M4-H-58

4-H TV

SCIENCE CLUB 2

Instructional Materials Guide

Adapted from "4-H TV Science Club 2, Instructional Materials Guide," published by the Extension Service, Kansas State University, Kansas, with permission.

EXTENSION DIVISION
VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY

February 1972

Learn by Doing

This Instructional Materials Guide contains supplementary materials related to each program of the 4-H TV Science Club 2. The materials should suggest student activities, additional projects, and sources of additional information. This guide should not be used as a lesson plan for activities.

The basic information presents those concepts within the scope of the TV presentation. The information should suggest areas of further study for a more complete understanding of the subject.

The TV program notes indicate ideas presented on TV beyond the scope of the basic information.

Discussion questions are given as suggestions of ideas and are not intended to be used as a quiz of the materials. Answers are not given to most questions since the student's background and ability provide answers the student understands.

The additional studies are for students interested in continued study of the subject. These suggestions contain studies leading to projects and to enrichment through research.

The bibliography contains listings of use to the student, teacher, parent, and 4-H leader.

TV Presentation Format

Introduction of subject with leader and members.

Visiting experts provides major information.

Club business meeting and review of projects from previous TV program.

Preview of project work.

General Bibliography

Challand, Helen J., and Elizabeth R. Brandt. Science Activities From A to Z. Chicago: Childrens Press, 1962.

Goldstein, Philip. How to Do an Experiment. New York: Harcourt, Brace and Company, 1957.

Morholt, Evelyn, and others. A Sourcebook for the Biological Sciences. New York: Harcourt, Brace and Company, 1958.

National College of Education. Young People's Science Encyclopedia. Chicago: Childrens Press, 1962.

Parker, Bertha M. Science Experiences: Elementary School. New York: Harper and Row, Publishers, Inc., 1958.

700 Science Experiments for Everyone. New York: Doubleday and Company, 1958.

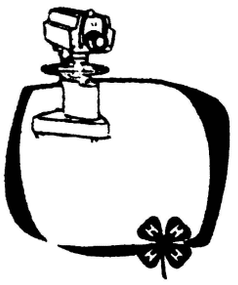
Table of Contents

		Page
Program 1	The Science of Fire	3
Program 2	The Science of Animals (Skeletons)	4
Program 3	The Science of Astronomy (Time Keeping Projects)	5
Program 4	The Science of Plants	6
Program 5	The Science of Archeology	8
Program 6	The Science of Physics	9
Program 7	The Science of Behavior	10
Program 8	The Science of Microbiology	12
Program 9	The Science of Meteorology	13
Program 10	The Science of Chemistry	15

M4-H-58
Cooperative Extension Service
February 1972

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. W. E. Skelton, Dean, Extension Division, Cooperative Extension Service, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

Meeting No. 1:



The Science of Fire

Basic Information

Fire is the process of chemically combining oxygen and another substance (fuel) with resulting heat. The flame of many fires is the glowing of gases heated to high temperatures by the reaction. Not all fires produce a flame (i.e., charcoal.)

The three requirements for fire are
(a) fuel (combustible material)
(b) oxygen (usually from the air)
(c) heat (kindling temperature)

The kindling temperature depends on
(a) chemical nature of substance
(b) surface area presented to the oxygen

Spontaneous combustion is the result of internal chemical reactions producing heat (reaches kindling temperature.)

Fire extinguishers work on the principle of removing one of the three requirements for fire:
1. Removing oxygen (smothering) - fire blanket, dirt, carbon dioxide.
2. Cooling fuel below kindling temperature - dry ice, water evaporating on hot surface.
3. Removing fuel - gas valve, dynamite used on burning gas well.

Classes of fires:
Class A - fires which leave ashes (wood, hay, cloth, etc.)
Class B - fuel floats on water (grease, gasoline, oil, etc.)
Class C - electrical equipment (motors, wiring, appliances, etc.)

Extinguishers are designed to
(a) put out a particular class of fire
(b) be portable
(c) be easily stored

TV Program Notes

Carbon dioxide (CO_2) does not burn, is invisible, and is heavier than air.

Hot electrical wiring is included as a type of fire.

Fire Inspector visits the club.

Discussion Suggestions

1. Review basic information.
2. Causes of fires (spontaneous combustion, electrical fires, carelessness, etc.)
3. Dangers of fires (heat, smoke, damage, etc.)
4. Fire prevention.
5. Fire protection (fire department, school fire drills, etc.)
6. Products of combustion (ashes, gases, water vapor.)

Additional Studies

1. Classes of fire and extinguishers for each class.
2. Home fire hazard survey.
3. Fires not needing oxygen.
4. Flames can identify chemical elements.
5. Visit fire department.

Bibliography

Adler, Irving. Fire in Your Life. New York: The John Day Company, 1955.

Brooks, William O., and others. Modern Physical Science. New York: Holt, Rinehart and Winston, Inc., 1966. pp. 90-93.

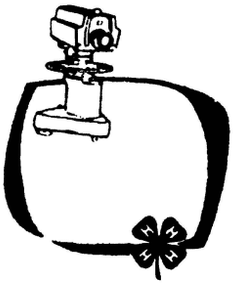
Holden, Raymond. All About Fires. New York: Random House, 1964.

Wilson, Dorothy. Fire Prevention. New York: Franklin Watts, Inc., 1965.

Meeting No. 2:

The Science of Animals

(Skeletons)



Basic Information

The science of animals is zoology. Because of the large numbers of different kinds of animals, a classification system must divide these animals into groups with similar characteristics.

A simple classification:
- Animals without backbones (invertebrates)
  - a. Animals with no skeleton (amoeba, worm, etc.)
  - b. Animals with an external skelton (exoskeleton--insects, lobster, spiders, etc.)
- Animals with backbones (vertebrates)
  - Vertebrates have internal skeletons (endoskeleton.)
  - Some may have portions of the skeleton external (turtle) or may have external armor (armadillo.)

Animals with exoskeletons include insects, centipedes, lobsters, and similar animals. The skeletal material is called chitin. The exoskeleton does not change in size and must be discarded and replaced with a new structure as the animal grows. (This is similar to a snake shedding its skin of scales. The snake, however, is a vertebrate.)

The endoskeleton is composed of parts called bones. The hardness of the bone is due to the chemical, calcium phosphate.

Not all animals have the same kind of bone. Birds have light, air-filled bones to reduce weight for flying.

Bones may change in size allowing growth.

The size and shape of bones affects the abilities of animals. For example: man, monkeys, and apes have opposing thumbs (the thumb can touch each of the other digits) allowing them to grasp.

Man has 206 named bones.

The purposes of the skeleton are to
- a. provide a supporting framework for the soft parts
- b. protect delicate structures
- c. provide for the attachment of muscles
- d. supply blood cells
- e. store minerals

TV Program Notes

The size and shape of the bones indicate the type of muscle attachment (keel bone of birds,) special structures (webbed feet,) and special abilities (unhinged jaw of snakes.)

Discussion Suggestions

1. Review basic information.
2. Means of support besides skeletons (cellulose of plant cells, shells, spines, etc.)
3. Compare bone structures of common animals, homologous structures, (5 digits, shoulder blade, etc.)
4. Which skeleton is best (man, birds, reptiles?)
5. Do bones grow like tree trunks? (Both grow by adding cells. Trees add to height at upper end. Bones may grow along lines of stress in any direction.)
6. What are the structures of a bone? (Outer membrane, bony layer, marrow--check reference material.)

Additional Studies

1. Advantages and disadvantages of exoskeleton and endoskeleton.
2. Prepare bird or reptile skeleton.
3. Taxidermy.
4. Lever action of bone structures.
5. Bone diseases.

Bibliography

Burnett, R. Will, and others. Zoology - An Introduction to the Animal Kingdom (A Golden Nature Guide.) New York: Simon and Schuster, 1957.

Fitzpatrick, Frederick L., and John E. Hole. Modern Life Science. New York: Holt, Rinehart and Winston, Inc., 1966. pp. 288-294.

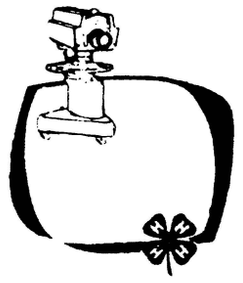
Navarra, John G., and Joseph Zafforoni. Today's Basic Science 6. New York: Harper and Row, Publishers, Inc., 1963. pp. 211-222.

Otto, James H., and Albert Towle. Modern Biology. New York: Holt, Rinehart and Winston, Inc., 1965. pp. 551-564.

Meeting No. 3:

The Science of Astronomy

(Time Keeping Projects)



Basic Information

Keeping time is based on
(a) mechanical devices
(b) observations of the apparent motions of objects in the sky (including seasonal changes.)

Early man used the phases of the moon, the position of the rising and setting sun, and seasonal effects on plants, weather, and climates to calculate time. These observations led to the science of astronomy. Mechanical devices were made to relate to these observations (hourglass, time candle, water clock, and the pendulum.)

The year is based on two types of observations.
Tropical year - (365 days, 5 hours, 48 minutes, and 46 seconds) the length of time between two consecutive vernal equinoxes (sun directly over the equator.)
Sidereal year - (365 days, 6 hours, 9 minutes, and 10 seconds) the length of time between the apparent position of the sun and a fixed star and the return to the same position.
Other measurements of the year include the anomalistic year, lunar year, and the eclipse year (see References.)

The day may be measured by the rotation of the the earth (apparent solar time) or the position of the stars (sidereal time.)
Apparent solar time - may be measured with a sundial.
Mean solar time - average of solar time - may be measured with a clock.
Sidereal time - may be measured with sidereal clock (used in astronomy and navigation.)

To observe the position of the sun, moon, and stars, astronomers have used several simple devices:
1. Sundial - tells hours by the position of the shadow and tells months by the length of the shadow.
2. Astrolabe - shows the angular position of the stars with respect to the horizon and the angular position with respect to geographic directions (the sextant is related to the astrolabe and is used to locate geographic latitude and longitude.)
3. Telescope - magnifies astronomical objects.
4. Photographs and drawings - shows slow changes in the apparent positions of astronomical objects.

TV Program Notes

Because of the present inclination of the earth's axis, the pole star (Polaris) is directly above the North Pole of the earth. This star always appears in about the same position and can be used as a reference point. Polaris may be located by following a direct line from the two stars at the front of the cup of the Big Dipper to the last star on the handle of the Little Dupper.

Discussion Suggestions

1. Review basic information.
2. How do we know the methods of measuring time by ancient man?
3. Why do we have leap year? (Year is not exactly 365 days long.)
4. Latitude and longitude.
5. How many and why: years in century (100,) years in decade (10,) months in year (12,) hours in day (24,) minutes in hour (60,) and seconds in minute (60.)
6. Why do the stars, moon, and sun appear to move daily? Do they really move at all?

Additional Studies

1. The atomic clock - Are atoms more accurate than stars?
2. Calendar confusion - The history of the modern calendar.
3. A new calendar - "Thirty days hath February"- proposed changes in the calendar and the reasons for change.
4. Julian day - the scientific calendar.
5. Will Polaris always be North?
6. The mystery of Stonehenge, England.

Bibliography

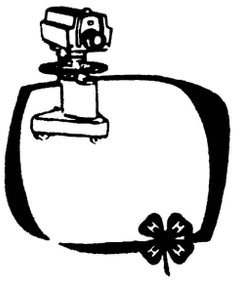
Asimov, Isaac. The Clock We Live On. New York: Abelard-Schuman, 1959.

Bell, Thelma H., and Corydon Bell. The Riddle of Time. New York: Viking Press, 1963.

Bernhard, Hubert J., and others. New Handbook of the Heavens. New York: The New American Library of World Literature, Inc., 1948. pp. 170-205.

Ramsey, William L., and Raymond A. Burckley. Modern Earth Science. New York: Holt, Rinehart and Winston, Inc., 1965. pp. 110-125.

Meeting No. 4:



The Science of Plants

Basic Information

The science of plants is called botany.

Plants are the only living thing capable of making organic compounds (carbohydrates) from inorganic substances and can be considered as food factories.

Photosynthesis (combining by the use of light) is the process of combining carbon dioxide (CO_2) and water (H_2O) in the presence of light energy (sunlight) and chlorophyll to form a simple sugar (carbohydrate.)

The plant kingdom can be broadly divided into the flowerless plants (bacteria, algae, fungi, mosses, and ferns) and the seed plants. The seed plants include

(a) cone-bearing plants (pine, spruce, cedar, fir)
(b) flowering plants (grasses, fruit and nut trees, vegetables, flowers.)

The basic structures of the seed-bearing plants are the (a) roots, (b) stem, (c) leaf, and (d) flower, fruit, and seed.

The function of the root is
(a) to anchor the plant
(b) to absorb water and minerals

Water and minerals enter the root by the processes of diffusion and osmosis. These processes are responsible for movement of water and minerals through the plant.

The function of the stem is
(a) conduction of food, minerals, and water from one part of the plant to another
(b) production and display of leaves

All buds originate on the stem. The buds may develop new leaves, new stems, and flowers.

The leaf is the true food factory. There are many types of leaves including needles, simple leaves, compound leaves (with leaflets,) and some spines or scales. In addition to photosynthesis, the leaf is the major structure for transpiration (the passage of excess water into the air as vapor.)

The flower is a specialized structure for reproduction. After a short time a part of the flower develops into the fruit containing the seeds. Some flowering plants may be propagated (multiplying the number of plants) by leaf, stem, or root cuttings, or grafting onto another plant.

The seed contains a tiny, living plant (embryo,) stored food (cotyledon,) and the seed coat.

Germination (the start of growth or sprouting) requires moisture, the correct temperature, and oxygen.

Plant parts respond to stimuli of light, gravity, and water. The responses are called tropisms.
(a) Geotropism - response to gravity.
(b) Phototropism - response to light.
(c) Hydrotropism - response to moisture.

TV Program Notes

Time-lapse photography may be used to study plant growth. Pictures are taken one by one over an extended period of time. The developed film is then projected as a movie in a few seconds.

Iodine can be used to test for the presence of starch in foods or plant parts. The iodine reacts with the starch to produce a dark blue-black color.

A greenhouse produces an artifical environment for plant growth in which the ideal conditions are controlled for maximum growth.

Visit a greenhouse.

Discussion Suggestions

1. Review basic information.
2. Compare similarities and differences of plants and animal cells.
3. Leaf color in autumn.
4. Official state flowers - name, characteristics, uses.
5. Part of plant used for food by man or other animal.
6. Is plant shade useful to the plant (preserve moisure evaporation?)
7. Type of leaf structure or fruit of common local plants.

Additional Studies

1. More than one kind of chlorophyll (Chromatography.)
2. A balanced aquarium.
3. Leaf collection.
4. Do tree seeds fly? Collection of tree seeds.
5. Fertilizers and plant growth.
6. Visit greenhouse.
7. Chemical tests for nutrients in plants.

Bibliography

Cavanna, Betty. The First Book of Wildflowers. New York: Franklin Watts, Inc., 1961.

Fitzpatrick, Frederick L., and John W. Hole. Modern Life Science. New York: Holt, Rinehart and Winston, Inc., 1966. pp. 440-455.

Navarra, John G., and Joseph Zafforoni. Today's Basic Science 5. New York: Harper and Row, Publishers, Inc., 1953. pp. 149-180.

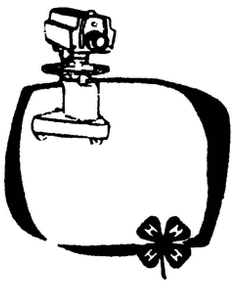
Russell, Solveig P. The Study of Trees Made Simple. Garden City, New York: Doubleday and Company, Inc., 1962.

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

Zim, Herbert S., and Alexander C. Martin. Flowers - A Guide to Familiar American Wildflowers (A Golden Nature Guide.) New York: Simon and Schuster, 1950.

Meeting No. 5:

The Science of Archeology



Basic Information

Archeology is the study of the life and culture of ancient peoples. Archeologists must depend on the discovery of artifacts (anything used or made by man) to study ancient peoples since written history may not include a particular civilization.

Artifacts may include arrowheads, spear points, bowls, grinding stones, beads, carvings, paintings, etc.

Artifacts must often be discovered by digging since surface materials may have been destroyed, carried away, or moved from the original position.

To learn where to dig:

A survey is made which includes natural features (drinking water, navigable streams, fishing spots, stone quarries, and wood source, protection, etc.) and cultural needs (farm land, hunting areas, or fishing areas depending on economics of culture.)

Using maps and personal survey, a study is made of the local area (get permission from land owners.) A survey notebook is used to record possible sites.

To start the "dig" (excavation site):

A grid for reference is plotted covering the entire area (see Project 1 in project manual.)

The site must be accurately identified geographically.

A base line is established.

The remaining area is divided into conveniently sized sections. (Archeologists use surveying instruments and techniques.)

The archeologist must keep an accurate record of each portion of the dig.

a. Position within the grid is noted.
b. Depth is measured.
c. Each discovery is marked and identified.
d. Soil layers and characteristics are examined.
e. Artifacts are carefully preserved.

Since artifacts may be brittle and easily damaged, an archeologist may use a small trowel for digging and a small brush to clean the artifact.

To date the age of the discovery, many methods are employed (see references):

a. Comparison with known discoveries.
b. Study geologic evidence (glacial, water, and wind deposits.)
c. Count tree ring growth.
d. Analyze pollen deposits.
e. Use radioactive dating methods.

Closely related to archeology is paleontology (the study of ancient plants and animals.) Any evidence of ancient life is called a fossil.

TV Program Notes

A mummy is not an artifact, but articles found in association with the mummy (desiccated human remains) are very important artifacts.

Artifacts may serve as clues for geologists, climatologists, or mineralogists in their search for knowledge.

Never move an artifact until it is tagged and recorded.

Discussion Suggestions

1. Review basic information.
2. What is known about the ancient civilizations or geologic past of your area?
3. Why are archeologist's digs more important than arrowhead hunters?
4. Why do we study the past?
5. Discuss some important archeological discoveries (Dead Sea Scrolls, Pompeii, King Tutankhamen's tomb, etc.)
6. What discoveries of our civilization may archeologists of the future use to describe our way of life?

Additional Studies

1. Collection of maps and pictures of historic landmarks.
2. Survey the area around your home for good campsite locations.
3. First Americans - How long before Columbus? Study history of Indian tribes of North America.
4. Was Columbus first? Leif Ericson - first European in America.

Bibliography

Braidwood, Robert J. Prehistoric Men. Chicago: Chicago Natural History Museum Press, 1957.

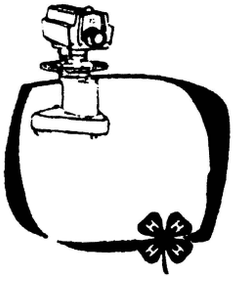
Kubic, Nora B. The First Book of Archaeology. New York: Franklin Watts, Inc., 1957.

Mars, W. T., and Jan Fairservis. People and Places. New York: The World Publishing Company, 1951.

Martin, Paul S. Digging Into History. Chicago: Chicago Natural History Museum Press, 1959.

Robbins, Maurice, and Mary B. Irving. The Amateur Archaeologist's Handbook. New York: Thomas Y. Cromwell Company, 1965.

Meeting No. 6:



The Science of Physics

Basic Information

Pressure is defined as the force (push or pull) on any unit of area. If the force is measured in pounds and the area in square inches, the pressure would be measured in pounds per square inch.

Air pressure is caused by weight of all the air over any particular point. Air pressure at sea level is 14.7 pounds per square inch. The total weight of the atmosphere is 5,000,000,000,000,000 tons (equal to a block of granite 1,000 miles long by 1,000 miles wide by 1/2 mile high.)

The pressure of any confined fluid (liquid or gas) is equal in all directions (Pascal's Law.) At any particular point, the air pressure is the same in all directions.

Air pressure is measured with a barometer.

A vacuum is a space containing nothing. Nature seems to dislike a vacuum and exerts natural pressures (air pressure) to try filling the vacuum. A soda straw works on this principle. Sucking on the straw produces a partial vacuum. Air exerting pressure in all directions pushes on the surface of the liquid forcing it through the straw.

Gases can be compressed (reduced in size by increasing the pressure.) Compressed gases exert pressure greater than air pressure and can be used to do work. A tire pump, air rifle, and pop gun use compressed air.

As the speed of air (or any gas) increases, the pressure is reduced (Bernoulli's Principle.) Air moving faster across the top of an airplane wing exerts less pressure than the air on the bottom of the wing. Air pressure differences lift the wing (and airplane.) This can be illustrated by blowing between two sheets of paper suspended from one side.

TV Program Notes

Demonstrations include suction cups, soda straw, and various types of air rifles. Each of these demonstrations were explained by the use of air pressure. Additional study could relate these examples to the principles listed in "Basic Information."

Discussion Suggestions

1. Review basic information.
2. Does the depth of a liquid have an effect on pressure? (Pressure is proportional to depth.) How could we find the pressure at the bottom of a swimming pool?
3. Why don't we feel air pressure?
4. Are winds related to air pressure?
5. Why do your ears "pop" as you drive up a mountain road?
6. What would happen to a balloon placed in a freezer? What would happen to the balloon in a warm oven? Try it.

Additional Studies

1. Close the end of a straw with clay and hold your thumb over that end of the straw. Try to drive the straw through a potato (don't hit your hand.) Try with an open straw. How does air pressure aid in this experiment?
2. Do altimeters measure air pressure or altitude?
3. If air pressure can lift a 30 inch column of mercury, how high can it lift water?
4. Blow on your hand with your lips close together. Blow with your mouth wide open. Does this help explain the operation of a refrigerator?
5. Bernoulli's Principle. Try to blow a table tennis ball from a small funnel. Explain on the basis of pressures.

6. Place the head of a kitchen match about 1/2 inch in length, in a soft drink bottle filled with water. Place your thumb over the end of the bottle and push gently downward. Be careful or the bottle may break. The match head should move downward. There are air spaces in the wood of the match. Knowing this, explain what happens.

Bibliography

Brinckerhoff, Richard, and others. The Physical World. New York: Harcourt, Brace and World, Inc., 1963. pp. 14-15.

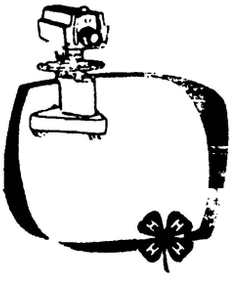
Brooks, William O., and others. Modern Physical Science. New York: Holt, Rinehart and Winston, Inc., 1965. pp. 212-223.

Navarra, John G., and Joseph Zafforoni. Today's Basic Science 5. New York: Harper and Row, Publishers, Inc., 1963. pp. 7-20.

Ramsey, William L., and Raymond A. Burckley. Modern Earth Science. New York: Holt, Rinehart and Winston, Inc., 1965. pp. 529-532.

Meeting No. 7:

The Science of Behavior



Basic Information

Psychology is the observation and interpretation of mental processes, conscious and subconscious.

Two approaches to the functioning of the mind:

- Behaviorism - outward acts can be more accurately observed, and are possibly more significant, than the thoughts.
- Cognitive (Gestalt) - perception (understanding) is the result of mental processes creating relationships.

Abnormal behavior may be broadly classified as:

1. Neurotic - abnormal only in certain areas, rational (aware and thinking) in others.
2. Psychotic - all or nearly all loss of contact with reality.

Symptoms of neuroses:

1. Anxiety state - conflicts producing mental tension.
2. Hypochondria - pretended illness to escape anxiety.
3. Hysteria - physical symptoms of illness used for escape.
4. Phobia - fear of certain anxiety-producing conditions.
5. Depression - a surrender to anxiety.

Psychoses include delusions, hallucinations, garbled speech, garbled thoughts, and exaggerated emotional states.

Types of psychosis:

- Simple schizophrenia - emotionally insulated (separate physical and emotional worlds.)
- Hebephrenia - returning to infant-like behavior.
- Catatonia - physical immobility alternating with frenzy.
- Paranoia - delusions of grandeur or persecutions.
- Manic-Depression - alternating mania (high state of excitement) and depressions. Extremes are from delirium to complete inaction.

Learning processes include:

- conditioning - repeated stimilus (cause for action) and response (action)
- trial and error - includes connecting (responses which produce satisfactions are learned.)
- reinforcing - rewarding correct behavior.
- programming - developing from simple to complex ideas.

Major ways of investigating the mind:

- Observing - usually using animals whose behavior patterns are relatively simple.
- Interpreting - analysis of external or self observations by relating to known patterns of behavior.

Scientific method (a guide to common sense investigations):

1. Define problem - a need (problem) must exist and must have expressed limits.
2. Review literature - study the works of others on this or related problems.
3. Outline investigation:
   a. hypothesis - "educated guess" about a possible solution.
   b. experimentation - procedures proving or disproving hypothesis.
   c. observation - seeing, sensing, measuring, and recording all aspects of experimentation.
4. Analysis:
   a. relating reasults with hypothesis.
   b. conclusion - statement of results.
5. Application - using conclusion to:
   a. study new problem or
   b. find a practical use.

TV Program Notes

Demonstrations include conditioning of rat and quail showing simple to complex learning, optical illusions, and a baby's responses.

Rewards are given for correct response to reinforce correct response.

Some behavior actions are due to fear of punishment.

Research psychologist visits the club.

Discussion Suggestions

1. Review basic information.
2. What are man's senses? What do they measure?
3. Is mental illness more terrible than physical illness? Is it harder to diagnose or understand?
4. What are dreams?
5. What are emotions and moods? Describe or demonstrate.
6. Why do we want to understand behavior? (Understand abnormal behavior, ways of learning, ways of controlling the mind, etc.)
7. Relate the scientific method to a known, simple problem.

Additional Studies

1. The mind - physical structure of nervous system.
2. Optical illusions - fooling the mind.
3. Effect of drugs on behavior (alcohol, heroin, LSD, etc.)
4. Mental hospitals and modern treatment of mental illness - visit mental hospital.
5. I.Q. tests - what do they measure?
6. Hypnosis.

Bibliography

Beeler, Nelson F., and Franklyn M. Branley. Experiments with Optical Illusions. New York: Thomas Y. Cromwell Company, 1951.

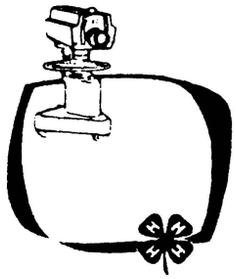
Fitzpatrick Frederick L., and John W. Hole. Modern Life Science. New York: Holt, Rinehart and Winston, Inc., 1966. pp. 410-414.

McBain, W. N., and R. C. Johnson. The Science of Ourselves. New York: Harper and Row, Publishers, Inc., 1962.

Navarra, John G., and Joseph Zafforoni. Today's Basic Science 5. New York: Harper and Row, Publishers, Inc., 1963. pp. 7-20.

Wilson, John R. The Mind (Life Science Library.) New York: Time Incorporated, 1964.

Meeting No. 8:



The Science of Microbiology

Basic Information

The science of microbiology is concerned with living things too small to be seen without the aid of magnification.

Some microorganisms cause disease (pathogenic) and others are harmless or useful.

Pathogenic organisms include viruses, Rickettsiae, bacteria, protozoans, molds, and moldlike fungi.

Viruses cannot grow outside of living cells but can survive in crystalline states for long periods under most conditions. Virus-caused diseases include chickenpox, smallpox, influenza, colds, mumps, measles, polio, rabies, and yellow fever.

Rickettsiae represent a life form between bacteria and viruses. Diseases include Rocky Mountain spotted fever, typhus fever, and trench fever.

Diseases caused by bacteria include diptheria, scarlet fever, tetanus, typhoid fever, tuberculosis, cholera, and botulism.

Infections are spread by:
- water - sewage contamination,
- droplet - sneeze or cough,
- contact - contact with sores or lesions,
- wound - broken skin providing entrance,
- carriers - humans, birds, insects, other animals containing pathogenic organisms.

Body defenses against disease are:
- skin and mucous membranes - prevent entrance into blood stream (tears, acids, coughing aid this defense)
- white blood cells - destroy organisms by engulfing
- antibodies - chemicals which destroy bacteria or neutralize their effects.

Control of disease

A. Injections
   1. vaccine - stimulates body to produce antibodies.
   2. serum - destroys bacteria or their poisons.

B. Drugs
   1. sulfa drugs
   2. antibiotics - produced by living organisms including bacteria, molds, moldlike fungi. Penicillin is produced from a mold similar to the mold found on oranges.

C. Bacteriophage
   Using living viruses of certain types to destroy pathogenic bacteria.

Prevention of disease:
- Antiseptics and disinfectants - kill bacteria or prevent growth (germicides.)
- Public health programs - water, sewage, and garbage treatment.
- Sterilization - kill bacteria with high temperature, ultra-violet light, or atomic radiation.

Microorganisms need food source, moisture, and warmth. They can be controlled by removing these requirements or by raising temperature to very high levels.

Tools of the microbiologists include microscopes, electron microscopes, cultures (samples of living organisms,) nutrient (to feed culture,) autoclave (sterilization,) incubator (to provide proper growth conditions, and stains (increase visibility of the organism under the microscope.

TV Program Notes

Demonstration of soap being used to break the surface tension of water. Water will then carry away dirt, microbes, etc.

The proper use of the microscope is shown with rules to protect the slide and the microscope.

Film clips show samples of microorganisms with representative samples of many types of simple plants and animals.

Discussion Suggestions

1. Review basic information.
2. Public health and your community.
3. What care do hospitals use in preventing the spread of infection?
4. What are the best conditions of heat and moisture for bacteria growth? (Relate to known conditions where bacteria are found.)
5. How are common diseases spread and treated?
6. How are microorganisms useful. (Decay to produce humus in soil, making cheese, fermentation, etc.)

Additional Studies

1. Are we infecting outer space? Cares in protecting infectious microbes from reaching outer space.
2. How do microbes reproduce?
3. How do microorganisms survive outside living organsims?
4. Antibiotics - our newest weapon against disease.
5. History of microbiology - Pasteur, Jenner, etc.
6. Visit public health office, local water treatment plant, or hospital.
7. Immunity.

Bibliography

Anderson, M.D. Through the Microscope. Garden City, New York: Natural History Press, 1965.

Christensen, Clyde M. The Molds and Man. Minneapolis: University of Minnesota Press, 1961.

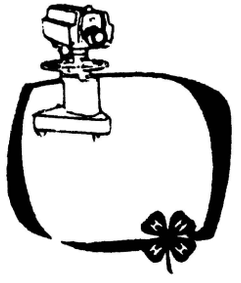
Fitzpatrick, Frederick L., and John W. Hole. Modern Life Science. New York: Holt, Rinehart and Winston, Inc., 1966.

Schneider, Leo. Microbes In Your Life. New York: Harcourt, Brace and World, Inc., 1966.

Stehli, Georg. The Microscope and How to Use It. New York: Pocket Books, Inc., 1960

Meeting No. 9:

The Science of Meteorology



Basic Information

Meteorology is the study of the atmosphere and its changes (including weather.)

The study of weather can be based on a few basic principles. Variations and relationships between these principles cause the complexity of weather. These principles are:

1. Energy received by the atmosphere from the sun and earth is in balance with energy given off by the atmosphere to the earth and to space (energy budget.)
   a. The tilt of the earth's axis is the basis for seasons.
   b. Water heats and cools more slowly than land.
   c. Local geography affects the energy budget of that region.
2. Warm air weighs less per volume than cool air and has a greater capacity for water vapor.
   a. Air flows from high pressure to low pressure (winds.)
   b. Cooling air reduces its capacity for water vapor causing condensation (clouds) and precipitation (rain, snow, etc.)
3. The earth rotates on its axis.

The following weather phenomena can be related to these pcinciples:

Winds - Unequal heating of the earth and atmosphere produces areas of high and low pressure. Rotation of the earth causes the winds to follow curved paths (Coriolis effect.)

Clouds and Precipitation - Warm air is displaced upward by cooler air or mountains and is cooled. As it cools, the air loses capacity for water vapor. The excess water condenses to form clouds. Cloud droplets collect (coalesce) to form precipitation.

Fronts - High and low pressure cells move across the earth's surface. The boundary between two cells of different temperatures and pressures is called a front.

Storms - Warm, moist air rises rapidly. Condensation and precipitation create turbulence in the cloud area producing gusty winds. The turbulence causes static electric charges to accumulate in regions of the cloud. Discharge from cloud to cloud or cloud to ground produces lightening. The shock wave of lightning-heated air produces thunder.

Instruments of meteorology:

Barometer - to measure air pressure
Thermometer - to measure air temperature
Hygrometer - to measure humidity (moisture content)
Precipitation gauges - to measure rain and snow

Anemometer - to measure wind direction.
Radiosonde - radio-equipped balloons to measure weather conditions at high altitudes.
Radar - to locate cloud formations.
Weather maps and teletype information - to extend range of knowledge of weather conditions.

Purpose of meteorology
1. Weather forecasting
2. Research for weather causes and control
3. Adaptation to weather and climate (farm crops, building construction, clothing, etc.)

TV Program Notes

Condensation nuclei (dust or smoke particles) are needed in the formation of a cloud. The nuclei provide surfaces on which condensation occurs.

As air rises, the pressure decreases and the air expands. The expanding air's temperature is lowered. The cooler air has a smaller capacity for water vapor and condensation begins.

Graphs which record sunlight quantities can show sunrise, sunset, cloud cover, and seasonal changes in daylight hours.

Discussion Suggestions

1. Review basic information.
2. How accurate are weather forecasts? (possible project.)
3. Why are forecasts necessary?
4. Why do we want to control and regulate the weather?
5. Why do we study today's weather to forecast tomorrow's weather? (Weather cells follow general directions across country.)
6. What is the climate of your area?
7. What are tornadoes? What damage do they cause?

Additional Studies

1. Do cloud types indicate the present weather or predict the weather of the future.
2. Are "old wives" tales wrong? Chirping crickets, red sunsets, halo around the moon, etc., may indicate weather changes.
3. Can man steer a hurricane?
4. Is man changing the earth's climate?
5. Visit local weather bureau or airport.
6. Is the temperature of the air and the air pressure related? (A graph of each factor over a several month period may show relationships.)

Bibliography

Holmes, David C. Weather Made Clear. New York: Sterling Publishing Company, Inc., 1962.

Lehr, Paul E., and others. Weather - A Guide to Phenomena and Forecasts (A Golden Nature Guide.) New York: Simon and Schuster, 1957.

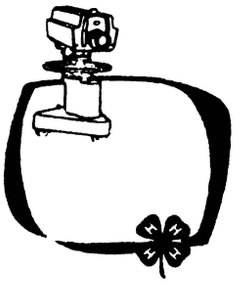
Navarra, John G., and Joseph Zafforoni. Today's Basic Science 5. New York: Harper and Row, Publishers, Inc., 1963. pp. 113-148.

Navarra, John G., and Joseph Zafforoni. Today's Basic Science 6. New York: Harper and Row, Publishers, Inc., 1963. pp. 31-74.

Ramsey, William L., and Raymond A. Burckley. Modern Earth Science. New York: Holt, Rinehart and Winston, Inc., 1965. pp. 524-628.

Sloane, Eric. How Can You Forecast the Weather. Greenwich, Connecticut: Fawcett Publications, Inc., 1957.

Meeting No. 10:



The Science of Chemistry

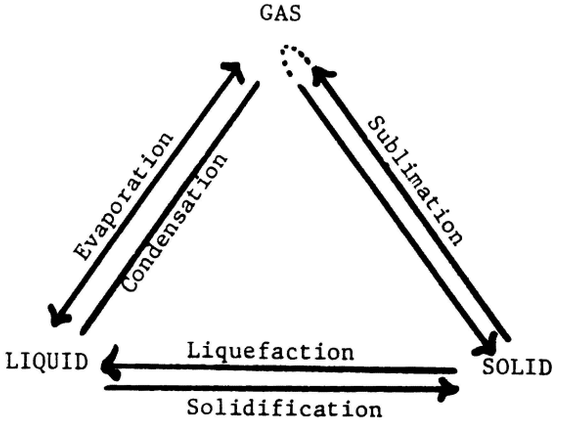
Basic Information

Chemistry deals with the composition and properities of substances and the reactions which change the composition and properties of substances.

In describing the properties of a substance, the chemist must understand the physical states of matter: solids, liquids, and gases.

1. Solid - matter with definite shape and definite volume.
2. Liquid - matter with indefinite shape (takes the shape of the container) and definite volume (not easily compressed.)
3. Gas - matter with indefinite shape and indefinite volume (fills its container and can be compressed or expanded.)

Figure 1

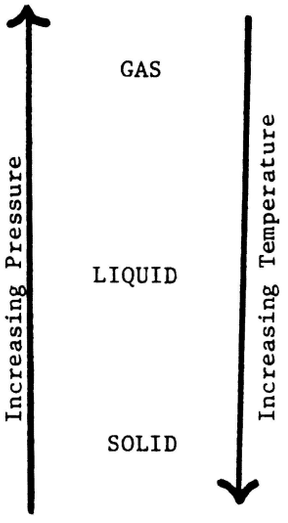


Changes of state (Figure 1):

1. Evaporation - changing from liquid to gas.
2. Liquefaction - changing from solid to liquid (melting.)
3. Condensation - changing from gas to liquid.
4. Solidification - changing from liquid to solid (freezing.)
5. Sublimation - changing directly from solid to gas or gas to solid.

For any particular substance the solid exists at lower temperatures than the liquid. The liquid exists at lower temperatures than the gas (Figure 2.)

Figure 2



Simple changes of state are not chemical changes because the composition remains the same. Some chemical changes result in a product of a different state than the original substances (i.e., two liquids may react to form a solid.)

Each substance has a particular temperature (under normal pressure) at which it boils and a particular temperature at which it melts. These temperatures may be used to separate and purify the substance or to identify the substance.

TV Program Notes

Dry ice is placed in water. The carbon dioxide can be seen changing from solid to a gas (bubbles.)

A super-saturated solution (a solution containing a greater amount of dissolved material than it normally could hold) is seeded with a crystal causing immediate crystallizing of the excess, dissolved material.

The making of synthetic fibers (by mixing two liquids) is shown.

Liquid latex used in paints is shown as a change from a solid to a liquid.

A research chemist visits the club.

Discussion Suggestions

1. Review basic information.
2. Is sand a liquid or a solid? Is flour a liquid or a solid?
3. Can a liquid evaporate without boiling?
4. Are "Silly-Putty" and "Super-Stuff" liquids or solids?
5. What processes cause dew and frost to form (Figure 1?)
6. Trace the water cycle of nature using Figure 1.

Additional Studies

1. The rock cycle.
2. Physical and chemical changes.
3. How many elements?
4. How does a pressure cooker work?
5. Why must high altitude aircraft be pressurized?
6. SCUBA diving - how man has adjusted to living under the pressures of the ocean.
7. Colloids.
8. Plasma - an unusual state of matter.

Bibliography

Brinckerhoff, Richard, and others. The Physical World. New York: Harcourt, Brace and World, Inc., 1963. pp. 52-58, 72-85.

Brooks, William O., and others. Modern Physical Science. New York: Holt, Rinehart and Winston, Inc., 1966. pp. 9-11.

Freeman, Mae, and Ira Freeman. Fun With Chemistry. New York: Random House, 1944.

Goldberg, Lazer. Golden Adventure Book of Chemistry. New York: Capitol Publishing Company, Inc., 1965.