acquire the attitudes of scientists and learn to apply these attitudes appropriately in daily experiences.

4. understands that science is one but not the only way of viewing natural phenomena, and that even among the sciences there are different points of view.

5. should come to understand the various interrelationships among science, technology, and society and to perceive his personal involvement in these activities.

6. appreciates the interaction of science and technology, recognizing that each reflects as well as stimulates the course of special development, but that science and technology do not progress at equal rates.

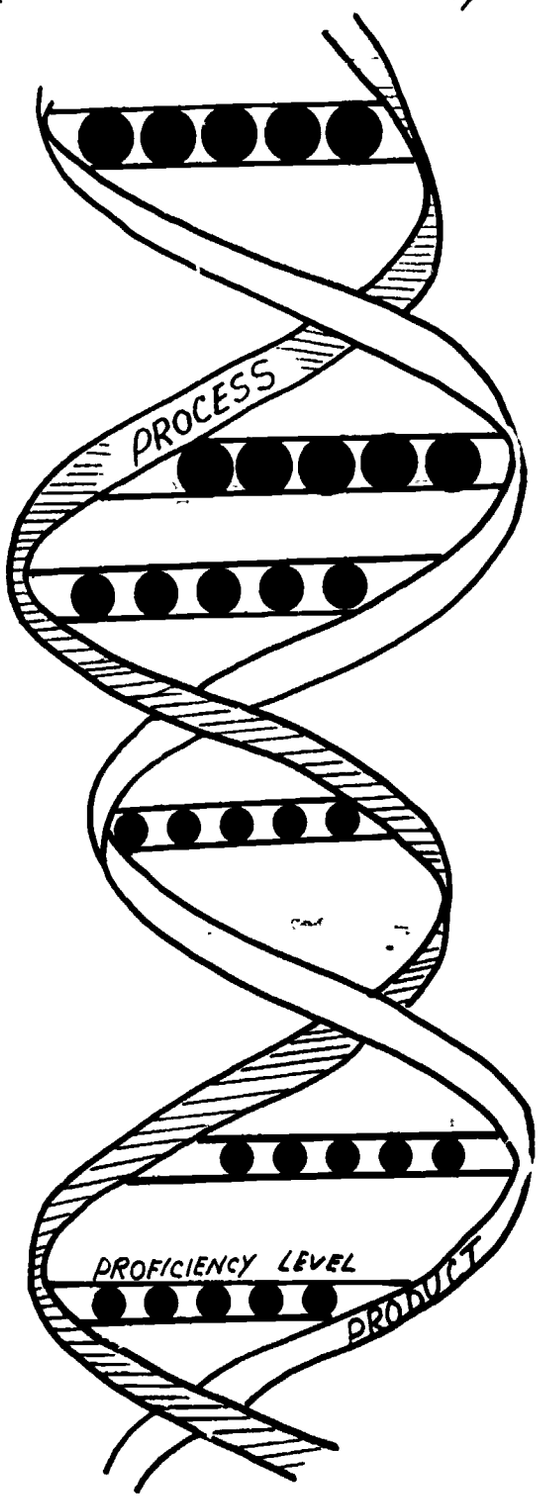
7. recognizes that knowledge in science evolves and that the knowledge of one generation may subsume, overturn, or complement previous knowledge.

8. should learn and develop numerous useful psychomotor skills through the study of science.

9. acquires a variety of interests in and enthusiasm for science that may lead to vocational and/or avocational interests.

MODEL FOR

SCIENTIFIC LITERACY



The model for the student's scientific literacy illustrates the intermingling of the scientific process of investigation with the product of basic scientific principles. This intermingling is brought about in the learning experiences at each proficiency level. The model is open-ended to symbolize the need for continual education throughout an individual's life.

Taxonomy of Objectives

Proficiency Level No. 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No. III, V

Proficiency Level Objective Statement: No. 1

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Educational Objective Statements:

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Taxonomy of Objectives

Proficiency Level No. 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No I, III, V

Proficiency Level Objective Statement: No. 2

The student will describe a sample of matter according to its physical characteristics.

Educational Objective Statements:

1. The student will differentiate between mass and weight in terms of how they differ in concept, how they are measured, the units used, and why the terms are sometimes used interchangeably.
2. The student will order several samples of matter from highest to lowest density.
3. The student will describe several samples of matter by using those properties which are appropriate from the following list:

a. color,	f. shape,	k. crystallinity vs. noncrystalline,
b. odor,	g. texture,	l. magnetic vs. nonmagnetic,
c. taste,	h. mass,	m. metal vs. nonmetal,
d. density,	i. weight,	n. opacity vs. transparent,
e. volume,	j. hardness,	o. elasticity vs. nonelasticity.

4. The student will describe several living things according to their physical characteristics.
5. The student will describe several physical changes which may occur in matter.
6. The student will contrast the properties of an object which has undergone a physical change with the properties of the object after it undergoes a chemical change.

Taxonomy of Objectives

Proficiency Level No. 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No. I, III, IV

Proficiency Level Objective Statement: No. 3

The student will formulate generalizations concerning the static properties of matter

Educational Objective Statements:

1. The student will summarize the history of man's experiences with the static properties of matter.
2. The student will classify different materials in terms of: those which are easily charged and those which are not.
3. The student will demonstrate the existence of the two types of charges.
4. The student will summarize how Franklin identified and named the two types of charges.
5. The student will discover the law of charges using charged pith balls.
6. The student will determine which of ten objects is charged and which charge they bear by using a simple electroscope.
7. The student will differentiate between electrical conductors and insulators.
8. The student will demonstrate how a static discharge is produced by using a Wimshurst machine or Van de Graaf generator.
9. The student will describe lightning as a giant static discharge.
10. The student will discuss static discharges in terms of: (a) how man protects himself against unwanted static and (b) practical applications of using static.
11. The student will discuss the validity of the statement that lightning never strikes twice in the same place.

Taxonomy of Objectives

Proficiency Level No 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No. I, III, IV

Proficiency Level Objective Statement: No. 4

The student will summarize the history of the discovery of subatomic particles in terms of their implications for developing a model of the atom.

Educational Objective Statements:

1. The student will state the contributions of the following men to our present understanding of the structure of matter: Democritus, Aristotle, Galileo, Gassendi, Leuwenhoëk, Newton, Boyle, Lavoisier, Dalton and Mendeleev.

2. The student will explain how various forms of the Crookes tube can be used to show that the cathode ray consists of a stream of tiny particles.

3. The student will recount how Thomson's work with electrons led him to his "Plum Pudding" model of the atom.

4 The student will describe the work of Madame Curie and her contemporaries in the study of radiation.

5. The student will summarize evidence which enabled Rutherford to formulate his model of the atom.

6. The student will explain how the discovery of the proton led Goldstein and his contemporaries to propose the "building block" theory of atoms.

7. The student will compare the Bohr Model of the atom with Rutherford's in terms of similarities and differences.

8. The student will contrast the electron cloud model of the atom with the Bohr Model.

9. The student will specify the importance of supplementing the Bohr Model with the Quantum Model of the atom.

10. The student will explain how the discovery of the neutron contributed to Chadwick's model of the atom.

11. The student will describe the role of the meson in the nucleus of the atom.

Taxonomy of Objectives

Proficiency Level No 13

Proficiency Level Statement Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No. I, IV, V

Proficiency Level Objective Statement: No. 5

The student will explain how the atoms of the various elements differ from each other using the Bohr model of the atom.

Educational Objective Statements:

1. The student will define an electrically stable atom using his knowledge of static electricity.
2. The student will relate the atomic number of an element to its atomic structure.
3. The student will estimate the atomic weights of various elements using the number of protons and neutrons in the atoms.
4. The student will compare the isotopic forms of various elements.
5. The student will specify the electron configuration of various atoms as a function of its atomic number.
6. The student will determine the correct oxidation number for the atoms of various elements.

Taxonomy of Objectives

Proficiency Level No. 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No. I, IV, V

Proficiency Level Objective Statement: No. 6

The student will describe various methods for classifying atoms.

Educational Objective Statements:

1. The student will write the symbols for forty of the most commonly used elements.
2. The student will explain the rationale for assigning elements according to families or groups in the periodic chart according to their electron configuration.
3. The student will explain the rationale for assigning elements to periods or series in the periodic chart according to their atomic number.
4. The student will explain the rationale for classifying elements into metal, nonmetal and noble gas groups.
5. The student will classify the atoms of elements according to the ions they form.
6. The student will classify the atoms of elements according to their isotopic forms.
7. The student will describe how we can classify atoms by the light which they emit.
8. The student will classify the elements according to their abundance by weight in our earth.

Taxonomy of Objectives

Proficiency Level No 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment

Major Unifying Concept No I, III, IV, V

Proficiency Level Objective Statement: No 7

The student will summarize the role of ionic and covalent bonding in the formation of compounds.

Educational Objective Statements:

1 The student will conclude that atoms combine in order to achieve a more stable energy state.

2 The student will describe the bonding process as one that involves electrons in the outermost energy level.

3. The student will describe the ionic bond (a) relating principles of electrostatics to bond formation and (b) as one that forms by a complete transfer of electrons.

4. The student will predict compounds that will form by ionic bonding using the periodic chart of elements.

5 The student will perform an experiment in order to prepare a compound composed of a metal and a nonmetal

6. The student will demonstrate the orderly arrangement of ions in a crystal.

7. The student will describe a covalent bond as one that forms when two nuclei have the same or nearly the same attraction for the electron of another atom resulting in a sharing of a pair of electrons between the atoms.

8. The student will predict which elements may combine by forming a covalent bond using the periodic chart of elements.

9. The student will construct models of some simple covalently bonded molecules.

10 The student will summarize the significance of using chemical formulae in describing compounds.

11 The student will discuss the significance of covalent and ionic bonding in terms of the presence of crystalline minerals in the earth's crust.

Taxonomy of Objectives

Proficiency Level No 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 8

The student will relate how four basic types of chemical reactions are important to man.

Educational Objective Statements:

1. The student will categorize chemical reactions as one of four types: (a) composition, (b) decomposition, (c) simple replacement, and (d) double replacement from the following:

   a. burning magnesium ribbon,
   b. placing burning sulfur in oxygen,
   c. heating iron and sulfur,
   d. mixing solutions of sodium chloride and silver nitrate,
   e. placing mossy zinc metal in dilute hydrochloric acid,
   f. heating steel wool in air,
   g. placing pea sized piece of sodium in water,
   h. heating mercuric oxide,
   i. placing a copper strip in silver nitrate solution,
   j. electrolysis of water,
   k. placing iron filings in a solution of copper sulfate,
   l. placing calcium oxide in water,
   m. neutralization of solutions of sodium hydroxide and hydrochloric acid,
   n. heating solution of carbonic acid or shaking bottle of carbonated water.

2. The student will write word and formula equations for each of several chemical reactions showing: (a) reactants, (b) products, (c) exothermic or endothermic, (d) type of product formed - gas, liquid, solid.

3. The student will describe energy conversions in exothermic and endothermic reactions.

4. The student will analyze one or more of the following industrial processes in terms of the type (s) of chemical reactions involved.

   a. production of sodium in the Downs cell,
   b. extraction of magnesium from sea water,
   c refining of copper from the ore,
   d. production of aluminum,
   e. making glass.

5. The student will explain the effect of:

   a. leaving unprotected metal exposed to the atmosphere.
   b. throwing cans of aluminum in fresh and salt water,
   c. dumping industrial acid in fresh water,
   d. dumping solutions of mercury, chromium, copper in salt water

Taxonomy of Objectives

Proficiency Level No. 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No. I, III, V

Proficiency Level Objective Statement: No. 9

The student will describe the evidence which supports the molecular theory of the structure of matter.

Educational Objective Statements:

1. The student will state evidence to support the contention that molecules exist and that there are spaces between them.
2. The student will demonstrate an event which supports the notion that molecules are in constant motion.
3. The student will describe indirect evidence to support the idea that molecules differ in size.
4. The student will perform a demonstration which will support the contention that there are attractive forces between molecules.
5. The student will debate the following statement: "If matter is made of molecules, living organisms can be described in molecular terms".

Taxonomy of Objectives

Proficiency Level No. 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 10

The student will explain that cells are highly developed and organized structures.

Educational Objective Statements:

1. The student will summarize cell history and theory including the works of such scientists as Hooke, Schleider and Schwann, Dujardin, and Brown.

2. The student will contrast plant and animal cells in terms of structure and function.

3. The student will measure various plant and animal cells in terms of the following: (a) total cell size, (b) size of the nucleus, and (c) size of vacuoles.

4. The student will describe plant and animal cells in terms of the specialized function which they perform in a multicellular organism.

5. The student will explain why certain plant and animal cells, such as amoeba, chlorella, paramecium, and euglena, can exist alone.

6. The student will explain the role that genes and chromosomes play in the cell.

7. The student will discuss DNA and RNA in terms of the composition and major function of each.

8. The student will explain that cellular activity is like a "chemical factory" in terms of: DNA, RNA, salinity, carbohydrates, proteins, fats, and enzyme action.

9 The student will summarize the role of mitochondria as the "powerhouse" of the cell in terms of: chemical change, chemical bonding, and ATP-ADP cycle.

Taxonomy of Objectives

Proficiency Level No. 13

Proficiency Level Statement: Our concept of energy and the structure of matter help us to understand our physical environment.

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 11

The student will describe cellular activity using his knowledge of the molecular theory of matter.

Educational Objective Statements:

1 The student will explain the process of diffusion in molecular terms.

2. The student will explain two conditions from the flowing list that affect osmosis: concentration, membrane involved, molecules involved, and size of the particle.

3. The student will summarize the two processes, oxidation and respiration, as the adding of oxygen during the breakdown of food to release energy.

4. The student will summarize the role of mitochondria as the "powerhouse" of the cell in terms of: chemical change, chemical bonding, and ATP-ADP cycle.

5. The student will discuss the active transport system in the cell.

6 The student will design experiments to illustrate the processes, turgidity and plasmolysis.

Taxonomy of Objectives

Proficiency Level No. 14

Proficiency Level Statement: Phenomena occurring in living and non-living systems can be qualitatively described and quantified.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 1

The student will explain the specialization necessary for complex organisms to survive and adapt to their environment

Educational Objective Statements:

1. The student will compare the division of labor in a factory with a division of labor with living cells.

2 The student will describe the function of specialized cells in any multicellular organism, such as Grantia, in terms of their role in helping the organism to survive.

3. The student will compare specialized cells such as muscle, bone, blood, etc., with one celled organisms such as the amoeba or paramecium in terms of similarities and differences of each.

4 The student will describe how the functioning of the circulatory, digestive, muscular, nervous, and respiratory systems assist in maintaining homeostasis in the earthworm, frog, and man within their environment.

5. The student will utilize his knowledge of the circulatory, digestive, muscular, nervous, and respiratory systems to explain a minimum of three of the following situations: (a) the earth worm consumes everything in front of him as he burrows through the ground, (b) earthworms are not found in dry, well lighted areas, (c) often earthworms are found on the surface after a heavy rainfall, (d) tadpoles cannot live on land, however, an adult frog can live on land and water, (e) frogs seem to move more easily in water than on land, (f) while watching a frog feed, it seems that its eyes as well as its mouth are involved in the feeding process (g) man needs assistance to breathe under water (h) some track runners collapse after a cross country race, (j) certain whistles can be heard by animals but not by man.

6. The student will explain that animals with keen hearing and sight are better adapted for survival than those possessing these traits in terms of ability to sense a variety of wavelengths and the images formed in seeing.

Taxonomy of Objectives

Proficiency Level No. 14

Proficiency Level Statement: Phenomena occurring in living and non-living systems can be qualitatively described and quantified.

Major Unifying Concept No. II, III, IV

Proficiency Level Objective Statement: No. 2

The student will specify how diseases, drugs, tobacco, and alcohol affect the homeostatis of an organism in terms of: cause, effect and possible solution.

Educational Objective Statements:

1. The student will compare bacteria, viruses, protozoa, fungi, and parasites in terms of: (a) conditions needed for growth, (b) structural similarities and differences and (c) mechanisms of invading a host.
2. The student will describe diseases caused by the following: bacteria, fungi, protozoa, viruses, and worm parasites.
3. The student will describe the six leading causes of human death in the United States in terms of: (a) number that die each year, (b) Federal Funding allotted to overcome each cause (c) symptoms for detection.
4. The student will utilize Robert Koch's postulates to decide whether a specific disease is caused by a living organism.
5. The student will discuss the contribution of Louis Pasteur in identifying and curing diseases.
6. The student will illustrate the role each of the following play in the decrease of disease: vaccination, chemical substances, disinfectants and antibiotics.
7. The student will compare the differences between natural immunity and acquired immunity both active and passive.
8. The student will explain why drug use should be by doctor prescription only.
9. The student will discuss the physiological and psychological effects of drugs.
10. The student will assess the impact of the "Drug Culture" on the youth in the United States.
11. The student will relate the physiological effects smoking has on the body and its association with various diseases.
12. The student will explain alcoholism in terms of: (a) factors that affect the rate of alcohol absorption in the blood (b) classification of alcohol as a disease and (c) affects on the nervous system.

Taxonomy of Objectives

Proficiency Level No. 14

Proficiency Level Statement. Phenomena occurring in living and non-living systems can be qualitatively described and quantified

Major Unifying Concept No. I

Proficiency Level Objective Statements No. 3

The student will describe how man has used structural phenomena to organize the study of living things.

Educational Objective Statements:

1. The student will form his own system of classification of familiar objects based on their characteristics.
2. The student will compare the classifications systems of Aristotle and John Ray.
3. The student will write an essay about the evidence which exists to show that Carolus Linnaeus deserves the title of the "Father of Modern Classification".
4. The student will classify ten plants and animals according to Linnaeus' system.
5. The student will examine various "improved" classification systems since Linnaeus in terms of: (a) organization, (b) clearing up old problems, (c) creating any new problems.
6. The student will chart the structural and functional similarities and differences of algae, fungi, moss, liverworts and ferns.
7. The student will list the structural and functional similarities of vascular plants - angiosperms and gymnosperms.
8. The student will name two distinct characteristics that place each of the following animals into a different phyla: sponge, jellyfish, earthworm, flatworm, roundworms, clam, starfish, grasshooper, and one of the following: bird, fish, reptile, amphibian, and mammal.

Taxonomy of Objectives

Proficiency Level No. 14

Proficiency Level Statement: Phenomena occurring in living and non-living systems can be qualitatively described and quantified.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 4

The student will defend the position that organism survival demands adapting to external changes.

Educational Objective Statements:

1. The student will determine which method of population count is to be used - estimation or actual count in terms of area to be covered, time available, and importance of the data.
2. The student will estimate the population within a ten foot square after counting all plants and animals in an area of six square inches.
3. The student will write a description of at least two of the following communities: forest, desert, grassland, tropical, savannah, and tundra in terms of the climate and the population of organisms found there.
4. The student will observe what happens to a community, such as in a woodland terrarium, when climatic factors have been altered.
5. The student will summarize five factors that affect stability within a community.
6. The student will explain the succession of plant life taking place in a familiar area.
7. The student will compare at least two climax communities in terms of: plant life, animal life, moisture, soil, fertility, and temperature range.
8. The student will describe a boundary community in terms of: plant life, animal life, moisture, soil, fertility, and temperature range.

Taxonomy of Objectives

Proficiency Level No. 14

Proficiency Level Statement: Phenomena occurring in living and non-living systems can be qualitatively described and quantified

Major Unifying Concept No. II, IV, V

Proficiency Level Objective Statement: No. 5

The student will explain how the concepts of heat and temperature help us to explain pressure and volume changes in gases

Educational Objective Statements:

1. The student will differentiate between heat and temperature in terms of the principles of the Kinetic Molecular Theory.
2. The student will conclude that both liquid and solid type thermometers operate according to the principle of expansion and contraction.
3. The student will explain why a standard temperature scale is needed to effectively communicate temperature measurements.
4. The student will compare the Celsius, Kelvin and Fahrenheit temperature scales in terms of: their fixed calibration points, difference in value of each "degree", historical development, and major uses of each.
5. The student will explain the significance of the concept of "absolute zero" for an ideal gas in terms of: heat transfer principles and the Kinetic Molecular Theory.
6. The student will calculate the heat content of a sample of matter using the principles of calorimetry.
7. The student will summarize the behavior of gases in terms of Boyle's Law and Charles' Law.
8. The student will explain Boyle's and Charles' Laws in terms of the Kinetic Molecular Theory.
9. The student will relate the gas laws to the physiological effects on the human body during underwater exploration.

Taxonomy of Objectives

Proficiency Level No. 14

Proficiency Level Statement: Phenomena occurring in living and non-living systems can be qualitatively described and quantified.

Major Unifying Concept No. IV. V

Proficiency Level Objective Statement: No. 6

The student will explain the causes of ocean and wind currents in terms of heat transfer by conduction and convection.

Educational Objective Statements:

1. The student will explain the process of heat conduction in water and air in terms of the kinetic molecular theory.
2. The student will demonstrate the differences between a heat conductor and an insulator.
3. The student will explain convection in terms of: fluids, varying temperatures, varying densities and gravitation effects.
4. The student will compare ten ocean currents of the world in terms of: location, directional nature, and approximate range in temperature change.
5. The student will explain the causes of global wind patterns.
6. The student will compare the pattern of winds in the atmosphere to the production of surface currents in the ocean in terms of: (a) a cause and effect relationship and (b) the principles of conduction and convection.

Taxonomy of Objectives

Proficiency Level No. 14

Proficiency Level Statement Phenomena occurring in living and non-living systems can be qualitatively described and quantified.

Major Unifying Concept No I, III, IV, V

Proficiency Level Objective Statement: No. 7

The student will explain weather patterns in terms of: fronts, cloud formations, temperature, winds, air pressure, air masses, precipitation, hydrologic cycle, weather maps, and instrumentation.

Educational Objective Statements:

1. The student will explain how and where air masses are formed and how they may be modified to become stable or unstable.

2. The student will describe the various types of fronts in terms of their motion and associated weather patterns

3. The student will explain melting, freezing, evaporation, condensation, and sublimation in terms of: (a) the principles of heat transfer during a change of phase and (b) the molecular nature of matter.

4. The student will explain how the various types of clouds are formed and why they produce different types of precipitation.

5. The student will be able to explain the water cycle in terms of: (a) the sun as an energy source, (b) the process of evaporation, (c) sublimination, (d) precipitation, (e) condensation, (f) surface water, (g) underground flow, and (h) humidity.

6. The student will trace the history of the development of weather measuring instruments.

7. The student will formulate weather predictions (a) based on a series of weather maps and (b) problems associated with accurate predictions.

8. The student will relate the following factors to weather changes: water vapor, air pressure, and the sun's heat.

Taxonomy of Objectives

Proficiency Level No. 15

Proficiency Level Statement: The sun is the principal source of energy for our environment.

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 1

The student will summarize the basic properties of wave propagation.

Educational Objective Statements:

1. The student will demonstrate that the basic nature of transverse wave motion is in a straight line.
2. The student will relate the physical characteristics of the medium to its effect on wave propagation.
3. The student will explain wave characteristics in terms of amplitude, crest, trough, wave length, and frequency.
4. The student will explain the relationship between values for frequency, wave length, and velocity.
5. The student will contrast organization of named waves in the electromagnetic spectrum in terms of wave length.
6. The student will describe the motion of medium in transverse waves.
7. The student will compare the characteristics of ultraviolet, infrared, and visible light.
8. The student will relate the use of man's senses to perception of light of different wave lengths from visible to infrared.
9. The student will compare the spectra of various light sources.
10. The student will distinguish between bright line and absorption spectra.
11. The student will summarize the application of the principles of spectroscopy of photographic analysis of light from distant stars.

Taxonomy of Objectives

Proficiency Level No. 15

Proficiency Level Statement. The sun is the principal source of energy for our environment.

Major Unifying Concept No. I, III, V

Proficiency Level Objective Statement: No. 2

The student will summarize the structure, features, and energy production of the sun.

Educational Objective Statements:

1. The student will describe the photosphere in terms of: temperature, color, energy releases, prominences, and granules.
2. The student will describe the chromosphere in terms of: location on the sun, comparison to other layers, color, solar flares, and prominences.
3. The student will describe the interior of the sun as a nuclear reaction zone.
4. The student will describe the radiative envelope of the sun in terms of its function as a zone of radiative equilibrium.
5. The student will describe the corona in terms of: color of light produced, density, temperature, and prominences.
6. The student will summarize evidence to support the conclusion that the sun rotates on its axis.
7. The student will describe sunspots in terms of: light, intensity, temperatures, longevity, regions, "sunspot cycle", polarity and zones.
8. The student will explain the fusion process in terms of matter involved and energy released.
9. The student will explain how the sun keeps producing such a tremendous amount of energy in terms of Einstein's famous equation $E=MC^2$

Taxonomy of Objectives

Proficiency Level No. 15

Proficiency Level Statement: The sun is the principal source of energy for our environment.

Major Unifying Concept No. II, III, V

Proficiency Level Objective Statement: No. 3

The student will explain the albedo effect and Greenhouse effect in terms of a matter-energy interaction.

Educational Objective Statements:

1. The student will explain the albedo effect in terms of a daily cycle of incoming and outgoing energy.
2. The student will list several examples of the use of reflectivity to reduce temperatures.
3. The student will list several examples of dark color radiation absorption.
4. The student will explain the Greenhouse effect in terms of the effect the earth's atmosphere has on the absorption and reflection of radiant energy.
5. The student will explain the extraordinary heating of the earth's surface when cloud cover or high concentration of pollutants is present.

Taxonomy of Objectives

Proficiency Level No 15

Proficiency Level Statement: The sun is the principal source of energy for our environment.

Major Unifying Concept No I, III, V

Proficiency Level Objective Statement: No. 4

The student will discuss the solar and lunar eclipse in terms of: occurrence, position of planets, and related phenomena.

Educational Objective Statements:

1. The student will summarize the relative positions of the sun, earth and moon during lunar and solar eclipses.
2. The student will design a procedure to illustrate the formation of partial and total eclipses.
3. The student will compare penumbra and umbra in terms of the formation and the differences of each.
4. The student will explain why solar eclipses are less common than lunar eclipses.
5. The student will explain why the same eclipse appears different from varying locations on the earth.
6. The student will trace the path of a recent eclipse.

Taxonomy of Objectives

Proficiency Level No. 15

Proficiency Level Statement: The sun is the principal source of energy for our environment.

Major Unifying Concept No. IV, V

Proficiency Level Objective Statement: No. 5

The student will explain the use of the grid system in locating specific regions on the earth.

Educational Objective Statements:

1. The student will summarize evidence to support the contention that the earth is not perfectly round.

2. The student will discuss: (a) the need for a reference system, (b) the criteria by which a reference system is judged to be useful, and (c) the reasoning behind the earth's system of latitude and longitude.

3. The student will locate the following cities: London, Moscow, Cairo, Greenwich, Tokyo, Sydney, Chicago and Seattle using the latitude and longtitude grid system.

Taxonomy of Objectives

Proficiency Level No. 15

Proficiency Level Statement: The sun is the principal source of energy for our environment.

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 6

The student will summarize how the revolution of the earth determines the seasons and climate patterns on earth.

Educational Objective Statements:

1. The student will conclude that the earth's axis tilts 23-1/2° perpendicular to the ellipse and is always pointed toward Polaris.
2. The student will demonstrate that vertical rays are more concentrated than oblique rays and therefore, generate more heat when absorbed by the earth.
3. The student will conclude that the curvature of the earth is responsible for the relative concentration of incident solar radiation.
4. The student will explain seasonal changes in terms of the traversing, vertical rays from northern to southern hemisphere.
5. The student will compare the Arctic and Antarctic regions in terms of similarities and differences in climate.
6. The student will explain the uniqueness of the phenomena of the land of the midnight sun.
7. The student will describe weather conditions in the tropics and polar regions as being relatively constant with those in the mid-latitude region of the earth as variable.
8. The student will explain causes of seasonal changes on earth in terms of: the tilt of the earth's axis, its orbit around the sun, the curvature of the earth's surface and the dates and astronomical significance of the dates which mark the beginning of the seasons.

Taxonomy of Objectives

Proficiency Level No. 15

Proficiency Level Statement: The sun is the principal source of energy for our environment.

Major Unifying Concept No. II, III, IV, V

Proficiency Level Objective Statement: No. 7

The student will summarize those factors that influence winds, ocean currents, and weather.

Educational Objective Statements:

1. The student will describe layers of the atmosphere in terms of: (a) height, (b) thickness, (c) physical and chemical properties, and (d) types of activity.
2. The student will describe the components of the lower atmospheric layer in terms of their influence on weather patterns.
3. The student will demonstrate the difference of the heating effects created by varying the angle of light incident to a surface.
4. The student will summarize the relationships between color, surface texture and type of material on the rate and amount of radiant energy absorbed by the material.
5. The student will specify the way in which land and sea breezes occur in terms of the concept of convection currents.
6. The student will specify the surface air currents created by unequal heating of the globe
7. The student will explain the coriolis effect on winds in terms of: (a) relationship between the acceleration produced by a force on the direction of the force in space and (b) the rotation of the earth.
8. The student will specify the characteristics of the following winds over the earth: horse latitudes, doldrums, polar easterlies, prevailing winds, and trade winds.
9. The student will summarize the causes of ocean currents in the major bodies of the earth's water.
10. The student will explain the effect of the following currents on the climate in nearby regions: South Equatorial Current, Peru Current, Equatorial Countercurrent, Labrador Current, California Current, Canary Current and Gulf Stream.
11. The student will contrast the physical and chemical properties of the Gulf Stream and its marine life with that of the North Atlantic.

Taxonomy of Objectives

Proficiency Level No. 15

Proficiency Level Statement: The sun is the principal source of energy for our environment.

Major Unifying Concept No. I, IV

Proficiency Level Objective Statement: No. 8

The student will summarize the relationship between the structure and function of green plants in terms of their role in food production.

Educational Objective Statements:

1. The student will relate the apparent color of light to wavelength characteristics.
2. The student will differentiate between the additive and subtractive systems of color reproduction.
3. The student will specify the role that light plays in photosynthesis.
4. The student will perform an experiment to determine that a green pigment, chlorophyll must be present for photosynthesis to occur in plants.
5. The student will perform tests on several substances in order to identify them as a starch or a sugar.
6. The student will explain the gas production in plants in terms of his observation.
7. The student will describe photosynthesis in terms of: (a) structures and functions of the leaf parts involved, (b) ingredients and products produced, and (c) word and formula equations.
8. The student will summarize the factors that influence the regulation of the opening and closing of the stomata.
9. The student will analyze a graph of plant respiration rates over a twelve month period in terms of the relationship between the amount of energy available and the rates of respiration.
10. The student will compare the photosynthetic and respiration processes in terms of similarities and differences.
11. The student will summarize translocation in plants.

Taxonomy of Objectives

Proficiency Level No. 15

Proficiency Level Statement: The sun is the principal source of energy for our environment.

Major Unifying Concept No. II, IV, V

Proficiency Level Objective Statement: No. 9

The student will summarize the interrelationship between organisms in a food chain and a food web in terms of the acquisition o food and energy transfer.

Educational Objective Statements:

1. The student will summarize the interrelationships of producers, consumers, decomposers, parasites and predators.
2. The student will compare the following relationships: commensalism, mutualism, and parasitism.
3. The student will specify the type of symbiosis that is best illustrated by the following: (a) ants of certain species protect aphids from which they receive a sugary secretion, honeydew, (b) protists live in the digestive tract of a termite aiding the termite to digest food, (c) a piece of mistletoe growing on the limb of an oak tree makes its own food without harming the tree, and (d) a virus lives inside the bacterial cell within the small intestines of a dog.
4. The student will prepare diagrams of the following chains: parasite, predator, and decomposer.
5. The student will describe how a saprophyte grows.
6. The student will prepare a food web of the organisms in a land environment under study.
7. The student will analyze the energy lost at various steps of an energy pyramid.

Taxonomy of Objectives

Proficiency Level No. 15

Proficiency Level Statement: The sun is the principal source of energy for our environment.

Major Unifying Concept No. II, III, IV, V

Proficiency Level Objective Statement: No. 10

The student will summarize the history of the formation of fossil fuels and the need to conserve these resources today.

Educational Objective Statements:

1. The student will discuss the significance of the carbon cycle in the biosphere.
2. The student will summarize the steps involved in the formation of coal, oil, and natural gas.
3. The student will describe where fossil fuels are found and characteristics of fossil fuel areas.
4. The student will describe how fossil fuels are obtained from the earth.
5. The student will summarize the economic importance of fossil fuels, and the relationship between supply and demand.
6. The student will discuss the need for conservation of natural resources.

Taxonomy of Objectives

Proficiency Level No. 16

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 1

The student will explain how the fossil record helps us to understand the history of the earth and its life forms.

Educational Objective Statements:

1. The student will relate the concept of radioactive half-life to the determination of the age of fossils, artifacts, and rocks.
2. The student will describe the various kinds of information that can be determined from fossil study.
3. The student will compare the eras, periods and epochs in terms of their approximate dates, characteristics, life forms, and general climatic conditions.
4. The student will compare present life forms with the fossilized life forms of the past.

Taxonomy of Objectives

Proficiency Level No. 16

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 2

The student will explain asexual and sexual reproduction in terms of: cell division, internal and external reproduction, and stages in development from zygote through birth.

Educational Objective Statements:

1. The student will explain mitosis in terms of: the stages, where mitosis occurs, its being a continuous process, and how it maintains the number of chromosomes in a cell for a given species.

2. The student will discuss meiosis in terms of: the reduction-division process and fertilization.

3. The student will diagram how a minimum of four one-cell organisms reproduce.

4. The student will explain the advantages and disadvantages of external and internal fertilization.

5. The student will summarize the development of an organism in terms of: zygote formation, cleavage stages, and embryo.

Taxonomy of Objectives

Proficiency Level No. 16

Proficiency Level Statement: Our environment changes through time

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 3

The student will explain hereditary occurrences in terms of: historical development, chromosomes mapping, sex determination and sex linkage, linkage and crossover, and changes in hereditary material.

Educational Objective Statements:

1. The student will describe the role played by each of the following in the development of hereditary concepts: Lamarck, Mendel, Sutton, Maigen, and Bridges.
2. The student will explain why the individual members in the class may exhibit different characteristics of eye color, hair color, and type of hair.
3. The student will describe the use of chromosome maps in determing sex and sex-linked traits.
4. The student will describe gene linkage, crossing over and their role in formulating accurate chromosome maps.
5. The student will demonstrate his knowledge of Mendel's hypothesis by graphing a homozygote, heterozygote and a dihybrid cross.
6. The student will discuss chromosomal changes and their impact on organism survival.

Taxonomy of Objectives

Proficiency Level No. 10

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No. I, II, III, IV

Proficiency Level Objective Statement: No. 4

The student will describe the chemical basis for heredity.

Educational Objective Statements:

1. The student will trace the history of man's knowledge of heredity from Mendel to Watson and Crick.
2. The student will specify the chemical composition of DNA and its structural arrangements.
3. The student will specify the chemical composition of RNA and its structural arrangement.
4. The student will describe the role of DNA and RNA in the hereditary process.
5. The student will describe gene mutation in terms of the changes that occur in DNA.

Taxonomy of Objectives

Proficiency Level No. 16

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No. I, II, III, IV

Proficiency Level Objective Statement: No. 5

The student will summarize man's knowledge of the evolutionary process in terms of: (a) scientists and their theories, (b) natural vs. domestic breeding, (c) factors that influence population size, (d) basis for modern theories, and (e) scientific studies that assist in the development of modern theories.

Educational Objective Statements:

1. The student will summarize the main steps that led Lamarck to the following conclusions:
   a. the use and disuse principle,
   b. the inheritance of acquired characteristics.
2. The student will compare the work of Alfred Wallace and Charles Darwin by using the following: backgrounds and research that led to their theories of evolution.
3. The student will describe how Wiseman's work emphasized the observation that variations between organisms were due to one of two causes, inheritable factors or factors which are not inheritable.
4. The student will summarize the significance of DeVries' theory of gene mutation to the development of new species.
5. The student will apply Darwin's theories in order to explain the existence of a given population such as horses.
6. The student will compare the evolution of an animal in nature with one that has been bred by man on the basis of: (a) genetic variation, (b) gene mutations, (c) struggle for existence, and (d) survival of the fittest through natural selection.
7. The student will infer how the following factors affect the size of a population: available food, birth rate, enemies, migration and emigration.
8. The student will specify examples that illustrate how each of the following is used by scientists in their study of the relationships between different species: (a) fossils, (b) morphology, (c) physiology, (d) embryology, (e) genetics, and (f) species distribution.
9. The student will relate the significance of each of the following in the development of current evolutionary theories: (a) changes in genes and chromosomes, (b) species isolation, (c) natural selection by differential reproduction, (d) the different rates of evolution at different times, (e) different organisms evolving at different rates, (f) new species usually evolving from less specialized members of the group and (g) only populations evolving, not individuals.

Taxonomy of Objectives

Proficiency Level No. 16

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 6

The student will discuss the current concept of the evolution of our planet.

Educational Objective Statements:

1. The student will contrast the weaknesses and strengths of the following theories of cosmogony:
   a. Collision Theory,
   b. Near Miss Theory,
   c. Nebular Theory,
   d. Exploding Star Theory,
   e. Whirlpool or Roller Bearing Theory.

2. The student will describe evidence which shows that the earth's lithosphere has changed.

3. The student will describe the current understanding of how the earth's primordial atmosphere changed to its present composition.

4. The student will explain how air pollution alters the properties of the earth's atmosphere.

5. The student will define ways in which air pollution can alter living things.

6. The student will contrast the chemical constituency of the earth's lithosphere, hydrosphere, and atmosphere.

Taxonomy of Objectives

Proficiency Level No 16

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 7

The student will describe how the processes of weathering and erosion alter the earth's surface.

Educational Objective Statements:

1. The student will illustrate the action of five different mechanical weathering agents.
2. The student will explain the role of gravity in the mechanical weathering and erosion processes.
3. The student will describe how air can be a factor in the erosion process.
4. The student will compare the effects of chemical weathering on different types of rocks.
5. The student will correlate the various factors which affect the rates of weathering and erosion.
6. The student will apply the Law of Conservation of matter to the weathering process.
7. The student will describe how the formation of a solution of mineral ions in water plays a role in chemical weathering.
8. The student will describe five cases in which oxidation plays a role in chemical weathering.
9. The student will discuss the role of carbon dioxide in the weathering process.
10. The student will construct a visual with an accompanying written explanation of the calcium cycle.

Taxonomy of Objectives

Proficiency Level No. 10

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No. I, II, III, IV

Proficiency Level Objective Statement: No. 8

The student will trace a specified particle of matter through a typical rock cycle in order to identify the alternate paths that may be followed as rocks are broken down.

Educational Objective Statements:

1. The student will compare the three rock types in terms of their physical characteristics, composition and location in the earth's crust.
2. The student will describe the three rock types in terms of their differences in formation and mechanisms of formation.
3. The student will discuss the three classes of rocks in terms of the relationship between heat and temperature and the changing characteristics of rock during the cycle.
4. The student will specify alternate paths that could be followed in the rock cycle when environmental conditions are changed.

Taxonomy of Objectives

Proficiency Level No. 16

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No. III, IV, V

Proficiency Level Objective Statement: No. 9

The student will defend the following statement: "The crust of the earth is in constant change".

Educational Objective Statements:

1. The student will specify evidence in support of the continental drift theory.
2. The student will contrast the present continent of North America with the continent of 2.5 billion years ago including the following: features of today's continent that were evident 2.5 billion years ago, time of the existence of the Rocky Mountains, Great Lakes, and Hudson Bay.
3. The student will describe several theories for continent building.
4. The student will illustrate the geologic history of the region indicating those rock formations that are sedimentary, igneous, and metamorphic, inferences of age for each, geological structure and conditions which led to the formation of the rock structures.
5. The student will discuss several theories of mountain building.
6. The student will compare the effects of glaciers on North America to the areas which were not covered by ice.
7. The student will describe how the exposed layers of the earth's crust, such as seen in the Grand Canyon, are a record of the history of the earth's surface.

Taxonomy of Objectives

Proficiency Level No. 1c

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No. III, IV, V

Proficiency Level Objective Statement: No. 10

The student will discuss how our understanding of wave motion helps us better understand and describe our planet.

Educational Objective Statements:

1. The student will specify properties of longitudinal waves.
2. The student will discuss the refraction of longitudinal waves.
3. The student will list those characteristics of the earth's structure predicted by wave propagation.
4. The student will describe the theoretical properties of the earth's core and mantle
5. The student will relate general physical features of the earth to the frequency of severe quakes.
6. The student will list the types of waves of a typical earthquake and describe their modes of travel

Taxonomy of Objectives

Proficiency Level No. 16

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 11

The student will describe the significance of the Doppler Effect in understanding the motion of objects in our universe.

Educational Objective Statements:

1. The student will explain how we use parallax and aberration of starlight to prove that the earth revolves around the sun.
2. The student will account for the Doppler Effect in terms of the properties of wave propagation.
3. The student will specify situations where the Doppler Effect is observed in sound waves.
4. The student will compare the spectral classes of the stars.
5. The student will explain how the "Red Shift" and the "Blue Shift" in the spectrum of stars and galaxies give a clue to their relative motions.
6. The student will describe the pattern of motion in the universe as suggested by the "Red" and "Blue" Shifts.
7. The student will discuss several theories which attempt to account for the past and future of the universe.
8. The student will classify the galaxies in the universe according to their shape and motion.
9. The student will explain how the Doppler Effect is used to ascertain the rotational periods of various planets.
10. The student will describe the application of the Doppler Effect to satellite tracking.

Taxonomy of Objective

Proficiency Level No 10

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No I, III, IV, V

Proficiency Level Objective Statement: No 12

The student will describe the history of man's efforts to measure time.

Educational Objective Statements:

1 The student will describe the celestial sphere and how its grid system is related to the earth's

2 The student will classify the stars by the magnitude system.

3 The student will explain why certain stars are navigation stars.

4. The student will illustrate why the altitudes of Polaris in degrees is the same as north latitude

5 The student will determine which stars are circumpolar at our latitude.

6 The student will distinguish between seasonal and nonseasonal constellations

7 The student will specify at least four cyclic events in the heavens and report on man's early efforts to explain them.

8. The student will report on man's early efforts to measure time.

9 The student will construct a lunar calendar for the current year.

10 The student will, with the aid of a "wall calendar", explain why his lunar calendar will not correlate exactly to the seasons over a long period of time.

11 The student will compare solar and siderial time

12. The student will compare the Julian and Gregorian calendars

13. The student will describe early measuring devices of time such as the sundial, hour glasses and water clock and the principles by which each functions

14. The student will explain how the periodicity of the pendulum can be employed as the basic principle of a Grandfather's Clock.

15 The student will compare the principles of the spring driven clock with the pendulum clock.

16. The student will explain how the development of the chronometer revolutionized navigation.

17. The student will describe how electromagnetic waves can be used for time measurement.

18. The student will explain how the vibrations of certain atoms are used to measure small time intervals.

Taxonomy of Objectives

Proficiency Level No. 1c

Proficiency Level Statement: Our environment changes through time.

Major Unifying Concept No II, III, IV

Proficiency Level Objective Statement: No. 13

The student will explain biological clock mechanisms in terms of the role they play in organism survival and factors that trigger the operation of specific mechanisms.

Educational Objective Statements:

1. The student will use their definition of biological clocks to list a minimum of five biological clock mechanisms
2. The student will discuss movements of plant structures in terms of: day-night cycle and seed growth and development.
3. The student will identify factors that trigger the function of specific biological clock mechanisms.
4. The student will discuss the significance of eclipses in studying biological clock mechanisms.
5. The student will assess the importance of biological clocks in the human body in terms of: (a) blood pressure, (b) heart beat rates, (c) sugar levels, and (d) glandular secretions.

Taxonomy of Objectives

Proficiency Level No 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No. V

Proficiency Level Objective Statement: No. 1

The student will resolve elementary vector problems involving addition and subtraction.

Educational Objective Statements:

1. The student will distinguish between a vector and a scalar.
2. The student will use displacement vectors to demonstrate how vectors are added.
3. The student will use force vectors to demonstrate how vectors are subtracted.
4. The student will resolve various word problems using vector addition and subtraction.

Taxonomy of Objectives

Proficiency Level No. 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 2

The student will relate forces to starting and stopping of an object.

Educational Objective Statements:

1. The student will demonstrate that a force is needed to move and stop an object.
2. The student will show that a force called gravity is exerted on all objects on the earth.
3. The student will perform a self-designed experiment in order to determine the inertial properties of matter.
4. The student will explain how sliding and rolling friction affect the motion of a given object.

Taxonomy of Objectives

Proficiency Level No. 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No. III, IV, V

Proficiency Level Objective Statement: No. 3

The student will specify the importance of the concept of time in order to distinguish between uniform and accelerated motion.

Educational Objective Statements:

1. The student will describe why it is hard to define time in philosophical or lexical terms.
2. The student will show that once an object is set in motion it will move with a uniform velocity.
3. The student will determine the velocity of a simple moving object.
4. The student will conclude that a constant force will produce accelerated motion.
5. The student will design a method to calculate the acceleration of a moving object.

Taxonomy of Objectives

Proficiency Level No. 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No. III, IV, V

Proficiency Level Objective Statement: No. 4

The student will discuss the precepts of Universal Gravitation with special reference to the earth's gravity.

Educational Objective Statements:

1. The student will conclude that the gravitational attraction between two objects in the universe is a function of their mass and the separation between them.
2. The student will describe the earth's gravitational field in terms of field strength as related to the distance from the center of gravity.
3. The student will describe the force of gravitational fields in terms of the inverse square law.
4. The student will demonstrate that gravitational kinetic and gravitational potential energy of an object near the earth's surface is a function of its height.
5. The student will summarize the relationship between gravity and geotropic responses in plants.

Taxonomy of Objectives

Proficiency Level No 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No. III, IV, V

Proficiency Level Objective Statement: No. 5

The student will explain how Newton's laws describe motion including motion due to gravity.

Educational Objective Statements:

1. The student will recount how Galileo and his contemporaries changed man's understanding of the motion of a falling object.
2. The student will describe Newton's contribution to our understanding of Universal Gravitation.
3. The student will rediscover the inertial properties of matter as described in Newton's First Law.
4. The student will explain how Newton's Second Law relates to forces, mass, and acceleration.
5. The student will demonstrate Newton's Third Law.
6. The student will measure, in at least two different ways, the gravitational acceleration near the earth's surface to accuracy of the measuring techniques.
7. The student will compute weights for various familiar objects and express that weight in metric units.
8. The student will distinguish between gravitational and inertial mass.

Taxonomy of Objectives

Proficiency Level No 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No. III, IV, V

Proficiency Level Objective Statement: No. 6

The student will describe how a surrounding fluid can affect an object.

Educational Objective Statements:

1. The student will show that the motion of a body falling through the atmosphere is modified by its shape and size.
2. The student will demonstrate how the properties of fluid density and viscosity affect the motion of a body falling through it.
3. The student will describe how the density of the falling object affects its motion as it falls through a fluid.
4. The student will discover for himself that relationship known as Archimedes' principle.
5. The student will use Archimedes' principles to explain why a certain object sinks or floats in a certain fluid.
6. The student will explain why an object reaches terminal velocity as it falls through a fluid.
7. The student will show that all objects fall with the same acceleration in a vacuum.
8. The student will compare the flight of airplanes to the flight of birds in terms of the principles governing their motion.

Taxonomy of Objectives

Proficiency Level No. 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 7

The student will describe the basic principles of kinematics and dynamics.

Educational Objective Statements:

1. The student will define work as a force moving through a distance.
2. The student will define power as the rate of doing work.
3. The student will conclude that the work put into a simple machine will equal the work obtained.
4. The student will define potential energy with respect to the position or condition of an object.
5. The student will define kinetic energy as a function of the mass and square of the velocity of a moving object.
6. The student will demonstrate that an object may possess both kinetic energy and potential energy at the same time.
7. The student will formulate the statement of the principle of the conservation of energy.
8. The student will demonstrate that work done on an object will yield an equivalent amount of kinetic energy.
9. The student will explain the concept of heat-work equivalence.
10. The student will define momentum as a function of the mass and velocity of a moving object.
11. The student will demonstrate the equivalence of impulse and momentum.
12. The student will formulate the principle of the conservation of momentum.

Taxonomy of Objectives

Proficiency Level No. 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 8

The student will describe orbital motion as a logical extension of projectile motion.

Educational Objective Statements:

1. The student will describe projectile motion as a special case of "free fall" motion.
2. The student will resolve the motion of a projectile into its component velocity vectors.
3. The student will describe the conditions necessary to establish an orbit.
4. The student will explain the role of centripetal force in orbital motion.
5. The student will relate the radial velocity of an orbiting object to the amount of centripetal force required to stabilize its orbit.
6. The student will explain why centrifugal force is a "fictitious force".
7. The student will demonstrate that an elliptical orbit is easier to attain than a circular one.
8. The student will explain why the orbits of artificial satellites must be established beyond the earth's atmosphere.
9. The student will compare the Ptolemaic and Copernican models of the solar system.
10. The student will explain Kepler's First Law using an eclipse which he has constructed.
11. The student will describe the substance of Kepler's Second Law.
12. The student will discuss how Kepler derived his Third Law.
13. The student will describe the planets and moons of our solar system in terms of: size, mass, shape, orbit, rotation, revolution, density, atmosphere, temperature, escape velocity, surface gravity, inclination of orbit, inclination of axis, and mean distance from the sun.

Taxonomy of Objectives

Proficiency Level No. 17

Proficiency Level Statement: Forces and fields influence matter in our environment

Major Unifying Concept No. I, III, V

Proficiency Level Objective Statement: No. 9

The student will describe the properties of magnets in terms of the nature of force fields and their effect on other objects.

Educational Objective Statements:

1. The student will reenact some of man's early experiences with lodestone.
2. The student will specify the properties of lodestone.
3. The student will compare the properties of amber and lodestone.
4. The student will discover the Law of Magnets.
5. The student will diagram the magnetic field around a bar and horseshoe magnet.
6. The student will diagram the interaction of the fields between two bar magnets when placed North-to-North pole and North-to-South pole.
7. The student will classify magnetic material as paramagnetic or diamagnetic.

Taxonomy of Objectives

Proficiency Level No 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No. I, III, IV, V

Proficiency Level Objective Statement: No. 10

The student will discuss magnetism in terms of the molecular and atomic theories.

Educational Objective Statements:

1. The student will discuss magnetism in terms of the polar nature of molecules.
2. The student will explain diamagnetism as a result of the orbital motion of the electron.
3. The student will explain paramagnetism in terms of "unpaired" electron spin.
4. The student will compare magnetic materials with nonmagnetic materials in terms of electron motion.
5. The student will explain ferromagnetism in terms of the "domain" concept.

Taxonomy of Objectives

Proficiency Level No. 17

Proficiency Level Statement: Forces and fields influence matter in our environment

Major Unifying Concept No. I, III, V

Proficiency Level Objective Statement: No. 11

The student will discuss evidence which supports the ideas that the earth is a single large magnet.

Educational Objective Statements:

1. The student will describe the earth as a magnet with magnetic poles.
2. The student will conclude that the earth has distinct, slowly moving magnetic poles which are not related to the geographic poles.
3. The student will explain the use of a compass in navigation using the following terms: magnetic pole, magnetic field, inclination, north and south seeking poles, and variation.
4. The student will explain terrestrial magnetism in terms of fluid motion in the earth's interior.
5. The student will summarize knowledge concerning the following statement: "The crystal alignment of various layers of the earth influenced by the earth's magnetic field reveals information about the history of the earth's magnetic poles."
6. The student will explain how the sun distorts the earth's magnetic field
7. The student will explain how the earth's magnetic field traps charged particles to form the Van Allen Belts
8. The student will explain the aurorae as related to the magnetic field of the earth.
9. The student will compare the magnetic fields of other planets and moons to the earth's magnetic field.
10. The student will describe several theories which account for the navigation abilities of migratory birds.

Taxonomy of Objectives

Proficiency Level No. 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 12

The student will relate the basic tenets of direct current electricity to the electro-chemical process in the human organism.

Educational Objective Statements:

1. The student will contrast wet cell and dry cell batteries in terms of their mode of generating an electric current.
2. The student will discover Ohm's Law.
3. The student will formulate an explanation of the relationships between the length of a resister and the production of current and voltage.
4. The student will compare a series and parallel circuit.
5. The student will use a thermocouple to explain that a current flow can be generated by exposing certain metals to light
6. The student will specify how thermocouples are used in at least three familiar devices.
7. The student will describe the electro-chemical charges that take place in a neuron in terms of: (a) the resting cell, (b) the stimulated cell, (c) the passage of impulse to adjacent cells.
8. The student will explain nerve impulses in terms of: (a) speed of impulses, (b) threshold, (c) all or none law of conduction, and (d) recharge period.
9. The student will prepare an illustration of the electro-chemical process involved in a reflex arc in terms of: (a) receptor, (b) afferent nerve pathway, (c) modulator - brain or spinal cord, (d) efferent nerve pathway, and (e) effectors.

Taxonomy of Objectives

Proficiency Level No 17

Proficiency Level Statement: Forces and fields influence matter in our environment

Major Unifying Concept No. III, IV, V

Proficiency Level Objective Statement: No. 13

The student will discuss the relationship of electrical currents and magnetism.

Educational Objective Statements:

1. The student will explain the "left hand rule" in terms of the direction of current flow and the polarity of the magret.

2. The student will conclude that the strength of the electromagnet is a function of the current in the wire, the number of coils, and the nature of the core

3. The student will use Oersted's experiment to conclude that electricity produces magnetism.

4. The student will use Faraday's experiment to conclude that magnetism produces electricity.

5. The student will describe how the electromagnet is used in modern technology.

Taxonomy of Objectives

Proficiency Level No. 17

Proficiency Level Statement: Forces and fields influence matter in our environment.

Major Unifying Concept No I, III, IV, V

Proficiency Level Objective Statement: No. 14

The student will explain the production, use, and advantages of alternating current electricity

Educational Objective Statements:

1. The student will demonstrate that a current is generated either by moving a conductor through a magnetic field or by moving the field across a conductor.
2. The student will describe how an alternating current can be produced by moving an electrical conductor back and forth through a magnetic field.
3. The student will explain the functioning of A. C. motors and generators in terms of: magnetic fields, moving coils, electromagnetic induction, and mechanical and electrical energy conversions.
4. The student will describe how transformers employ the principle of induction to vary voltage.
5. The student will demonstrate how a current can be measured by using a calibrated scale and the use of a moving induction coil in a magnetic field.
6. The student will explain the operation of a generator using the terms: field magnet, brushes, split rings, and armature.
7. The student will compare the principle of the electric generator and electric motor.
8. The student will compare D.C. motors and D.C. generators in terms of their energy transformations.
9. The student will compare A.C. motors and A.C. generators in terms of their energy transformations.
10. The student will conclude that their voltage changing ability makes A.C. more advantageous than D.C.
11. The student will explain the role of electric motors and generators in contemporary technology

Taxonomy of Objectives

Proficiency Level No. 18

Proficiency Level Statement: Man seeks information about other environments.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 1

The student will discuss the technology that has allowed man to escape earth's gravitational field in order to explore space environment.

Educational Objective Statements:

1. The student will summarize the history of man's attempts to explore outer space.
2. The student will compare the propulsion systems, (gas - heating rocket, ion rocket, and proton rocket) in terms of: (a) type of fuel, (b) heat produced, (c) chemical, mechanical and kinetic energy changes, and (d) effectiveness in attaining escape velocity.
3. The student will compare the differences in rocket fuels in terms of: (a) specific thrust (thrust per pound of fuel), (b) storage, (c) oxidizers, and (d) danger.
4. The student will apply Newton's laws to the three stages of a rocket.
5. The student will discuss the factors that influence the speed of a rocket: (a) design features, (b) weight of rocket, and (c) temperature, weight and velocity of exhaust gas.
6. The student will describe the basic patterns of a typical space trip from take-off to landing.
7. The student will explain the effect of the earth's atmosphere on a rocket at take-off, in flight, on descent, and landing.
8. The student will discuss the changing forces throughout a space trip on the astronaut.
9. The student will describe the environment beyond the earth's atmosphere in terms of: (a) solar flare, (b) solar wind, (c) cosmic radiation, (d) micrometeroid, and (e) lack of an atmosphere.
10. The student will summarize problems associated with landing a spacecraft.
11. The student will specify how technology copes with maintaining an artificial environment in terms of: (a) types of suits, (b) communication systems, (c) heat and meteroid protection, (d) pressure regulation, (e) temperature control, (f) oxygen systems, (g) human waste system, (h) eating and drinking, (i) construction materials, (j) design features (k) back-up systems, (l) problems associated with isolation, day-night cycles, close confinement and observing surroundings accurately.

12. The student will relate the ground support systems to the success of the flight.

13 The student will write a composition on the selection and training of astronauts.

Taxonomy of Objectives

Proficiency Level No. 18

Proficiency Level Statement: Man seeks information about other environments.

Major Unifying Concept No. II, III, IV, V

roficiency Level Objective Statement: No. 2

The student will discuss the role which space exploration has played in changing our lives and extending our knowledge.

Educational Objective Statements:

1. The student will debate the social, political, and economic problems associated with the space program.

2. The student will summarize the importance of earth orbiting satellites in the areas of: (a) communication, (b) weather, (c) military, and (d) reporting information concerning the environment outside the earth's atmosphere.

3 The student will describe how a space station simulates the earth's gravitational environment.

4. The student will specify knowledge discovered by scientists sending unmanned space probes through space and to distant planets.

5. The student will describe the phases of a space project, such as Project Apollo, in terms of: path travelled, goals of the mission, manned versus unmanned landing, problems, and results of the mission.

6. The student will discuss what we have learned and what questions remain unanswered about the moon.

7. The student will design prototype space colonies to support life on the moon and an orbital space station.

8. The student will describe pollution associated with space travel.

Taxonomy of Objectives

Proficiency Level No. 18

Proficiency Level Statement: Man seeks information about other environments.

Major Unifying Concept No. I, II, IV

Proficiency Level Objective Statement: No. 3

The student will describe the history of man's attempts to better understand the underwater environments of the world including the Chesapeake Bay.

Educational Objective Statements:

1. The student will account for man's interest, past and present, in the waters of the world.
2. The student will describe the role of the oceanographer in generating scientific knowledge.
3. The student will discuss the contributions of the following pioneers in oceanography: Forbes, Maury, Thornison, Murray, Palumbo, Hinsen, Chun, the Prince of Monaco, Leemann, and Jacques Cousteau.
4. The ssudent will describe the work of these early American men and organizations in oceanographic research: Agassiz, the Albatross and the Fish Commission, Hydrographic office and the U. S. Navy, U. S. Coast Guard and the Geodetic Survey.
5. The student will describe recent technological advancements which improve the techniques of modern oceanographic research.
6. The student will summarize the findings of early and recent projects carried out to study the Chesapeake Bay.

Taxonomy of Objectives

Proficiency Level No. 18

Proficiency Level Statement: Man seeks information about other environments.

Major Unifying Concept No. II, III, IV, V

Proficiency Level Objective Statement: No 4

The student will describe the theories which attempt to account for the topography of the ocean floor and the Chesapeake Bay.

Educational Objective Statements:

1. The student will compare the submergent, emergent, compoung and neutral shorelines, according to their features and how they are formed.
2. The student will describe the role of coral in the shoreline environment.
3. The student will compare several continental shelves in terms of their structures, location, sizes, and methods of origin.
4. The student will describe several abyssal plains in terms of their size, depth, location, composition and method of origin.
5. The students will discuss the theories which attempt to account for faults and escarpments on the floors of the ocean.
6. The student will describe the system of mid-ocean ridges of the ocean floor.
7. The student will explain the current theories which account for the formation of submarine canyons and mountains.
8. The student will discuss several theories which account for the formation of seamounts, guyots, atolls, island reefs and island arcs.
9. The student will illustrate the bottom topography of the Chesapeake Bay.
10. The student will summarize the history of the formation of the Chesapeake Bay.

Taxonomy of Objectives

Proficiency Level No. 18

Proficiency Level Statement: Man seeks information about other environments.

Major Unifying Concept No. II, III, IV, V

Proficiency Level Objective Statement: No. 5

The student will describe the properties of the hydrosphere in various salt and brackish water bodies of the earth.

Educational Objective Statements:

1. The student will describe the significance of the five basic salts in determining the chemistry of ocean brine.
2. The student will explain how the following factors affect the surface salinities of the ocean: evaporation, formation of sea ice, precipitation, melting of sea ice, and runoff from land.
3. The student will calculate the water pressure felt on an object at various ocean depths.
4. The student will describe the gases and their relative amounts which are dissolved in the waters of the earth.
5. The student will explain the fluctuations in the surface temperatures of the waters of the earth.
6. The student will explain the density variations of the waters of the earth in terms of the salinity and temperature of the waters.
7. The student will account for the various ocean currents of the world in terms of: temperature, density, and surface winds.
8. The student will compare the organisms and chemistry of the Gulf Stream with the surrounding North Atlantic.

Taxonomy of Objectives

Proficiency Level No. 18

Proficiency Level Statement: Man seeks information about other environments.

Major Unifying Concept No. I, II, III, IV

Proficiency Level Objective Statement: No. 6

The student will compare life forms in the ocean with life forms in the Chesapeake Bay in terms of: (a) types, (b) location, (c) affect on total life, (c) food web, (e) abundance, (f) distribution and (g) adaptation.

Educational Objective Statements:

1. The student will describe the role that a marine biologist plays in increasing the knowledge of the ocean and the Bay and methods which they use in sampling specimen.
2. The student will defend the statement: "The ocean is an underwater pasture that captures energy from the sun for all marine organisms."
3. The student will describe the types of plant life found in the Chesapeake Bay and oceans.
4. The student will compare the benthos or bottom dwellers in the ocean and the bay in terms of: (a) types, (b) abundance, (c) size range, (d) location, and (e) interactions that exist between the animal and plant life.
5. The student will cite evidence to support the statement: "Members of the benthos are important factors in the formation of land forms such as barrier reefs and atolls".
6. The student will discuss several organisms that have places in the nekton classification in terms of: (a) why they are grouped in this way, ( ) special adaptations for survival in the area, and (c) barriers of distribution.
7. The student will discuss the interactions that exist between the following nekton dwellers: (a) fish, (b) squid, (c) sea fowl, (d) sea otters, sea lions and sea cows, and (e) whales.
8. The student will discuss food webs in the oceans and the Chesapeake Bay.

Taxonomy of Objectives

Proficiency Level No. 19

Proficiency Level Statement: Technology brings about changes in life as it affects the individual and his environment.

Major Unifying Concept No. II, III, IV, V

Proficiency Level Objective Statement: No. 1

The student will explain the role of antibiosis in organism survival.

Educational Objective Statements:

1. The student will formulate an operational description of antibiosis that will include the aspect of antibiosis as being an interaction between two kinds of organisms in which one is killed or injured by substances given off by the other.

2. The student will identify specific antibiosis situations between plants.

3. The student will analyze the cause and effect relationship between the appearance of a large fish kill and the occurrence of a Red Tide in the same region.

4. The student will specify some plants that have an antibiotic effect on man and other animals.

5. The student will discuss antibiotics in terms of: (a) definition, (b) history of man's knowledge, (c) commercial production, and (d) effect on microbes.

6. The student will describe the effects of specific antibiotics on the host and the invading microbe.

Taxonomy of Objectives

Proficiency Level No. 19

Proficiency Level Statement: Technology brings about changes in life as it affects the individual and his environment.

Major Unifying Concept No I, II, III, IV, V

Proficiency Level Objective Statement: No. 2

The student will formulate generalizations of the role of technology in stabilizing man's health.

Educational Objective Statements:

1. The student will describe the services provided by the Multiphasic Health Testing Center in terms of the following: (a) personnel, (b) equipment, (c) problems associated with the MHT Center, and (d) the practicality of these centers on a large scale basis.
2. The student will summarize the beneficial effects provided by the MHT Center.
3. The student will explain the role of the followi vices in diagnosing human health conditions: (a) x-ray machine, (b) electrocard aph, (c) electroencephalograph, (d) respirometer, (e) audiometer, and (f) bloc mpling and counting.
4. The student will analyze a specified human epidemic in terms of: (a) cause, (b) effect on the population, and (c) medical knowledge known at the time.
5. The student will discuss the effect that prolonging life has on the total environment.
6. The student will contrast the social, moral, economic, physical, and religious problems associated with transplants and artificial implantations in human beings.
7. The student will explain the basic operation and role of one or more of the following prosthetic devices in stabilizing man's health: braille, amauroscope, hearing aid, artificial larynx, pacemaker, and myoelectric control system.

Taxonomy of Objectives

Proficiency Level No. 19

Proficiency Level Statement: Technology brings about changes in life as it affects the individual and his environment.

Major Unifying Concept No. I, II, III, V

Proficiency Level Objective Statement: No. 3

The student will explain how our technology is used in coping with the problems associated with the population explosion.

Educational Objective Statements:

1. The student will summarize quantitatively the past, present, and projected future of the population growth in the United States.
2. The student will specify the significance of "building up" instead of "out" as a method of land organization.
3. The student will formulate projections of the probable best use of land areas in the year 2000 in the United States considering population growth, Federal Land Preserves, and the use of land for recreation and survival.
4. The student will compare agricultural systems of the U.S.A. and the Soviet Union in terms of: (a) output per capita, (b) percent of population involved in farming, (c) total output, (d) cost per item, and (e) variety of items.
5. The student will discuss three plans for low-cost mass housing in the future in terms of: cost, social arrangement, and architecture.
6. The student will evaluate existing zoning laws and projected growth of Anne Arundel County in terms of present appropriateness and need for future change.
7. The student will contrast at least three electric power sources for our future use in terms of: economics, placement of within or near populous areas, and effect on the environment.
8. The student will describe implications of the predicted energy crisis.
9. The student will compare the road system in the U.S.A. during the periods of 1890-1910, 1915-1965, 1970-2000 in terms of: structure, function, efficiency in moving people, and effect on the environment.
10. The student will summarize the history of bridge building in terms of: basic materials and designs of the bridges.

11. The student will describe several improvements in the means and efficiency of shipping commodities during the periods 1980-1910, 1915-1965, 1970-2000.

12. The student will summarize the increased need for communication and ways technology has helped.

Taxonomy of Objectives

Proficiency Level No. 19

Proficiency Level Statement: Technology brings about changes in life as it affects the individual and his environment.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 4

The student will discuss the present and projected future significance of computer technology in the world.

Educational Objective Statements:

1. The student will summarize the history of the development of the computer.
2. The student will compare the semantic with the linguistic approach.
3. The student will apply the semantic versus linguistic approaches to computerized information retrieval.
4. The student will describe the functions of the five basic components of a computer.
5. The student will specify: (a) several computer languages used today, and (b) the advantages and disadvantages of using each.
6. The student will explain the application of computers in one of the following areas or in a student suggested area: communication, transportation, health, billing, preparing sales reports, controlling inventory, running a steel plant, education.
7. The student will illustrate by role playing what society would be like in the year 2000 if the world is taken over by "computer priests" (the technologists).

Taxonomy of Objectives

Proficiency Level No. 20

Proficiency Level Statement: Pollution of the environment has increased with the growth of technology and population.

Major Unifying Concept No. II, III, IV, V

Proficiency Level Objective Statement: No. 1

The student will analyze the condition of our water resources in terms of: causes, effects and possible solutions of pollution in order to preserve the resources for future living and recreation.

Educational Objective Statements:

1. The student will describe the water pollution problem for several major water areas in terms of: (a) geographical location and water current pattern, (b) the people and industry, (c) the people and industry placing demands on water resources, and (d) causes of pollution.
2. The student will determine the quality of water in several areas of Anne Arundel County.
3. The student will specify the causes of pollution in Anne Arundel County.
4. The student will summarize the effects that various water pollutants have on living things.
5. The student will analyze the effectiveness to date of legislation and its enforcement in order to clean and protect our water resources.
6. The student will discuss the following questions: "Can Lake Erie be saved?" and "Can we prevent the Chesapeake Bay from dying?"
7. The student will summarize the beneficial and detrimental effects associated with using major bodies of water for purposes of underwater farming, underwater city living, and building floating airports or electric power plants.
8. The student will formulate a hypothesis of the problems associated with maintaining water resources for living and recreation in the year 2000.

Taxonomy of Objectives

Proficiency Level No. 20

Proficiency Level Statement: Pollution of the environment has increased with the growth of technology and population.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 2

The student will generalize about the problems of air pollution in terms of: causes, effects, and possible solutions.

Educational Objective Statements:

1. The student will describe a minimum of ten causes of air pollution in the United States.
2. The student will discuss the effects of air pollutants on living things in Maryland.
3. The student will determine the quality of the air in various locations of Anne Arundel County.
4. The student will discuss the following questions: (a) "What ways do people have to make others stop polluting?", (b) "Why are some polluters difficult to control?", and (c) "What can you do as a citizen to cut down on pollution?".
5. The student will describe several harmful effects to the environment which stem from the use of the combustion engine.
6. The student will discuss several technological advances in terms of their effectiveness in overcoming specific air pollutant problems.

Taxonomy of Objectives

Proficiency Level No. 20

Proficiency Level Statement: Pollution of the environment has increased with the growth of technology and population.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 3

The student will generalize about the problems of land pollution in terms of: causes, effects, and possible solutions.

Educational Objective Statements:

1. The student will describe a minimum of five ways in which man has misused land and natural resources.
2. The student will describe a minimum of five causes of land pollution in the United States.
3. The student will determine the components and quality of soil in various locations of Anne Arundel County.
4. The student will discuss the effects of land misuse and pollution.
5. The student will describe several methods of conserving soil and natural resources in Maryland.
6. The student will summarize the effect of current legislation in order to curtail land pollution in Maryland.
7. The student will formulate a proposal dealing with economical, effective and non-polluting methods of disposing solid waste on a local and national level.

Taxonomy of Objectives

Proficiency Level No. 20

Proficiency Level Statement: Pollution of the environment has increased with the growth of technology and population.

Major Unifying Concept No. II, III, IV, V

Proficiency Level Objective Statement: No. 4

The student will discuss noise pollution in terms of: causes, effects, and possible solutions.

Educational Objective Statements:

1. The student will describe a minimum of five causes of noise pollution.
2. The student will summarize the effects of various noises on people including source and decibel level.
3. The student will analyze the work of research centers, government, and public and private segments of society in order to curtail noise pollution in terms of what is known about the problem and possible solutions.

Taxonomy of Objectives

Proficiency Level No. 21

Proficiency Level Statement: Technological advances affect individuals in our society.

Major Unifying Concept No. II, III, V

Proficiency Level Objective Statement: No. 1

The student will examine the impact of technology on society by evaluating the effects in Anne Arundel County in terms of the individual's role, society's demands, and provision for expansion as populations increase.

Educational Objective Statements:

1. The student will describe ten ways that technology affects the individual in society.
2. The student will evaluate society's increased demands for technology and need for environmental restrictions.
3. The student will explain the need for detailed planning to allow for balanced use of local resources as population expands.

Taxonomy of Objectives

Proficiency Level No. 21

Proficiency Level Statement: Technological advances affect individuals in our society.

Major Unifying Concept No. II, III, IV, V

Proficiency Level Objective Statement: No. 2

The student will describe the technological innovations as they affect change and occupational trends.

Educational Objective Statements:

1. The student will evaluate the importance of an industry in terms of: (a) products, (b) job opportunities, (c) influence on economy, (d) social status, and (e) job possibilities.

2. The student will summarize how the technology of transportation has changed and its effect on society.

3. The student will summarize the theory and development of communications in terms of improvements, job opportunities, and future role of the following: (a) television, (b) radio, (d) radar, (d) telegraph, and (e) telephone.

Taxonomy of Objectives

Proficiency Level No. 21

Proficiency Level Statement: Technological advances affect individuals in our society.

Major Unifying Concept No. II, III, IV

Proficiency Level Objective Statement: No. 3

The student will discuss the effects of cultural uniformity and diversity in terms of: mass production, modern cities, fewer and larger organizations, mass media, and class structures.

Educational Objective Statements:

1. The student will contrast the advantages and disadvantages of mass production.
2. The student will plan an ideal American city considering the aspects of cultural uniformity and diversity.
3. The student will theorize as to a possible correlation between technological changes and organizations.
4. The student will summarize the role and influence of mass media in the United States as it affects cultural uniformity and diversity.
5. The student will discuss the significance of technology on class structures in today's American society.

Taxonomy of Objectives

Proficiency Level No. 21

Proficiency Level Statement: Technological advances affect individuals in our society.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 4

The student will write a composition on the significance of centralization and specialization in our environment in terms of government, occupations, and national policies dealing with welfare, health, economics, and education.

Educational Objective Statements:

1. The student will discuss the role of the welfare department in the environment.
2. The student will specify five policies set up by the health department and discuss how they were initiated.
3. The student will discuss the comparisons of the allotment for environmental controls with other items on the local and national budget.
4. The student will judge the value of the work of the educational system in educating the public on environmental problems and controls.
5. The student will list a minimum of four environmental job clusters.

Taxonomy of Objectives

Proficiency Level No. 21

Proficiency Level Statement: Technological advances affect individuals in our society.

Major Unifying Concept No. II, III, IV

Proficiency Level Statement: No. 5

The student will discuss the role of technology in the evolution of philosophical, religious, and social thought.

Educational Objective Statements:

1. The student will discuss the style of living in terms of: bureaucracy, leisure time, urbanization, conflicts and co-operation in international interdependence.

2. The student will trace alterations in philosophical, religious, and social thought over the past two hundred years in America.

3. The student will formulate a critique of the favorable and detrimental effects of technology on the individual.

Taxonomy of Objectives

Proficiency Level No. 21

Proficiency Level Statement: Technological advances affect individuals in our society.

Major Unifying Concept No. I, II, III, IV, V

Proficiency Level Objective Statement: No. 6

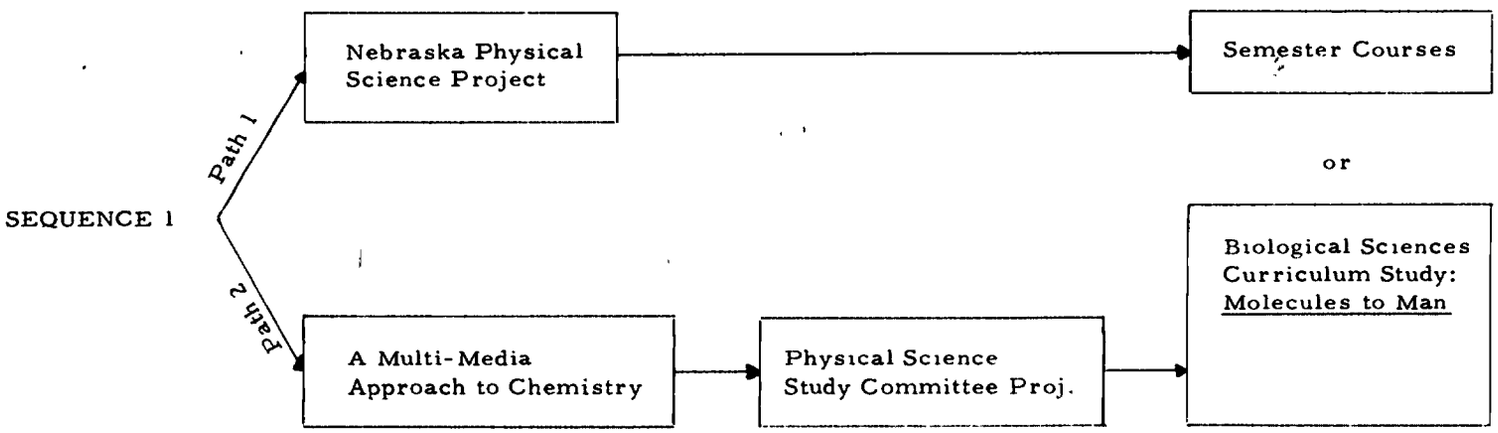
The student will construct a model plan for Anne Arundel County based on current population trends and density studies.

Educational Objective Statements:

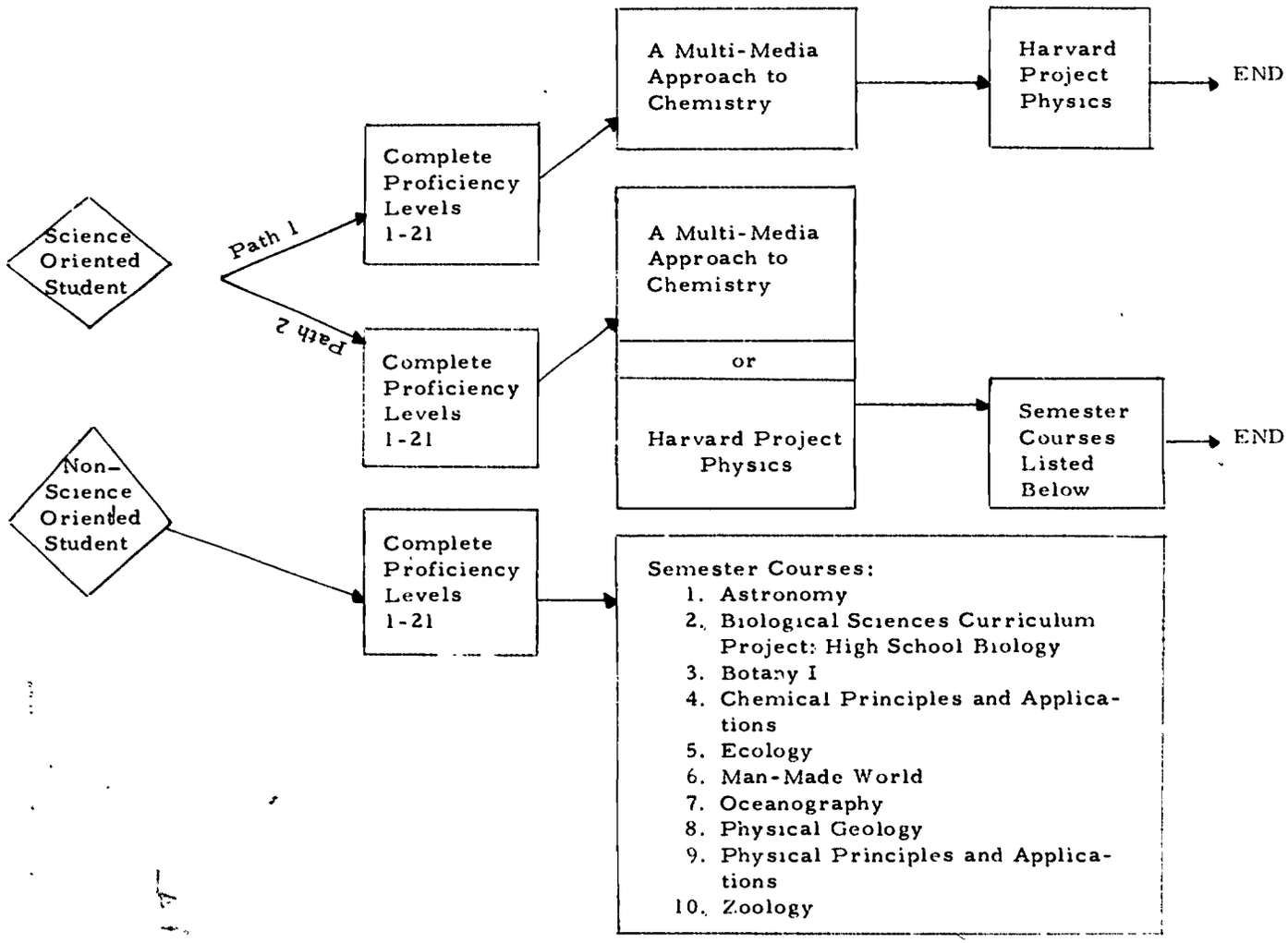
1. The student will graph the existing population against the projected population for the future in Anne Arundel County.
2. The student will explain the need for and implications of the local projection for the future in Anne Arundel County.
3. The student will discuss where the demands exist for additional utilities, schools, parks, and transportation in Anne Arundel County.
4. The student will determine if zoning changes may be necessary for Anne Arundel County.
5. The student will specify where local town buildings can best be located to service the communities in Anne Arundel County.
6. The student will discuss with other students what environmental controls must be developed as the population expands in Anne Arundel County.
7. The student will design an idealized model of Anne Arundel County which would relate population, their needs, and the physical environment.

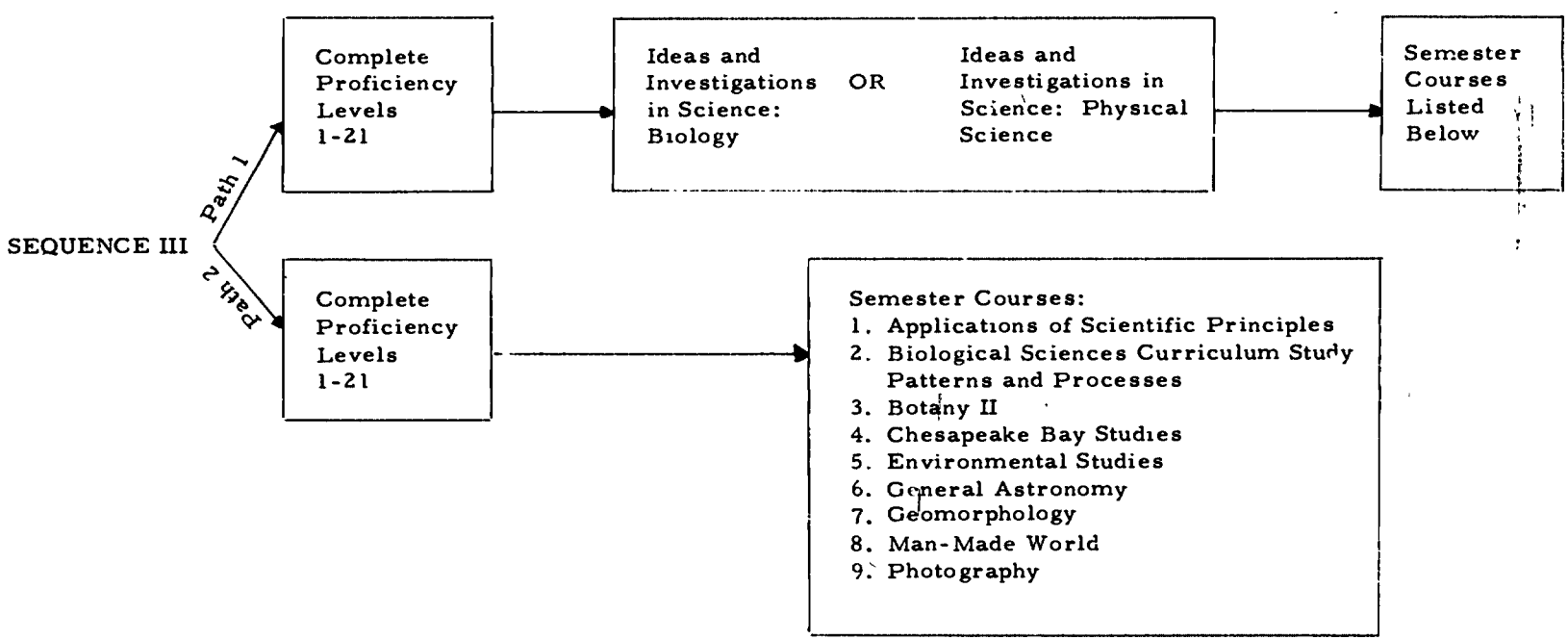
SCIENCE COURSES

11th and 12th GRADE COURSE OFFERINGS



SEQUENCE II


Science Oriented Student
Path 1
Path 2
Complete Proficiency Levels 1-21
Complete Proficiency Levels 1-21
A Multi-Media Approach to Chemistry
Harvard Project Physics
END
A Multi-Media Approach to Chemistry
or
Harvard Project Physics
Semester Courses Listed Below
END
Non-Science Oriented Student
Complete Proficiency Levels 1-21
Semester Courses:
1. Astronomy
2. Biological Sciences Curriculum Project: High School Biology
3. Botany I
4. Chemical Principles and Applications
5. Ecology
6. Man-Made World
7. Oceanography
8. Physical Geology
9. Physical Principles and Applications
10. Zoology


SEQUENCE III
Path 1
Path 2
Complete Proficiency Levels 1-21
Ideas and Investigations in Science: Biology
OR
Ideas and Investigations in Science: Physical Science
Semester Courses Listed Below
Complete Proficiency Levels 1-21
Semester Courses:
1. Applications of Scientific Principles
2. Biological Sciences Curriculum Study Patterns and Processes
3. Botany II
4. Chesapeake Bay Studies
5. Environmental Studies
6. General Astronomy
7. Geomorphology
8. Man-Made World
9. Photography

SEQUENCE I

Students following Sequence I are those who have completed Proficiency Levels 1-21 at the end of the ninth grade.

I. NAME OF COURSE: Nebraska Physical Science Program
University of Nebraska
117C Annex
Lincoln, Nebraska 68508

II. RATIONALE:

The purpose of this course is to provide the student with the option to complete a two-year unified chemistry-physics course.

III. GENERAL DESCRIPTION:

The course has the following units:

Unit I Orientation
Unit II Atomic Theory
Unit III Mechanics
Unit IV States of Matter
Unit V Electrical Nature of Matter
Unit VI Chemical Reactions

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21

I. NAME OF COURSE: A Multi-Media Approach to Chemistry
(A Title III, E.S.E.A. Project)

II. RATIONALE:

This course offers the college preparatory student the option of taking an individualized chemistry program. The term multi-media refers to the many learning approaches offered for student selection. The optional approaches include films, filmstrips, programmed instruction, sound-slide presentations, super eight concept loops, audio tapes, texts, teacher presentations, investigation activities, and use of the computer. There is a basic core of material for all to learn with several optional paths provided for each lesson and a variety of additional activities for those who want to know more. The course is individualized and self-paced (students working at their own rate) and is designed to teach as much as a student's curiosity demands.

III. GENERAL DESCRIPTION:

The first two units introduce the students to chemical and physical principles essential to the learning of chemistry. The initial knowledge base is expanded in depth as learning proceeds in the following units:

Unit I Chemistry an Investigative Science
Unit II The Characteristics and Concepts of Matter
Unit III Atomic Structure
Unit IV Periodicity
Unit V Bonding in Matter
Unit VI Formula Writing and Naming
Unit VII The Nature of Chemical Reactions

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
One year course
For 10th and/or 11th grade college-bound students.

I. NAME OF COURSE: Physical Science Study Committee Physics 3rd Edition (D.C. Heath Company)

II. RATIONALE:

This course provides a firm academic background for later studies in physics at the college level and develops problem solving skills.

III. GENERAL DESCRIPTION:

The PSSC Physics course is characteristically used with high ability college-bound students. It is a rigorous but interesting course whose heart is the textbook. In addition to the text there are a lab guide, lab apparatus, a number of films, standardized tests, and a growing series of paperback books in related fields.

The new text is not organized on the basis of units but instead consists of twenty-seven chapters which form the basis for a physics course. The text begins with the concepts and associated problems of light properties and proceeds through geometric optics. It includes the following: particle and wave models of light, vector solutions, straight line and circulation motion, gravity, kinetic-potential energy, impulse-momentum, heat, electricity, magnetism, quantum theory and matter waves.

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
Algebra
Plane Geometry

I. NAME OF COURSE: Biological Sciences Curriculum Study: Molecules to Man

II. RATIONALE:

This course is planned to help students understand the nature of biological science by clarifying and broadening new biological concepts and stressing unifying principles within the framework of scientific inquiry.

III. GENERAL DESCRIPTION:

The course includes the following units:

Unit	I	Biology: Interaction of Facts and Ideas
Unit	II	Evolution of Life Processes
Unit	III	Evolution of the Cell
Unit	IV	Multicellular Organisms: New Individuals
Unit	V	Multicellular Organisms: Genetic Continuity
Unit	VI	Multicellular Organisms: Energy Utilization
Unit	VII	Multicellular Organisms: Unifying Systems
Unit	VIII	High levels of Organization

IV. HOW IT FITS INTO PROGRAM:

Prerequisites: Proficiency Levels 1-21
Chemistry
One-year course

SEQUENCE II

I. NAME OF COURSE: Harvard Project Physics (Holt, Rinehart and Winston Company)

II. RATIONALE:

This course is designed to accomplish the following: help students increase their knowledge of the physical world by concentrating on the main ideas that characterize physics as a science; and permit students to see physics as a many-sided human activity by presenting the subject in historical and cultural perspective.

III. GENERAL DESCRIPTION:

The course has the following units:

Unit I The language of motion
Unit II Free fall - Galileo describes motion
Unit III The birth of dynamics - Newton explains motion
Unit IV Understanding motion

IV. HOW IT FITS INTO PROGRAM:

Prerequisites: Proficiency Levels 1-21 and first-year algebra
One year course.

I NAME OF COURSE: A Multi-Media Approach to Chemistry
(A Title III, E.S.E.A. Project)

II. RATIONALE:

This course offers the college preparatory student the option of taking an individualized chemistry program. The term multi-media refers to the many learning approaches offered for student selection. The optional approaches include films, filmstrips, programmed instruction, soundslide presentations, super eight concept loops, audio, texts, teacher presentations, investigation activities and use of the computer. There is a basic core of material for all to learn with several optional paths provided for each lesson and a variety of additional activities for those who want to know more. The course is individualized and self-paced (students working at their own rate) and is designed to teach as much as a student's curiosity demands.

III. GENERAL DESCRIPTION:

The first two units introduce the students to chemical and physical principles essential to the learning of chemistry. The initial knowledge base is expanded in depth as learning proceeds in the following units:

Unit	I	Chemistry an Investigative Science
Unit	II	The Characteristics and Concepts of Matter
Unit	III	Atomic Structure
Unit	IV	Periodicity
Unit	V	Bonding in Matter
Unit	VI	Formula Writing and Naming
Unit	VII	The Nature of Chemical Reactions

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
One year course
For 10th and/or 11th grade college-bound students.

I NAME OF COURSE: Biological Sciences Curriculum Study: High School Biology (Rand-McNally)

II. RATIONALE:

This course is designed to help students understand the following: the nature of scientific inquiry; the limitations of science and of the scientific method; the diversity of life; the interrelations of all organisms; the biological bases of problems in medicine, public health, agriculture, and conservation; the historical development of biological concepts and their dependence upon the nature of society and technology; and man's place in nature.

III. GENERAL DESCRIPTION:

The following units are contained in this course:

Unit I The world of life; the biosphere
Unit II Diversity among living things
Unit III Patterns in the biosphere
Unit IV Within the individual organism
Unit V Continuity of the biosphere
Unit VI Man and the biosphere

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
One year course

I. NAME OF COURSE: Botany I

II. RATIONALE:

This course provides the student with detailed experiences in study of plant life. It builds upon his biological and chemical background as aspects of the plant kirgdom are delved into in greater depth. The student is made keenly aware that to study plant life, other scientific disciplines must be studied as well.

III. GENERAL DESCRIPTION:

This course has the following units:

I. Classification and naming of plants
II. Plant body of seed plants
III. The metabolic plant cell
IV. The chemistry and physiology of the cell
V. The dividing cell
VI. The roots, stems and leaves
VII. Soil and mineral nutrition
VIII. Detailed study of the mechanisms of photosynthesis and respiration
IX. Morphology and physiology of flowers, fruits and seeds
X. Heredity and variation
XI Factors influencing plant growth.
XII. Plants without chlorophyll
XIII. The versus-as scientific puzzle
XIV. Bryophytes
XV. Vascular plants
XVI. Gymnosperms
XVII. Angiosperms
XVIII. Evolution
XIX. Ecology

IV. HOW IT FITS INTO PROGRAM:

Prerequisites: chemistry, Proficiency Levels 1-21
A semester course

I. NAME OF COURSE: Chemical Principles and Applications

II. RATIONALE:

This course provides an opportunity for students who are not planning to study further in the sciences to acquire a basic knowledge of chemical principles and an understanding of their application in today's society.

III. GENERAL DESCRIPTION:

The course has the following units:

I. Characteristics and Properties of Matter
II. The Basic Nature of Matter
III. Periodicity of Properties
IV. Bonding in Matter
V. Chemical Formulas and Equations
VI. Stochiometry of Chemical Reactions
VII. The Chemistry of Selected Industrial Processes
VIII. Metals and Metallurgy
IX. Chemistry of Gardening and Agriculture
X. Chemistry in Building and Home Products
XI. Textiles, Dyes, Paper and Paint
XII. The Chemistry of Photography

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
A semester course.

I. NAME OF COURSE: Ecology

II. RATIONALE:

In this course the student explores the physical and biological environments and the interraltionship involved. Stress is placed on current priorities and pressing problems with suggestive alternative solutions.

III. GENERAL DESCRIPTION:

This course has the following units:

I. The physical environment
II. Biotic environment
III. The balance of nature
IV. The ecology of man and his influence on the environment
V. Current problems and possible solutions
VI. What lies ahead?

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
A semester course

I. NAME OF COURSE: Man-made World (McGraw-Hill)

II. RATIONALE:

This course improves the technological literacy of the student by offering him an understanding of the capabilities, characteristics, and limitations of modern technology.

III. GENERAL DESCRIPTION:

The course consists of the following units:

I Technology and man
II Decision-making
III Optimization
IV Modeling
V Systems
VI Patterns of change
VII Feedback
VIII. Stability
IX Machines and systems for men
X Thinking man's machine
XI Communicating with computers
XII Logical thought and logic circuits
XIII Logic circuits as building blocks
XIV Machine memory
XV Minimicro computer

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21 and first year of algebra
A one year course.

I. NAME OF COURSE: Oceanography

II. RATIONALE:

The objective of this course is to provide the student with an understanding of oceanography by illustrating the inter-disciplinary nature of the subject and to offer students aquatic oriented laboratory and field experiences which will improve their manipulative skills, develop problem-solving techniques, and increase awareness of the marine environment.

III. GENERAL DESCRIPTION:

The course has the following units:

I General characteristics of the hydrosphere
II Evolution of the study of oceanography
III Physical characteristics of the hydrosphere
IV Physical properties of water
V The effects of the sun on the hydrosphere
VI The effects of the wind on the oceans
VII Long waves and tides
VIII Chemical properties of the ocean
IX Topography of the ocean floor
X Marine life
XI Characteristics of shore line regions
XII Technology of the ocean

IV. HOW IT FITS INTO PROGRAM:

Prerequisites: Proficiency Levels: 1-21
A semester course

I. NAME OF COURSE: Physical Geology - Geology Earth Science Sourcebook, Holt, Rinehart and Winston.

II. RATIONALE:

This course is designed to serve the needs of students interested in continuing the learning initiated in the sequence of proficiency levels.

III. GENERAL DESCRIPTION:

The course has the following units:

I The earth's place in our solar system
II Geologic time
III Earthquakes and the earth's interior
IV Mountain building and rock deformation
V The atmosphere
VI Waters of the continents
VII Erosion and landforms
VIII Glaciation
IX Mineral resources
X Lunar resources

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
A semester course.

I. NAME OF COURSE: Physical Principles and Applications

II. RATIONALE:

This course provides a background in basic physical science concepts for the college-bound student who will not major or minor in the science.

III. GENERAL DESCRIPTION:

The course has the following units:

I Properties of matter
II Properties of energy
III Energy changes
IV Electricity and magnetism
V Wave properties
VI Optics
VII Kinetic - Potential energy
VIII Impulse-momentum
IX Heat-temperature
X Solar system characteristics
XI Circular motion
XII Fields
XIII Development of atomic models
XIV Nuclear energy

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21 and algebra I
A semester course

I. NAME OF COURSE: Zoology

II. RATIONALE:

This course provides the student with an indepth study of the animal kingdom and offers insight into experiences that have affected man.

III. GENERAL DESCRIPTION:

The course has the following units:

I Comparative anatomy, physiology, morphology (with emphasis on man)
II Embryology
III Genetics
IV Evolution

IV. HOW IT FITS INTO PROGRAM:

Prerequisites: Proficiency Levels 1-21
A semester course

SEQUENCE III

I. NAME OF COURSE: Environmental Studies

II. RATIONALE:

This course offers the student experiences related to his environment in terms of problems related to it and the possible solutions to these problems.

III. GENERAL DESCRIPTION:

The course has the following units:

I Physical environment
II Biotic environment
III Pollution of the bay and air
IV Industrial and technological affects on the environment
V Affects of unchecked population explosion
VI Current environmental problems and some possible solutions
VII List priority decisions that must be made on a national, local and personal level

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
A semester course

I. NAME OF COURSE: General Astronomy

II. RATIONALE:

This course makes the student aware of basic concepts in astronomy in order that he might more meaningfully follow the future achievements of space technology.

III. GENERAL DESCRIPTION:

This course has the following units:

I The Solar System
II Seasons
III Tides
IV Cosmology
V History and purposes of space probes and manned flights
VI The Milky Way Galaxy
VII Life Cycle of Stars
VIII Nebula
IX Constellations

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
A semester course

I. NAME OF COURSE: Geomorphology

II. RATIONALE:

The course will serve the needs of students interested in continuing learning initiated in the sequence of proficiency levels and who will use the experience as their initial, probably only, course in the subject.

III. GENERAL DESCRIPTION:

The course has the following units:

I The structure of the Earth
II The Earth's Composition
III Volcanoes
IV Earthquakes and the Earth's Interior
V Mountain Building
VI The Atmosphere
VII Weathering-Constructive and Destructive
VIII Waters of the Earth
IX Mineral Resourses and Conservation
X The Earth in Space and Time

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
A semester course

I. NAME OF COURSE: Photography

II. RATIONALE:

This course provides experiences related to physical phenomena and offers experiences that may lead to possible vocations or a vocation.

III. GENERAL DESCRIPTION:

The course has the following units:

I Camera-in relation to the eye
II Effect of light on film
III Processing of film (chemistry)
IV Reversal process of putting film on paper enlarging and contact
V Print processing
VI Variations of special techniques with black and white film
VII Processing of color transparency film
VIII Projection techniques

IV. HOW IT FITS INTO PROGRAM:

Prerequisites: Proficiency Levels 1-21
A semester course

I. NAME OF COURSE: Ideas and Investigations in Science Biology (Prentice-Hall)

II. RATIONALE:

This course permits the student to derive a sequence of concepts from a series of laboratory investigations and involves him in the processes of science as he uncovers each concept in the laboratory. In addition to its investigative nature, it presents social implications as an integral and relevant part of the material.

III. GENERAL DESCRIPTION:

The course has the following units:

I Inquiry
II Evolution
III Genetics
IV Homeostasis
V Ecology

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
A semester course

I. NAME OF COURSE: Ideas and Investigations of Science: Physical Science (Prentice-Hall)

II. RATIONALE:

This course permits the student to derive a sequence of concepts from a series of laboratory investigations and involves him in the processes of science as he uncovers each concept in the laboratory. In addition to its investigative nature, it presents problems with social implications as an integral and relevant part of as much of the material as possible.

III. GENERAL DESCRIPTION:

The course has the following units:

I Predicting
II Matter
III Energy
IV Interaction
V Technology

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
A semester course

I. NAME OF COURSE: Applications of Scientific Principles

II. RATIONALE:

A course in which the student applies chemical-physical principles in order to understand the basic nature of things, comprehend the methods by which familiar products are manufactured, make knowledgeable consumer decisions, and appreciate the role of technology in our society.

III. GENERAL DESCRIPTION:

The course has the following units:

I	Properties of solids, liquids and gases
II	Atomism of matter
III	Bonding of atoms
IV	Chemical formulas and equations
V	Periodicity of properties
VI	Electrochemistry
VII	The chemistry of drugs and medicines
VIII	The chemistry of cosmetics
IX	The chemistry of fabrics
X	The cooking and preservation of foods
XI	The chemistry of fuels and refrigeration
XII	The chemistry of construction materials and household implements
XIII	The disposal of waste
XIV	Chemical hobbies
XV	Vocations related to chemistry
XVI	Chemistry of paints
XVII	Physical properties of metals
XVIII	Practical problems with friction
XIX	Physical principles involved in boating
XX	Practical electricity
XXI	Practical application of wave theory
XXII	Practical applications of heat and temperature
XXIII	Principles of Photography

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels 1-21
A semester course
Student will select four topics, or an original topic per semester acceptable to teaching.

I. NAME OF COURSE: Biological Sciences Curriculum Study: Patterns and Processes, Holt, Rinehart, Winston.

II. RATIONALE:

This course leads the student to an understanding of basic biological patterns and processes with the emphases on man and mankind.

III. GENERAL DESCRIPTION:

The course has the following units:

I Ecological relationships
II Energy relationships
III Reproduction and development
IV Patterns of inheritance

IV. HOW IT FITS INTO PROGRAM:

Prerequisites: Proficiency Levels 1-21
A one year course

I. NAME OF COURSE: Botany II

II. RATIONALE:

This course provides the student with an opportunity to study the fauna and flora of Maryland. He will learn techniques for identifying, growing, and maintaining plants.

III. GENERAL DESCRIPTION:

The course has the following units:

I Taxonomy of plants
II Identification of plants based on structure
III Soil studies
IV Techniques involved in germination and growth of plants
V Study of the factors influencing growth
VI Plant diseases and mineral deficiency
VII Heredity and variation
VIII Crossbreeding of plants
IX Plant ecology

IV. HOW IT FITS INTO PROGRAM:

Prerequisites: Proficiency Levels 1-21
A semester course

I. NAME OF COURSE: Chesapeake Bay Studies

II. RATIONALE:

This course provides an understanding of the nature and significance of the Chesapeake Bay.

III. GENERAL DESCRIPTION:

The course has the following units:

I History of formation
II Bottom topography
III Rivers
IV Tidal changes
V Currents
VI Historical items
VII Erosion
VIII Political problems
IX Bay as a trade route
X Associated industries and occupations
XI Conawingo Dam
XII Tourism
XIII Major ports
XIV Lesser ports
XV Associated folk tales
XVI Light houses and bouy systems
XVII History of boats on the Bay
XVIII Barrier effect of temperature, pressure, and salinity in determining the habitat of marine organisms
XIX Navigational devices as sextant, chronometer, charts, drift bottles, fixes
XX Role of plankton in the food chain
XXI Food webs and food chains
XXII Basic knowledge of protozoa, sponges, coelenterates, flatworms, round worms, Bracheopodia, segmented worms, mollusca, arthropoda, echinodermata
XXIII Life near the shoreline
XXIV Life in deep sea
XXV Identification of Bay fish
XXVI Identification and preservation of marine plant life
XXVII Salt water aquarium studies
XXVIII Bay pollution research
a) industrial wastes
b) technology
c) chemical weathering and pollutants affecting the composition of Bay water
XXIX Man's role in maintaining the Bay as a source of food supply, revenue, recreational sites

IV. HOW IT FITS INTO PROGRAM:

Prerequisites: Proficiency Levels 1-21
A semester course

I. NAME OF COURSE: Astronomy

II. RATIONALE:

This course is designed to make the student aware of the principles and history of the study of astronomy necessary for a reasonable degree of scientific literacy in the "space age".

III. GENERAL DESCRIPTION:

The course consists of the following units:

I. Review and Exploration
   a) Solar system
   b) Aspects and occulations
   c) Kepler's Laws
   d) Principles of Astrophysics
   e) Theories of the origin of the solar system and the Universe
   f) Constellations and celestial navigation

II. Life Cycle of Stars
   a) Color, size, temperature relations
   b) Novae
   c) Source of stellar energies

III. Telescopes, Spectroscopes and Radio Astronomy

IV. Motion and the Doppler Effect

V. Structures in the Universe
   a) Planetary system
   b) Milky Way galaxy
   c) Comparative galactic structures
   d) Star clusters and systems
   e) Nebulae
   f) Interstellar and inter galastic material

VI. Measuring Distances
   a) Doppler Effect
   b) Absolute and apparent magnitudes of stars
   c) Parallax

VII. The Question of Cosmic Rays

VIII. The Mysterious Quasars and Pulsars

IX. Relativistic Astronomy

X. Contributions of Ptolemy, Corpernicus, Galileo, Herschel, Cassini, Lowell, Tombaugh, Newton, Leverrier, Russell, Einstein, and others.

IV. HOW IT FITS INTO PROGRAM:

Prerequisite: Proficiency Levels: 1-21 and first year of algebra
A semester course

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