LEARNING TO INVESTIGATE
A PROPOSED CURRICULUM GUIDE FOR SEVENTH GRADE LIFE SCIENCE

A PROFESSIONAL PAPER

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BY

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We hereby recommend that the Professional Paper prepared under our supervision by Shirle Holder Pace entitled LEARNING TO INVESTIGATE-A PROPOSED CURRICULUM GUIDE FOR SEVENTH GRADE LIFE SCIENCE

be accepted as fulfilling this part of the requirements for the Degree of Master of Science in Science Education.

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INTRODUCTION

This curriculum guide was prepared to suggest areas of emphasis for a Seventh Grade Life Science course. The materials in this guide are based upon a recent survey of time distribution for Sixth Grade Science study in Garland, Texas (see appendix 1). The areas which appeared to have been briefly introduced in the Sixth Grade were considered as the areas for emphasis for this curriculum guide. However, each teacher should choose activities appropriate for his or her students. These activities may be determined with the help of Vitrogan attitude scale (see appendix 2).

Another purpose of the guide is to make available to Life Science teachers (especially those with an inadequate science background) a curriculum which can be used with a minimum of research. Within each unit of study are suggested student and teacher activities which utilize the inquiry method, discovery method, and process approach, closely following the content of current textbooks.

A third purpose for this curriculum guide was to compile a reference list which gives laboratory and projects' plans and procedures available in the Dallas County area.

CLIMATE OF THE CLASSROOM

WHY USE THE INQUIRY METHOD

As a result of recent research (Stewart, 1970) into the status of the science curriculums, programs, and student activities in the public secondary schools of Texas the following conclusions and recommendations were made:

1. Greater attention should be placed on newer systems of teaching such as the inquiry and laboratory approach.
2. A greater variety of teaching materials and aids would enrich the science classrooms of Texas secondary schools.
3. Science instruction could benefit greatly from more flexible scheduling of classes, allowing more time for open-ended experiments and student research projects.

Some researchers suggested that students in an inquiry program learned the important core of information of the traditional, plus the new updated knowledge in the course with inquiry methods. It was also presumed that the students retained better understandings for a longer period of time as a result of being in an investigative program (Lisonbee and Fullerton, 1964). A guiding principle of new programs is to treat science as systems of inquiry, and to present phenomena directly through experiences in the laboratory, in the field, in the classroom, and by film and television. The laboratory is used to encourage students to discover ideas and to adopt some views and processes employed in real scientific investigations (Wolfe, 1970).

The trends in Science Education in curriculum development for Grades K-9, as presented by Philip G. Johnson (Wolfe, 1970) are toward:

1. Less subject matter.
2. Many unstructured instructional methods.
3. The use of more books.
4. Emphasis on how to discover knowledge.
5. Student skill in inquiry as a teaching goal.
6. Concepts that arise in confirming and rejecting hypotheses.
7. Use of the term "science," rather than "general science."
8. Stress on making and recording quantitative observations.
9. Use of films that report one or more experiments.
10. Experience planned for the basic education of all students.
11. Science as something that grows out of investigation.
12. Science built on mathematics.

Through review of the above studies and many other related articles, the most productive climate for any classroom would seem to be based on science as a process, with empahasis on the inquiry method. Using current trends with an individualized approach, the teacher should be able to assist each student to focus and maintain interest in areas of science that appeal to him. Using inquiry, process, and discovery methods in addition to traditional methods of learning should increase the problem-solving ability of the students, and better prepare them for real-life situations (Burns and Ellis, 1970).

LIFE SCIENCE-GRADE SEVEN

UNIT TOPICS

I. Methods and Processes — Suggested Time: 15-20 hours

A. Material from text:

Focus on Life Science-Chapter One; Appendix A

Interaction of Man and the Biosphere-Section One; Appendix A; Appendix C

B. Sketch of Content

The Methods of Science

Getting Started in the Laboratory

Laboratory Safety

Forming a Good Question

Tools of the Scientist

Learning to use the Microscope

Measurement and the Metric System

Inquiry and the Aquarium/Terrarium

Concepts and Objectives	Suggested Activities	Suggested Materials
To introduce scientific methods, emphasizing science as inquiry	Discussion of scientific methods.	Heimler, Charles H., <u>Focus on Life Science</u>, Columbus: Charles E. Merrill Publishing Company, 1969, pp. 4 and 5.
To enable students to identify: Experimental group, control, variable, purpose, and some procedures	Laboratory: Testing the effects of crowding on living things (by counting the average number of tail flicks per minute of different numbers of common goldfish in gallon jars).	Berger, Eric, Directorial Editor: <u>Science World Scholastic Magazine</u>, October 26, 1970, pp. 28-29.
	Laboratory: Student preparation of hay infusion for examination of organisms at a later date.	Abraham, Norman; Beidleman, Richard G.; Moore, John A.; Moores, Michael; Utley, William J., <u>Interaction of Man and the Biosphere</u>, Chicago: Rand McNally and Company, 1970, p. 9.
For students to learn the necessity of working with safety	Class discussion of composite of safety rules for the laboratory.	Sprinkle, John P., Coordinator; Funk, Donald E.; Koepke, John F.; and Mills, Royal B., Jr.,

		Biology-To study Life, A Laboratory Manual, Corpus Christi School District, 1967, pp. 3-7.
To have the student view the laboratory as an area where the process of science can best be carried out by learning the proper use of equipment	Use of role-playing to act out some common accidents and the proper first aid procedures.	Sprinkle, et al., pp. 3-7.
To help students see the value of forming a good question	Students should draw two straight parallel lines on tracing paper and place this over a figure of straight lines radiating from a central point. Many types of questions should be asked about the figure and lines, having students record their answers (data). Students should decide which questions are easiest to investigate.	Rasmussen, Frederick A.; Holobinko, Paul; and Showalter, Victor M., Man and the Environment, New York: Houghton Mufflin Company, 1971, pp. 4-6.
To help students learn to ask investigable questions about events they experience	Two groups of students, equal in number, compare the number of words they can memorize from a list. (Unknown: in one list, the first letter of each word spells "basketball.") Have each student taste a glucose test-paper; then record the results. In each case, the students should form the questions and investigative proce- they could use to explain their activities.	Rasmussen, et al., pp. 7-8.

To provide students with continued practice in investigative exercise	Investigations of five unknown substances, to find out which ones are alive.	Abraham, _et_ _al_., pp. 14-15.
To introduce the microscope as one tool of the scientist, and assist students in successfully learning its uses	Teacher gives demonstration of the procedure for using the microscope, with students' practice immediately following the demonstration.	Gerdes, Raymond A.; Burkett, Ray D.; and Hupp, Eugene W., _Laboratory Exercises in Biology_, Dubuque, Iowa: Kendall-Hunt Publishing Company, 1969, pp. 2-3.
	Demonstrate how to properly make a wet mount, and check student's products.	Tortora, Gerard J.; Donald R. Cicero; and Howard I. Parish, _Plant Form and Function in the Laboratory_, Toronto: The MacMillan Company, 1970, pp. 4-5.
To introduce the metric system of measurement as a scientific system of measurement	Teacher demonstration of metric measures and their uses. Question students as to their knowledge of the history of the metric system and its progress in the United States.	Heimler, _et_ _al_., pp. 18-21. "Metric Units of Measure," pamplet by Metric Association, Inc., 1970

	Students could measure several objects using the metric units of length, volume, and mass. For example, books, desk, the amount of liquid in an unmarked container, a door, or a window. (Basically, all conversions should be from metric to metric.)	Abraham, <u>et</u> <u>al</u>., Appendix C. <u>Metric</u> <u>Chart</u>, Curtin Scientific Company, #4081D, 1967 Catalog, Dallas, Texas, p. 37.
To provide students with a source of information about interactions within an ecosystem	The teacher could demonstrate a room aquarium, having students list the physical and biological components.	Abraham, <u>et</u> <u>al</u>., Teacher Guide, pp. 13B-13D.
To provide students with continued practice in recording and analyzing data	Students should record and comment on any changes that occur in the aquariums during the semester.	Aquarium Handbooks, <u>Fin</u> <u>Facts</u>, Long Island City: Wardly Products Company, Inc.
	A gallon jar and assortment of materials should be made available for each laboratory group to construct their idea of an "ecosystem."	<u>Handbook and Catalog for Aquarium Hobbyists</u>, Volume I, Number 3, Brooklyn: Halvin Products Company, Inc., 1969. Cobbett, William K., "BSCS Special Materials Really Work," <u>The American Biology Teacher</u>, Volume 32, Number 7, (October, 1970), pp. 415-417.

Lesser, Milton S., <u>Life Science-Intermediate Level</u>, New York: Amsco School Publications, Inc., 1968, p. 51.

Heimler, pp. 32-33.

Film: "Life in an Aquarium," #682, color, 16mm, Dallas County Film Library, 14 minutes.

Teacher demonstration of a terrarium. Class groups set up and maintain a class terrarium. Students should keep a record of changes and events that occur within the terrarium.

Abraham, et al., Appendix D.

Zoology Manual, Natural Science Merit Badge, New Jersey: National Office, Boy Scouts of America, 1966, p. 64.

II. Matter and Energy

Suggested Time:
5-10 hours

A. Material from text:

Focus on Life Science-Chapter Three

B. Sketch of Content

Classification of Matter

Temperature

Physical and Chemical Changes

Symbols and Formulas

Atoms

Chemical Bonds

Concepts and Objectives	Suggested Activities	Suggested Materials
To help students understand the nature of science by providing them with investigative practice	Provide each group with one teaspoon, each of sand, brown sugar, powdered yeast, radish seeds, and table salt. Sugar and molasses solutions, magnifiers, soil, and water are available with containers to test each substance to see if it is alive. Students keep charts of predictions and conclusions.	Abraham, pp. 14-15.
To show the importance of temperature to living things	Place small pieces of foods in areas of varied temperature. After a few days, check the state of each and record results. (A chart or transparency to contrast the temperature scales as given in Heimler is useful.)	Heimler, pp. 57-58.
	Sugar solutions could be made with the water at various temperatures. A record should be kept of the time required in each case for the sugar cube to dissolve, and at which temperature water will dissolve the largest number of sugar cubes.	Navarra, John G.; Zafforoni, Joseph; and Garone, John, <u>Today's Basic Science</u>, Harper and Row, Evanston, Illinois, 1965, p. 238. Film: "Simple Changes in Matter," #762.

		Dallas County Film Library, 15 min.
To acquaint students with the classification of elements, and the order in which they are studied	A periodic chart of the elements can be used to point out certain "families" of elements.	Curtin Scientific Company, #4080, 1967 catalog, p. 37.
	After a discussion of atoms and their imagined structure, students could construct Bohr models of different atoms from beads, wire, and marbles. Drawings should be recorded in their notebooks. Bonding can be shown with two wires through one or more beads.	Heimler, pp. 64-69.

III. Interaction of Environment and Living Things (Emphasis on Plants)

Suggested Time: 20-30 hours

A. Material from text:

<u>Focus on Life Science</u>-Chapter Two, Chapter Nine, Chapter Ten, and Chapter Fourteen

<u>Interaction of Man and the Biosphere</u>-Section Two

B. Sketch of Content

Light and the Green Plant

Light and the Euglena

Comparing Cells

Plant Growth

Energy and the Ecosystem

Concepts and Objectives	Suggested Activities	Suggested Materials
To introduce the green plant as the site of starch production	The leaves of geranium plants that have been in different conditions for several days could be tested for starch content.	Abraham, *et al.*, pp. 25-27.
	Or, cover some leaves on one plant and then test both covered and uncovered leaves for starch. Students should sketch "before and after" pictures in notebooks.	Heimler, pp. 200-201.
To show how the green plant is important in the interaction of living things and their environment	Place an elodea plant under an inverted funnel and test tube in a beaker containing sodium bicarbonate solution. Place some plants in dark and others in a strong light. Test for oxygen with a glowing splint after several hours.	Heimler, pp. 30-31.
	Students should record all data and conclusions in their notebooks.	
To help students learn the role of carbon dioxide in an environment, and to strengthen the concept of confidence in an experiment which contains a control	Two starved geranium plants could be placed in a window. A bell jar over one plant would also cover two (200 ml) jars or beakers of solid sodium hydroxide. After a few days, a leaf from each plant would be tested for starch content.	Heimler, p. 200. Abraham, *et al.*, pp. 30-31.

To provide continued practice in the manipulation of laboratory equipment	A manometer, potassium hydroxide, and a choice of organisms should be provided for each laboratory group. A change in air pressure should be indicated as the organism uses some of the gas in the container. Students should devise their controls and predict the outcome of the experiment.	Rasmussen, *et al.*, pp. 91-93.
	Chlorophyll could be removed from leaves by boiling them in alcohol for use in a chromatography demonstration.	Heimler, pp. 201-202.
To present a brief comparison of plant and animals cells	Elodea cells and cheek cells can be compared on wet mounts under the microscope. Drawings of each with characteristics noted should be recorded in the student's notebook.	Abraham, *et al.*, pp. 42-43.
	Some Euglenas could be secured to demonstrate their reaction to light.	Rasmussen, *et al.*, pp. 129-130.
To demonstrate the effects of different portions of the white light spectrum on the growth of green plants	Cardboard boxes could have a cut-out window on each side covered with various colors of cellophane covering the window to vary the color of light reaching a young bean or pumpkin plant placed inside each box. Each plant should be a certain distance from a light bulb, and each should receive the same amount of water daily.	Heimler, p. 213. Rasmussen, *et al.*, pp. 145-148.

To demonstrate the effects of gravity on root growth	Radish seeds will sprout on a blotter between two slides standing in a dish of water. After the roots are one inch long, reverse the top and bottom and check the roots again in a few days.	Fitzpatrick, Frederick L., and Hole, John W., <u>Modern Life Science</u>, New York: Holt, Rinehart, and Winston, Inc., 1970, p. 263.
To provide continued investigation into factors affecting plant growth	Various seeds could be planted in different types of soil, and at different depths. Records of what happens could be recorded daily in student notebooks.	Fitzpatrick and Hole, p. 259.
To present the green plant as the producer in various ecosystems	Photos of different regions which show the vegetation of each region could be studied by the students. They should list all possible physical factors affecting the plant growth in the area and the types and numbers of plants shown.	Abraham, <u>et al</u>., pp. 43-46.

IV. Interaction Within an Organism Suggested Time: 5-10 hours

A. Material from text:

Focus on Life Science-Chapter Four

Interaction of Man and the Biosphere-

Section Three

B. Sketch of Content

Digestive System of the Frog and Pig

A Model Cell

Converting Foods to Energy

The Role of Enzymes, Temperature, and

Surface Area

Concepts and Objectives	Suggested Activities	Suggested Materials
Overall Objective:		
To introduce digestion as an interaction within an organism		
To acquaint students with the anatomy of lower animals and some procedures of dissection	Preserved frogs and perhaps a pig embryo could be dissected and stored from year to year for re-examination by students. New specimens are needed to demonstrate the dissection. If possible a live specimen should be secured and double pithed just before class so that the heart will remain beating after dissection.	Abraham, _et al_., pp. 48-52.
To introduce diffusion and osmosis as physical factors affecting interactions within an organism	Osmosis could be demonstrated using molasses solution in a thistle tube with a semi-permeable membrane over the large opening fastened with rubber bands. Suspended in a beaker of water, the level of the molasses would rise to show diffusion had taken place.	Fitzpatrick and Hole, pp. 122-123. Heimler, pp. 101-103.
	Osmosis may be shown in living membranes using the carrot root (containing sugar solution) suspended in a beaker or jar.	Fitzpatrick and Hole, pp. 123-124.

	Plasmolysis may be seen by putting a chip of potato in plain water, and one in salt water.	Heimler, pp. 102-103.
	A model cell could be constructed to test whether starch or sugar can pass through a cell membrane.	Abraham, _et_ _al_., p. 56.
To present some activities which demonstrate the processes involved in changing food to energy	Students could test starch solutions that may or may not contain saliva for starch and sugar. Starch digestion could be tested at various temperatures. Students should continue to record all results.	Abraham, _et_ _al_., pp. 60-61, 63.
To introduce the role of enzymes, temperature, and surface area	Digestion in the small intestine can be studied using Mett's tubes of cooked egg white, pancreatin solution, and two small pieces of lard. This would demonstrate the areas of digestion for fat and protein.	Abraham, _et_ _al_., pp. 67-68.
	To demonstrate the role of surface area, two dialysis membrane tubes of different lengths containing IKI solution could be placed in gallon jars of starch solution. The students should decide why the length of the membrane makes a difference, and how this relates to the surface area of the small intestine.	Abraham, _et_ _al_., Teacher Guide, pp. 70A-70B.

V. Transportation in an organism

Suggested Time: 5-10 hours

A. Material from text:

<u>Focus on Life Science</u>-Chapter Five

<u>Interaction of Man and the Biosphere</u>-Section Four

B. Sketch of Content

Pulse Rate

Circulatory System of a Frog and a Pig

Circulation in a Goldfish

The Human Circulatory System

Transport in Plants: Roots, Capillary Action, and Surface Area

Concepts and Objectives	Suggested Activities	Suggested Materials
To introduce students to some likenesses and differences in the anatomies of lower and more complex animals	Students can count each other's pulse rate during various activities and while at rest.	Abraham, <u>et</u> <u>al</u>., pp. 81-82.
	The previously dissected frogs could be re-studied with concentration on the heart and the circulatory system.	Abraham, <u>et</u> <u>al</u>., pp. 83-85. Heimler, pp. 80-83.
	Circulation could be observed in the tail of a goldfish, comparing the sizes of a red blood cell to the size of a capillary.	Heimler, p. 82.
	The heart of a frog and a chicken (or perhaps a beef heart) could be dissected to study differences in construction, followed by a discussion of hearts of invertebrates, fish, birds, and mammals.	
	A model of the heart is useful in learning the names of the parts of the heart and the path of circulation. A clear plastic toy device will pump red liquid in proper directions by use of a rubber bulb for a pump.	Heimler, p. 302.
	Students could prepare a report on heart transplants and artificial hearts and blood vessels.	

To provide students an opportunity to study root structure and function	Germinating radish or tomato seeds can be studied for area of greatest growth on a root, and the increased surface area provided by root hairs.	Abraham, et al., p. 88. Heimler, p. 187.
To provide students an opportunity to study stem structure and function	Celery can be split lengthwise half-way through a stem, with the base of one stem standing in dye solution and the other half in salt solution. Cross-sections of these and other stems could be studied, as well as prepared slides.	Abraham, et al., pp. 90-92. Fitzpatrick and Hole, pp. 167-169. Heimler, pp. 187-188; 190.
	Capillary tubing may be used with colored water to simulate transport in stems.	Abraham, et al., Teacher Guide, pp. 94C-94E.
To provide students an opportunity to study leaf structure and function	Prepared slides of a cross-section of a leaf should be studied to learn the various parts and their functions.	Heimler, pp. 192-193.
	Surface area and evaporation relation-ships can be shown with "leaves" of paper and "stems" of capillary tubing.	Abraham, et al., Teacher Guide, pp. 94F-94G.
	A photometer could be devised and used to make tests of various conditions involved in water loss in plants.	Rasmussen, et al., pp. 158-165.

VI. How Food is used and affected by Other Organisms

Suggested Time: 10-15 hours

A. Material from text:

<u>Focus on Life Science</u>-Chapter Twelve, Chapter Thirteen, and Chapter Twenty-Two

<u>Interaction of Man and the Biosphere</u>-Section Five

B. Sketch of Content

Nutrients in Food

Energy from Food

Why Food Spoils

Ways to Control Spoilage

Bacteria and Viruses

Concepts and Objectives	Suggested Activities	Suggested Materials
To introduce students to the concept of a calorie	Students could calculate the number of calories required to raise the temperature of different volumes of water for differing numbers of degrees C.	Abraham, _et al._, pp. 98-99.
To present a method for measuring the number of calories in different foods	The approximate number of calories in different foods can be measured by using coffee-can calorimeters and small samples of adolescent favorite foods.	Abraham, _et al._, pp. 100-104. Heimler, pp. 449-451.
To help students find advantages and disadvantages in decomposition due to microbial action	Two small squares of hamburger could be tested for spoilage by placing each in a small amount of water, boiling only one and testing for microorganisms afterwards. Students could interview grocery, meat, and produce managers for information on avoiding spoilage.	Rasmussen, _et al._, pp. 211-213.
	Several small piles of various types of garbage could be buried in wet soil, left for several days, then removed to determine which substances will decompose and which ones will not decompose.	Rasmussen, _et al._, pp. 216-217.
To introduce students to some organisms responsible for spoilage	The hay water could again be studied with emphasis on the types of bacteria found therein. Also, prepared slides	Heimler, p. 233.

	of all shapes of bacteria should be studied with students making sketches for a record of each type.	
To acquaint students with methods of studying and identifying microorganisms	Students could grow mold and bacteria on agar in petri dishes, testing the affects of different substances on the growth of microorganisms.	Rasmussen, *et al.*, pp. 236-243. Fitzpatrick and Hole, pp. 388-392.

VII. Human Biology — Suggested Time: 15-20 hours

A. Material from text:

<u>Focus on Life Science</u>-Chapter Fifteen, Chapter Sixteen, Chapter Seventeen, and Chapter Eighteen

B. Sketch of Content

Organs and Systems

Respiration, Excretion, and Digestion

The Nervous System

Concepts and Objectives	Suggested Activities	Suggested Materials
Overall Objective: To help students learn some of the biological concepts related to the structure and function of the human body		
To familiarize students with their respiratory system	The amount of air a person's lungs will hold can be measured by exhaling into an inverted bottle containing a measured amount of water. Each student should record the volume of water he displaced.	Heimler, p. 283.
To familiarize students with the structure and function of the human skeletal system	If a model of a skeleton is not available, store toy departments often carry plastic models which are helpful to students.	Heimler, p. 285.
	Students could cite cases of injuries involving torn or sprained ligaments and tendons.	
	A teacher demonstration could be performed to dissolve minerals in a bone by soaking it in dilute HCl for several days.	Heimler, p. 286.

	A fresh bone may be baked to remove water, and therefore, weight. Or, the bone could be sawed lengthwise and students could label the parts.	Heimler, p. 287.
To present to students a comparison of voluntary and involuntary muscles	Students could blink their eyelids to show voluntary control of muscles, then record the length of time that each could refrain from blinking to show involuntary control of muscles.	Heimler, p. 289.
To introduce students to some of the physical properties of protoplasm	With a supply of unflavored gelatin to simulate protoplasm, students could first make observations on the gel state, then add an equal amount of water, stir, and observe protoplasm in the colloidal state.	Heimler, p. 291.
To re-emphasize the cell as the basic unit of structure and function in living things	A colored transparency of a model cell drawing, similar to the sketch in <u>Modern Life Science</u>, Chapter Three, is useful for learning the parts of a model cell.	Fitzpatrick and Hole, p. 41.
	Plant cells could be again contrasted to animal cells with a sketch similar to the one above, but definitely of a plant cell.	Fitzpatrick and Hole, p. 48.
To relate the varying structure of different cells of the body to their functions	Students could study prepared slides, or clear drawings of specialized body cells, relating structure and function also, they could contrast body cells to a non-specialized cell such as an amoeba.	Heimler, p. 292.

To relate the heart-beat to the amount of muscular activity	The pulse of each student should be taken, averaging the boys and the girls separately. After rapid exercise, the pulse rate could be averaged again.	Heimler, p. 304.
To help students learn some activities of the blood	A drop of blood on a slide could be observed under a microscope while distilled water is added. Students should relate the resulting burst cells to osmotic pressure.	Heimler, p. 313.
	A drop of blood on a slide could have a needle drawn through every half minute. Students should measure the time it takes for clotting to begin.	Heimler, p. 317.
	Glass tubing, a gallon jar, with the bottom removed, balloons, and rubber sheeting can be used to construct a "lung bottle" to demonstrate the physics of breathing.	Fitzpatrick and Hole, p. 323.
To acquaint students with some of the processes of digestion	Soda cracker could be tested first with Iodine and Benedict's solution; chewed and the tests repeated. Students may be able to name the enzyme responsible for the conversion.	Heimler, p. 334.
	Sodium bicarbonate and bile salt could each be added to mixtures of olive oil and water, mixed, and observed for students' conclusions.	Heimler, p. 337.

To acquaint students with reflex acts and habits as controlled by the nervous system	Students could observe each others eyes to note the reaction of pupils to changes in light exposure.	Heimler, p. 352.
	Students could clap their hands in front of each other's eyes to see if anyone could prevent the eye-blink reflex.	Fitzpatrick and Hole, p. 347.
	Students should demonstrate the reflex act of striking the area of the leg just below the kneecap. They should know which is the stimulus and which is the response.	Heimler, p. 360.

VIII. Internal Balance

Suggested Time:
10-15 hours

A. Material from text:

<u>Focus on Life Science</u>-Chapter Eight and

Chapter Eighteen

<u>Interaction of Man and the Biosphere</u>-

Section Six

B. Sketch of Content

Reaction Time

Pressure Receptor

Plant Coordination

Concepts and Objectives	Suggested Activities	Suggested Materials
Overall Objective: To provide a more in-depth study of the internal controls placed on body functions		
	Each eye of each student could be tested for pupil response; descriptions of responses should be recorded.	Abraham, *et al.*, pp. 112-113.
	Reaction time for each student could be measured with the "dropped" paper.	Abraham, *et al.*, Teacher Guide, pp. 117B-117C.
	Pressure Receptors could be "mapped" for each student using straight pins extending from a cork.	Abraham, *et al.*, pp. 115-116.
	After images could be used to stimulate interest for raising questions about visual purple and persistence of vision.	Abraham, *et al.*, pp. 118-119.
	Potted plants may be turned on their sides to demonstrate plant coordination and to encourage interest in a study of auxins.	Abraham, *et al.*, Teacher Guide, pp. 128A-128E.

IX. Man and the Environment — Suggested Time: 10-15 hours

A. Material from text:

Focus on Life Science-Chapter Twenty-five

Interaction of Man and the Biosphere-

Section Seven

B. Sketch of Content

How Man Affects the Environment

Forms of Pollution

Our Community's Environmental Quality

Using Pesticides

Air Pollution at Our House

Concepts and Objectives	Suggested Activities	Suggested Materials
Overall Objective: To help the student learn many substances he and his family add to the environment which are harmful to living things		
	Many different organisms could be collected by the student. A variety of household products could be used to test their effects on the organisms. The students should spend time in studying the normal behavior of each organism. The effects of the products on the organisms with varying strengths of the solutions should be recorded, with each group reporting results to the class.	Rasmussen, <u>et</u> <u>al</u>., pp. 255-262.
	Each student could list everything his family adds to the air, water, or soil, with suggestions as to how to reduce their contribution to the local pollution.	Rasmussen, <u>et</u> <u>al</u>., p. 262.
To acquaint students with the forms of pollution in our environment, and some	The students could be assigned to report on some cases of wise use or misuse of knowledge as applied to man and his environment.	Brandwein, Paul F.; Burnett, R. Will; and Stollberg, Robert, <u>Life, Its Forms and</u>

possible ways to curb its spread		*Changes*, Harcourt, Brace and World, Inc., New York, 1968, pp. 513-516.
	Students could form groups to study pollution, soil erosion, destruction of living organisms, garbage disposal, and the general cleanliness of the city in which they live. Environmental quality and improvement ratings should be taken.	Brandwein, *et al.*, p. 516. Abraham, *et al.*, p. 141.
	Students could collect samples of water from various sources in and around the city. Each sample could be filtered, and the mass of the impurities measured. Students should form hypothesis as to the cause of the impurities in each location, and some possible ways to correct water pollution in problem areas.	Fitzpatrick and Hole, pp. 538-539.
	Air pollution in different parts of the community could be measured with dissolved particles collected in distilled water for one month.	Rasmussen, *et al.*, p. 356.
	Air particles might also be collected on a glass slide coated on one side with a thin layer of vasoline. More locations could be used and shorter exposure time (1 or 2 days) are useful.	Rasmussen, *et al.*, p. 359.

An "environmental court" could be set up to "hear" cases in which progress may be detrimental to the environment.	Abraham, et al., pp. 156-157.

X. Ecological Interactions

Suggested Time: 5-10 hours

A. Material from text:

Focus on Life Science-Chapter Twenty-four

Interaction of Man and the Biosphere-

Section Eight

B. Sketch of Content

Population Members and Changes

Cooperation and Competition

Food Chains and Food Webs

The Grassland Ecosystems

Climax Ecosystems

Concepts and Objectives	Suggested Activities	Suggested Materials
To introduce students to different interactions between organisms; both harmful and beneficial	Students could learn the meaning of population and how to find a random sample by estimating the number of beans in a cup through various procedures.	Abraham, _et al._, pp. 163-164.
	A class population chart may be kept for one term to demonstrate changes.	
	Environmental resistence could be studied using the hay-water mixtures (or pond water containing several populations) and a variety of chemicals or substances which could either be limiting or promote growth for the populations. Students should make hypothesis about the effect of the various substances for the different populations.	Abraham, _et al._, pp. 168-169.
	Merion bluegrass seeds and radish or cucumber seeds can be germinated separately and together to demonstrate antibiosis. Filtered liquid from different soaked seeds could be added to other germinating seeds and compared to a control group.	Rasmussen, _et al._, pp. 235-237.

Interaction between molds, bacteria, human tears and saliva can be studied in different mixtures.

Rasmussen, <u>et al</u>., pp. 238-243.

Films which demonstrate food chains and food webs could be interspersed throughout the study. After each film, a food pyramid for that geographical area could be developed by the students.

Rasmussen, <u>et al</u>., pp. 188-191.

Films available at Dallas County Library are as follows:

#2422, "Microscopic Life; World of the Invisible."

#681, "Life in a pond," color (c), 11 minutes.

#698, "Life in the Sea," Black and White (B&W), 11 minutes.

#1282, "Life in the Forest," c., 11 min.

#643, "Life on a Dead Tree," c., 11 min.

#689, "Seashore Life," c., 11 minutes.

#2437, "World in a Marsh," c., 19 min.

	#2995, "Large Animals of the artic," c., 14 minutes.
The grassland ecosystem could be studied through class reports, with emphasis on the role of the coyote in the food web of that area.	Rasmussen, _et al_., pp. 195-209.
The student could make circle drawings of randomly placed names of members of a food web, showing the consequences if a primary consumer is "scratched out" of the drawing.	Abraham, _et al_., pp. 175-178.
Students should be able to match a list of organisms to the name of the area in which they are commonly found.	Abraham, _et al_., pp. 180-181.

XI. Classification System — Suggested Time: 6-8 hours

A. Materials from text:

<u>Focus on Life Science</u>-Chapter Nine

B. Sketch of Content

Naming Organisms

Classifying Objects

Classification of Plants

Classification of Animals

Concepts and Objectives	Suggested Activities	Suggested Materials
To acquaint students with taxonomic nomenclature and grouping	Students could work in groups to: A, List as many common names of animals as can be remembered; B. Study in the library to compose a list of descriptive Latin or Greek terms; C, Using the Latin or Greek words, name the animals listed in A.; D. Compare these names to a chart of the animal kingdom, if possible.	Abraham, _et al_., pp. 209-218.
	Students could work in small groups to practice a classification system in which they define the characteristics which will be used for each group. They might classify pictures of mythical figures, extinct organisms, pressed leaves, or stamps.	Abraham, _et al_., pp. 219-225.
To make students aware of the vast numbers and variety of living organisms in our biosphere	Fresh or preserved collections of plants and animals could be utilized (covering labels if necessary) by using a simple key to identify the different species. A key might then be devised for the practice groups in the last exercise.	Abraham, _et al_., pp. 226-227.

XII. Reproduction Suggested Time: 5-10 hours

A. Material from text:

<u>Focus on Life Science</u>-Chapter Six and Chapter Eleven

<u>Interaction of Man and the Biosphere</u>-Section Ten

B. Sketch of Content

Asexual Reproduction

Sexual Reproduction

Concepts and Objectives	Suggested Activities	Suggested Materials
Overall Objective: To present reproduction to the student as maintenance of the species		
	Asexual reproduction may be shown in accumulating several plants which demonstrate reproduction by leaflets, plantlets, layering, rhizomes, spores, stolons, and grafting.	Abraham, *et al.*, pp. 230-234.
	Regeneration can be demonstrated in the fresh-water planarian by maintaining a class culture with various cuts used.	Heimler, p. 113.
To stress the major difference between asexual and sexual reproduction	Mitosis can be observed by the student in onion root cells. Sketches of the different stages should be made and numbered.	Fitzpatrick and Hole, p. 426.
	Mitosis as a form of asexual reproduction can be observed in budding yeast cells, and possibly in some protists from the hay-water mixture.	Abraham, *et al.*, p. 234.
	Potato slices could be observed as another example of asexual reproduction. Some slices without eyes should be included.	Abraham, *et al.*, p. 239.

Students could investigate cuttings from coleus and geranium plants with different soils or in water. Root-foods could be trimmed and planted to observe new vegetation. Plantlets could be taken from the parent plant and observed for responses to moist soil.	Brandwein, et al., pp. 298-300.
A description of mitosis and meiosis and comparison between the two should be made before further investigation, if not already discussed.	Fitzpatrick and Hole, p. 428.
Frog sperm may be observed by dissecting a mature frog to remove the testes and suspending the contents in 10% Holtfreter's solution. The active sperm may be observed using the microscope and temporary mounts.	Abraham, et al., pp. 239A-239B.
Dissection of a flower (students could bring many types) leads to the investigation of sexual reproduction in complex plants. An example of each part of the flower could be mounted on the laboratory sheet with transparent tape to preserve the quality and aid in learning to identify the various parts. If the different flowers have pollen grains present, they could be observed under a microscope for similarities and differences.	Fitzpatrick and Hole, p. 442. Dallas County Library Film: #1039, "How Flowers make seeds," color, 11 minutes.

XIII. Genetics

Suggested Time:
15-20 hours

A. Material from text:

<u>Focus on Life Science</u>-Chapter Seven and Chapter Nineteen

B. Sketch of Content

Inheritance (Mendelian Laws)

Gamete Formation

Chance and Probability

Genetic Checkers

How Genes Change

Concepts and Objectives	Suggested Activities	Suggested Materials
To illustrate to students how characteristics are inherited, and to explain sources of variation	Members of the class could be compared according to height, weight, hair color, eye color, or other characteristics. Data should be plotted on a graph for each characteristic. Similarities in the line connecting the data should be brought out by the students. A model for the inheritance of any of these traits could be made using cardboard squares. Students should be able to work through a model of inheritance for any of the traits, using the squares as gametes, demonstrating variability of gametes and recombination.	Abraham, et al., pp. 242-249. Brandwein, et al., pp. 425-449.
To acquaint students with Mendelian Laws, his reasonings, and his findings	After demonstrations of Mendel's Laws using the Punnet squares, students should be able to make predictions of different crosses on paper. Some crosses should be complete dominance and some of incomplete dominance. (Genetic Checkers)	Fitzpatrick and Hole, pp. 478-483.
To further demonstrate complete dominance and blending	Pieces of red and white cellophane, and blue and yellow cellophane (respectively) could be combined. Also, bags of colored and white beans could be used as a model in predictions.	Fitzpatrick and Hole, p. 484.

	Students could make class reports on mutations, hybrid vigor (as in corn species), and possible future use of hybrids.	Heimler, pp. 148-153.
To provide additional study for those who need reinforcement of concepts	Gamete formation could be reviewed (with pipe cleaners as part of the model) for those who need reinforcement of the concepts. Exercises in probability and chance could be done with coins. Sex determination could be shown using red and white chips on the drawn Punnett squares.	Abraham, *et al.*, pp. 249B-249I, and 265-267.
	Some additional characteristics to investigate might be variations in students' palm line; fingerprints; length of nose; face; or eyes; peripheral vision; and hair growth patterns.	

XIV. Change Through Time

Suggested Time: 14-20 hours

A. Material from text:

<u>Focus on Life Science</u>-Chapter Twenty-three

<u>Interaction of Man and the Biosphere</u>-

Section Twelve

B. Sketch of Content

The Ancient Biosphere

How Change Occurs in Nature

Random Selection

Nonrandom Selection

Genetic Drift

Natural Selection

Concepts and Objectives	Suggested Activities	Suggested Materials
Overall Objective: To acquaint students with some ways organisms and environments have changed over the ages		
	Each group of students could select an ancient period or epoch from the geologic time scale for study. Dioramas or drawings could be developed for class review. Discussions should bring out how much reconstruction is based on fact, and how much is an artist's imagination.	Morholt, Evelyn; Brandwein, Paul F.; and Joseph, Alexander, *A Sourcebook for the Biological Sciences*, New York: Harcourt, Brace and World, Inc., 1966. p. 516.
	Some helpful filmstrips:	*Encyclopaedia Britannica Films*, 1966,
	"How Plants and Animals Have Changed."	Film #1161,
	"The Age of the Earth and Living Things."	Film #1162,
	"How Living Things Are Adapted."	Film #1163,
	"How Adaptation Helps Living Things Survive."	Film #1164.

To interest students in some types of fossils commonly found in Texas	A display could be made of collected fossils, grouped according to similarities and differences.	Mason, John M. and Peters, Ruth T., <u>Life Science, A Modern Course</u>, Princeton, New Jersey: D. Van Nostrand Company, Inc., 1965, p. 369.
To allow students to discover some of the ways that change can occur in nature	After discussion of the evolution of the horse, students could practice with a model of selection which has resulted in some modern breeds of horses. Each group of four students would have 16 cards marked <u>heavy</u> and 16 marked <u>slender</u>. One member of each team should report to the class what procedure his team followed in developing a particular kind of horse.	Abraham, <u>et al.</u>, pp. 288-289.
	Models of random and nonrandom selection can be worked through using cards to represent light or dark insects and "eaten" or "escaped," first with no preference for colors, and then with the dark insects having a selective advantage.	Abraham, <u>et al.</u>, pp. 290-293.
	Genetic drift may be demonstrated by selecting two pairs of the cards at random, as if they were the gene pool for a new population which had flown or been blown to an isolated area.	

To demonstrate some results of natural selection	Using many pictures of organisms and/ or preserved specimens, students should be able to identify some adaptations which might be a result of natural selection.	Heimler, pp. 465-467.

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"Life in the Forest." #1282. Color, 11 min.

"Life in the Sea." #698. Black and White, 11 min.

"Life on a Dead Tree." #643. Color, 11 min.

"Microscopic Life: World of the Invisible." #2422. Color, 12 min.

"Seashore Life." #689. Color, 11 min.

"Simple Changes in Matter." #762. Black and White, 15 min.

"World in a Marsh." #2437. Color, 19 min.

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APPENDIX 1. RESULTS OF A SURVEY OF SIXTH GRADE TEACHERS

The following are results of a survey of Sixth Grade teachers made in March and April of 1971 in Garland, Texas. Nine of the twenty-two schools were randomly selected, with personal interviews arranged for the first five schools that could be contacted. The remaining four schools received the surveys by mail, accompanied by a letter of explanation. All surveys were completed and returned within one month. Results were mailed to the teachers at the beginning of the 1971-1972 school year, and to the Seventh Grade Life Science teachers in Garland.

Most teachers interviewed indicated a need for materials and additional room in which to work. This was the main reason cited for the small amount of laboratory or investigative experiences. The responses given by the teachers are tabulated on a copy of the survey. The totals under each section varied due to individual responses.

SURVEY: SIXTH GRADE SCIENCE CLASSES

This survey is part of an effort to begin coordination of the science program in elementary and middle school grades in Garland, Texas. Repetition of subject matter from upper elementary to seventh and eighth grades should be used only when necessary to strengthen concepts which are difficult to understand. Your cooperation toward the planning of seventh and eighth grade science classes is greatly appreciated, and is necessary in determining where the emphasis should be placed in seventh grade planning for the next five years.

Check the phrases that best complete each of the following statements:

1. Our science study is approached in the following way(s):

   __4__ a. Units of study during one portion of the school year.

   __4__ b. Units of study throughout the school year.

   _____ c. A few days's study when interest seems high or materials are available.

   __5__ d. Some time each day is alloted for science study.

2. Our estimated time spent in science discovery activities is as follows:

__3__ a. 0- 5% of our science time.

__5__ b. 10-20% of our science time.

__1__ c. 20-35% of our science time.

__1__ d. 35-50% of our science time.

__1__ e. Other (60-75% discussion)__________

3. The student's experience with laboratory work is as follows:

__4__ a. He is able to observe displays and results of laboratory work demonstrated for him.

__7__ b. He is able to manipulate basic laboratory equipment after demonstration of proper use of the equipment, a few times during the year.

_____ c. He manipulates laboratory equipment safely after demonstration of proper useage many times during the year.

_____ d. He is unable to safely manipulate laboratory equipment at this age.

_____ e. Other ____________________.

4. The average student's reaction to laboratory equipment is as follows:

__4__ a. He displays much interest and excitement, needing frequent reminders to act more calmly and with safety.

__2__ b. He shows appreciation for laboratory activities by working steadily and with caution.

__1__ c. He sometimes shows interest, but usually regards it as "recess," without gaining knowledge.

__3__ d. He is grateful for laboratory work, and wants more time for it.

__1__ e. Other "Most enjoy it and learn from it," said one teacher.

5. The approximate number of hours allotted to each area of our science and/or health studies is as follows:

__15.0__ hours: Human Anatomy

__10.5__ hours: Nutrition

__7.0__ hours: Protozoans

__2.5__ hours: Tools of the Scientists

__2.5__ hours: Photosynthesis

__7.0__ hours: Vertebrates

__7.0__ hours: Invertebrates

__7.0__ hours: Methods of the Scientists (Attitudes and Processes)

__4.0__ hours: Plant Growth and Behavior

__3.0__ hours: The Cell

__5.0__ hours: Physical and Chemical Change

__8.0__ hours: Human Physiology

__2.0__ hours: Heredity

3.0 hours: Ecosystems and Food Chains

2.0 hours: Man-managed Ecosystems

5.0 hours: Environmental Pollution

19.0 hours: Other Science Subjects ______________

____

APPENDIX 2. CHARACTERISTICS OF STUDENTS' ATTITUDE TOWARD SCIENCE

The following attitude scale is the result of research completed at Yeshiva University (Vitrogan, 1968) to provide at least one means for assessing the degree to which an individual may be oriented toward science. Secondary students, boys and girls, ranging in age from thirteen to fifteen years, had interest in science measured by the Kuder Preference Record: Vocational Form. It was concluded that interest in science and attitude toward science may be viewed as different personality attributes, since they were found to have a low correlation.

A positive generalized attitude toward science is characterized as follows:

1. A predisposition to discern the degree in which one person or thing differs from another: a tendency to emphasize differences.
2. A tendency to challenge authority, to test traditional beliefs and customs with actual observations and experience.
3. A readiness to change as changing conditions require: a multiple and flexible approach to people and things.
4. An ability to differentiate between controlled and

reliable observation as opposed to casual observation.

5. A basic notion that reality is to be regarded as a process implying continuous change; no two things are exactly alike; no one thing stays the same.

6. Structure, in the form of relations and equations, the nature of the phenomenon, the broad unifying principle in stressed rather than the application (detail) or function.

7. Greater concern for research rather than findings; greater emphasis on the enquiring, the questioning, rather than the final answers obtained; the form of the question is considered more important than the answer observed.

8. An emphasis on probability type explanations rather than absolute solutions.

A non-positive generalized attitude toward science is characterized by:

1. A tendency to emphasize similarities and overlook and minimize differences; a predisposition to expect different things to be the same.

2. A predisposition to accept authority and suggestion.

3. A tendency to maintain established beliefs regardless of changing conditions; a singular and rigid approach to people and things.

4. An inability to distinguish between casual and controlled observations.
5. A static orientation where reality is viewed as having an unchanging character, a stability and constancy.
6. Emphasis of the relations in the form of equations, experimental design, and logic are minimized; function, utility and application are stressed.
7. A perference for final answers obtained from basic questions minimizing the methods used in inquiring; the answer is considered more important than the way in which the questions are asked.
8. An acceptance of absolute solutions.