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## ABSTRACT

This document outlines the first part of a two-part senior high school general science course designed to familiarize students with elementary chemistry, basic fundamentals and principles of matter and energy, earth structure and movement, introductory astronomy, and interpretation of data. Included are listings of adopted texts, performance objectives, course outline, laboratory investigations, reports and projects, discussion questions, films, references, and a master reference sheet. (SL)

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CONCEPTS AND APPLICATIONS OF SCIENCE I  
122933  
SCIENCE

Written by John Mayer and Bettie Lou McCollum  
for the  
DIVISION OF INSTRUCTION  
Dade County Public Schools  
Miami, Fla.  
1976

SE 021 415

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## CONCEPTS AND APPLICATIONS OF SCIENCE I

### COURSE DESCRIPTION:

This course is designed to identify and familiarize students with major concepts and applications of biological, physical, and earth sciences. The areas to be covered are basic genetics, ecology, elementary chemistry, basic fundamental principles of matter and energy, earth structure and movement, atmospheric conditions, introductory astronomy and interpretation of data.

### ENROLLMENT GUIDELINES:

This quin is the first part of two quin courses prepared to provide a strong background in general science for the serious academic students who have completed four quins of science in senior high school, and who also need a wider base in scientific knowledge.

### STATE ADOPTED TEXTS:

Oram, Raymond F. et al. Biology: Living Systems. Columbus, Ohio: Charles E. Merrill Publishing Co., 1973.

Kaskel, Albert et al. Laboratory Biology - Investigating Living Systems. Columbus, Ohio: Charles E. Merrill Publishing Co., 1973.

Biological Sciences Curriculum Study. Biological Science: An Inquiry Into Life. New York: Harcourt Brace Javanovich, Inc., 1973.

Brown, Walter R. and Anderson, Norman D. Physical Science: A Search For Understanding. Philadelphia: J. B. Lippincott Company, 1972.

Tracy, George R. et al. Modern Physical Science. New York: Holt, Rinehart and Winston, Inc., 1974.

Gerfin, Richard. Laboratory Investigations For Modern Physical Science. New York: Holt, Rinehart, and Winston, Inc., 1974.

Otto, James H. et al. Modern Biology. New York: Holt, Rinehart and Winston, Inc., 1973.

Namowitz, Samuel and Stone, Donald B. Earth Science. The World We Live In. New York: American Book Company, 1975.

Namowitz, Samuel and Stone, Donald B. Activities In Earth Sciences. New York: American Book Company, 1975.

Bishop, Margaret et al. Focus On Earth Science. Columbus, Ohio: Charles E. Merrill, 1976.

Bishop, Margaret and Lewis, Phyllis. Earth Science: A Learning Strategy For The Laboratory. Columbus, Ohio: Charles E. Merrill, 1976.

Lavoroni, Charles W. et al. Water Pollution. Menlo Park, California:  
Addison-Wesley Publishing Co., 1971.

Lavoroni, Charles W. et al. Air Pollution. Menlo Park, California:  
Addison-Wesley Publishing Co., 1971.

Lavoroni, Charles W. et al. Noise Pollution. Menlo Park, California:  
Addison-Wesley Publishing Co., 1971.

## PERFORMANCE OBJECTIVES

The student will:

1. identify the following parts of a controlled experiment: problem, hypothesis, control, independent variable, dependent variable, variables to be held constant, quantitative and qualitative data, use of sufficient trials, objective interpretation of data to arrive at conclusions.
2. change qualitative data collected during an activity to a quantitative form.
3. state the value of positive and negative findings that result from scientific investigations.
4. using a table of common ions and their names, correct formulas for common compounds, such as, sodium chloride, hydrochloric acid, chalk, Epsom's salt, sulfuric acid, etc.
5. given the atomic number and mass number of an atom, state the number of protons, neutrons, and electrons in the atom.
6. demonstrate periodic relationships shown in the periodic chart by describing the common families of elements and groups of elements by stating their common electronic structure.
7. given a list of functional groups, name five of the compounds as an alcohol, organic acid, ether, aldehyde, or ester.
8. after studying the electronic structure of group form, state reasons for the large number of compounds of carbon.
9. write and balance the general equation for photosynthesis.
10. define giant, supergiant, white dwarf, Cepheid, and main sequence star as stages in a star's life history.
11. trace the evolution of a star from the condensation of interstellar matter to the white dwarf stage.
12. list the characteristics of the Milky Way Galaxy.
13. explain how scientists use a star's spectrum to determine its chemical composition.
14. compare and contrast the visible light spectrum with the whole electromagnetic spectrum.
15. explain that the plotting of heavenly bodies is difficult because everything is in motion.

16. given a map, draw in the "ring of fire" and cite reasons for volcanic activity in those areas.
17. given a global map, draw their concept of "Pangea" and list reasons to substantiate their map.
18. given proper instructions, demonstrate their knowledge of the Moh's Rock Hardness Scale by correctly assigning the proper hardness scale to three samples.
19. given a matching exercise, discriminate between geological concepts, such as, faulting, erosion, Tsunami, earthquakes, glaciation, and Continental Drift Theory.
20. given sufficient data, estimate the age of various types of matter by applying radioactive dating methods, fossil forms and sedimentation theory.
21. select a major river of the world and trace its flow from its source to its mouth marking the river's contributions to the geology, ecology, and economics of the land.

## COURSE OUTLINE

### I. Use of the scientific method in solving problems

- A. Clearly stated problem
- B. Hypothesis
- C. Experiment
  - 1. Control
  - 2. Independent variable
  - 3. Dependent variable
  - 4. Variable to be held constant
  - 5. Use of sufficient trials
- D. Data Collection
  - 1. Quantitative
  - 2. Qualitative
- E. Objective interpretation of data to arrive at conclusions
- F. Value of positive and negative results

### II. Chemistry

- (A) Earth's Matter
  - a. Elements and atoms
  - b. Compounds
  - c. Sub-atomic particles
  - d. Atomic and molecular weights
- (B) Structure of Matter
  - a. Nucleus
  - b. Energy shells or levels
  - c. Ions
  - d. Isotopes
- (C) Physical Properties

(D) Chemical Properties

(E) Models

1. Hydrogen, Helium, Methane, Carbon Dioxide and Water

(F) Radioactivity

(G) Practical Chemical Formulas

1.  $H_2O$ ,  $NaCl$ ,  $MgSO_4$ ,  $CH_4$ ,  $C_2H_6$ ,  $C$ ,  $CO_2$ ,  $HCl$ ,  $H_2SO_4$

(H) Simple Chemical Equations

(I) Safety Precautions

### III. Earth Science

1. Astronomy

(A) The Universe

a. Study and origin of the universe

b. Radio sources

c. Classification of the stars

d. Radiant energy

e. Stars and galaxies

(B) Solar System

a. Origin of the solar system

b. The sun

c. The planets

d. Comets, meteoroids, meteors, and meteorites

(C) Measurement and Space Travel

a. Exploring space

b. Location and navigation

c. Keeping time

d. Travel to the moon

## 2. Geology

- a. The changing crust
  - 1. Theories of uplift
  - 2. Continental Drift
  - 3. Plate tectonics
- b. Rocks and Minerals
- c. Diastrophism
  - 1. Earthquakes
  - 2. Tsunami
  - 3. Faulting
- d. Pollution of Water
  - 1. Surface water
  - 2. Ground water

## LABORATORY INVESTIGATIONS

Kaskel, Albert et al. Laboratory Biology - Investigating Living Systems. Columbus, Ohio: Charles E. Merrill Publishing Co., 1973.

1. Solving a Problem with a Scientific Method (Lab 4, pp. 15-19.)
2. Using Metric Units (Lab 5, pp. 21-24)

Biological Sciences Curriculum Study. Biological Science: An Inquiry Into Life. New York: Harcourt Brace Javanovich, Inc., 1973.

3. Asking questions: seeking answers (Inquiry 1-1, pp. 4-5)

Andrews, William et al. A Guide to the Study of Terrestrial Ecology. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1974.

4. Introduction of an Exotic Insect Species, pp. 232-233.

Eisler, Sanford E. and Stock, Murray. Using Line Graphs. New York: Cambridge Book Company, 1972.

5. A number of activities (pp. 67-96) to give students an opportunity to construct graphs and interpret data from prepared graphs.

Gerfin, Richard. Laboratory Investigations for Modern Physical Science. New York: Holt, Rinehart, and Winston, 1974.

6. Matter and Change #5 p. 23
7. A Close Look at a Chemical Reaction #6 p. 29
8. Liquids, Solids, and Chemical Reactions #9 p. 39
9. Chemistry in the Home #15 p. 58
10. Using Chemical Reactions to Identify Metals #16 p. 62
11. The Reflecting Telescope #24 p. 75
12. Locating Some Well-Known Stars and Constellations #26 p. 81
13. Finding Your Latitude #32 p. 105
14. Finding Your Longitude #33 p. 109
15. Time and Date Around the World #35 p. 115
16. Learning to Identify Minerals #3 p. 5
17. Learning to Identify Minerals #4 p. 7
18. The Specific Gravity of Rocks #10 p. 29
19. Great Circle Routes #34 p. 111
20. Mapping a Mountain #14 p. 35
21. Scale, Distance and Symbols of a Topographic Map #17 p. 47

## REPORTS AND PROJECTS

1. Prepare a report on a specific antibiotic. Include in your report how the antibiotic was discovered, diseases against which it is useful and information on controlled experiments that led to its effective use.
2. Madam Marie Curie and Pierre Curie
3. Major Chemical Pollutants
4. Minerals versus Ores
5. H<sub>2</sub>O in Its Three Phases
6. Isotopes in Medicine and Agriculture
7. Ten Common Chemical Compounds and Their Practical Uses
8. Cryogenics
9. Radioactive Elements and Compounds
10. Nuclear Power Plants of F.P.L.
11. Radio Telescopes
12. U. F. O's
13. Miami's Sky at Night In The Winter
14. Miami's Sky at Night In The Summer
15. Super Nova, Nova
16. Our Nearest Stars
17. Telescopes
18. Careers in Astronomy
19. Old Myths and Legends
20. Astrology versus Astronomy
21. Geothermal Energy'
22. Saint Andreas Fault
23. Famous Volcanoes of the Past and Present
24. Tsunami Warning Systems in the Pacific Ocean Area
25. Minerals of Florida
26. Rain Water From Sea Water
27. Types of Rocks
28. Moh's Scale
29. Moho
30. Careers in Geology

## DISCUSSION QUESTIONS

1. Consider how many years passed between the discovery of Plasmodium by a French army physician (Laveran) and acceptance of the hypothesis "Plasmodium causes malaria".
  - (a) How can you explain that scientists were slow in accepting hypothesis?
  - (b) How is an hypothesis tested?
  - (c) How could it be demonstrated whether a particular organism causes a particular disease? (Biological Sciences Curriculum Study. Biological Science: An Inquiry Into Life. New York: Harcourt Brace Javanovich, Inc., 1973.)
2. Discuss how all results from scientific investigations can be useful to future scientists.
3. Interpret data from prepared graphs and share information with groups.
4. How are the transuranium elements produced and what importance do these elements have in today's world?
5. What effect does chemistry have on your everyday school life and home life?
6. How has organic chemistry changed our world from the stand point of health, standard of living and environmental problems?
7. What major new chemical products were developed during your lifetime, your father's lifetime, and your grandfather's lifetime?
8. How are chemistry and the fields of economics, politics, health, and sports related?
9. How was the speed of light determined?
10. What does Universe mean and how do you understand it?
11. How are stars born, become mature, and die?
12. Compare Astronomy to Astrology.
13. Do you think life exists elsewhere in our universe? If so why?
14. What are the causes of earthquakes and what preventative measures can be taken to preserve life and property?
15. Is the United States dependent upon other nations for some vital minerals?
16. What do geologists do? What types of geologists are there?
17. Briefly describe the major geologic features of Florida.
18. Describe the geologic development of the Florida Keys.

## FILMS

1. Aristotle and the Scientific Method  
AV# 1-12492, 14'
2. Louis Pasteur - Man of Science  
AV# 1-30095, 30'
3. Health Heroes - The Battle Against Disease  
AV# 1-05098, 11'
4. Scientific Method in Action  
AV# 1-10079, 19'
5. Survey (The)  
AV# 1-14472, 20'
6. Chemical Families  
AV# 1-10819, 22' C
7. Crystal and Their Structure  
AV# 1-10824, 22' C
8. Acids, Bases, and Salts  
AV# 1-10947 21' C
9. Carbon and Its Compounds  
AV# 1-01968, 11' BW
10. Copper Mining  
AV# 1-11598, 14' C
11. Handling Chemicals - Solids, Liquids and Gases  
AV# 1-04988, 11' C
12. Chemistry of Aluminum  
AV# 1-10942, 10' C
13. How Many Stars?  
AV# 1-01524, 10' BW
14. How We Study The Sun  
AV# 1-12783, 15' C
15. How To Measure Time  
AV# 1-05457, 11' C
16. Mystery of Time  
AV# 1-48017, 40' C
17. Radio Waves  
AV# 1-30208, 27' C
18. Understanding Our Universe  
AV# 1-01534, 11' C

19. Birth of a Florida Key  
AV# 1-12252, 14'C
20. Time, Lines, and Events  
AV# 1-14370, 19'C
21. Mountains on the Move  
AV# 1-02054, 11'C
22. Geological History of the Grand Canyon  
AV# 1-12929, 11'C
23. From Ice to Life  
AV# 1-02015, 11'BW
24. Earth Beneath the Sea  
AV# 1-31828, 22'C
25. Energy, The Dilemma  
AV# 1-13123, 20'C

#### FILMSTRIPS

1. Metamorphic Rocks Ward's Natural Science 1961C, 55F
2. Lakes and Oceans Ward's Natural Science 1961C, 55F
3. Igneous Rocks Ward's Natural Science 1961C, 68F
4. Sedimentary Rocks Ward's Natural Science 1961C, 60F
5. Streams and Rivers Ward's Natural Science 1963, 60F
6. Volcanism Ward's Natural Science 1963C, 65F

## REFERENCES

1. Andrews, William et al. A Guide to the Study of Terrestrial Ecology. Englewood Cliffs, New Jersey: Prentice Hall, Inc. 1974.
2. American Geological Institute. Investigating the Earth. Boston: Houghton Mifflin Company, 1976.
3. Biological Sciences Curriculum Study. Biological Science: An Inquiry Into Life. New York: Harcourt Brace Jovanovich, Inc., 1973.
4. Biological Sciences Curriculum Study. Biological Sciences Molecules to Man. New York: Houghton Mifflin Company, 1968.
5. Bishop, Margaret and Lewis, Phyllis. Earth Science: A Learning for the Laboratory. Columbus, Ohio: Charles E. Merrill, 1976.
6. Bishop, Margaret et al. Focus on Earth Science. Columbus, Ohio: Charles E. Merrill, 1976.
7. Brandwein, Paul F. et al. The Earth: Its Living Things. New York: Harcourt Brace Jovanovich, Inc., 1970.
8. Brown, Walter R. and Anderson, Norman D. Physical Science: A Search for Understanding. Philadelphia: J. B. Lippincott Company, 1972.
9. Eisler, Sanford E. and Stock, Murray. Using Line Graphs. New York: Cambridge Book Company, 1972.
10. Kaskel, Albert et al. Laboratory Biology - Investigating Living Systems. Columbus, Ohio: Charles E. Merrill Publishing Co., 1973.
11. Namowitz, Samuel and Stone, Donald B. Activities in Earth Sciences. New York: American Book Company, 1975.
12. Namowitz, Samuel and Stone, Donald B. Earth Science. The World We Live In. New York: American Book Company, 1975.
13. Oram, Raymond F. et al. Biology: Living Systems. Columbus Ohio: Charles E. Merrill Publishing Co., 1973.
14. Otto, James H. et al. Modern Biology. New York: Holt, Rinehart and Winston, Inc., 1973.
15. Tracy, George R. et al. Modern Physical Science. New York: Holt, Rinehart and Winston, Inc., 1974.
16. Weinberg, Stanley L. Biology: An Inquiry Into Life. Boston: Allyn Bacon, Inc. 1974.

MASTER SHEET - CONCEPTS AND APPLICATIONS OF SCIENCE I

Objectives	Texts	Lab.	Suppl. Refs.	Films	Film-strips	Reports Projects	Discuss. Quest.
1 2 3	1-Ch. 2 2-Ch. 1 3-Ch. 1 5-Ch. 1	1,2,3,4, 5	1-pp.612- 614	1,2,3 4,5		1	1,3 2
4 5 6	4 4-Ch. 3, p.42 4-Ch. 3 p.45	7	15-pp.158- 162 15-pp.360- 361	6		5 7 6	
7 8 9	4-Ch. 5 4-Ch. 5 4-Ch. 6		15-pp.170 171	9		4	6 7
10 11 12	6-Ch. 27 6-Ch. 27 6-Ch. 26,7	11 12		13 14 7,8,9, 10		11 15,16 13,14	10 11 12
13 14 15	7-Ch. 1 6-Ch. 26, p. 397	11 12 15		20,23		17 20 11,19 12	11,12 13 10
16 17 18	6-Ch. 15 6-Ch. 14, p. 211 7-Ch. 2, p. 113	16, 17 18 19,20		13 14 24,25	1 2,3	21,22 23,28 29,27	15,16 17
19 20 21	7-Ch. 6,12 7-Ch. 3, p. 301,177 Ch. 23 6-Ch. 10	19,20 21 15		15 16 22,23 17,18	4 5	21,22 29,30	15,16 18
			17				
				14			