R E P O R T   R E S U M E S

ED 018 382 SE 004 436

APPENDIX AND BIBLIOGRAPHY TO BE USED WITH LIFE AND EARTH SCIENCE GUIDES.

BY- MAHLER, FRED
COOPERATIVE CURRICULUM CTR.FOR IMP.OF EDUC.OPPOR.

PUB DATE SEP 67
EDRS PRICE MF-$0.50 HC-$2.60 63P.

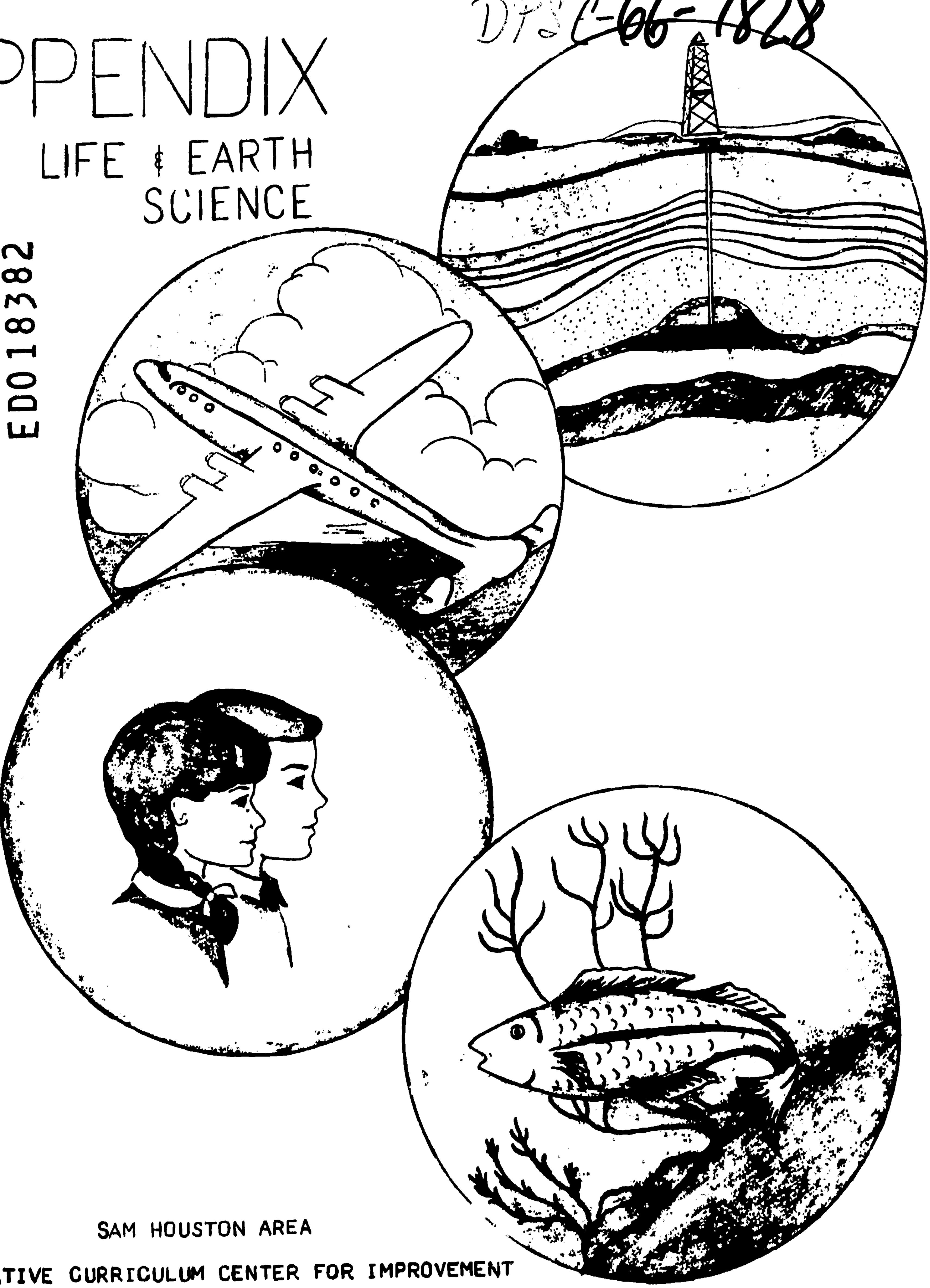
DESCRIPTORS- *BIBLIOGRAPHIES, *BIOLOGY, *ELEMENTARY SCHOOL SCIENCE, *EARTH SCIENCE, *PHYSICAL SCIENCES, *SECONDARY SCHOOL SCIENCE, *SCIENCE ACTIVITIES, *TEACHING GUIDES, BOOKS, CURRICULUM GUIDES, TEXTBOOKS, TEACHING TECHNIQUES,

CONTAINED IN THIS TEACHER'S GUIDE FOR LIFE AND EARTH SCIENCES ARE BIBLIOGRAPHIES, DEMONSTRATIONS, AND EXPERIMENTS. BOOKS ARE LISTED FOR JUNIOR HIGH SCHOOL SCIENCE WHICH COVER A WIDE RANGE OF SUBJECTS, INCLUDING NATURE STUDY, BIOLOGY, CHEMISTRY, AND PHYSICS AS WELL AS MORE HIGHLY SPECIALIZED FIELDS OF THE PHYSICAL SCIENCES. TEXTBOOKS LISTED INCLUDE THOSE FOR COLLEGE SCIENCE TEACHER PREPARATION, AS WELL AS THOSE FOR THE JUNIOR HIGH SCHOOL. SCIENTIFIC AMERICAN REPRINTS ARE LISTED. CURRICULUM GUIDES FOR ELEMENTARY, JUNIOR HIGH, AND HIGH SCHOOL ARE INCLUDED. THE BIBLIOGRAPHY SECTION CONCLUDES WITH A LIST OF BOOKLETS, BUT THE LEVEL FOR EACH OF THESE IS NOT INDICATED. THE REMAINDER OF THE MATERIAL IS A COMPILATION OF DEMONSTRATIONS AND EXPERIMENTS. (DH)

DPSC-66-1828

APPENDIX AND BIBLIOGRAPHY

LIFE & EARTH SCIENCE



SAM HOUSTON AREA

COOPERATIVE CURRICULUM CENTER FOR IMPROVEMENT

OF EDUCATIONAL OPPORTUNITIES

HUNTSVILLE, TEXAS

APPENDIX AND BIBLIOGRAPHY

TO BE USED WITH

LIFE AND EARTH SCIENCE GUIDES

Written and Compiled
by
Title III Science Workshop Participants

Sam Houston Area

Cooperative Curriculum Center for Improvement

of Educational Opportunities

September, 1967

Dr. Fred Mahler, Project Director

The work presented or reported herein was performed pursuant to a Grant from the U. S. Office of Education, Department of Health, Education, and Welfare.

TITLE III SCIENCE WORKSHOP

STAFF

Dr. Arthur Hughes, Director

Dr. Dewey Davis   Mr. Marcus Rigby

PARTICIPANTS

Emzie Bridges
New Waverly I. S. D.

Albert B. Crank
Navasota I. S. D.

John E. Davis
Crockett I. S. D.

Ruth Davis
Oakhurst I. S. D.

Alice Ann Fannin
Madisonville I. S. D.

Linda Goerland
Kirby-Houston I. S. D.

Jerry Johnson
Navasota I. S. D.

Ronald Johnson
Conroe I. S. D.

Penny Lawson
Cypress-Fairbanks I. S. D.

Jimmy Lee McClain
Northeast Houston I. S. D.

Margaret Murphy
Conroe I. S. D.

Jimmy Powell
Austonio I. S. D.

Emmit Ross Roach
Kennard I. S. D.

John H. Simpson
Huntsville I. S. D.

Miriam Smith
Conroe I. S. D.

Nola D. Starling
Cleveland I. S. D.

Kenneth Ray Stegall
Cleveland I. S. D.

Robert Thomas
Aldine I. S. D.

Jerry Thurston
New Waverly I. S. D.

Robbie Trant
Madisonville I. S. D.

Robert Lee Washington
Trinity I. S. D.

Lovie Watkins
Huntsville I. S. D.

TABLE OF CONTENTS

BIBLIOGRAPHY

BOOKS

Junior High School Science

Andrews, Roy Chapman. This Amazing Planet. New York: G. P. Putnam's Sons, 1940.

Arnold, Pauline, and Percival White. The Automation Age. New York: Holiday House, 1963.

Asimov, Isaac. The Human Body. Boston: Houghton-Mifflin Co., 1963.

Atkinson, D. T. Magic, Myth, and Medicine. New York: Fawcett Publishing, Inc., 1962.

Barker, Will. Familiar Animals of America. New York: Harper and Row, 1956.

Barr, George. Research Ideas for Young Scientists. New York: McGraw-Hill, 1958.

Bartlett, Ruth. Insect Engineers. New York: William Morrow & Co., 1957.

Bates, Marstone. South America. New York: Time, Inc., 1964.

Beeler, Nelson F. and Franklin M. Branley. Experiments With Light. New York: Thomas Crowell Co., 1964.

Beiser, Germaine and Arthur. Physics for Everybody. New York: E. P. Dutton & Co., 1960.

Bendick, Jeanne. How Much and How Many. New York: McGraw-Hill, 1960.

Bergwin, Clyde R. and William T. Coleman. Animal Astronauts: They Opened the Way to the Stars. Englewood Cliffs: Prentice-Hall, Inc., 1966.

Berrill, N. J. The Living Tide. New York: Fawcett World Library, 1964.

Beston, Henry. The Outermost House. New York: The Viking Press, 1967.

Branley, Franklyn M. Experiments in the Principles of Space Travel. New York: Thomas Y. Crowell Co., 1955.

Buchsbaum, Ralph, Lorus J. Milne. The Lower Animals. Garden City: Doubleday & Co., 1966.

Buchsbaum, Ralph. Animals Without Backbones. Chicago: University of Chicago Press, 1948.

Burchard, Peter. Balloons. New York: MacMillan Co., 1960.

Calder, Ritchie. The Wonderful World of Medicine. Garden City, N. Y.: Garden City Books, 1958.

Carson, Rachael. The Edge of the Sea. Boston: Houghton-Mifflin Co., 1955.

Chamberlain, Joseph Miles, Thomas D. Nicholson. Planets, Stars, & Space. New York: Creative Educational Society, Inc., 1962.

Clapesattle, Helen. The Mayo Brothers. Boston: Houghton-Mifflin Company, 1962.

Cochran, Doris M. Living Amphibians of the World. Garden City, New York: Doubleday & Company, 1966.

Colbert, Edwin H. Millions of Years Ago. New York: Thomas Y. Crowell, 1958.

Cooper, Elizabeth K. Science In Your Own Back Yard. New York: Harcourt, Brace & World, 1958.

Corrington, Julian D. Exploring With Your Microscope. New York: McGraw-Hill, 1957.

Defant, Albert. Ebb and Flow. Ann Arbor, Michigan: The University of Michigan, 1960.

Dewey, Anne Perkins. Robert Goddard, Space Pioneer. Boston: Little, Brown, & Company, 1962.

Dickinson, Alice. The First Book of Plants. New York: Franklin Watts, 1953.

Dowden, Anne Ophelia. Look At a Flower. New York: Thomas Y. Crowell, 1963.

Eberle, Irmengarde. Modern Medical Discoveries. New York: Thomas Y. Crowell Company, 1963.

Editors of Fortune. Great American Scientists. Englewood Cliffs: Prentice-Hall, 1961.

Ets, Marie Hall. The Story of a Baby. New York: The Viking Press, 1966.

Faraday, Michael. The Chemical History of a Candle. New York: Thomas Y. Crowell Company, 1957.

Farb, Peter. Living Earth. New York: Harper & Row, 1959.

_______. The Forest. New York: Time, Inc., 1963.

Fenton, Carroll Lane and Mildred Adams. The Fossil Book. Garden City, N. Y.: Doubleday & Company, 1958.

Fenton, Carroll Lane. Trees and Their World. New York: The John Day Company, 1957.

Forbush, Edward Howe, and John Bichard May. A Natural History of American Birds of Eastern and Central North America. Boston, Mass.: Houghton-Mifflin Co., 1955.

Gamow, George. A Star Called the Sun. New York: The Viking Press, 1966.

Herald, Earl S. Living Fishes of the World. Garden City, N. Y.: Doubleday & Company, 1965.

Hoffman, Katherine B. Chemistry of Life. Washington, D. C.: National Science Teachers Association, 1964.

Hogben, Lancelot. The Wonderful World of Mathematics. Garden City, N. Y.: Doubleday & Company, 1955.

Holling, Clancy Holling. Pagoo. Boston, Mass.: Houghton-Mifflin Company, 1957.

Hutchins, Carleen Maley. Life's Key - DNA. New York: Coward-McCann, Inc., 1961.

Hyde, Margaret O. Animal Clocks and Compasses. New York: McGraw-Hill, 1960.

Hynek, J. Allen. Challenge of the Universe. Washington, D. C.: National Science Teachers Association, 1965.

Irving, Robert. Electronics. New York: Alfred A. Knopf, 1961.

Jaffe, Bernard. Crucibles, The Story of Chemistry. New York: Fawcett Premier, 1966.

Jaworski, Irene D., and Alexander Joseph. Atomic Energy. New York: Harcourt, Brace & World, 1961.

Johnson, Gaylord. Discover the Stars. New York: Sentinel Book Publishers, Inc., 1965.

______. Hunting With the Microscope. New York: Sentinel Book Publisher, Inc., 1963.

Kadesch, Dr. Robert R. The Crazy Cantilever & Other Science Experiments. New York: Harper & Row, 1961.

Kane, Henry B. The Tale of a Wood. New York: Alfred A. Knopf, 1962.

Krutch, Joseph Wood. The Great Chain of Life. Boston: Houghton-Mifflin Co., 1956.

Laird, Charles and Ruth. Weathercasting. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1966.

Lewinsohn, Richard. Science, Prophecy, and Prediction. New York: Fawcett World Library, 1962.

Lisitzky, Gene. Four Ways of Being Human. New York: The Viking Press, 1966.

McCabe, Charles Law, and Charles L. Bauer. Metals, Atoms, and Alloys. Washington, D. C.: National Science Teachers Association, 1963.

Mann, Lucille Quarry. Tropical Fish. New York: Sentinel Books Publishing Inc., 1966.

Mattersdorf, Leo. A Key To the Heavens. New York: Fawcett World Library, 1962.

Mead, Margaret. People and Places. New York: The World Publishing Co., 1959.

Meeuse, J. D. The Story of Pollination. New York: The Ronald Press Company, 1961.

Mickelsen, Olaf. Nutrition Science and You. Washington, D. C.: National Science Teachers Association, 1964.

Milne, Lorus J. The Mountains. New York: Time, Inc., 1962.

Mitchell, Lane. Ceramics: Stone Age to Space Age. Washington, D. C.: National Science Teachers Association, 1963.

Moffat, Samuel. Life Beyond the Earth. Washington, D. C.: National Science Teachers Association, 1965.

New York Times. America's Race For the Moon. New York: Random House, 1962.

Noshpitz, Joseph D. Understanding Ourselves. New York: Coward-McCann, Inc., 1964.

Nourse, Alan E. The Body. New York: Time, Inc., 1964.

O'Brien, Robert. Machines. New York: Time, Inc., 1964.

Ommanney, F. D. The Fishes. New York: Time, Inc., 1964.

Overbeek, Johannes van. The Lore of Living Plants. Washington, D. C.: National Science Teachers Association, 1964.

Paffenbarger, George C. Frontiers of Dental Science. Washington, D. C.: National Science Teachers Association, 1964.

Parker, Bertha Morris. Insects and Their Ways. New York: Harper & Row, 1966.

Peterson, Roger Tory. A Field Guide to the Birds. Boston, Mass.: Houghton Mifflin Co., 1960.

_______. A Field Guide to Western Birds. Boston, Mass.: Houghton Mifflin Co., 1961.

_______. How to Know the Birds. New York: The New American Library, 1957.

_______. The Birds. New York: Time, Inc., 1963.

Pfeiffer, John E. The Search for Early Man. New York: Harper & Row, 1960.

Phillips, Mary Geisler. Dragonflies and Damselflies. New York: Thomas Y. Crowell, 1960.

Platt, Rutherford. 1001 Answers to Questions About Trees. New York: Grosset & Dunlap, 1959.

Pollack, Philip. Careers and Opportunities in Chemistry. New York: E. P. Dutton & Co., 1966.

_______. Careers and Opportunities in Physics. New York: E. P. Dutton & Co., 1961.

Pope, Clifford H. The Reptile World. New York: Alfred A. Knopf, 1966.

_______. Turtles of the United States and Canada. New York: Alfred A. Knopf, 1961.

Reed, Maxwell. Patterns in the Sky. New York: William Morrow & Co., 1951.

_______. The Earth for Sam. New York: Harcourt, Brace, & World, Inc., 1960.

_______. The Stars for Sam. New York: Harcourt, Brace, & World, Inc., 1960.

Rogers, Julia Ellen. The Shell Book. Boston, Mass.: Charles T. Branford Co., 1960.

Rosenfeld, Sam. Science Experiments With Water. New York: Harvey House, 1965.

Ruchlis, Hy. Orbit. New York: Harper & Row, 1958.

Sanderson, Ivan T. How To Know the American Mammals. New York: The New American Library, 1951.

_______. Living Mammals of the World. Garden City, N. Y.: Doubleday & Co., 1965.

_______. The Continent We Live On. New York: Random House, 1962.

Schneider, Herman. Everyday Weather and How It Works. New York: McGraw-Hill, 1961.

Seaborg, Glenn T. Elements of the Universe. New York: E. P. Dutton & Co., 1965.

Selsam, Millicent E. Play With Plants. New York: William Morrow & Co., 1949.

Shuttlesworth, Dorothy. The Story of Spiders. Garden City, N. Y.: Doubleday & Company, 1959.

Simon, Harold J. Microbs and Men. Washington, D. C.: National Science Teachers Association, 1963.

Sloane, Eric. How Can You Forecast the Weather. New York: Fawcett World Library, 1964.

Sproul, Edith E. The Science Book of the Human Body. New York: Franklin Watts, 1955.

Stanley, Wendell M. and Evans G. Valens. Viruses and the Nature of Life. New York: E. P. Dutton & Co., 1961.

Stine, G. Harry. Man and the Space Frontier. New York: Alfred A. Knopf, 1962.

Teale, Edwin Way. Grassroot Jungles. New York: Dodd, Mead, & Co., 1966.

Thomson, Sir J. Arthur. Riddles of Science. New York: Fawcett World Library, 1962.

Udane, Bernard. Student's Handbook of Science. New York: Fredrick Ungar Publishing Co., 1960.

Wells, Robert. Wonders of Flight. New York: Dodd, Mead, & Co., 1962.

White, Anne Terry. Lost Worlds. New York: Random House, 1960.

Wooley, Sir Leonard. Digging Up the Past. Baltimore, Maryland: Penguin Books, 1965.

Youden, W. J. Experimentation and Measurement. Washington, D. C.: National Science Teachers Association, 1966.

Zim, Herbert. Dinosaurs. New York: Morrow Junior Books, 1954.

_______. Mammals. New York: Golden Press, 1955.

_______. Stars. New York: Golden Press, 1956.

TEXTBOOKS

Barnard, J. Darrell. The Macmillan Science Life Series. New York: The Macmillan Co., 1962, grades 1-6.

Blough, Glenn O., Marshall, Bailey, Beauchamp. The Basic Science Program, Grades 1-6. Chicago: Scott, Foresman, & Co., 1965.

Brandwein, Paul F. Concepts In Science, Grades 1-6. New York: Harcourt, Brace, & World, Inc., 1966.

Craig, Gerald S., and Marguerite W. Lembach. Science Today and Tomorrow, Grades 1-6. Boston: Ginn & Company, 1960.

Dowling, Thomas I., Freeman, Lacy, and Tippet. Understanding Science Series, Grades 1-6. Philadelphia, Penn.: John C. Winston Co., 1958.

Navarra, John Gabriel, and Joseph Zafforoni. Today's Basic Science, Grades 1-6. New York: Harper & Row, 1963.

Schneider, Herman and Nina. Elementary Science, Grades 1-6. Boston, Mass.: D. C. Heath & Co., 1955.

Thurber, Walter A., and Mary C. Durkee. Exploring Science, Grades 1-6. Boston, Mass.: Allyn & Bacon, 1966.

TEXTBOOKS: (JUNIOR HIGH)

Beauchamp, William L., and others. Science is Explaining. Grade 7. Chicago: Scott, Foresman & Company, 1964.

_______. Science is Understanding, Grade 8. Chicago: Scott, Foresman & Company, 1964.

Blanc, Sam S., Fischler, and Gardner. Modern Science I. New York: Holt, Rinehart, & Winston, 1963.

_______. Modern Science II. New York: Holt, Rinehart, and Winston, Inc., 1963.

Craig, Gerald S., Arey, and Sheckles. Science Today and Tomorrow Series, Grades 7 & 8. New York: Ginn & Co., 1961.

Davis, Ira C. and Burnett and Gross. Science - Experiment and Discovery, Grade 8. New York: Henry Holt & Co., 1958.

MacCracken, Helen D. and others. Basic Earth Science. Chicago: L. W. Singer Co., 1964.

_______. Basic Life Science. Chicago: The L. W. Singer Co., 1964.

Mason, John M., and Ruth T. Peterson. Life Science - A Modern Course. New York: D. Van Nostrand, 1965.

Namowitz, Samuel N., and David B. Stone. Earth Science: The World We Live In. New York: D. Van Nostrand Co., Inc., 1965.

Navarra, John Gabriel, and Zafforoni, and Garone. Today's Basic Science - The Molecule and the Biosphere. New York: Harper & Row, 1965.

Ramsey, William L., and Raymond A. Burckley. Modern Earth Science. New York: Holt, Rinehart, & Winston, Inc., 1961.

Schneider, Herman and Nina. Heath Science Series. Boston: D.C. Heath & Co., 1966.

REPRINTS

Reprints from Scientific American. San Francisco: W. H. Freeman & Company.

Bailey, Herbert S., Jr. "The Voyage of the 'Challenger'". May, 1953.

Barnes, Virgil E. "Tektites." November, 1961.

Bascon, Willard. "Beaches." August, 1960.

_______. "Ocean Waves." August, 1959.

Bernstein, Joseph. "Tsunamis." August, 1954.

Broom, Robert. "The Ape-Men." November, 1949.

Brues, Charles T. "Insects In Amber." November, 1951.

Clark, J. Desmond. "Early Man In Africa." July, 1958.

Colbert, Edwin H. "The Ancestors of Mammals." March, 1949.

Crary, A. P. "The Antarctic." September, 1962.

Deevy, Edward S. "Bogs." October, 1958.

_______. "Living Records of the Ice Age." May, 1949.

Dietz, Robert S. "Astroblemes." August, 1961.

Doumani, George A., and William E. Long. "The Ancient Life of the Antarctic." September, 1962.

Eiseley, Loren C. "Charles Lyell." August, 1959.

Ellison, W. D. "Erosion by Raindrop." November, 1948.

Elsasser, Walter M. "The Earth As A Dynamo." May, 1958.

Emiliani, Cesare. "Ancient Temperatures." February, 1958.

Ericson, David B., and Goesta Wollin. "Micropaleontology." July, 1962.

Field, William O. "Glaciers." September, 1955.

Glaessner, Martin F. "Pre-Cambrian Animals." April, 1951.

Heezen, Henry C. "The Origin of Submarine Canyons." August, 1965.

Janssen, Raymond E. "The History of a River." June, 1952.

Kellogg, Charles E. "Soil." July, 1950.

Kettlewell, H. B. D. "Darwin's Missing Evidence." March, 1959.

Kort, V. G. "The Antarctic Ocean." September, 1962.

Kuenen, Philip H. "Sand." April, 1960.

Leopold, Luna B. and W. B. Langbein. "River Meanders." June, 1966.

Llano, George A. "The Terrestrial Life of the Antarctic." September, 1962.

McNeil, Mary. "Lateritic Soils." November, 1964.

Malkus, Joanne Starr. "The Origin of Hurricanes." August, 1957.

Matthes, Gerrard H. "Paradoxes of the Mississippi." April, 1951.

Millot, Jacques. "The Coelacanth." December, 1955.

Murphy, Robert Cushman. "The Oceanic Life of the Antarctic." September, 1962.

Newell, Norman D. "Crisis in the History of Life." February, 1963.

Oliver, Jack. "Long Earthquake Waves." March, 1959.

Opik, Ernest J. "Climate and the Changing Sun." June, 1958.

Pequegnat, Willis E. "Whales, Plankton, and Man." January, 1958.

Plass, Gilbert N. "Carbon Dioxide and Climate." July, 1959.

Roberts, Walter Orr. "Sun Clouds and Rain Clouds." April, 1957.

Robin, Gordon de Q. "The Ice of the Antarctic." September, 1962.

Roedder, Edwin. "Ancient Fluids In Crystals." October, 1962.

Rubin, Morton J. "The Antarctic and the Weather." September, 1962.

Sayre, A. N. "Ground Water." November, 1950.

Stommel, Henry. "The Anatomy of the Atlantic." January, 1955.

Tepper, Morris. "Tornadoes." May, 1958.

Tuttle, O. Frank. "The Origin of Granite." April, 1955.

Urey, Harold C. "The Origin of the Earth." October, 1952.

Weckler, J. E. "Neanderthal Man." December, 1957.

Went, Frits W. "Climate and Agriculture." August, 1959.

Wexler, Harry. "Volcanoes and World Climate." April, 1952.

Williams, Howel. "Volcanoes." November, 1951.

Woodcock, A. H. "Salt and Rain." October, 1951.

Woolard, G. P. "The Land of the Antarctic." September, 1962.

Wright, Sir Charles. "The Antarctic and the Upper Atmosphere." September, 1962.

ELEMENTARY CURRICULUM GUIDES

An Elementary Science Source Book, Vol. I. Bismarck, N. Dakota: Department of Public Instruction, (n.d.).

An Elementary Science Source Book, Vol. II. Bismarck, N. Dakota: Department of Public Instruction, (n.d.).

An Overview of the Elementary School Curriculum. Lansing, Michigan: Lansing School District, 1966-67.

An Overview of the United Space Exploration Program. Niagara Falls, New York: Niagara Falls Independent School District, 1963.

A Resource Guide in Science for the Elementary Schools. Pasadena, California: Pasadena City Schools, (n.d.).

Chemistry for Iowa Schools. Iowa: Iowa State Department of Public Instruction, 1965.

Course of Study: Elementary Science. Mason City, Iowa: Mason City Public Schools, 1965.

Elementary Science. East Chicago, Indiana: East Chicago, Indiana Public Schools, 1963.

Elementary Science Guide, Grades 1-6. La Marque, Texas: La Marque Independent School District, 1961.

Elementary Science Handbook for the Elementary Schools of North Dakota. Bismarck, North Dakota: Department of Public Instruction, (n.d.).

Elementary Science Handbook for the Teachers. Fort Worth, Texas: Fort Worth Public Schools, 1964.

Health Science Grades 1-8. Dallas, Texas: Dallas Independent School District, 1958.

Health-Science for Grades 6 and 7. Houston, Texas: Spring Branch Independent School District, 1965.

Laboratory Experiences for Junior High School Science. Arlington, Virgina: Arlington County Public Schools, 1966.

Resource Units for Fifth Grade Science. Las Cruces, New Mexico: Las Cruces School District, 1964.

Resource Units for First Grade Science. Las Cruces, New Mexico: Las Cruces School District, 1964.

Resource Units for Fourth Grade Science. Las Cruces, New Mexico: Las Cruces School District, 1964.

Resource Units for Second Grade Science. Las Cruces, New Mexico: Las Cruces School District, 1964.

Resource Units for Sixth Grade Science. Las Cruces, New Mexico: Las Cruces School District, 1964.

Resource Units for Third Grade Science. Las Cruces, New Mexico: Las Cruces School District, 1964.

Science and Health - A Curriculum Guide, Grade Eight. Louisville, Kentucky: Louisville Public Schools, 1961.

Science for Georgia Schools, Volume I - Primary. Georgia: Georgia Department of Education, 1958.

Science for Iowa Schools. Iowa: State of Iowa, 1964.

Science Today for Tomorrow's World. Dade, Florida: Dade County Board of Public Instruction, 1966.

Suggested Science Experiences for the Study of Living Things Using the Magnifier Kit. Los Angeles, California: Los Angeles City Schools, 1965.

Suggested Science Experiences for the Study of Sound Energy Using the Telephone Kit. Los Angeles, California: Los Angeles City Schools, 1965.

Suggested Science Experiences for the Supplementary Electricity and Magnetism Kit. Los Angeles, California: Los Angeles City Schools, 1965.

Suggestive Guide for Teaching Science in Elementary Grades. Mena, Arkansas: Mena School District, 1959.

Teaching Primary Science, Vol. I. Crowley, La.: Acadia Parish School Board, 1962.

Teaching Primary Science, Vol. II. Crowley, La.: Acadia Parish School Board, 1962.

Teaching Primary Science, Vol. III. Crowley, La.: Acadia Parish School Board, 1962.

Tentative Curriculum Guide for Nongraded Primary Program. San Angelo, Texas: San Angelo Public Schools, 1963.

JUNIOR HIGH & HIGH SCHOOL CURRICULUM GUIDES

A Guide for Teaching Physical Science. Houston, Texas: Spring Branch Independent School District, (n.d.).

Aids in General Science for the Slow Learner. Pinellas County, Florida: Pinellas County Schools, 1964.

Air, Winds, and Weather. New York: Holt, Rinehart, and Winston, 1962.

Alcohol, Tobacco, Narcotics. Denver,Colorado: Denver Public Schools, 1964.

A Teaching Guide for Science Grade Eight, Earth Science & Life Science. Austin, Texas: Austin Independent School District, (n.d.)

Atomic Energy. Portland, Oregon: Portland Public Schools, (n.d.).

Biology Laboratory Guide. Arlington, Va.: Arlington County Public Schools, 1964.

Challenging the Gifted Student Through Projects in Biology. Houston, Texas: Houston Independent School District, 1956.

Chemistry. Niagara Falls, New York: Niagara Falls School District, 1962.

Chemistry. Portland, Oregon: Portland Public Schools, (n.d.).

Chemistry and Physics & Physics. San Angelo, Texas: San Angelo Independent School District, 1964.

<u>Course of Study - Life Science Grade 7</u>. Port Neches, Texas: Port Neches Independent School District, 1966.

<u>Curriculum Guide for Earth Science</u>. Arlington, Va.: Arlington Public Schools, 1967.

<u>Dialect Checklist - Pacific Northwest</u>. Portland, Oregon: Portland Public Schools, (n.d.).

<u>Electricity & Magnitism and Chemistry & Botany</u>. San Angelo, Texas: San Angelo Independent School District, 1960.

<u>Elementary Chemistry & Elementary Zoology</u>. San Angelo, Texas: San Angelo Independent School District, 1963.

<u>Elementary Meteorology & Elementary Geology</u>. San Angelo, Texas: San Angelo Independent School District, 1960.

<u>Energy Changes in the Atmosphere and Hydrosphere</u>. New York: Board of Education, 1964.

<u>Functional Anatomy & Elementary Chemistry</u>. San Angelo, Texas: San Angelo Independent School District, (n.d.).

<u>General Physical Science Pupil Laboratory Manual, Teacher's Edition</u>. Fort Worth, Texas: Fort Worth Public Schools, 1966.

<u>General Science - A Handbook for Teachers of Grade Nine</u>. Fort Worth, Texas: Fort Worth Public Schools, 1962.

<u>Geology of Foothills and Front Range in the Vicinity of Morrison, Colorado</u>. Denver, Colorado: Denver Public Schools, 1962.

<u>Guides for Teaching Science Grades 1-6</u>. Columbia, S. Car.: State Department of Education, 1962.

<u>Guides for Teaching Science Grades 7-12</u>. Columbia, S. Car.: State Department of Education, 1962.

<u>Health Interests of Children</u>. Denver, Colo.: Denver Public Schools, 1954.

<u>Health, General Science, Biology, Chemistry, and Physics</u>. Navasota, Texas: Navasota Independent School District, (n.d.).

<u>Health - Science & Safety, Basic Grade 7</u>. Louisville, Kentucky: Louisville Public Schools, 1960.

<u>Heat, Light, and Sound</u>. Portland, Ore.: Portland Public Schools, (n.d.).

Hints for Health Teaching. Denver, Colorado: Denver Public Schools, 1965.

Hydroponics. Portland, Oregon: Portland Public Schools, (n.d.).

Instruction Guide for Gardening. Los Angeles, California: Los Angeles City Schools, 1955.

Instructional Guide for Junior High School Science. Denver, Colo: Denver Public Schools, 1962.

Introductory Physical Science. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965.

Investigating the Earth. Boulder, Colo.: Earth Science Curriculum Project, 1965.

ITV Teacher's Guide Science 7. Dade County, Florida: Dade County Public Board of Instruction, 1967.

Junior High School General Science Course of Study. Los Angeles, California: Los Angeles City Schools, 1963.

Junior High School Project. Michigan: Michigan Science Curriculum Committee, 1966.

Junior High School Science Guide Grades 7, 8, 9. Waco, Texas: Waco Independent School District, 1960.

Junior High Science Guide, Grade 9. Pinellas County, Florida: Pinellas County Schools, 1961.

Laboratory Experiences for Earth & Space Science. Arlington, Va.: Arlington County Public Schools, 1965.

Laboratory Experiences for Junior High School Science. Arlington, Va.: Arlington County Public Schools, 1966.

Lenses and Magnification. Portland, Oregon: Portland Public Schools, (n.d.).

Life-Earth Science Handbook for Teachers. Fort Worth, Texas: Fort Worth Public Schools, 1966.

Life Science Guide for Junior High School. Lakewood, Colo.: Jefferson County Public Schools, 1966.

Living on the Changing Crust of the Earth. New York: Board of Education, 1962.

Magnetism and Electricity. Portland, Ore.: Portland Public Schools, (n.d.).

Matter and Energy In Physics. New York: Board of Education, 1965.

Matter and Life In Space. New York: Board of Education, 1965.

Microscope Slide Making. Portland, Ore.: Portland Public Schools, (n.d.).

Orientation Guide for Science Curriculum - Upper Grades. Portland, Oregon: Portland Public Schools, (n.d.).

Physical and Earth Science. El Paso, Texas: El Paso Public Schools, 1962.

Physical Science Laboratory Experiments. 1964.

Physical Science Laboratory Manual. Houston, Texas: Spring Branch Independent School District, 1963.

Physical Science I - II, Grade 9. Houston, Texas: Houston Public Schools, 1962.

Physics, Chemistry, and Machines and Heat, Light, & Sound. San Angelo, Texas: San Angelo Independent School District, 1960.

Physics for Iowa Schools. Iowa: Department of Public Instruction, 1966.

Pinellas County Junior High Science Guide - Grade 7. Pinellas County, Florida: Pinellas County School, 1961.

Properties of Mixtures. New York: Board of Education, 1964.

Reproduction and Heredity. New York: Board of Education, 1965.

Resource Units for Eighth Grade Chemistry and Earth Science. Las Cruces, New Mexico: Las Cruces School District, 1963.

Resource Units for Ninth Grade Physics. Las Cruces, New Mexico: Las Cruces School District, 1965.

Revision of Junior High School General Science. Indiana: Indiana University School of Education, (n.d.).

Science 3, 4, 5, 6. Dade County, Florida: Dade County Public Schools, 1966.

Science - A Basic Curriculum Guide Grade 9. Louisville, Kentucky: Louisville Public Schools, 1963.

Science - A Curriculum Guide. Louisville, Kentucky: Louisville Public Schools, 1962.

Science and Health. Louisville, Kentucky: Louisville Public Schools, 1963.

Science and Health, Basic Program. Cincinnati, Ohio: Cincinnati Public Schools, 1964.

Science Course of Study. Pittsburgh, Pennsylvania: Pittsburgh Board of Public Education, 1964.

Science Course of Study Grade 8. Pittsburgh, Pennsylvania: Pittsburgh Board of Public Education, 1964.

Science Experiences from the Elementary Resource Units. Portland, Oregon: Portland Public Schools, (n.d.).

Science for Georgia Schools - Intermediate. Georgia: Department of Education, 1958.

Science for Iowa Schools Junior High. Iowa: Iowa State Department of Public Instruction, 1966.

Science for Secondary Schools. Hurst, Texas: Hurst-Euless-Bedford Independent School District, 1965-1966.

Science for Secondary Schools Resource Materials for Junior High School Science. Dallas, Texas: Dallas Independent School District, 1963.

Science General Guide - 7. Beaverton, Oregon: Beaverton School District, 1966.

Science General Guide - 8. Beaverton, Oregon: Beaverton School District, 1966.

Science Grade 8 - Life Science & Earth Science. Houston, Texas: Houston Independent School District, 1963.

Science, Health, and Safety. St. Louis, Missouri: St. Louis Public Schools, 1963.

Science - Junior High. Lakewood, Colorado: Jefferson County Public Schools, 1963.

Science of Measurement and Elementary Physics. San Angelo, Texas: San Angelo Independent School District, 1964.

Science Physics and Chemistry - Grade 9. San Angelo, Texas: San Angelo Independent School District, 1963.

Secondary School Course Outline for Science in Grades 6, 7, 8. Aldine, Texas: Aldine Independent School District, 1965.

Seventh and Eighth Grade Science. Conroe, Texas: Conroe Independent School District, (n.d.).

Simple Machines. Portland, Oregon: Portland Public Schools, (n.d.).

Sound. Portland, Oregon: Portland Public Schools, (n.d.).

Tentative Study Guide for General Science, Grade 7. Wichita Falls, Texas: Wichita Falls Public Schools, (n.d.).

The Chemistry of Life. New York: Board of Education, 1962.

The Materials of Life. New York: Board of Education, 1962.

The Science of Measurement and Elementary Astronomy. San Angelo, Texas: San Angelo Public Schools, 1960.

Universe. Portland, Oregon: Portland Public Schools, (n.d.).

Wave and Mechanical Motion. New York: Board of Education, 1965.

Weather, Air, and Water. Portland, Oregon: Portland Public Schools, (n.d.).

Working With Animals. New York: Holt, Rinehart, and Winston, 1959.

Working With Plants. New York: Holt, Rinehart, and Winston, 1959.

BOOKLETS

Blough, Glenn O. An Aquarium. New York: Harper and Row, 1962.

_______. Animals and Their Young. New York: Harper and Row, 1966.

_______. Animals Round the Year. New York: Harper and Row, 1963.

_______. Animals That Live Together. New York: Harper and Row, 1963.

_______. Birds In the Big Woods. New York: Harper and Row, 1963.

_______. How the Sun Helps Us. New York: Harper and Row, 1966.

_______. Plants Round the Year. New York: Harper and Row, 1962.

Blough, Glenn O. The Insect Parade. New York: Harper and Row, 1965.

_______. The Pet Show. New York: Harper and Row, 1962.

_______. Useful Plants and Animals. Harper and Row, 1962.

_______. Water Appears and Disappears. Harper and Row, 1962.

Parker, Bertha Morris. Adaptation to Environment. New York: Harper & Row, 1965.

_______. Animals of the Seashore. New York: Harper & Row, 1961.

_______. Animals of Yesterday. New York: Harper & Row, 1966.

_______. Animal Travels. New York: Harper & Row, 1966.

_______. Animals We Know. New York: Row, Peterson, & Co., 1960.

_______. Animal World. New York: Harper & Row, 1965.

_______. Ask the Weathermen. New York: Row, Peterson, & Co., 1961.

_______. Balance in Nature. New York: Harper & Row, 1965.

_______. Beyond the Solar System. New York: Harper & Row, 1966.

_______. Birds. New York: Harper & Row, 1966.

_______. Birds in Your Back Yard. New York: Harper & Row, 1962.

_______. Clouds, Rain, and Snow. New York: Harper & Row, 1963.

_______. Community Health. New York: Row, Peterson, & Co., 1961.

_______. Creatures of the Past. New York: Harper & Row, 1965.

_______. Dependent Plants. New York: Row, Peterson, & Co., 1960.

_______. Domesticated Animals. New York: Row, Peterson, & Co., 1959.

_______. Earth's Nearest Neighbor. New York: Harper & Row, 1966.

_______. Electricity. New York: Harper & Row, 1966.

_______. Fall Is Here. New York: Harper & Row, 1965.

Parker, Bertha Morris. Fire. New York: Row, Peterson, & Co., 1959.

_______. Fire, Friend and Foe. New York: Harper & Row, 1962.

_______. Fishes. New York: Harper & Row, 1963.

_______. Flowers, Fruits and Seeds. New York: Harper & Row, 1965.

_______. Gardens Indoors. New York: Row, Peterson, & Co., 1961.

_______. Heat. New York: Harper & Row, 1963.

_______. How We Are Built. New York: Harper & Row, 1966.

_______. Insects and Their Ways. New York: Harper & Row, 1966.

_______. Insect Societies. New York: Row, Peterson, & Co., 1961.

_______. Keeping Well. New York: Row, Peterson, & Co., 1961.

_______. Leaves. New York: Row, Peterson, & Co., 1960.

_______. Life Through the Ages. New York: Harper & Row, 1963.

_______. Light. New York: Harper & Row, 1963.

_______. Living Things. New York: Row, Peterson, & Co., 1960.

_______. Magnets. New York: Harper & Row, 1966.

_______. Matter, Molecules, & Atoms. New York: Harper & Row, 1965.

_______. Our Ocean of Air. New York: Row, Peterson, & Co., 1961.

_______. Out Into Space. New York: Harper & Row, 1965.

_______. Pebbles and Sea Shells. New York: Row, Peterson, & Co., 1959.

_______. Plant and Animal Partnerships. New York: Row, Peterson, & Co., 1961.

_______. Plant Factories. New York: Row, Peterson, & Co., 1961.

_______. Reptiles. New York: Harper & Row, 1962.

_______. Rockets and Missiles. New York: Harper & Row, 1963.

Parker, Bertha Morris. Satellites and Space Travel. New York: Harper & Row, 1963.

_______. Saving Our Wildlife. New York: Row, Peterson, & Co., 1960.

_______. Six-Legged Neighbors. New York: Row, Peterson, & Co., 1961.

_______. Sound. New York: Row, Peterson, & Co., 1961.

_______. Spiders. New York: Row, Peterson, & Co., 1961.

_______. Spring Is Here. New York: Harper & Row, 1962.

_______. Stories Read from the Rocks. New York: Harper & Row, 1965.

_______. Summer Is Here. New York: Harper & Row, 1965.

_______. Superstition or Science. New York: Harper & Row, 1963.

_______. The Air About Us. New York: Harper & Row, 1962.

_______. The Earth. New York: Harper & Row, 1963.

_______. The Earth's Changing Surface. New York: Harper & Row, 1963.

_______. The Garden and Its Friends. New York: Row, Peterson, & Company, 1961.

_______. The Plant World. New York: Harper & Row, 1963.

_______. The Scientist and His Tools. New York: Row, Peterson, & Company, 1960.

_______. The Sky Above Us. New York: Harper & Row, 1965.

_______. The Sun and Its Family. New York: Harper & Row, 1962.

_______. Toads and Frogs. New York: Harper & Row, 1966.

_______. Toys. New York: Harper & Row, 1962.

_______. Travel Aloft. New York: Harper & Row, 1965.

_______. Trees. New York: Harper & Row, 1965.

_______. Watch Them Grow Up. New York: Harper & Row, 1962.

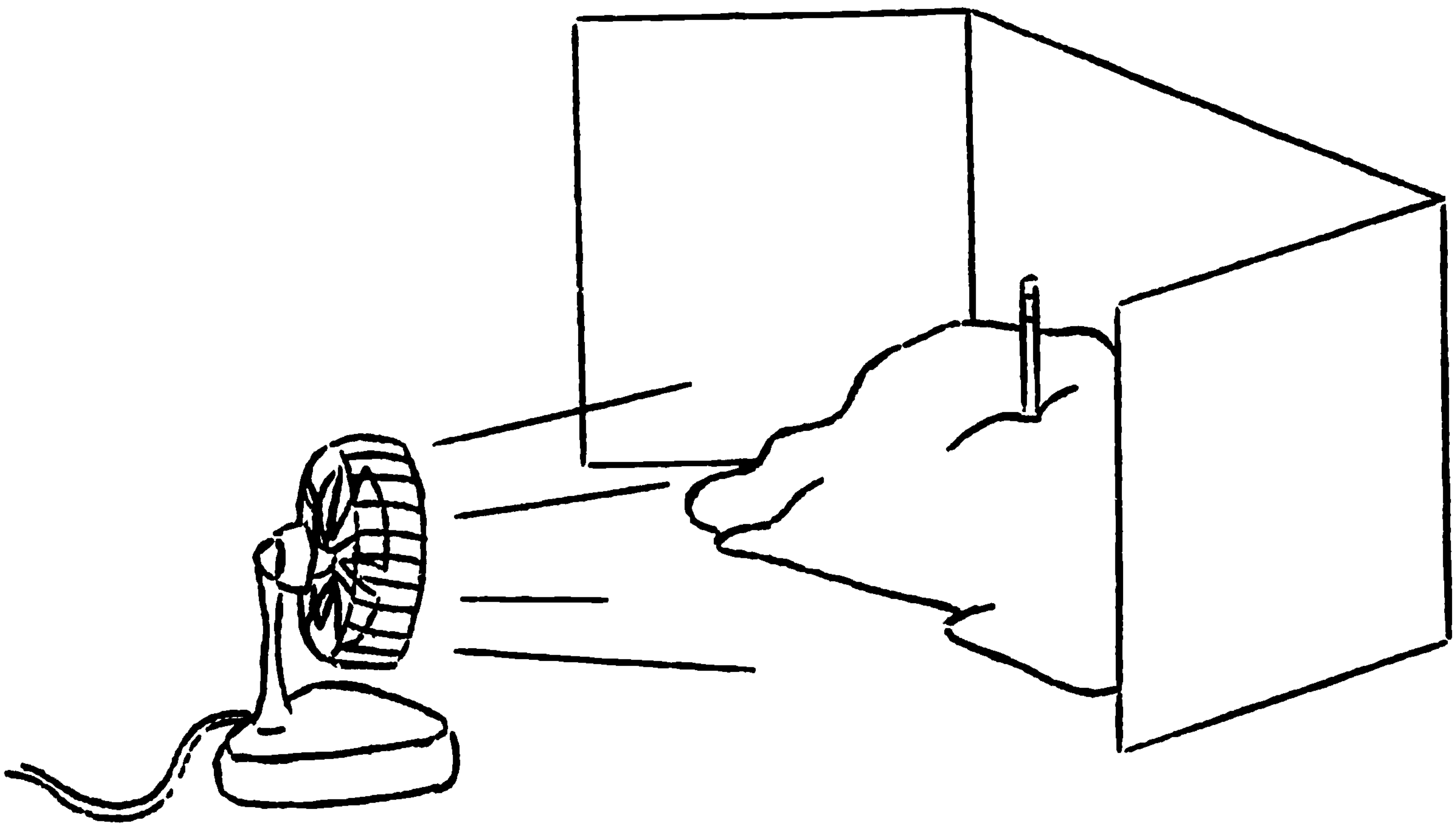
Parker, Bertha Morris. Ways of the Weather. New York: Row, Peterson, & Company, 1961.

_______. What Things Are Made Of. New York: Harper & Row, 1966.

_______. Winter Is Here. New York: Harper & Row, 1965.

_______. You As a Machine. New York: Row, Peterson, & Co., 1962.

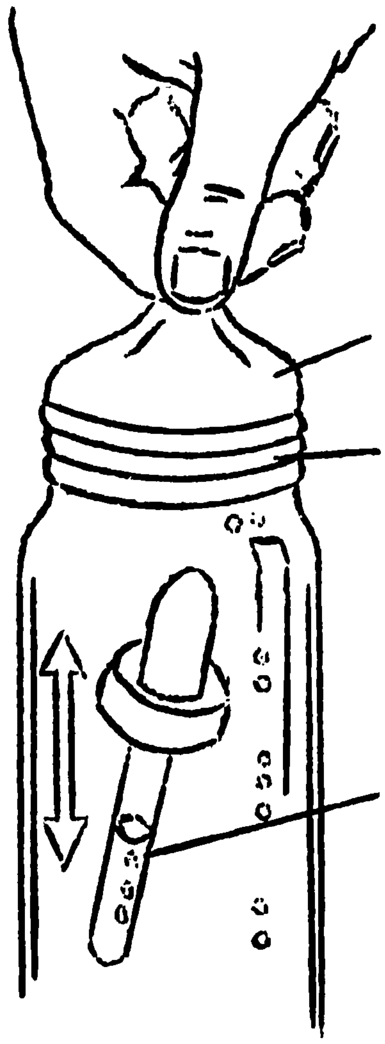
Wind Erosion



With an electric fan and a pile of dry sand interesting studies can be made of the effect of wind erosion and the formation and movement of sand dunes. If the studies are conducted indoors, sheets of cardboard can be used to keep the sand from scattering over the room.

Stick a pencil in a pile of sand to represent a tree and notice what happens when the wind blows across the sand. Consult library references about sand dunes, wind erosion, and deserts to gain ideas for other similar experiments.

A MYSTERY "DEVIL DIVER" WHO GOES UP AND DOWN



Obtain a tall, slender jar (such as a seltzer-tablet jar) and an eye dropper with a stem made of clear glass that will fit into the jar. Then fill the jar with water and partially fill the dropper so that it will not quite sink or sink very slowly when placed in the jar. Next stretch a piece of rubber from a balloon over the open top of the jar and fasten it on with a rubber band so the jar is sealed with a tight drum of rubber across its mouth. Then push down or pull up on the rubber drum and watch what happens.

If the eye dropper is filled with the correct amount of water, it will go down when the rubber drum is pushed into the jar or rise to the surface when the drum is pulled up. The increased pressure on the water, which is created when the rubber drum is pushed into the jar, causes more water to enter the dropper, compressing the air inside it. The added water makes the dropper heavier and it sinks.

When the rubber drum is pulled up, the pressure on the water is decreased to less than normal so the air in the dropper expands and expels some of the water from the dropper. This makes the dropper more buoyant and it rises. If pupils watch closely when the rubber drum is pushed or pulled, they should be able to see that the water level changes inside the dropper.

A dropper with a glass stem must be used as those with a plastic stems are not heavy enough. With a bit of practice, it is possible to reverse the push or pull on the rubber drum and cause the eye dropper to remain suspended halfway up from the bottom of the jar.

SIMULATING A TORNADO

Not only are contributing influences of the formation and maintainance largely unknown but specific measurements within a tornado are almost non-existent. The dirth of measurements are due to the twin difficulties of both getting to an operating tornado and having durable enough (no anemometer has yet withstood the force) and sensitive enough (barometers haven't been thougnt to cnange readings fast enough. Among the conditions known to be precursors of a tornado are:

A low layer of moisture laden with unstable air below 10,000 ft. with a deep upper layer of dry very stable temperature--inverted air above and a jet of strong winds at an intermediate level of about 15,000 feet usually parallel to occurring thunderstorms.

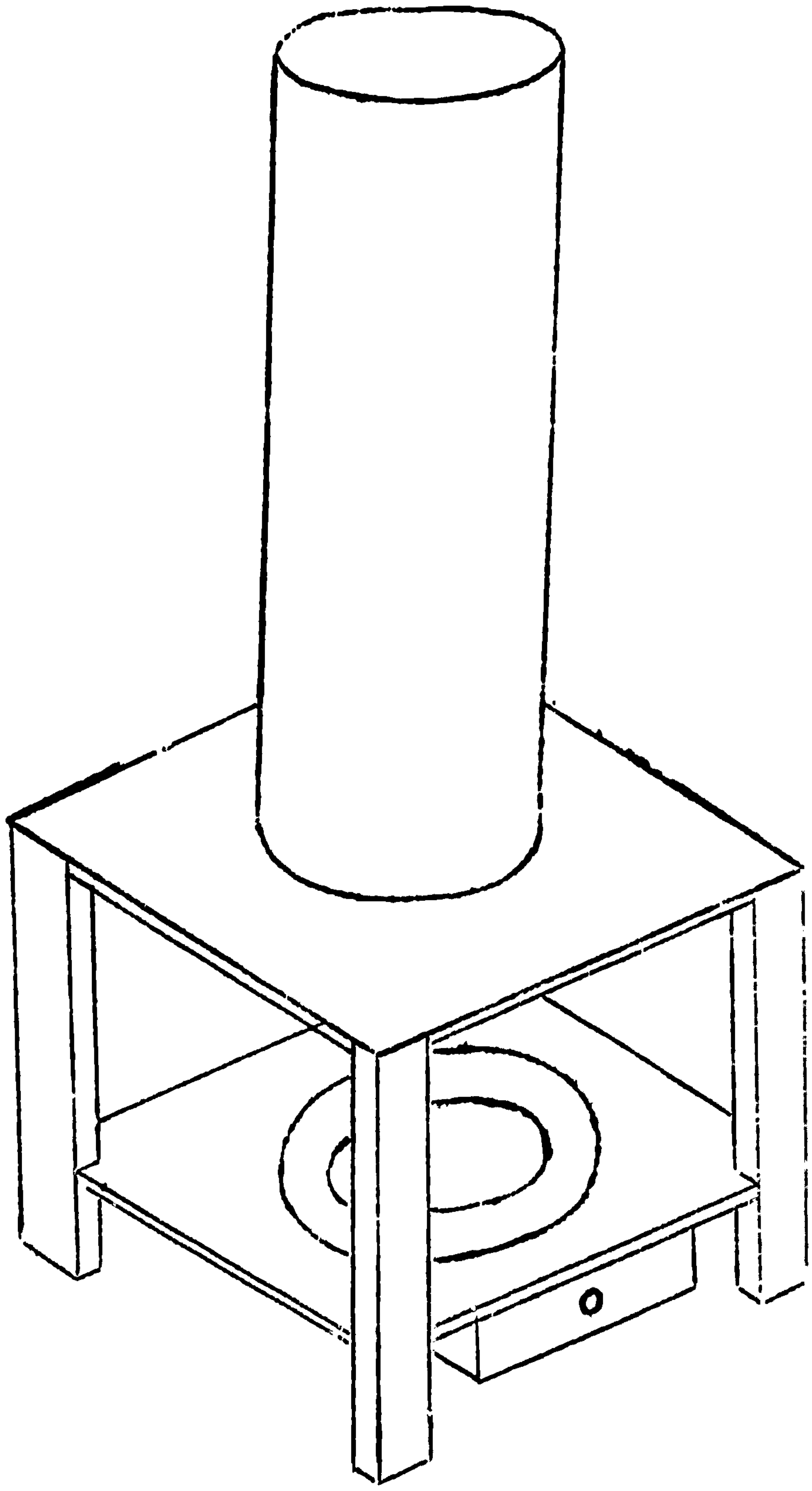
The tornado is usually proceeded by thunderstorms and hail and a sharp dip in pressure in the immediate vicinity (about 5 miles in diameter with smaller concentric areas increasingly changed to the ultimate center of the funnel 50 to 500 feet across). Funnels are known to dip down to the ground and they are hypothesized start hign up.

From our simulated version we can hypothesize some of the requirements of a tornado.

How is a tornado like a chimney? What energy source could supply the needs of a tornado? What makes the 'Twister' revolve in a counter-clockwise direction?

(The tornado is a small funnel up through the deep dry layer of air aloft like the gases moving up a chimney.) But how does a chimney work? (Without a fire a low pressure can be produced like a venturi tube by fast movement of air past or across the top of the chimney. With a chimney wind cannot be depended on to be present so we need to explore further to find out how a chimney works. Gases expand when heated; become bouyant and move upward. If an insulated jacket is provided the expanding gases laden with unburned carbon and other solids will not stop their upward movement or deposit their load on the surrounding walls. The gases will tend to move faster as the insulated chimney is made higher because there will be less pressure to oppose expansion as the chimney gets higher; the greater height adiabatically requires less heat to produce expansion because the greater the ascent the less dense and colder the atmosphere.

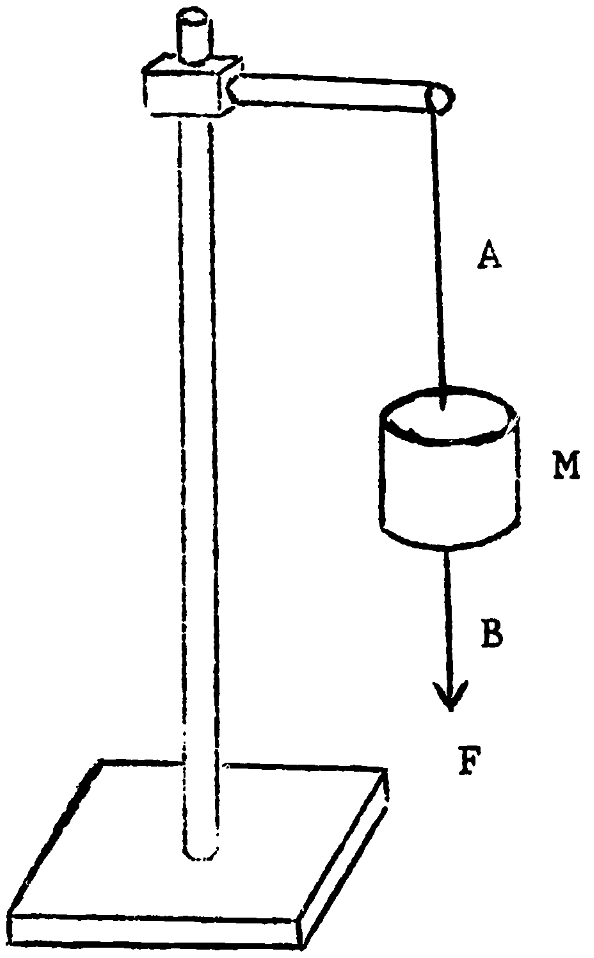
The jet wind high aloft could by the venturi effect help start a chimney action through the deep dry layer of air. Dry air could have insulation qualities which might promote a chimney action. The spin of the winds to the left caused by the rotation of the earth and known as the coriolus effect must certainly be involved in the winds spinning perhaps at the speed of sound. It has been noted that tornadoes generate a loud noise like a thousand freight trains. The energy could be supplied by condensing water droplets as in thunderstorms and no



doubt at least part of the energy comes from this source but since lightning is known to exist in the funnel maybe that energy is used as well.)

Overall we have raised many unanswered questions and proposed a few rather shaky answers. This one question we can leave to future research. Could you work out some possible solutions and test them?

INERTIA



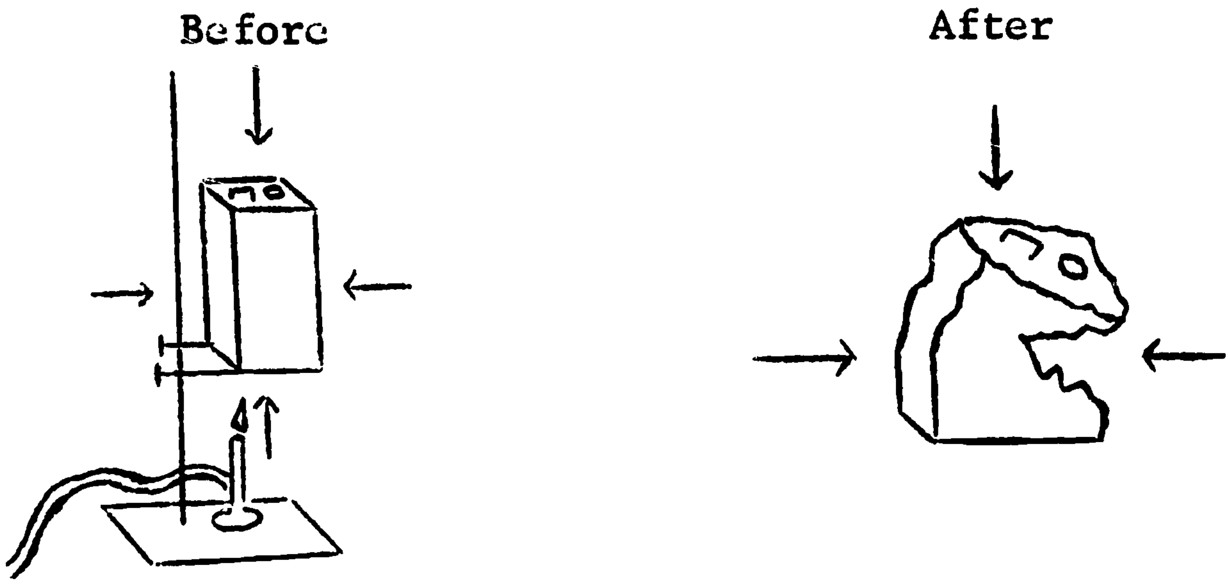
The inertia of a body may be defined as that property of a body which tends to resist any change in its state of rest or motion. Mass is defined as a quantitative measure of the inertia of a body.

An experiment illustrating inertia can be performed in the following manner. A small mass M of about 1000 gm is suspended by a fine thread A, then pulled downward by another piece of the same thread B. If the thread is suddenly jerked at B, the thread will always break at B; whereas if a slow steady pull is applied at B, then the thread will always break at A.

In the first case the force F is momentarily large causing the thread to break before the mass M has had time to move down enough to stretch and break thread A.

In the latter case the tension in A is equal to F plus the weight of mass M, thus the tension in the upper string is greater than the tension in the lower string so the upper string breaks.

AIR PRESSURE



Problem: To prove that air has pressure.

Materials: A rectangular, empty varnish can with a screw-top lid, a Bunsen burner, ring stand with ring and clamp, and water.

Method: Obtain a rectangular varnish can with a screw-top lid. Be sure the can is empty and clean. Heat about a cup of water in the can with the lid off. When the water boils and the steam escapes for a few minutes, turn off the heat and fasten the screw-top lid on very tightly.

Observations: The can was not really empty at the beginning of the experiment, but was filled with air. The steam saturated the molecules of air in the can. As the outside air cooled and condensed the steam in the can, a partial vacuum was formed and the can collapsed. This meant that the outside air pressure was greater than the air pressure inside the can, so the can was crushed. Air exerts pressure in all directions.

Conclusion: It was proved by this experiment that air has, or exerts, pressure. The pressure of air is 14.7 lbs.

per square inch at sea level.

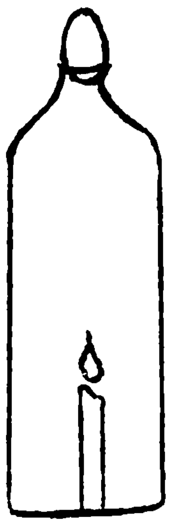
Practical Application: Air is used by man in a practical way to do work because it has weight (a cubic foot of air weighs from 1 to 1¼ ounces), occupies space, and presses upon surfaces. Some examples of its uses are with the <u>lift pump</u> for raising water from one level to another, the <u>siphon</u> for carrying a liquid over an elevation to a lower level, the <u>sealing of jars</u> in food preservation by the housewife, the vacuum cleaner, the force cup (or "plumber's friend") for unstopping drains, and simply drinking a liquid through a straw.

After the can has been crushed it can be inflated by putting a screw-top lid (on which a tire valve has been soldered) on the can and then, using a bicycle pump, inflate the can.

1. Explain how air has a pressure of 14.7 lb. per square inch.

2. Ask class if they have ever seen an egg inside a bottle.

3. Boil an egg and peel it. Eggs may also be soaked for 48 hours in vinegar. The egg shell will become soft and can be forced into the bottle.



4. Put a candle in a milk bottle.

5. Ask class why you have put the candle in the bottle.

6. Light the candle. Then put the boiled egg on top of the open milk bottle.

7. Ask the class why the egg bounces up and down on the top of the bottle.

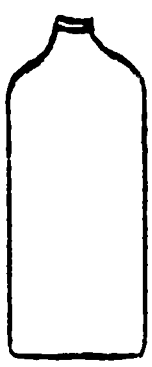
8. The egg is then forced into the vacuum inside the bottle.

Pascal's Law

1. The pressure placed on a liquid is increased by the same amount throughout the water.

2. For example if the pressure is 5 lbs. per square inch at the top of the bottle, and the bottom of the bottle is 50 square inches, then there is an increase of 250 lbs.

3. Take the bottle in the left hand. (Use something to protect the hand from cuts. One suggestion would be to wrap the first four inches of the neck of the bottle with electricians tape.

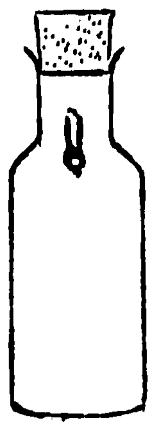


4. Bring the left hand to meet the heel of the right hand sharply.

5. The bottom should fall out of the bottle.

CARTESIAN DIVER

1. Ask class if they have ever seen floating wood sink.
2. Ask how they would go about making a match stem sink.
3. Fill a bottle with water. Place a match head with a small piece of wood.
4. Put pressure on the cork.
5. The wood begins to sink.
6. Explain that when pressure is applied the pressure is increased by the same amount throughout the water.



What happens to the water surface around the head of the match when the water pressure is increased?
(Air in the head of the match is compressed thereby changing the water displacement of the head of the match for the same weight and allowing the head of the match to sink.)

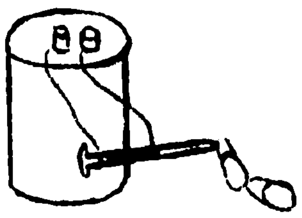
TEST FOR SUGAR

Materials needed: test tubes, rack, burner, Fehling's solution or Benedict's solution, test tube holder, brown sugar, and various foods.

Method and Observations: Place some brown sugar and water in a test tube, and add an equal amount of either Fehling's or Benedict's solution. Boil for a minute. The brick-red color indicates the presence of a simple sugar.

Test a piece of cracker for sugar. Chew the rest of the cracker for about two minutes. Now test the chewed cracker for sugar. (P ylin is an enzyme present in normal saliva that changes starch to simple sugar.)

ELECTROMAGNETISM



Purpose: The link between electricity and magnetism: electricity and a coil can combine to make a magnet.

Apparatus: Iron nail, insulated copper bell wire, no. 6 dry cell with screw terminals, paper clips.

Technique: Coil the wire around the nail leaving some free at the ends to connect to the positive and negative terminals. Try to attract the paper clips. Disconnect one of the wires.

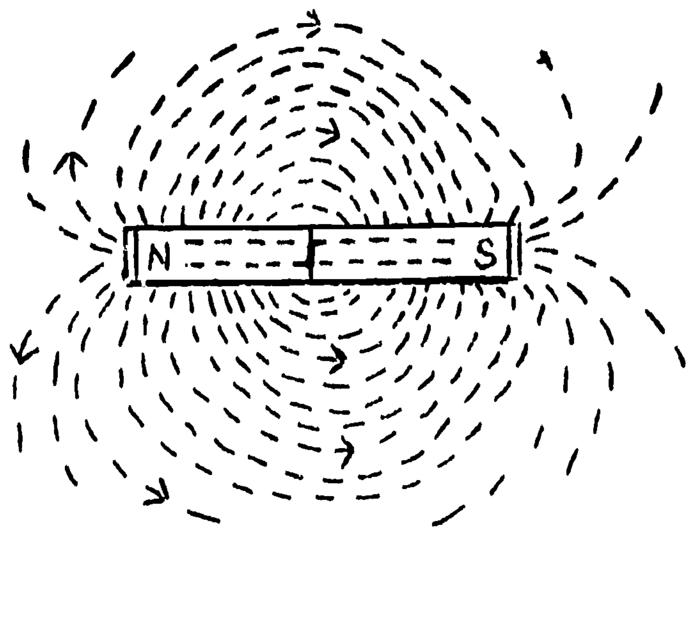
Observations: While the current is flowing, it will magnetize the nail. When the current is cut off, the nail loses it magnetic properties.

MAGNETIC FIELD

Purpose: To show the magnetic field around a bar magnet.

Apparatus: Bar magnet, iron filings

Technique: Place the bar magnet under a sheet of white



paper. Lightly sprinkle iron filings over the paper. Observe carefully for any pattern.

Observations: The flux lines (lines of force) will emerge from a magnet in the region of the N pole and enter the magnet in the region of the S pole. Every line is a closed path.

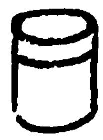
UNITS ON FUEL TRANSPORTATION POWER OR ENERGY

Some facts about power and the f el which produces it.

Burning gasoline must have 15 lbs. of air for every pound of gasoline.

$$C_8H_{18} + 12O_2 \longrightarrow 7CO_2 + CO + 9H_2O$$

(constituents of gasoline could contain lead and other additives)



The explosion is caused by the expansion of hot gases as may be seen from the equation.

Compression Ratio:

When compression ratio of an ordinary gasoline engine is 1/7 "one to seven". This means that 1/2 the space at the top of the piston contains hot gases -- and a spark will explode this to 7 times this volume. Thus, energy from gasoline is released.

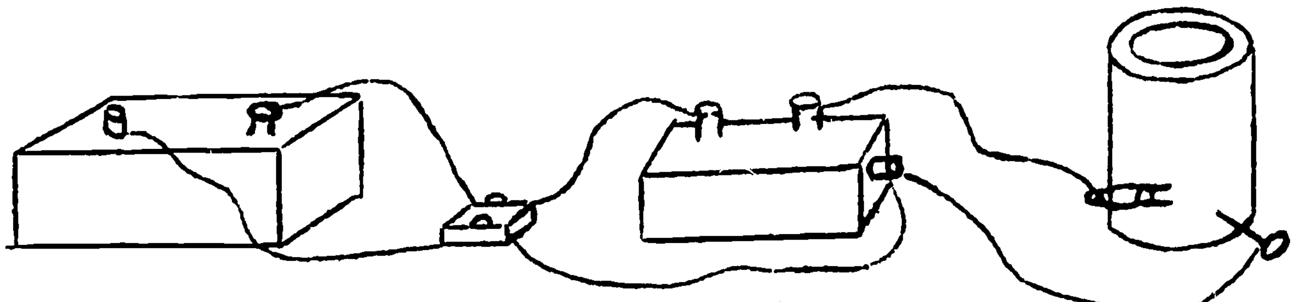
Diesel Engines have a very high compression ratio 1/16. So when a diesel charge is compressed to 1/16 of its volume, heat caused by the compression produces a temperature of 1000° F.

Increasing the Compression Ratio:

Increasing the compression ratio increases the possible heat range and thus increases efficiency.

The Diesel which is most efficient uses only 30% of the stored energy in fuel.

PRINCIPLE OF THE GASOLINE ENGINE



Purpose: To show that a great deal of energy is derived from a small amount of vaporized gasoline. To explain the principles of the gasoline engine.

Materials:
1) baking powder can
2) knife blade switch
3) copper wire
4) T-Ford spark coil
5) 6 or 12 volt battery
6) 1 nail
7) ounce or two of commercial gasoline
8) medicine dropper
9) alcohol lamp and alcohol
10) spark plug

Procedure: Make a small hole in the side of the can about 1 inch from the bottom. Screw the spark plug into the hole. At about 90 degrees from the plug hole make a small nail hole for inserting a nail.

With a medicine dropper place 5 or 6 drops of gasoline in the previously heated can and fasten the lid lightly. Now close the knife blade switch. Expect an explosion.

Caution: Never touch the wire between the battery and the can when the switch is closed. Severe shock will result.

SOME FACTS ABOUT POWER

James Watt - Inventor of the steam engine

1 hp. - 1 horse can lift $\underset{\text{wt.}}{\underline{\text{550 pounds}}}$ $\underset{\text{distance}}{\underline{\text{one foot}}}$ in $\underset{\text{time}}{\underline{\text{one second}}}$

1 hp. - 746 watts To develop a clearer conception of the watt - we say 1 watt is equal to the <u>power</u> of one <u>small</u> <u>kitten</u>.

1 hp. - power a man has is approximately 150 watts.

$$\text{So horsepower} - \frac{\text{weight x distance}}{\text{(550 x time in seconds)}}$$
$$60 \times 60$$

To calculate the power of a water fall you must know:

1) Height of the water fall
2) The weight of water falling in one second

Other teasers of stimulants:

1) Convection current in water
2) Electric Arc Lamp - (Hottest temperature and highest light known to man on earth)
3) Lemm battery

Calculations for this particular problem---

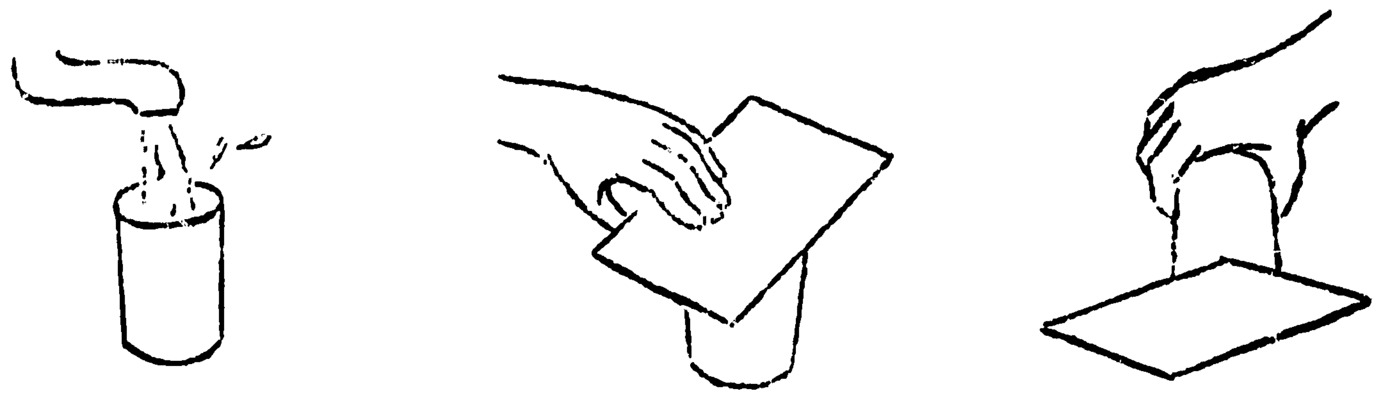
$C_8 H_{18} + 12O_2$

114 mol.wt. 384 mol. wt.

$$W = \frac{384 \text{ mol.wt.}}{114 \times 0.21} = 16$$

air is 21% oxygen

AIR PRESSURE



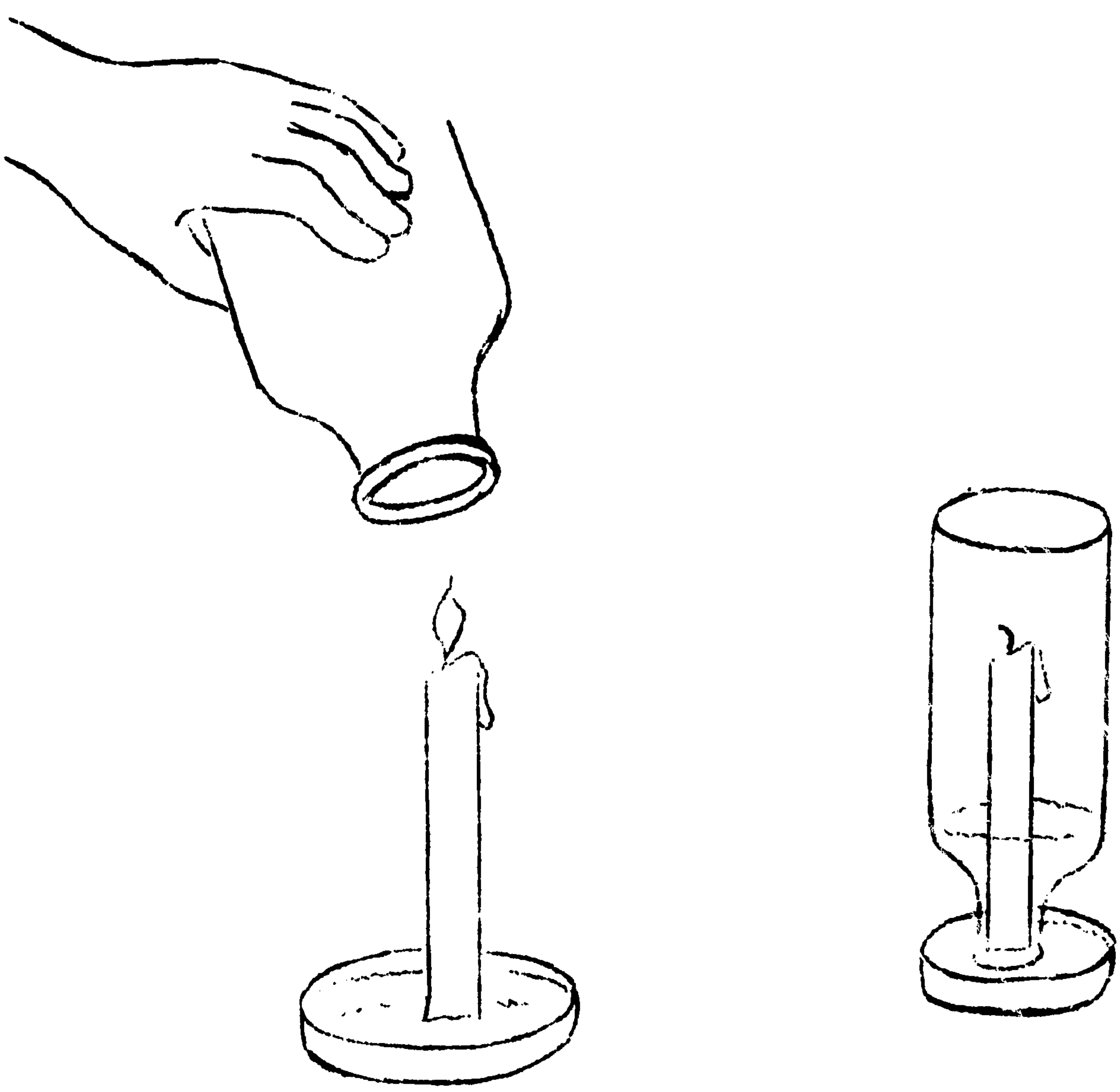
Fill a glass of water to the brim.

Take a piece of then, flat cardboard and hold it tightly over the mouth. Quickly turn the glass upside down. Take your hand away from the cardboard. This cardboard stays in place because air pressing upward holds in against the glass.

Tilt the glass. Hold it sideways, and still the card stays in place.

But do this experiment over the sink, just in case something goes wrong and you spill the water.

AIR PRESSING FROM THE OUTSIDE PUSHES THE WATER UP

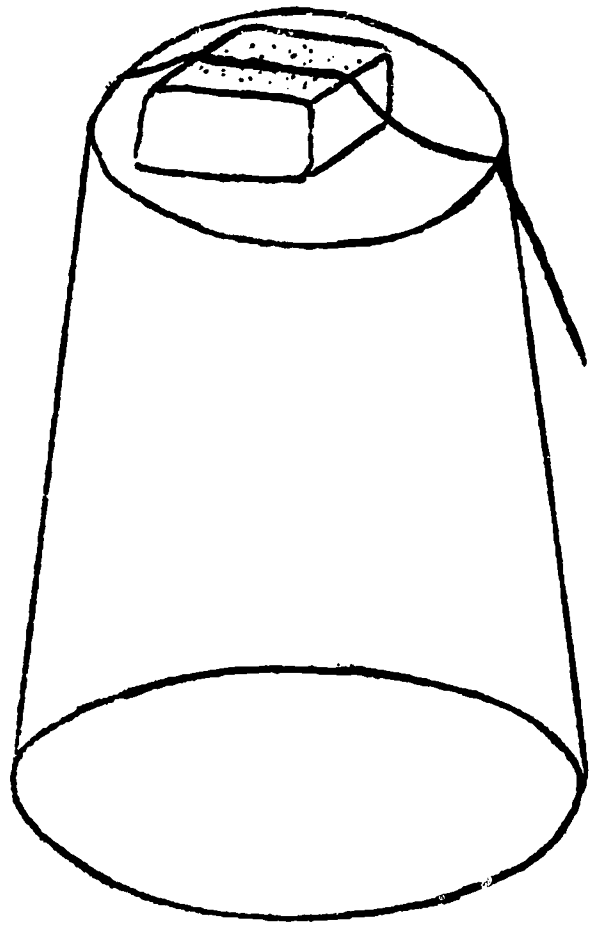


Stand a lighted candle firmly in the center of a soup plate with a drop of melted wax. Pour water into the plate until it is almost full.

Now place a milk bottle over the candle. Soon you will see the water climb up inside the bottle. Then the candle flame goes out.

The flame went out as soon as it used up the oxygen inside the bottle. The remaining part of the air took up less room, therefore the outside air was able to push water up into the bottle.

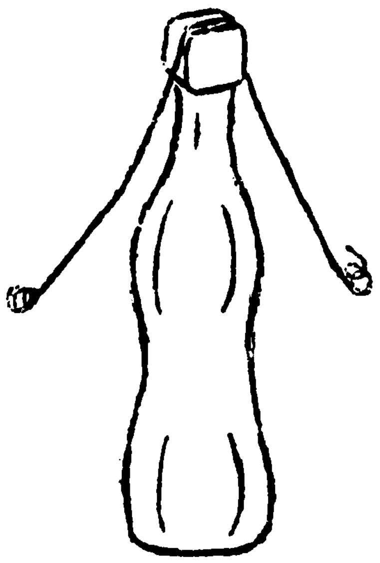
The air pressure on the outside of the bottle is greater than the air pressure on the inside of the bottle. Cold air is heavier than warm air.



Turn a glass upside down and place an ice cube on the bottom of the glass. Lay a string across the ice cube lengthwise. Sprinkle a small amount of salt on the ice cube and allow to stand for approximately 40 seconds. The ice cube may now be picked up with the string for it is now frozen securely to the string.

Since salt may be used to melt ice as in the removal of ice from sidewalks why is it that the ice cube freezes to the string?

REGELATION



To illustrate the importance of phase change due to pressure only you can cut through an ice cube with a wire to show the ice changing to liquid water and then, as pressure is released, the liquid water changing back to solid water.

Twist the ends of a strong, thin 8-12 inch wire about large nails or bolts to form handles. Place an ice cube on top of a coke bottle (allow the cube to set at room temperature for a short while so it will not be supercooled), place the wire across the cube and bear down heavily on the handles. In several minutes the wire will have passed completely through the cube, but the cube will still be whole.

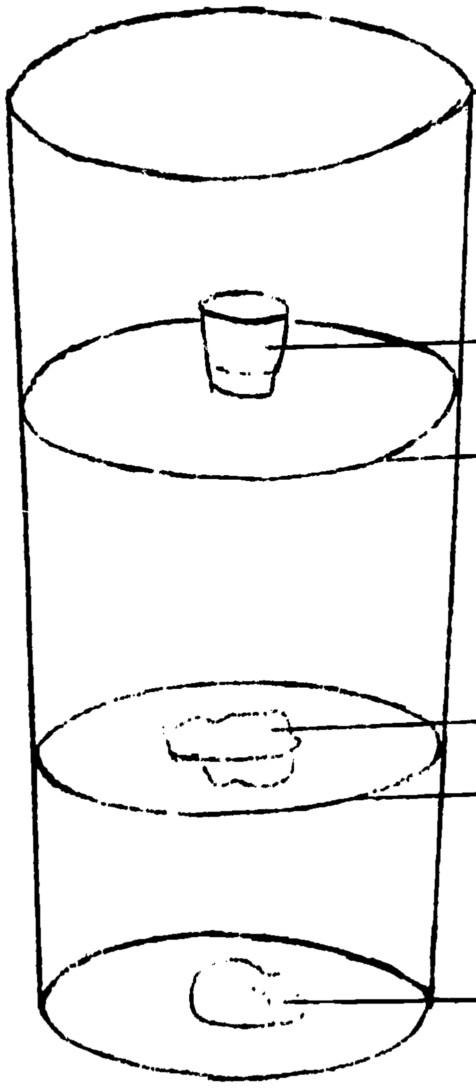
TAKING MIXTURES APART

Materials: A teakettle, a rubber tube that will fit the teakettle spout, hot plate, cup, a bowl, ice, water, food coloring, and table salt.

Procedure: Put about 2 cups of water, 3 drops of food coloring, and 2 teaspoonfuls of table salt into the teakettle. Arrange tube on spout of teakettle and place on the hot plate. Arrange the rubber tube so that the free end is in the clean glass. Put the glass in a pan of cracked ice or cold water. Let the water boil and boil. After a while you see drops of water coming from the tube into the glass. These drops of water will be clear. When enough water is in the glass, it will not taste salty and will not be colored.

Discussion: Ask what happened when mixture was heated. What happened to the salt and coloring? (Remained in the kettle.) Steam came through the tube and into the glass. When the steam was cooled, it turned to water vapor.

BUOYANCY



Materials: Large olive jar; kerosene or vegetable oil; small cork; paraffin, water, rock.

Procedure: Half fill an olive jar with water. Then slowly add kerosene until the container is nearly filled to the brim. (If no kerosene is available use cooking oil). Next drop a small rock, a small piece of paraffin, and a small cork into the liquid successively and observe what happens.

Water is heavier than kerosene or cooking oil, so the kerosene floats on top of the water. If pupils look closely, and especially if food coloring is added to the water, they will be able to see how the two liquids separate.

When the rock is dropped into the liquid, it sinks to the bottom of the container because it is heavier (has more weight per volume of a higher specific gravity) than either of the liquids. But when paraffin is dropped into the liquid, it behaves differently because it is heavier than kerosene but lighter than water.

For this reason, the paraffin sinks to the bottom of the kerosene, but floats on the water and appears to be suspended in the liquid near the center of the container.

Since the cork is lighter than either liquid (has a lower specific gravity than either of them), it floats on top of the kerosene.

If less water were used and some mercury were poured into the container, the rock wouldn't sink to the bottom of the jar. Instead it would float on top of the mercury--much to the surprise of the students. This is because the mercury has a higher specific gravity than even a rock.

EROSION

To learn about any stream in your area.

Why does this stream run in the direction it does? Is it a slow-running stream or a swift one, and why? Is yours a region with a great deal of rainfall or only a little?

To show that raindrops move soil.

Fill flat pans with soil, pat it down tight, and place several small flat stones on top. Set them in a rain and observe at intervals of half an hour, as long as the rain lasts. A sprinkling-can could be used for rain in case of necessity. What happened to the soil? If this experiment is done inside a schoolroom, the pan of soil should be set in a larger container because of the splash.

CARBON DIOXIDE CYCLE

To show there is carbon dioxide in soda water.

Soda water, such as is sold as bottled "pop" and at soda fountains, is made of water which contains carbon dioxide. When the pressure of the gas is released, as in removing the cap from a "pop" bottle, the gas escapes and produces bubbles.

To test for carbon dioxide.

Pour some fresh limewater (to prepare limewater, obtain some lime from the hardware or paint-supply store. Stir a tablespoonful of lime into a pint of water. The water will dissolve some of the lime, but will be milky in appearance. The undissolved lime can be filtered out) into a jar of carbon dioxide and shake vigorously. The limewater turns milky; and if it is left undisturbed for awhile, a white substance may be seen to settle at the bottom. This is the way that chemists test for CO_2.

To test breath for CO_2.

With a rubber, straw, or plastic tube, blow the breath through some fresh limewater. Does this test indicate any CO_2 in the breath?

ADAPTATION

To find how many animals escape their enemies.

Through discussion and reading one may encourage children to become interested in the different ways animals escape their enemies. Children might find it interesting to make a list of animals that are able to avoid close contact with their enemies.

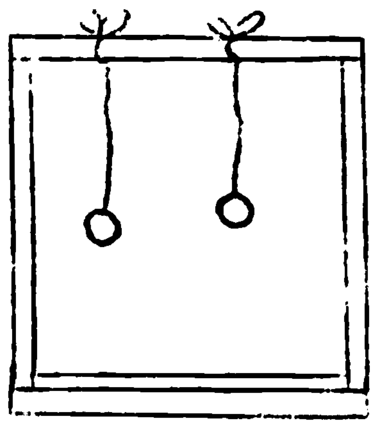
Children could list all the protective devices they know of. They might like to illustrate some of the protective devices in clay models, in sketches, or in murals. A horse or deer with its long, slender legs could show speed; animals with sharp teeth could show biting; animals with horns and antlers might illustrate how these are used for protection.

To show the effect of low temperatures on an animal which can survive great variations in temperature.

This may be demonstrated by placing a frog in a container of water to which some ice is gradually added, so that the temperature of the water is slowly lowered. Children can then observe that the frog becomes quite inactive as its body temperature drops nearer to that of the water. After it has stopped all activity, the frog may be taken out of the water and placed where it will be warmed slowly. As its body temperature rises, it will resume normal activity. This demonstration may also be performed by placing insects in a bottle or other glass container and then placing the container in ice water for some time. As the temperature within the bottle drops, the activity of the insects decreases. Grasshoppers or other fairly large insects may be used.

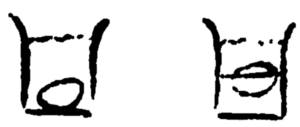
To learn which animals hibernate in your local community.

Inasmuch as climates differ so widely, this will need to be a local study. Learn what wild animals live in your community and then either ask someone in the community who knows about animals or obtain books to learn whether or not the animals hibernate and where.



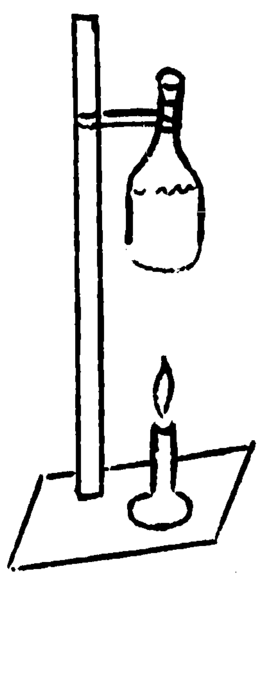
Purpose: Snows effect of increased motion. How it reduces pressure.

Hang two ping pong balls so tney are about 2 inches apart. (Use cement to attach string). Invite students to express opinions of what would happen if someone blew between the two balls. Would tney blow apart or would they come together?



Purpose: Shows effect of density on buoyancy. Fill two beakers about ½ full of H_2O. To the second beaker add about 4-5 tablespoons of Nacl---then very carefully pour a layer of water on top of the salt water. Drop an egg in and observe.

Purpose: To observe convection currents. Place hot water in a glass or jar. Add enough color to make very obvious. Place another jar of clear cooler water on top (mouth to mouth) with warm water. Observe.



Purpose: To observe relation of pressure to boiling point of water.

Heat H_2O in a bottle with a smaller neck. When it boils allow most of the air to escape tnen cap tigntly with a cork--invert bottle and pour H_2O over the top. Observe results.

RELATIVE ACTIVITY OF THE EARTH'S METALS

Metals and nonmetals are found in rocks and today we are concerned with the activity of metals.

Metals - elements that lose electrons easily and form positive ions.

Metals have these characteristics:

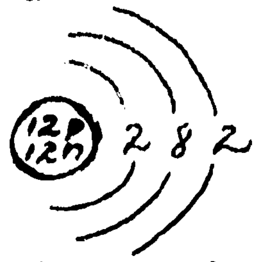
1. shiny luster
2. conduct both heat and electricity
3. they are ductile
4. they are malleable

We know that all rocks are composed of minerals and these minerals are composed of elements.

Element - a substance that cannot be changed by ordinary means into any other substance.

An element is composed of atoms.

Atoms are composed of protons, has a positive charge; neutrons, have a neutral charge in the nucleus. Surrounding the nucleus is a group of electrons, having a negative charge; these rovolve around the nucleus in definite orbits.



Mg (magnesium)

In the study of earth chemistry the electrons are the only thing involved in a chemical reaction.

In order of tendency to lose electrons

Na - Sodium
Ca - Calcium
Mg - Magnesium
Al - Aluminum
Zn - Zinc
Fe - Iron
Pb - Lead
Hg - Mercury

$$Mg^{++} + HCl^{+} \longrightarrow MgCl_2 + H$$

Questions to ask class:

1. When first define what a metal is, ask class to name some metals.

2. Then ask for some characteristics of metals.

3. Ask class which element is most active and why it is so active.

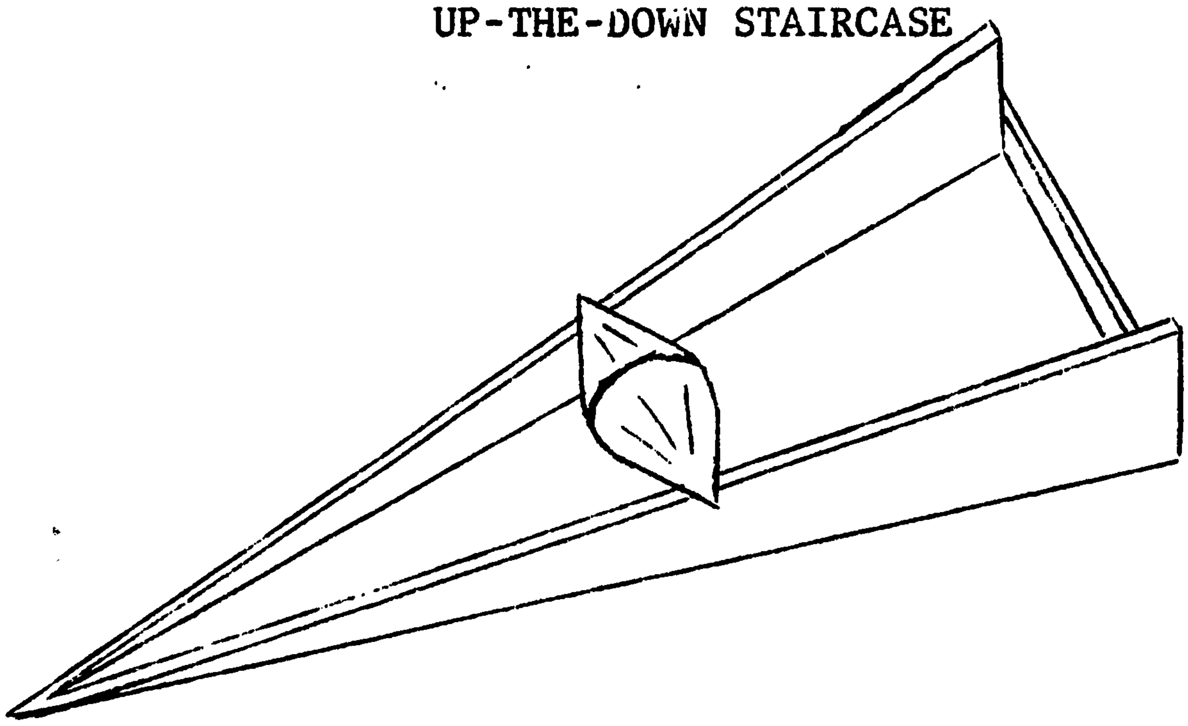
4. Ask class to name the gas which is being released.

Procedure:

Place nine test tubes in a test tube holder and place in each test tube (half full) HCl. Then take a small amount of sodium, calcium, magnesium, aluminum, zinc, iron, lead and mercury in this order in the test tubes.

A reaction will take place according to the activity of each metal.

UP-THE-DOWN STAIRCASE



Really this name isn't exactly correct but it comes close. You see, the center bob can be started to roll down-slope but it stops and rolls up-slope instead. Why does it do this?

Let's take a closer look. What happens to the center of gravity of the bob as represented by its two ends? While the bob seems to go up-slope the end goes lower. So really the bob while seemingly going up is really going down since its beveled sides let it sink down as it goes up-slope.

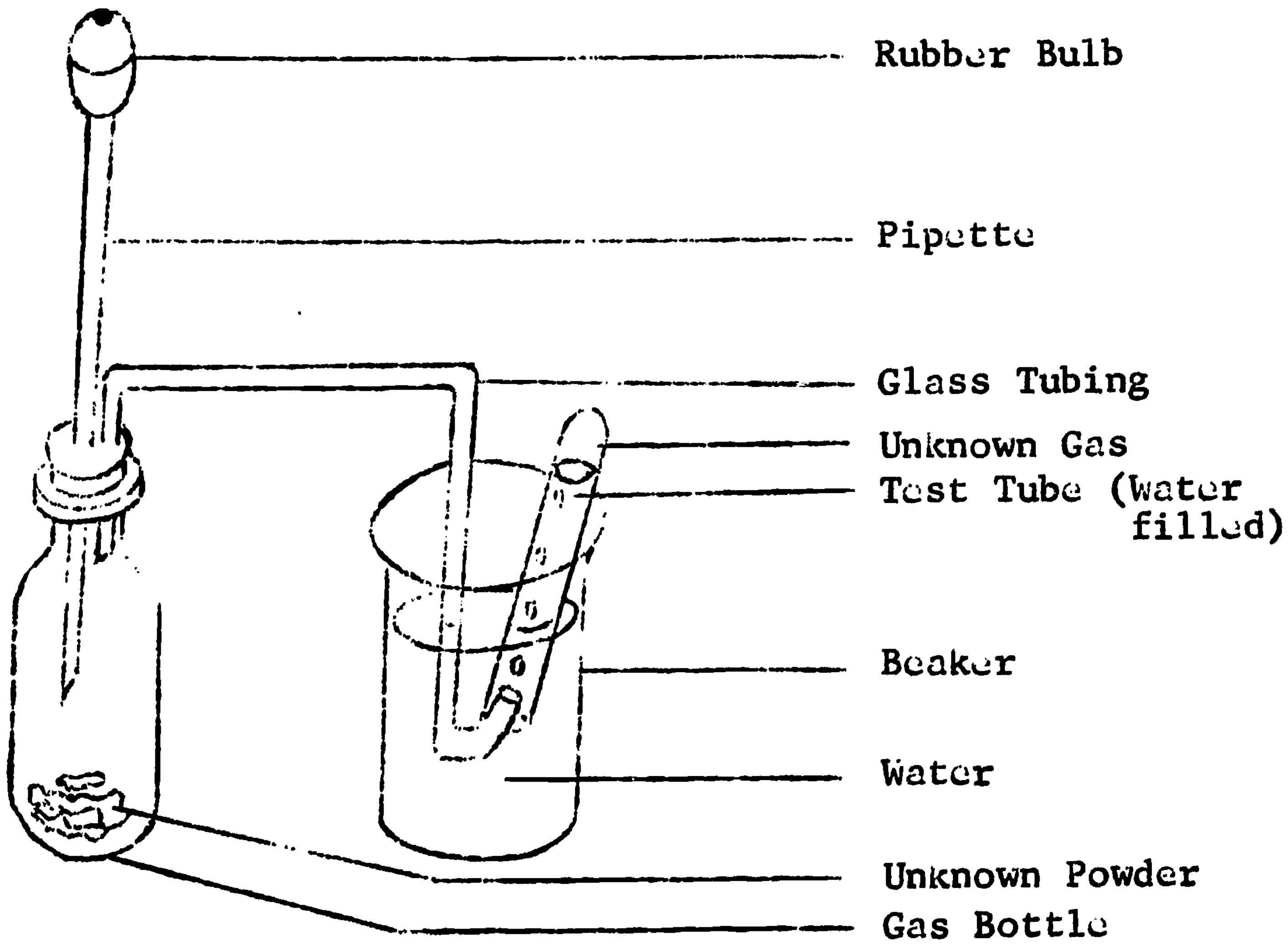
STARTING A FIRE WITH WATER

This is the approach used by one teacher with a group of students. Other approaches could be used.

I will be using two almost-white powders and a special liquid I will call fire-water. You will notice I have taken the precaution of asking a member of the class to man the dry chemical fire extinguisher in case we get too much of a fire going with our fire water. There are reasons not to trust too fully the power of the extinguisher on this fire so we will try to be cautious.

You probably have been led to believe that to have a fire you need oxygen, a fuel, and enough heat to arrive at the kindling temperature of the fuel. Let's see if you really need all of those things.

First I'll mix thoroughly about a half tablespoon of each of these two powders. Notice that the mixing is done on a large piece of asbestos to protect the table-top. Next I need a source of fire water. Luckily we have it piped right into the room. (Fill a glass from the C.W. tap and drink some.) Um!!! Tastes fine! Had to test it you know. Now I'll just fill this empty see-through water gun with fire-water and we'll be ready to go. (From 4 to 5 feet away shoot a few drops of fire-water onto the powder mixture.) (Sputtering gives way to a nice orange flame and leaving a larger black residue than the volume of the original powder mixture.) What do you smell? Doesn't it smell a little like a kitchen

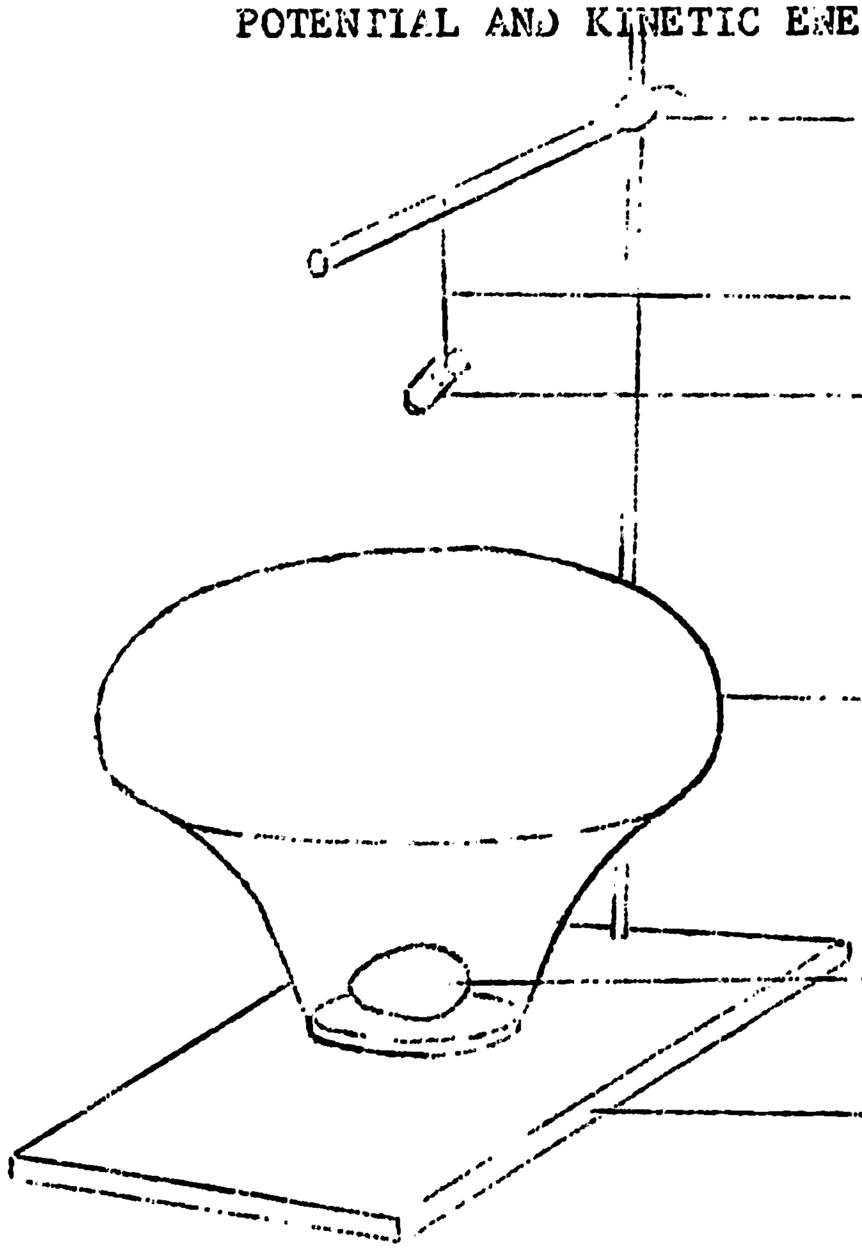

Rubber Bulb
Pipette
Glass Tubing
Unknown Gas
Test Tube (Water filled)
Beaker
Water
Unknown Powder
Gas Bottle

where a cake has been baked and fixed for company? What is the black residue? Burnt sugar maybe? If one of the powders was sugar what requirement of fire could it fill? (Fuel) If sugar is our fuel what else do we need? Was there any heat generated when the liquid was sprayed on the powders?

Let's take a small quantity of this light-yellowish powder (about a half tablespoon) and put it in this gas bottle.

If we squeeze the rubber ball on the end of the graduated pipette full of fire water from the cold-water tap. We see that a gas is produced. After we make enough gas to nearly replace all the air originally in the gas bottle we can collect a test tube of the gas and test it in some way. Say, the base of the gas bottle is getting hot. What kind of reaction gives off heat? (Exothermic) Would this heat supply one of the requirements we have been told must be present to have a fire? (Yes, adding heat to the kindling temperature of the fuel) What other requirement have we been led to believe is necessary to have a fire? (Oxygen) With oxygen in mind let's test a test tube of the gas with a glowing splint. (With luck, it flames.) By the way, I just remembered that I mixed $C_{12}H_{22}O_{11}$ with Na_2O_2 and added H_2O. If I could just have remembered it before, you could have figured this all out much faster.

DEMONSTRATING THE DIFFERENCE BETWEEN POTENTIAL AND KINETIC ENERGY



Understandings --

1. Energy is the capacity for doing work.

2. Energy exists in more than one form and can be changed from one form to another.

3. Energy cannot be created or destroyed by ordinary means, but each form can be changed into the other. Law of Conservation of Energy.

4. Kinetic energy is the energy of motion.

5. Potential energy is stored energy.

Tie a small dense weight (?0 grams or more) to a string. With the other pieces of apparatus in the approximate positions shown in the diagram, start hoisting the weight from the egg to a point about a foot directly above the egg and tie the weight to the support.

Explain that you or an assistant have expended energy to change the position of the weight.

Is potential energy stored in the weight due to its position?

Strike a match and set fire to the string. Observe the weight hitting the egg. Note that the weight had motion. Did it have energy? What broke the egg?

The energy of motion is called kinetic energy.

Can we reason how the law of conservation of energy is demonstrated in this action?

How does this activity show that kinetic and potential energy can be changed from one into the other?

As weight is raised its potential energy is increased. When it is released this energy becomes kinetic energy until the weight penetrates the egg.

FROM:

ERIC FACILITY
SUITE 601
1735 EYE STREET, N. W.
WASHINGTON, D.C. 20006