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ABSTRACT

This curriculum guide, developed to establish statewide curriculum standards for the Louisiana Competency-based Education Program, contains the minimum competencies and process skills that should be included in a biology course. It consists of: (1) a rationale for an effective science program; (2) a list and description of four major goals of science; (3) a list and description of eight basic process skills (such as predicting and classifying) and five integrated processes (such as controlling variables and defining operationally); and (4) a nine-part curriculum outline. These parts provide performance objectives correlated with a concept, process skill(s), and suggested activities for each of the following major topic areas: introduction to biology; cell biology; general reproduction; evolution; genetics; scientific basis of classification; the functioning organism (protists, plants, animals); human anatomy and physiology (examining the skeletal, muscular, digestive, circulatory, excretory, integumentary, respiratory, nervous, endocrine, and reproductive systems); and ecology. The outline is designed to allow flexibility in the teaching of Biology I from either the systematic or the phylogenetic approach. A list of references, a list of audiovisual suppliers, and brief comments on evaluation techniques are also provided. (JN)

STATE OF LOUISIANA
DEPARTMENT OF EDUCATION

BIOLOGY CURRICULUM GUIDE

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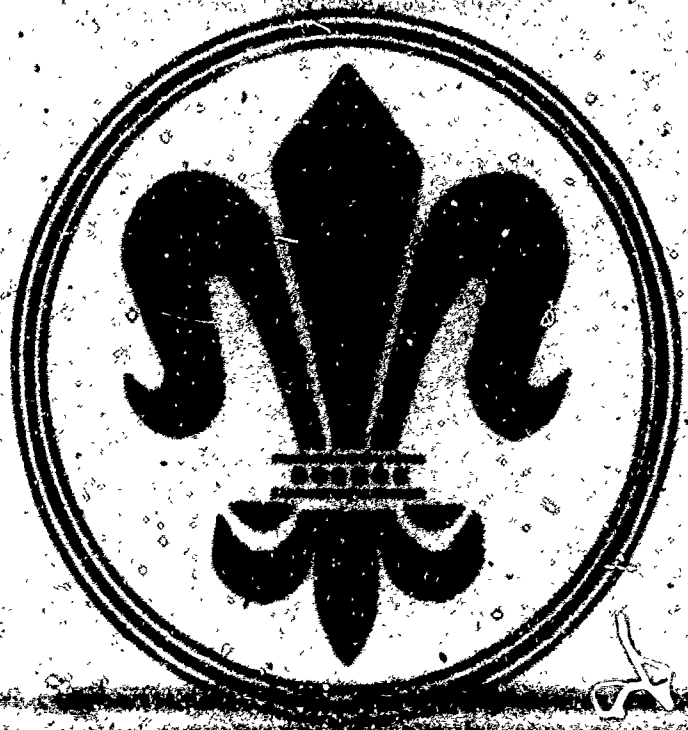

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1984

Issued by

Office of Academic Programs

THOMAS G. CLAUSEN, Ph.D.

Superintendent

FOREWORD

Act 750 of the 1979 Louisiana Legislature (R.S. 17:24.4) established the Louisiana Competency-Based Education Program. One of the most important provisions of Act 750 is the mandated development and establishment of statewide curriculum standards for required subjects. These curriculum standards include curriculum guides which contain minimum skills, suggested activities, and suggested materials of instruction.

During the 1979-80 school year, curriculum guides were developed by advisory and writing committees representing all levels of professional education and all geographic areas across the State of Louisiana for the following Science courses: Elementary K-6, Life Science, Earth Science, Physical Science, General Science, Biology, Chemistry, and Physics.

During the 1982-83 school year, the curriculum guides were piloted by teachers in school systems representing the different geographic areas of the State as well as urban, suburban, inner-city, and rural schools. The standard populations involved in the piloting reflect also the ethnic composition of Louisiana's student population. Based upon participants' recommendations at the close of the 1982-83 pilot study, the curriculum guides were revised to ensure that they are usable, appropriate, accurate, comprehensive, relevant, and clear.

Following the mandate of Act 750, the revised curriculum guides will be implemented statewide in the 1984-85 school year. The statewide implementation is not, however, the end of the curricular development process. A continuing procedure for revising and improving curricular materials has been instituted to ensure that Louisiana students have an exemplary curriculum available to them--a curriculum that is current, relevant, and comprehensive. Such a curriculum is essential if we are to provide the best possible educational opportunities for each student in the public schools of Louisiana.

Thomas G. Clausen, Ph.D.

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PREFACE

The Biology Curriculum Guide contains the minimum competencies and process skills that should be included in a Biology course. Each teacher should build on the foundation of these minimum competencies to establish the maximum program possible for his/her students. The teacher must take special care to incorporate all skills contained in this guide within the framework of his/her instructional program. The guide is flexible enough to be adapted to most of the commercial basal programs; and teachers may adjust the sequence of content based on the needs of their students, the available equipment, and the textbooks.

The guide contains suggested activities designed to assist the teacher in teaching each competency; however, the teacher and the students should not be limited to these activities nor bound to use all of them. There are many other activities available to the teacher which will help him/her to present each competency and process skill to the student. It is hoped that the teacher will be resourceful in using many types of experiences to teach the topics listed.

Methods of science instruction, to be most effective, must be based upon the development of process skills in critical thinking. An effort has been made to incorporate numerous process skills in the suggested activities, and the teacher should use as many of these skills as possible in daily instruction.

This curriculum guide should be of special benefit to the teacher in helping to organize the Biology course. It is suggested that additional textbooks, workbooks, and laboratory manuals be consulted for activities, demonstrations, and experiments to supplement those described in this curriculum guide.

The committee on Competency-Based Education agrees that human reproduction should be included in the curriculum. However, in light of the legislative action taken in 1979, these materials should be developed by the local school systems.

RATIONALE

Developments in science technology have improved our way of living and have become a major influence on our culture. No one in our culture escapes the direct influence of science. Because of the impact of science on our social, economic, and political institutions, the education of every responsible citizen must include not only the basic principles of science but also the attitudes and processes of scientific thought.

The nature of science itself determines the way that it should be taught. The definition of science is a two-fold one: It is (1) an unending method or process of seeking new knowledge, and (2) the body of knowledge which results from this search. Science is an intellectual, active process which involves an investigator of any age and something to investigate. The discipline of science taught by the process approach teaches the student how to learn, and that intellectual gain is a permanent one for the student.

The process approach develops the intellectual abilities of students. Some students develop thinking skills in the normal course of growing up in a complex world, but the acquisition of useful skills and attitudes is by no means automatic. Many students succeed in school by repeating what they are told in a slightly different form or by memorizing; such strategies are of little extended value. At present, relatively few students develop persistence in and zest for dealing with new concepts because they are not aware of their intellectual capabilities. Thus, they need literally to experience application of scientific process skills in different situations.

To be most effective, methods of science instruction must be based upon the development of skills in critical thinking. Guided practice in experimenting, observing, gathering information, organizing facts, and drawing conclusions will help to develop critical thinking skills. Laboratory techniques should be employed whenever possible, and inquiry teaching/learning situations using both deductive and inductive reasoning should be the predominant method used in all classroom activities. The teacher's role in a process-oriented science classroom includes being a provider of problems, a discussion leader, a supplier of clues (when necessary), and a skillful questioner, i.e., a facilitator of learning activities. Thus, the aim of an effective science program should be to equip each child with competencies in the basic processes and concepts of science through individual participation in activities and investigations specifically designed to develop such capabilities.

GOALS

Achieving scientific literacy involves the development of attitudes, process skills, concepts, and social aspects of science and technology. Based upon this belief, the following major goals of science are stated:

1. To Foster Positive Attitudes Toward the Scientific Process

   Students will develop a deep appreciation of the role the scientific process plays in their everyday lives.

2. To Develop Process Skills

   Process skills development should be an integral part of science activities for students. Students should be given opportunities to develop those intellectual processes of inquiry and thought by which scientific phenomena are explained, measured, predicted, organized, and communicated.

   Basic Process Skills: Observing, inferring, classifying, using numbers, measuring, using space-time relationships, communicating, predicting.

   Integrated Process Skills: Controlling variables, defining operationally, formulating hypotheses, interpreting data, experimenting.

3. To Acquire Knowledge

   Included in the basic science curriculum should be those scientific facts, principles, concepts, and terms which will enable the students to understand and interpret natural phenomena.

   Areas of Knowledge: Life Science, Physical Science, Earth Science

4. To Recognize Social Aspects of Science and Technology

   The students should (a) understand the interrelationships of science, technology, and social and economic development; and (b) recognize both the limitations and the usefulness of science and technology in advancing human welfare.

PROCESS SKILLS

Eight basic process skills are stressed: (1) observing, (2) inferring, (3) classifying, (4) using numbers, (5) measuring, (6) using spacetime relationships, (7) communicating, and (8) predicting. There is a progressive intellectual development with each process category. A brief description of each basic process skill follows:

OBSERVING: To observe is to use one or more of the five senses to perceive properties of objects or events as they are. Statements about observations should be (1) quantitative where possible, (2) descriptive regarding change(s) and rates of change(s), and (3) free of interpretations, assumptions, or inferences.

INFERRING: To infer is to make statements about objects or events based on observations but not the result of direct perception. Inferences may or may not be accurate interpretations or explanations of observations. Inferences are based on (1) observations, (2) reasoning, and (3) past experience of the observer. Inferences require evaluations and judgment. Inferences based on one set of observations may suggest further observation which in turn requires modification of original inferences. Inferences lead to predictions.

CLASSIFYING: Classifying is the grouping or ordering of phenomena according to an established scheme. Objects and events may be classified on the basis of observations. Classification schemes are based on observable similarities and differences in arbitrarily selected properties. Classification keys are used to place items within a scheme as well as to retrieve information from a scheme.

USING NUMBERS: To use numbers is to deal with the measurement, properties, and relationships of quantities by the use of symbols.

MEASURING: To measure is to find out the extent, size, quantity, capacity, etc., of something, especially by comparison with a standard. Once the concept of measuring is introduced and mastered in the kindergarten and first grade, the metric and/or SI system should be used exclusively.

USING SPACE/TIME RELATIONSHIP: Space/Time relationships is the process that develops skills in the description of spatial relationships and their changes with time. It includes the study of shapes, time, direction, spatial arrangement, symmetry, motion, and rate of change.

COMMUNICATING: To communicate is to pass information along from one person to another. Communications may be verbal, nonverbal (i.e., gestures), written, or pictorial (pictures, maps, charts, and graphs). Communications should be concise, accurate, clear, precise descriptions of what is perceived.

PREDICTING: Predicting is forecasting what future observations might be; it is closely related to observing, inferring, and classifying. The reliability of predictions depends upon the accuracy of past and present observations and upon the nature of the event being predicted.

As basic progressive, intellectual development proceeds in each basic process skill, the interrelated nature of the processes is manifested in the five integrated processes: (1) controlling variables, (2) defining operationally, (3) formulating hypotheses, (4) interpreting data, and (5) experimenting. A brief description of each integrated process skill follows:

CONTROLLING VARIABLES: A variable is any factor in a situation that may change or vary. Investigators in science and other disciplines try to determine what variables influence the behavior of a system by manipulating one variable, called the manipulated (independent) variable and measuring its effect on another variable, called the responding (dependent) variable. As this is done, all other variables are held constant. If there is a change in only one variable and an effect is produced on another variable, then the investigator can conclude that the effect has been brought about by the changes in the manipulated variable. If more than one variable changes, there can be no certainty at all about which of the changing variables causes the effect on the responding variable.

DEFINING OPERATIONALLY: To define operationally is to choose a procedure for measuring a variable. In a scientific investigation, measurements of the variables are made; however, the investigator must decide how to measure each variable. An operational definition of a variable is a definition determined by the investigator for the purpose of measuring the variable during an investigation; thus, different operational definitions of the same variable may be used by different investigators.

FORMULATING HYPOTHESES: To formulate a hypothesis is to make a guess about the relationships between variables. A hypothesis is usually stated before any sensible investigation or experiment is performed because the hypothesis provides guidance to an investigator about the data to collect. A hypothesis is an expression of what the investigator thinks will be the effect of the manipulated variable on the responding variable. A workable hypothesis is stated in such a way that, upon testing, its credibility can be established.

CONTENT OUTLINE*

I: Introduction to Biology
- A. Scientific method
- B. Living vs. nonliving
- C. Equipment and materials

II. Cell Biology
- A. Parts of the cell
- B. Levels of cellular organization
- C. Cellular energy
  1. Photosynthesis
  2. Respiration

III. General Reproduction
- A. Spontaneous generation
- B. Cell division
  1. Mitosis
  2. Meiosis
- C. Types of reproduction
  1. Asexual
  2. Sexual

IV. Evolution

V. Genetics
- A. DNA Molecules
- B. Laws of heredity

VI. Scientific Basis of Classification
- A. Linnaeus
- B. Levels of classification
- C. Structural similarities

VII. The Functioning Organism
- A. Protist
  1. Algae
  2. Fungi
  3. Bacteria
  4. Protozoans
- B. Plants
  1. Nonvascular and vascular plants
  2. Seed plants
- C. Animals
  1. Lower invertebrates
  2. Higher invertebrates
  3. Vertebrates

VIII. Human Anatomy and Physiology
- A. Skeletal system
- B. Muscular system
- C. Digestive system
- D. Circulatory system
- E. Excretory system/Integumentary system
- F. Respiratory system
- G. Nervous system
- H. Endocrine system
- I. Reproductive system

VIX. Ecology

*This outline is designed to allow flexibility in the teaching of Biology I from the systemic approach or the phylogenic approach. Teachers using the systemic approach would include a survey of the major animal phyla and man in the teaching of each system. Teachers using the phylogenic approach would cover the ten organ systems with each major phyla of animals.

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COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
I. INTRODUCTION TO BIOLOGY The student will be able to:			
1. Identify the following equipment: a. Scalpel b. Forceps c. Test tubes d. Beakers e. Graduated cylinder f. Balance g. Bunsen burner h. Microscope-compound-dissecting i. Scissors	Equipment used in biology	Observing, classifying	1. Available equipment items should be featured for students to observe and identify. 2. Hand out sheet with diagram of these pieces of equipment.
2. Identify steps of scientific method: a. Problem b. Read literature related to problem c. Hypothesis d. Design experiment (procedure) and perform e. Collect pertinent data and organize into graphs, charts, etc. f. Interpret data and form conclusions	Method of acquiring scientific knowledge	Classifying	1. Give examples of steps. 2. Use experiment from any lab manual and relate it to the scientific metnod. 3. Point out each part in the lab done in class (reinforcement). 4. Review: a. How to make graphs (line). b. How to interpret graphs.
3. Observe and identify characteristics of living vs. nonliving things: a. Structure or form b. Reproduction of species c. Irritability (responds to stimuli) d. Metabolism (movement, growth, gaseous exchange, food getting and eliminating, etc.)	Living vs. nonliving	Observing, predicting, classifying, inferring, defining operationally	1. Observe some living specimens and list characteristics exhibited. 2. Observe nonliving objects and list characteristics.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
4. Identify parts of microscope: a. Eyepiece b. Body tube c. Revolving nosepiece d. High power objective e. Low power objective f. Stage g. Stage clips h. Diaphragm i. Mirror or illuminator j. Base k. Arm l. Coarse adjustment knob m. Fine adjustment knob	Microscope	Observing, communicating	1. Provide microscope(s) to students to learn parts. 2. Conduct a lab investigation on care and use of the microscope.
5. Prepare a wet mount.	Slide preparation	Defining operationally, controlling variables, experimenting, inferring, observing	1. Conduct a lab on preparing a wet mount. 2. Prepare wet mounts of algae, pond water.
II. CELL BIOLOGY			
6. Identify and state the functions of the cell wall, membrane, nucleus, and cytoplasm.	Cell structure	Observing, communicating	1. Prepare wet mount preparations of onion skin, cheek cells and elodea. 2. Draw a diagram of the cell parts that can be identified from a microscope slide. 3. View transparency of the cell, cell models, and filmstrips and films on cells and the nucleus.
7. Recognize the movement of materials.	Diffusion (osmosis)	Observing, predicting, defining operationally	Cellulose tubing containing starch solution, a second tube containing glucose. Place starch in a beaker with iodine and the glucose tube in plain water. Check movement of glucose with Test-tape or any general diffusion experiment.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
8. Compare and contrast the functions of cells, tissues, organs, systems, and organisms.	Levels of organization	Observing, classifying	Bulletin board showing the relationship of cell organization. Handouts on cell organization.
9. Describe the photosynthetic process in green plants.	Photosynthesis	Experimenting, interpreting data, inferring, predicting, controlling variables	1. Place experimental plants in varying intensities of light and darkened areas. 2. Conduct an iodine test on a variegated coleus plant or any plant that has been placed in the dark.
10. Observe that all organisms carry on respiration.	Respiration	Observing, experimenting, inferring, controlling variables, predicting, measuring, using numbers	1. Yeast for CO_2 liberation. 2. Balanced aquarium. 3. Human respiration using indicators for CO_2 (Example: NaOH or phenolphthalein).
11. Compare and recognize that photosynthesis is opposite to the process of respiration.	Respiration-Photosynthesis	Observing, inferring, predicting, defining operationally	Construct comparison chart, bulletin board of pictures (plant and animal relationship), plants and fish in aquarium (elodea and snail). Filmstrip: Photosynthesis.
III. GENERAL REPRODUCTION			
12. Define spontaneous generation.	Spontaneous generation	Defining operationally, controlling variables, inferring, predicting, interpreting data	Describe Louis Pasteur and Redi's experiment to disprove spontaneous generation.
13. State that two cells are produced from one cell in mitosis.	Mitosis	Observing, Communicating	1. Show slides on mitotic division in onion root tips. 2. Have students prepare models of mitotic stages of cells using yarn, pipe cleaners, etc. 3. Using colored chalk, draw cells on board; follow through stages of mitosis. 4. View transparencies on mitosis. 5. View films and filmstrips on mitosis.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			6. Models of mitosis.
14. Calculate the chromosome number of an egg or sperm cell after meiosis.	Meiosis	Predicting, using numbers, observing, communicating, inferring	1. Use transparencies, charts, films, and filmstrips on meiosis. 2. Give student a sample problem, then have students calculate number of chromosomes in a fruit fly sex cell, a human sex cell, etc.
15. Compare and contrast asexual and sexual reproduction in living organisms.	Types of reproduction	Classifying	Students should prepare a list of advantages and disadvantages of asexual and sexual reproduction.
IV. EVOLUTION			
16. Define evolution as the gradual change in an species over a long period of time.	Evolution	Using space/time relationships	Discussion: 1. Examine peppered moth. 2. Examine charts on the evolution of the horse, dog, and giraffe. 3. Measure the femur on 30 grasshoppers. Record results in chart and graph form. 4. Measure the length of the arms of 20 students. Record results. 5. View film on "DARWIN." Give written or oral reports on the life of Darwin.
V. GENETICS			
17. Explain that DNA is composed of chemicals combined in a certain way and this combination carries certain messages.	DNA	Communicating, inferring, observing, defining operationally	1. Construct DNA molecules using sugar cubes for sugar (deoxyribose), cherries for phosphates, white straws for the bonds between sugars and phosphates, and different colored straws or colored pipe cleaners. 2. Obtain models or kits available for structure of DNA. 3. Use paper cutouts of components of DNA which can be put together on

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			poster board and felt board. 4. Make chart of DNA and RNA and interrelations between the two. 5. Prepare transparency on movement of RNA.
18. Identify Gregor Mendel as the Father of Heredity and describe his laws of inheritance.	Laws of inheritance	Communicating inferring, experimenting	1. Use bulletin board on Mendel's accomplishments. 2. Canvass the classes to determine the number of students with the following traits: a. Tongue roller or nontongue roller b. TPC taster and nontaster c. Attached ear lobes and unattached ear lobes Determine from statistics which are dominant and recessive. 3. Use brown plastic chips to represent dominant brown color of some organisms and clear chips to represent recessive white color of other organisms. Place equal numbers of chips in cups and take one chip from each cup to compare genetic makeup and color of offspring. 5. Solve problem involving monohybrid, dihybrid crosses and sex-linked traits.
19. Differentiate x chromosomes from y chromosomes.	Sex determination	Observing, communicating, predicting, interpreting data	Diagram a cross between male (xy) and female (xx) using a punnett square.
VI. SCIENTIFIC BASIS OF CLASSIFICATION			
20. Recognize and describe Linnaeus' contribution to taxonomical nomenclature (genus-species naming).	Binomial nomenclature	Communicating	1. Give examples of genus and species: names of house cat, lion, dog, wolf, and man.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			2. Select an organism (man, dog, cat) and give its classification from kingdom to species. 3. Group shapes using nuts and bolts, a deck of cards, etc.
VII. FUNCTIONING ORGANISM			
21. Compare and contrast the structure and function of algae.	Algae function and structure	Observing, inferring, communicating, classifying	Observe samples of algae with the microscope. Filmstrip: Algae..
22. Distinguish the three basic shapes of bacteria.	Bacterial shapes	Observing, classifying, experimenting	1. Use microviewers and microslides to view the three forms of bacteria. 2. Have students make a bean infusion to strain and examine the three forms of bacteria. 3. Make diagrams and illustrations of the three forms of bacteria. NOTE: Technique in handling bacteria should be stressed.
23. Describe the groups of protozoans based on their structures for food getting and locomotion.	Protozoan locomotion and food-getting	Observing, experimenting, communicating, inferring	1. Microviewers and microslides of protozoa. 2. Culturing protozoans such as paramecium and euglena. 3. Observation of web mounts under the microscope. 4. Diagram or transparency to compare euglena with other protozoans.
24. Compare vascular and nonvascular plants.	Conduction in plants	Observing, classifying, inferring, predicting	Have students examine nonvascular plants (mosses) and vascular plants (ferns and others).
25. Classify vascular plants as conebearing and flower-producing seed plants.	Angiosperms and Gymnosperms	Observing, inferring, classifying, communicating, predicting	Given pictures of angiosperms and gymnosperms, explain reproduction of pine seeds as mature ovules.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
26. Identify the three main parts of a plant as the root, stem, and leaf.	Plant organs	Observing, classifying, communicating	Examine different plants to determine root, stem and leaf.
27. Define the main function of the root to be the absorption of water and minerals from the soil.	Function of roots	Observing, experimenting, inferring, defining operationally	Observe root hairs on radish seeds or corn seeds.
28. Distinguish between the two types of plant stems (woody and herbaceous).	Types of stems	Observing, classifying	Examine woody and herbaceous stems.
29. Identify xylem as the conducting tissue that transports water and minerals up to the stem and phloem as the tissues used to transport food down the stem.	Conduction in stems	Observing, classifying, inferring	Draw and label a cross section of both a monocot and dicot stem.
30. Define the main function of the leaf to be the production of food.	Function of a leaf	Experimenting, communicating, observing, formulating hypotheses, predicting	Conduct a starch test on a variegated leaf or a leaf that has a section covered for several days.
31. Explain that moisture control in plants is regulated by the leaves.	Transpiration	Observing, inferring, predicting	Examine pictures, slides, or microview slides of a cross section of leaf and identify stomate.
32. Identify the most distinguishing characteristics in lower and higher invertebrates (Coelenterates, mollusks, echinoderms, annelids, and arthropods).	Invertebrates and vertebrates	Observing, classifying, experimenting, inferring, interpretating data, communicating	Labs: 1. Feeding behavior in hydra. 2. Dissection of the earthworm. 3. Regeneration in planaria 4. Microscope slides on worms. 5. Dissection of crayfish. 6. Films: a. Coelenterates b. Mollusks c. Echinoderms d. Annelids e. Arthropods

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			7. Practical examination on specimens studied.
33. Describe the characteristics unique to each group of vertebrates (mammals, reptiles, fish, birds, and amphibians).	Vertebrates	Observing, classifying, experimenting, inferring, communicating	Labs: 1. Dissection of frog. 2. Dissection of fetal pig. 3. Films: a. Mammals b. Reptiles c. Fish d. Amphibians e. Birds 4. Practical examination on frog and fetal pig.
VIII. HUMAN ANATOMY AND PHYSIOLOGY			
34. Compare and contrast endoskeleton as opposed to exoskeleton.	Skeletal system	Observing, classifying, inferring	Using pictures of selected invertebrates with exoskeletons and pictures of vertebrate organisms, draw a chart listing similarities and differences.
35. Identify types of muscles as voluntary and involuntary.	Voluntary and involuntary muscles	Inferring, predicting, observing, formulating hypotheses	1. Shine light on pupil of eye and note results. Remove light and note results. 2. List all human functions that are controlled automatically by muscles. 3. Tap knee cap and note results.
36. Name the necessary nutrients in the diet and tell why they are necessary. a. Carbohydrates b. Fats c. Proteins d. Minerals e. Vitamins f. Water	Essential nutrients	Communicating, inferring, observing, experimenting, controlling variables, formulating hypotheses	1. Test foods for sugar, starch, proteins and fats. a. Sugar--Benedict's or Fehlings solution b. Starch--Iodine c. Proteins--HNO_3 or Millon's solution d. Fats--brown paper or Sudan IV 2. Display a bulletin board on balanced diet. 3. Keep record of foods for a week and calculate caloric content or type of food.

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
37. Match the organs below to the digestive system: a. Mouth b. Stomach c. Small intestine d. Large intestine	Digestive system	Classifying, inferring, experimenting, observing	1. Use diagram and/or transparency to outline digestive system. 2. Dissect frog or earthworm. 3. Use human torso models. 4. View films and filmstrip on digestion.
38. Distinguish between an open and a closed circulatory system.	Circulatory system	Classifying, observing, inferring	1. Explore open circulation in a grasshopper vs. closed in an earthworm or man. 2. Dissect crayfish or grasshopper and compare to dissection of earthworm to review both types.
39. Explain the function of blood.	Function of blood	Observing, communicating	1. Centrifuge blood and examine for red blood cells, white blood cells, and plasma. 2. Prepare blood smear. 3. Obtain prepared slides of blood smears and identify red blood cells and white blood cells.
40. Recognize the four basic blood types in humans.	Blood types	Experimenting, predicting, observing, inferring	Hold a blood typing lab. (It is advisable to obtain parental consent.)
41. Identify three types of blood vessels: a. Veins b. Arteries c. Capillaries	Blood vessels	Experimenting, predicting, formulating hypotheses, interpreting data	1. Observe capillaries in the tail of a goldfish. 2. Determine the rate of heart beat in humans. 3. View films and filmstrip on circulation.
42. Define the skin as an organ used to regulate body temperature and to expel wastes.	Excretory system	Observing, communicating, using numbers, experimenting, formulating hypotheses	1. Use wall chart, diagram (handout), and transparency to explain how blood vessels regulate temperature 2. Place arm in plastic bag and

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
			secure rubber band. Note appearance after 3 minutes. 3. Conduct an activity using dry palms; paint palms with iodine, allow to dry. Expose palms to heat for 5 minutes and blot carefully with paper towel. Remove and examine density of dots. 4. Examine a model of the skin.
43. Explain the function of the kidney as a blood filter and homeostatic mechanism.	Excretory system	Observing, communicating, experimenting, inferring	1. View a kidney model to show the anatomy of the human excretory system. 2. View transparencies, filmstrips, and films on the functioning kidney. 3. Make a field trip to hospital to observe dialysis machine. 4. Invite a resource person from hospital or medical center to discuss kidney transplants and how kidney machine works. 5. Dissect a kidney. Kidneys may be obtained from supermarket or slaughter house.
44. Explain the function of the respiratory system.	Respiratory system	Observing, communicating, experimenting, defining operationally	1. Label a diagram of the human respiratory system. 2. Employ transparencies, models, wall charts, etc., then discuss the parts of respiratory system.
45. Identify the parts of the nervous system and the parts of the brain in higher animals. Parts of the nervous system: 1. Brain 2. Spinal cord 3. Nerves	Nervous system	Observing, experimenting, communicating, predicting, formulating hypotheses, interpreting data	1. Examine charts and models. 2. Examine prepared slides on neuron using the microscope. 3. Dissect a sheep's brain. 4. View film, transparencies, and filmstrips on nervous system. 5. Have the student write his/her name 10 times. Measure the amount of time it takes. Now

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
Parts of the brain: 1. Cerebrum 2. Cerebellum 3. Medulla oblongata			switch hands and repeat the procedure.
46. Recognize that the endocrine system is a master control system for long term control of body systems.	Endocrine system	Referring, communicating, classifying	Student handout of human silhouette on which student draws endocrine glands in approximate location.
47. *Label the basic anatomy of the male reproductive system and know the function of each. Specific: Testes, scrotum, prostate, semen, penis.	Reproductive system	Observing, communicating, inferring	1. Use visual aids (transparencies, posters, drawings). 2. BSCS special materials has an excellent program (individualized instruction). 3. Label the parts and list the function of each male part.
48. *Identify the basic anatomy of the female reproductive system and know the function of each. Specific: Ovary, fallopian tubes, uterus, vagina.	Reproductive system	Observing, communicating, inferring	1. Films - local systems decide 2. Film loops - local systems decide 3. Model of pelvis showing anatomy 4. Model of reproductive system
49. *Define specific events that occur during the menstrual cycle: ovulation; purpose of uterine lining increasing in thickness; when ovulation occurs what happens (approximately) if fertilization does not occur?	Menstrual cycle	Communicating, inferring	1. Transparencies, charts 2. BSCS special materials has an excellent program (individualized instruction).
*The committee on CBE minimum standards agrees that human reproduction should be included in the curriculum. However, in light of legislative action taken in 1979, these materials should be developed by the local school system.			

COMPETENCY/PERFORMANCE OBJECTIVE	CONCEPT	PROCESS SKILLS	SUGGESTED ACTIVITY
VIX. ECOLOGY			
50. Analyze the interrelationships of a community specifically to identify food chains and energy pathways, food webs, interactions of environmental factors.	Communities	Communicating, defining operationally, inferring	1. Communities that can be sampled: an inch of soil, a log, playground, sidewalk or pavement 2. Films and/or filmstrips 3. Pictures of communities 4. Feature food webs and chains 5. Identification and discussion of features which affect the ecology of a given area

REFERENCE MATERIAL

Textbook Reference List:

1. Anderson, N., et al. Biological Science: An Ecological Approach. Boston: Houghton Mifflin, 1982.
2. Bauer, P., et al. Experiences in Biology. River Forest, Illinois: Laidlaw, 1981.
3. Creager, J.; Jantzen, P.; and Mariner, J. Macmillan Biology. New York: Macmillan, 1981.
4. Oram, R.; Hummer, P.; and Smooth, R. Biology: Living Systems. Columbus: Chas. E. Merrill, 1979.
5. Otto, J.; Toule, A.; and Bradley, J. Modern Biology. New York: Holt, 1981.
6. Slesnick, I., et al. Scott, Foresman Biology. Glenview, Illinois: Scott, Foresman, 1980.
7. Smallwood, W., and Alexander, P. Biology. Morristown, New Jersey: Silver Burdett, 1977.
8. Weinberg, S. Biology: An Inquiry Into the Nature of Life. Boston: Allyn and Bacon, 1977.
9. Weinberg, S. Biological Science: An Inquiry Into Life. 4th Edition. Boston: Harcourt, 1980.

AUDIOVISUAL SUPPLIERS

The audiovisual materials suggested in the curriculum guide can be obtained from the following suppliers:

Association Instructional Materials
347 Madison Avenue (Department DC)
New York, New York 10017

BFA-Ealing Corporation
2211 Michigan Avenue
Post Office Box 1795
Santa Monica, California 90406

BFA-Educational Media
2211 Michigan Avenue
Post Office Box 1795
Santa Monica, California 90406

Beckman Instruments Inc.
Attention: New Dimensions
2500 Harbor Boulevard
Fullerton, California 92634

Coronet Films
65 East South Water Street
Chicago, Illinois 60601

Education Audio-Visual Inc.
Pleasantville, New York 10570

Encyclopaedia Britannica
Educational Corp.
425 North Michigan Avenue
Chicago, Illinois 60611

Inquiry Audio Visuals
1754 West Farragut Avenue
Chicago, Illinois 60640

International Communication Films
1371 Reynolds Avenue
Santa Ana, California 92705

John Wiley and Sons, Inc.
605 Third Avenue
New York, New York 10016

Kalmia
Department C1
Concord, Massachusetts 01742

Lansford Publishing Co.
Post Office Box 8711
1088 Lincoln Avenue
San Jose, California 95155

McGraw-Hill Films
CRM/McGraw-Hill
110 15th Street
Del Mar, California 92014

Modern Learning Aids
1212 Avenue of the Americas
New York, New York 10036

Harper and Row Media
10 East 53rd Street
New York, New York 10022

Holt, Rinehart, and Winston, Inc.
383 Madison Avenue
New York, New York 10017

Indiana University
Audio-Visual Center
Office for Learning Resources
Bloomington, Indiana 47401

Prentice Hall Media
Servode HC236
150 White Plains Road
Terrytown, New York 10591

Scholarly Audio-Visuals Inc.
5 Beekman Street
New York, New York 10038

Science Software Systems Inc.
11899 West Pico Boulevard
West Los Angeles, California 90064

Shell Oil Film Library
1433 Sadlier Circle W. Drive
Indianapolis, Indiana 46239

Modern Talking Picture Service
2323 New Hyde Park Road
New Hyde Park, New York 11040

Peter M. Robeck and Company
230 Park Avenue
New York, New York, 10017

James J. Ruhl and Association
Post Office Box 4301
Fullerton, California 92631

Thorne Films
1229 University Avenue
Boulder, Colorado 80302

Universal Education and Visual Arts
100 Universal City Plaza
Universal City, California 91608

Westwood Educational Productions
701 Westport Road
Kansas City, Missouri 64111

Sutherland Educational Films
201 North Occidental Boulevard
Los Angeles, California 90026

Since these materials vary from quite simple to complex, teachers are urged to preview materials before presenting them to the class.

EVALUATION TECHNIQUES

Methods for evaluating pupils' achievement and progress are an integral part of the instructional program. Evaluation techniques must reflect (1) the objectives to be reached, and (2) the activities employed to reach those objectives. Since the objectives are stated clearly, the method of evaluation is indicated within the objective. The objectives are stated in behavioral terms, the process skills are identified, and suggested activities are listed. Thus, it is clear what the student is expected to be able to do after successful completion of a learning activity. The successful attainment of an objective can be demonstrated by having the student do specific things which can be observed.

Therefore, evaluation should consist of more than just paper and pencil tests on recall of factual knowledge. A variety of evaluation activities should be used.