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ABSTRACT

Provided is a collection of 54 health education activities which attempt to bridge the gap between health information and changing health-related behaviors. The activities, which vary in content and in levels of difficulty, are grouped into six chapters with a range of 3 to 11 activities in each chapter. Chapters focus on body organs and systems, the five senses, growth and development, nutrition and foods, pollution and diseases, and on drugs, poisons, and safety. Each activity includes title, focus (concepts and/or skills developed by the activity), background information, challenge (problem-oriented approach to stimulate youngsters' interests), a list of materials and equipment needed, instructional strategies, further challenges, and a list of student and teacher reference materials. An introductory chapter which defines health education and discusses the need for health education and children's interest in health topics is also included. (JN)

UNDERSTANDING THE HEALTHY BODY
CESI SOURCEBOOK III

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An Occasional Sourcebook of

The Council for Elementary Science, International

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The SMEAC Information Reference Center is pleased to cooperate with the Council for Elementary Science International in producing this third sourcebook. We believe that this publication will be of value to elementary and middle school teachers who wish to enrich their science programs with activities emphasizing creativity, inventiveness, and problem solving.

We invite your comments and suggestions for future publications.

Stanley L. Helgeson
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PREFACE

The CESI Board of Directors is pleased to present the third occasional sourcebook: Understanding the Healthy Body. This is another book of activities written by teachers specifically for elementary children.

The 54 activities cover the human body - its functions, its systems, its health, its growth and development. The activities are varied in content and in levels of difficulty so as to meet the needs of the classroom teacher.

This sourcebook has been made possible through the efforts of David Stronck. He developed it from the initial idea through to the finished product. CESI expresses appreciation to him for all his work.

The contributing authors are also a vital part of the project. We wish to thank them for their time and work on making this book a reality. Thanks also to the SMEAC Information Reference Center staff for making the publication of the book a possibility. A large thanks goes to Florence Stronck for doing the original typing and the artwork and SMEAC Information Reference Center staff for final typing.

CESI (The Council for Elementary Science, International) an affiliate of the National Science Teachers Association, is an organization interested in improving the science education of children. It is an organization OF teachers, presenting conventions and publications BY and FOR teachers.

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TABLE OF CONTENTS

CHAPTER IV - GROWTH AND DEVELOPMENT

CHAPTER V - NUTRITION AND FOODS

CHAPTER VI - POLLUTION AND DISEASES

CHAPTER VII - DRUGS, POISONS, AND SAFETY

CHAPTER I

A RATIONALE FOR HEALTH ACTIVITIES

The greatest potential for reducing premature deaths and avoidable disability lies in the assumption of personal responsibility for health.

> Richmond, J. B.: Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention. Washington, D. C.: U. S. Department of Health, Education, and Welfare, 1979.

DEFINING HEALTH EDUCATION

by David R. Stronck

Warren Schaller (1981) observed: "Everyone recognizes and assumes that the teaching day of the elementary teacher is intimately associated with health procedures -- in the school environment, in the health services that are performed, and in health education, or health science instruction. (p. 3)" Teachers want to provide their students with living-learning experiences that will motivate them toward healthy attitudes and practices. Health guidance needs a foundation of scientific information and understanding.

A widely accepted definition of health education ia the following from the Report of the 1972-1973 Joint Committee on Health Education Terminology (1974):

> A process with intellectual, psychological, and social dimensions relating to activities which increase the abilities of people to make informed decisions affecting their personal, family, and community well being. This process, based on scientific principles, facilitates learning and behavioral change in both health personnel and consumers, including children and youth. (p. 34)

Similarly the Society of State Directors of Health. Physical Education, and Recreation (1974) observed:

> The ultimate goal of a comprehensive school health program is to help every young person to achieve his (or her) full potential through becoming responsible for his (or her) personal health decisions and practices, through working with others to maintain a biological balance helpful to (humanity) and the environment, and through becoming a discriminating consumer of health information, health services, and health products. (p. 16)

Clearly the goals of health education are primarily the development of problem-solving skills and of appropriate healthy attitudes. These goals are best attained through the students doing activities, not through listening to lectures or memorizing information. Glen Gilbert (1978) has analyzed several dozens of teaching methods and strategies in health education. His analysis recognizes games, experiments, and demonstrations of the type found in this sourcebook as highly effective for instruction involving cognitive knowledge, affective attitudes, and psychomotor action.

Physical education, science, and health education share the common goal of developing high quality health in an individual.

In the province of British Columbia, health education is part of science in the elementary schools. In most of the states, health education is considered either a separate discipline or part of physical education. Most elementary-school teachers are more concerned with the problem of meeting the personal needs of their students than with the administrative classification of health education. The students' personal needs include an understanding of their bodies and of ways to keep their bodies healthy.

Unfortunately most science textbooks have little treatment of health topics. Robert Yager (1982) reports: "Biology, as it appears in the school program, is pure in the sense that there are few applications, little attention to current issues, no focus on personal needs of atudents, and little attention to career awareness. (p. 331)" Recently Yager and others have been advocating new curriculum materials that will organize biological information to serve the personal needs of students. This sourcebook is designed to serve that goal.

References

Gilbert, Glen. "Toward a Variety of Teaching Methods in Health Education." Health Education, September/October 1978.

Joint Committee on Health Education Terminology. "New Definitions: Report of the 1972-1973 Joint Committee on Health Education Terminology." Journal of School Health, 44: 33-37, 1974.

Schaller, W. B. The School Health Program. Philadelphia: Saunders, 1981, fifth edition.

Society of State Directors of Health, Physical Education, and Recreation. "A Statement of Basic Beliefs." School Health Review, March/April 1974.

Yager, Robert E. "The Crisis in Biology Education." The American Biology Teacher, 44 (6): 328-336, September 1982.

THE NEED FOR HEALTH EDUCATION

by David R. Stronck

Marc Lalonde (1974) introduced the concept that death and disease are caused by four major factors: biological factors, environmental hazards, the existing health care system, and unhealthy lifestyle. The Surgeon General of the United States (Richmond, 1979) provided the conclusions of American researchers analyzing the ten leading causes of death and relating them to Lalonde's four major factors: 10% of U. S. mortality is due to inadequate health care; 20% is due to biological factors; 20% is due to environmental factors; and approximately 50% results from a chosen lifestyle of unhealthy behaviors. Obviously there is an urgent need to prepare students for a lifetime of healthy living through developing their thinking and decision-making skills.

The Surgeon General's Report on Health Promotion and Disease Prevention (Richmond, 1979) makes specific recommendations to teachers, for example:

> Teachers, in particular, need to receive training in nutrition; and nutrition should be an integral part of the school curriculum. . . . Food choices are determined in part by the nutritional knowledge of the person who buys or prepares the food. Other factors include availability, personal and family likes and dislikes, and marketing and advertising practices. These factors should be addressed in educational initiatives to promote good food habits. (p. 131)

Similarly Kenneth R. Mechling and Donna L. Oliver make the following recommendations for the content of the science curriculum in the elementary schools:

> Science is not a subject that is studied only for the joy that it gives; rather, it is studied for the value it has for the children's lives now and in the future. Science should help children learn about themselves and the world around them. It should enable them to make wise decisions. It should help them to understand how their own bodies function; what causes day and night, the seasons, and weather; and how energy flows in ecosystems. It should help them to recognize societal issues related to science and technology, such as pollution, the use of pesticides to control agricultural pests, food production and nutrition, and energy production and consumption. Science classes are the place to begin learning and thinking about information relevant to issues concerning us now and in the future. (1982: 27-28)

Almost half of the topics listed by Mechling and Oliver (1982) are considered in this sourcebook, Understanding the Healthy Body. All of the topics in this sourcebook can assist in promoting better health among students. Many persons believe that the declining health and fitness of young Americans contribute much to the declining academic standards of the schools. The National Science Teachers Association (1978) observed:

> During interviews used to gather data for this working paper, many experienced teachers reported . . . growing restlessness and disinterest among students . . . There have been many attempts to explain how and why students are different today . . . Poor nutrition, part-time jobs, food additives, drugs, an emerging youth culture, and a host of other reasons have been given to account for the many changes in students today. Though there has been disagreement over why students are different from those of 15-20 years ago, there seems to be much agreement that students have changed and, as a result, science teachers have been confronted with new problems. (p. 14)

Youngsters today seem to be confronted with more problems than in previous years. The media, advertising, and peer groups increasingly suggest abuse of the healthy body. For example, smoking is a cause of cancer and heart attack according to the Surgeon General (Richmond, 1979). Nevertheless, powerful lobbies and advertising groups have attempted to contradict the Surgeon General's conclusions. Textbook publishers usually prefer to avoid issues that may upset the opinions of parents, teachers, and others. Fear of controversy has caused timid educators to omit teaching about nutrition, tobacco, alcohol, and other drugs. This sourcebook attempts to meet the problems of modern youth and to fill the gap of relevant materials missing from many textbooks.

Some textbook publishers have omitted health topics because the materials and equipment seemed to be too expensive for use in the elementary schools. This sourcebook has met the challenge of organizing fifty activities on health topics which use only "everyday" simple items that are found easily in the schools, grocery stores, hardware stores, and occasionally pet stores. Expensive items are not needed to provide the basic concepts.

References:

Lalonde, Marc. A New Perspective on the Health of Canadians. Ottowa, Ontario, Canada: Ministry of Health and Welfare, 1974.

Mechling, Kenneth R., and Donna L. Oliver. Characteristics of a Good Elementary Science Program, Part Two: Elaboration of the Principal's Checklist of Characteristics. Handbook III, Project for Promoting Science Among Elementary School Principals. Washington, D. C.: National Science Teachers Association, 1982.

National Science Teachers Association. Science Education: Accomplishments and Needs. Washington, D. C.: National Science Teachers Association; ERIC Clearinghouse for Science, Mathematics, and Environmental Education, The Ohio State University, Columbus, 1978.

Richmond, J. B. "Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention." Washington, D. C.: U. S. Department of Health, Education, and Welfare, 1979.

* *

The Health Activities Project is an excellent commercial program consisting of 64 student-centered activities grouped into 13 modules on topics of health, safety and nutrition. HAP was developed at the Lawrence Hall of Science, Berkeley, California, with funds from the Robert Wood Johnson Foundation. For more details, write to Hubbard, P. O. Box 104, Northbrook, IL 60062.

In Canada the Health Activities Project materials are available through Science Research Associates Limited, 707 Gordon Baker Road, Willowdale, Ontario M2H 2S6.

CHILDREN'S INTEREST IN HEALTH TOPICS

by David R. Stronck

Dawson and Bennitt (1981) have well described students' interest in science in their article, "What Do They Say They Want? Year 7 Students' Preferences in Science." In this study, 753 seventh graders ranked their preferences from a list of 77 items. Among the top twenty preferences were eight that relate to health education: the growth of a baby inside its mother; heart attacks and how they are caused; how to dissect dead animals; smoking and health; how children change as they get older; our brain and nerves; how we use our muscles and bones to move; and why children tend to be like their parents. The 353 girls in the same survey ranked 14 topics of health among their top twenty choices. They preferred the eight topics listed above and added the following six: our teeth; how people are different from each other; the heart and blood vessels; different foods we eat; germs and diseases; and digestion of food. Because 70% of the girls' top choices were health topics, emphasis on health education seems appropriate to motivate stronger interest in science among female students. This emphasis will not discourage the boys because they also rank highly many health topics.

Yarber (1981) reported on a survey of students' perceived need for instruction in all the health science content areas. Third graders wanted major emphasis on first aid, physical health, safety, diseases and disorders, and dental health. They also requested much emphasis on nutrition, consumer health, and mental health. Sixth graders also wanted major emphasis on first aid. These older children indicated much emphasis should be given to drug abuse and use, family life and sex education, physical health, and diseases and disorders.

Byler, Lewis, and Totman (1969) provided the conclusions from a survey of the health interests, concerns and problems of 5,000 students in selected schools of the state of Connecticut. They observed that boys and girls in kindergarten through grade two show much interest in a wide variety of health problems and ask many questions about their health, growth and development. A few of their questions are the following:

> How does my body get made? If they are bones, how come they can grow and not stick through our skin? What makes you stop growing? What is your heart made of? How can I tell if I have a fever? How can you tell which is a cow or a bull?

Third-grade children show a high degree of interest in the parts and functions of the body. They want to know where babies come from, how they are born, and how they develop. These children ask about the causes of diseases, their cures, and what diseases do their bodies.

Fourth-grade children have the same interests as the third graders in understanding their bodies, babies and diseases. But the older children are also interested in the different kinds, uses, and effects of drugs, including smoking.

In grades five and six, the students have great interest in the body's growth, development and function. They especially want to know all about the differences in the sexes. Byler, Lewis, and Totman (1969) comment:

> They have intense interest in menstruation, the interest reaching an almost feverish pitch in grade six, where all children -- boys and girls alike -- are conscious of the imminence of puberty. (p. 47)

These students continue their interest in understanding diseases, drugs, and smoking. They also express some interest in the topics of first aid, food and nutrition, weight-control diets, and exercise.

Many research studies clearly indicate that the topics of health education deserve much greater emphasis to meet the needs and interests of the students. In the elementary schools the disciplines of science and physical education have tended to neglect these topics. In this sourcebook, the topics are presented as part of science with the expanded perception of meeting personal needs and changing attitudes.

References

Byler, Ruth, Gertrude Lewis, and Ruth Totman, editors. Teach Us What We Want to Know. New York: Mental Health Materials Center, 1969.

Dawson, C. J., and N. Bennett. "What Do They Say They Want? Year 7 Students' Preferences in Science." Research in Science Education, 11: 193-201, 1981.

Yarber, William L. "Student Perceptions of Need for Family Life and Sex Education." Education, 101 (3): 279-284, Spring 1981.

WHAT THIS BOOK IS ALL ABOUT

by David R. Stronck

Understanding the Healthy Body is the third sourcebook of the Council for Elementary Science, International. All of the three sourcebooks are collections of activities that have been successfully used by teachers in the elementary, middle or junior-high schools. The authors of the activities are usually elementary-school teachers or professors of science education for the elementary schools. All of the sourcebooks have the same format for the activities and emphasis on inexpensive, easily-obtained materials and equipment.

Each of the sourcebooks has a special theme described by the title. The first sourcebook is Outdoor Areas As Learning Laboratories, compiled and edited by Alan J. McCormack. The second sourcebook is Expanding Children's Thinking Through Science, compiled and edited by Michael R. Cohen and Larry Flick. Because of the changing themes, only three authors have contributed to all three of the sourcebooks: Mildred Moseman, Vincent Sindt, and David Stronck.

The format for the activities is the following:

Title: We have tried to invent titles that reflect both the fun of the activity and its learning focus. In many instances, our hope is that the title itself will pique a youngster's curiosity.

Focus: This is a short description of the concepts and/or skills developed by the activity. It also provides a quick capsulation of the activity to assist the reader in rapidly understanding what the activity is all about.

Background: A few activities require specific background information that may not be readily available. In those cases we have provided enough information for you to begin the activity. Of course, further study and the use of references may often be needed.

Challenge(s): Using a challenge or problem-oriented approach to activities is one good way to stimulate youngsters' interests.

Materials and Equipment: A list of everything needed is provided with each activity. Feel free to vary the amounts of the materials to meet the needs of any class size. Construction plans are provided for home-made apparatus. Hopefully you will be able to find all the materials at little or no cost.

How-To-Do-It: These are suggestions for planning, organizing, and actually implementing the activities with youngsters. They are ways that have worked in the past. But, feel free to invent your own variations.

Further Challenges: One solved challenge always leads to new challenges (and those to new learning activities). Here can be found a few ideas for related, but different, learning activities. These challenges are entirely open-ended, and solutions are left to youngsters and their teachers.

References: Articles and books are identified to give both teachers and students useful information related to the activity.

Understanding the Healthy Body has the theme of health education activities. This sourcebook does not attempt to cover all topics of health education. It does not replace a textbook that may provide many details on the nature of specific diseases, anatomy, physiology and biochemistry. The relatively few topics considered in this sourcebook were largely determined by the interests of the contributing authors. The 54 activities of the sourcebook do relate to most of the fourteen health science topics identified by Yarber (1981). The 54 activities are grouped into six chapters with a range from eight to eleven activities in each chapter. The title of Chapter II is Body Organs and Systems; Chapter III, The Five Senses; Chapter IV, Growth and Development; Chapter V, Nutrition and Foods; Chapter VI, Pollution and Diseases; Chapter VII, Drugs, Poisons and Safety. Yarber's topics are found in the following chapters: consumer health in chapters V and VII; community health in chapters VI and VII; dental health in chapter VI; diseases and disorders in chapters II, III, and VI; drug abuse and use in chapter VII; family life and sex education in chapter IV; growth and development in chapter IV; nutrition in chapter V; personal health in chapters II and III; physical health in chapters II, III, and IV; pollution in chapter VI; and safety in chapter VII.

This sourcebook does not consider two of Yarber's topics: first aid and mental health. Teachers may seek additional information about first aid by contacting the Red Cross or St. John Ambulance; these organizations have offices in most large cities. Many excellent activities for mental health are found in the second CESI Sourcebook, especially in Chapter V on "Self Esteem." Chapter IV on "Values" in the second sourcebook also contains activities helpful in considering mental health. This same chapter also has activities on the topic of nutrition.

The 54 activities of the third CESI sourcebook attempt to bridge the gap between health information and changing health-related behaviors. Shymansky and others (1982) have observed that students in activity-based curricula out-performed their counterparts in the textbook-based classrooms on every criterion measured -- academic achievement, attitudes, process skill development, and performance in related school subjects. The best way to change attitudes is through activities, not memorizing information. Ruth Wellman (1978) cited 18 studies which found many advantages to first-hand manipulative experiences in science. Children in kindergarten to the third grade demonstrated improved process skills and success in beginning language and reading achievement. Wellman (1978) also found similar benefits

for children in grades 4, 5, and 6. Activity-oriented science programs seem to strengthen the development of language arts and reading skills. Hopefully the activities of this sourcebook will contribute toward making health topics interesting and fun experiences leading children to improved behaviors through practical understanding.

References:

Shymansky, James A., William C. Kyle, Jr., and Jennifer M. Alport. "How Effective Were the Hands-on Science Programs of Yesterday?" Science and Children, 20: 14-15, November/December 1982.

Wellman, Ruth T. "Science: A Basic for Language and Reading Development." In What Research Says to the Science Teacher, Volume I, edited by Mary Budd Rowe. Washington, D. C.: National Science Teachers Association, 1978.

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CHAPTER II

BODY ORGANS AND SYSTEMS

The study of Human Physiology, however -- by which I mean the Laws of Life, and Hygiene or the rules and observances by which health can be preserved and promoted -- has claims so superior to every other, and, at the same time, so little regard or understood by the community, that I shall ask the indulgence of the Board, while I attempt to vindicate its title to the first rank in our schools, after the elementary branches.

Horace Mann: "Sixth Annual Report of the Secretary of the Board of Education." Sixth Annual Report of the Board of Education Together with the Sixth Annual Report of the Secretary of the Board. Boston: Dutton and Wentworth, facsimile ed., 1843, p. 17-160.

BIG BAG OF AIR

by Sharon Moore

Focus: Oxygen is necessary for animals to maintain life. The lungs of an animal on land bring in the air. Life-supporting oxygen is separated from the air. When air is inhaled it follows a path from the nose to the trachea into bronchi. Within the lungs the air continues to flow from the bronchi into still smaller tubes called bronchioles. The bronchioles end in alveoli which are small air sacs. It is here in the alveoli that oxygen in the air passes into the bloodstream. It is also here that carbon dioxide as a waste product passes out of the bloodstream into the lungs to be exhaled from the body. Breathing air is necessary for our lives.

Challenge: Find out how much air your lungs can hold.

Materials and Equipment:

Dishpan
Rubber or plastic tubing about two feet long
Straws
Gallon jug (or four-liter plastic bag from a box of wine or other fluid)
Measuring cup and a ruler
Cardboard milk containers
Water

How-To-Do-It: Begin by predicting how much air you can exhale. Record some of the predictions for comparison with the actual results.

Fill the dishpan about a quarter full. Then completely fill the gallon jug. Putting your hand tightly around the mouth of the jug, turn it upside down in the dishpan. Be sure not to let air get into the jug.

Put a clean straw into one end of the tubing and slip the other end into the mouth of the jug. Blow into the straw with one long continuous breath until you have exhaled as much air as you can. This amount of air is called "vital capacity."

Carefully slide your hand over the mouth of the jug and turn it right side up. To see how much air you exhaled use the measuring cup to fill the jug again. Use one liter or two liter cardboard milk containers for measuring large amounts of water. Such containers are full at one liter or two liters when the water (milk) reaches the top edge of the box but not the angled flaps over the top. The amount of water it takes to refill the jug is the amount of air you exhaled! How does this amount compare with your predictions?

An alternate method is to use the four-liter plastic bag from a cardboard box of wine or other beverage. Open the bag's valve and

remove all contents; roll up the bag and expel all air. Breathe through the valve to inflate the bag. Close the valve when the vital capacity has been exhaled. Roll up enough of the bag to make turgid the part of the bag containing the exhaled air. Measure the size of the turgid part of the bag with a ruler. Then remove the cap which includes the valve from the bag. (Pliers allow easy removal of the cap although adults can often pull off the caps by using their fingers.) Add measured amounts of water to the bag until it is full at the measured length of the bag when it was turgid with the air of the vital capacity. Clean the valve area with a dilute bleach solution after each student uses it.

Further Challenges:

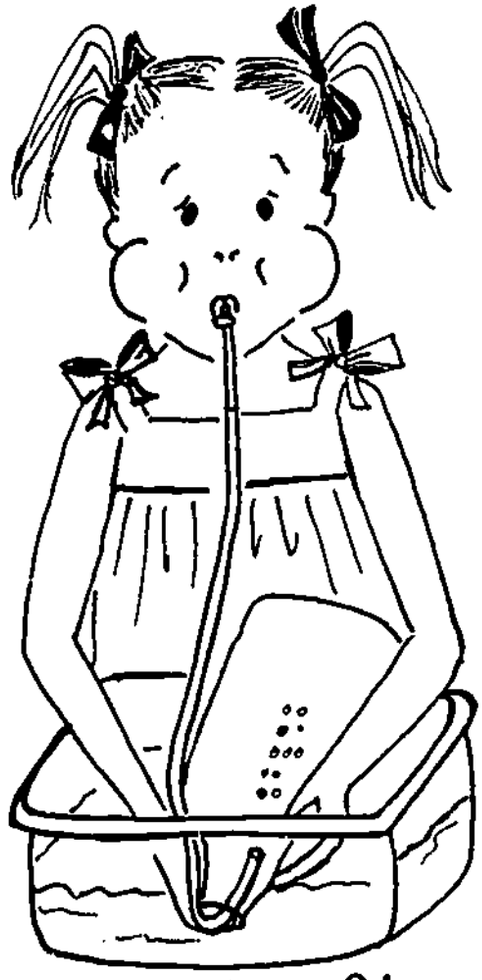
1) Make a chart or graph comparing the vital capacity of boys to that of girls.

2) Compare your vital capacity to that of an adult. Compare vital capacities of smokers and nonsmokers. (You will have to enlist adult volunteers for this one!) Do joggers have a greater vital capacity than people who don't jog?

References:

Allison, Linda. Blood and Guts. Boston: Little, Brown, and Company, 1976.

Both the American Cancer Society and The American Lung Association have material about the respiratory system which is usually available through the local chapters of these organizations.



AND THE BEAT GOES ON

by Lloyd Barrow and Nancy Jack

Focus: This activity focuses upon heart sounds, where on the body they can be heard, and normal heart beat rate.

Background: When children visit a doctor's office, a doctor or nurse often takes their pulse rate. The pulse of heartbeats can be felt at many places on the body. Usually the pulse is taken at the inside of the wrist. Another area of the body where the pulse can be easily felt is on the neck below the jaw and inside the large neck muscle. The inside of the upper arm may also provide a strong pulse.

Challenge: Locate on your partner's body where you hear the strongest heartbeat.

Materials and Equipment:

Stethoscope available from Hubbard, P.O. Box 104, Northbrook, Illinois, 60062, Order #6042, Approximate cost $4.00. Science Research Associates (Canada) Ltd., 707 Gordon Baker Road, Willowdale, Ontario N2H 2S6, Order #6042, Approximate cost $6.00 Canadian. (Refer to the next activity for a very simple but less efficient homemade stethoscope.)

How-To-Do-It:

Ask the children, "when you go to the doctor, why does she/he listen for heart sounds at several places on your body and take your pulse rate?" Have the children select a partner for doing the activities.

Each time a child uses the stethoscope, clean the earpieces with a paper towel moistened with a mild bleach. Warn the children that after the earpiece with the tube is placed in an ear, they must not press, shout, or bang the black disc of the stethoscope. The stethoscope allows hearing heart sounds through clothing.

Invite the children to do the following:

Locate on your partner's body where you hear the strongest heartbeat. Describe the location where it is the loudest. Describe the heart sounds you hear. What is your partner's heart rate for 15 seconds? How could you determine the heartbeat for 1 minute without waiting for 1 minute? What would your partner's rate be for 1 minute? Exchange roles with your partner and help him/her complete his/her paper.

The children will probably find:

1. Two heart sounds (lub-dub), 2. loudest heart sound location varies from student to student, and 3. normal heart beat rate varies.

Ask these "wrap-up" questions:

1. How does your location compare with two other teams?
2. Why does your doctor listen at different places to hear your heart?
3. Why doesn't everybody have the same heart beat rate?

Further Challenges:

1) Write a haiku about your heart and why it's important.

2) Create a puppet show about the circulatory system.

HEART THROBS

by Mildred Moseman

Focus: The activities will enable students to explore the effect of various activities on their hearts.

Background: Most children know that strenuous activity will quicken the heartbeat. However, different amounts and kinds of activity cause the heart to beat at different rates. Also, everyone's heart does not beat at exactly the same speed.

Challenge: Find out the make-up of the heart, function, manner in which it performs its job, and environmental effects on the heart. Try to determine the effects of various activities as well as age on the heart beat. Do all classmates have the same heart beat?

Materials and Equipment:

Stethoscope (or tubing with funnels)
18 inch (45 cm) piece of rubber tubing with
2 kitchen funnels (or two paper cups)
Small ball of clay
Match stick
Stop watch or clock with second hand

How-To-Do-It: Ask: "How fast does your heart beat?" Children can find out by taking their own pulse. A pulse is the throbbing that's caused by the heart forcing blood through a pathway called an artery. When an artery passes close to the skin, we can feel a pulse. With a pointer and middle fingers on one hand, children can find their pulse on the opposite wrist, just above the hand. Have them press down slightly with their fingers and count the beats felt for 15 seconds. Multiply the answer by four to find out how many times your heart beats each minute.

Usually people feel a pulse, but we can make a simple device to watch it. Put a small ball of clay over the pulse point on the wrist. Flatten the bottom of the ball slightly and stick the match stick into it. Now rest the arm on a table and watch the pulse. Count how many times the match moves.

A child can hear the heartbeat by putting an ear to a classmate's chest. The heartbeat can be heard more clearly with the help of an 18-inch piece of rubber tubing and two kitchen funnels or simply two paper cups. Fit one end of the tubing over the narrow end of each funnel or push through the bottoms of the cups. Put one funnel or cup to your ear and the other to your partner's chest. The "lub-dub" noise is the sound of blood rushing through the heart and the heart's valves, closing behind the blood. It's the sound the doctor hears through the stethoscope.

Have the children make a chart as shown below and to answer the questions:

Name	Inactive Pulse		Active Pulse		Recovery Pulse	
	Self	Partner	Self	Partner	Self	Partner

1. a. Guess how many times your heart beats in one minute.

   _____bpm (beats per minute)

   b. Have your partner take your pulse and record it in the inactive column as _____bpm.

   c. Take and record your partner's pulse.

2. a. Run in place for two minutes.

   b. Record your pulse rate in the active column.

   c. Have your partner run in place for two minutes.

   d. Record your partner's pulse rate.

Rest five minutes

3. a. Record both your pulse rates in the recovery column.

   b. Have your pulses returned to normal?

   c. Is your recovery rate faster than your partner's?

Instruct the children: By yourself or with a friend count the number of times your heart beats in a minute. Calculate the number of heartbeats in one class period and in one day. How many days are needed for one million heartbeats?

How many times does your heart beat by the age of one year, 16 years? You will reach one billion heartbeats in how many years? How many heartbeats in 100 years?

Arrange the following activities from easiest to hardest. Then do each, take pulse rate and see if the heart agrees. Allow plenty of time between activities.

Climbing up and down stairs
Lying down looking at ceiling
Walking around the block
Taking a test

Compare the pulse rate of each of your classmates. Prepare a graph that shows the results. Find the class average. How does your pulse rate compare with the class average? Compare class's average with pulse rates of kids in lower and higher grades. Any difference?

Further Challenges:

1) Discuss ways to keep heart healthy. Make a poster to illustrate the beat.

2) Have a nurse or doctor illustrate the use of a real stethoscope and the measurement of blood pressure.

3) Have a nurse or doctor discuss strokes and heart attacks. Children can then better understand such problems of their parents and grandparents.

4) Cardiopulmonary resuscitation can be illustrated and older students can be taught how to apply the technique.

5) Make a survey and record the name of songs in which the word heart is mentioned either in the title or song itself.

Reference:

Carolina Human Blood Pressure Manual, Carolina Supply Co., Burlington, North Carolina .27215.

HEART OF CLAY

by Larry Flick

Focus: Establishing the relationship among the parts of the human heart.

Challenge: Create a three-dimensional model of a heart from a two dimensional drawing.

Materials and Equipment:

A diagram of the heart from almost any biology or health book.
One pound of plasticine clay for each heart to be shaped.

Optional Equipment:

Small pieces of rubber tubing to represent blood vessels.

How-To-Do-It: Conduct enough discussion around the diagram of the heart to establish the connection between the general structure and function.

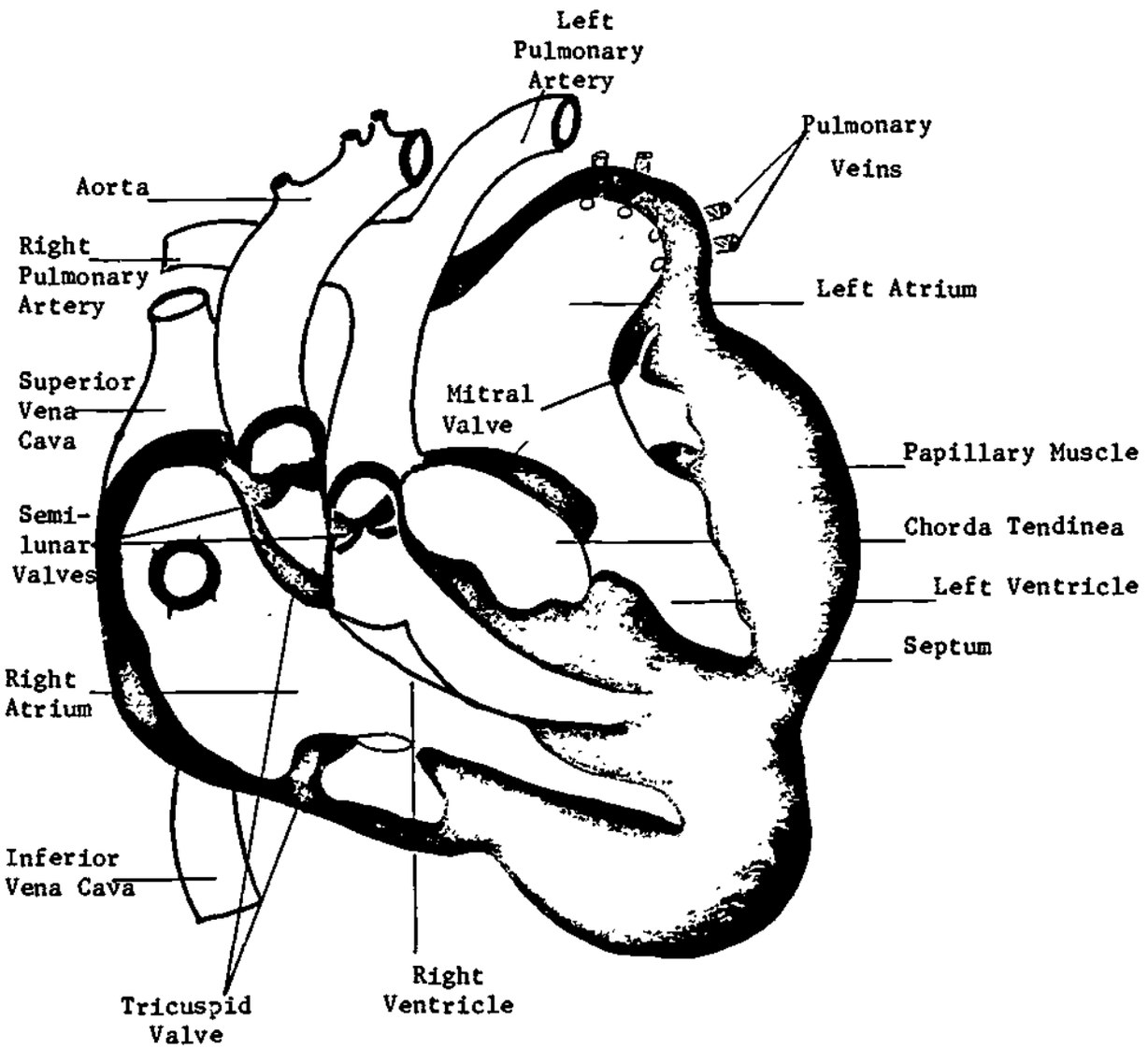
Demonstrate with a simple shape the problem of visualizing a three-dimensional object when flattened to two dimensions. Using a projector, the outline of an object can be traced on the board. Attempts to show the internal details of the object on the chalkboard tracing will emphasize some of the distortions caused by flat drawings.

Have each student fashion a clay model of the heart. This will take as much as 30 minutes for the best models. Display these so that the discussion concerning the structure and function can continue. Your own observations of their models will reveal some of the children's misconceptions as well as their insights.

Further Challenges:

1) Do the project again with the same students. Make a model that works like a heart instead of looking like a heart.

HUMAN HEART



A longitudinal section through the human heart

THE HEART STOPPER

by Ralph M. Fraser

Focus: Learn about the relationships between the heart and the blood vessels from a simple pump system.

Background: The heart is a large muscle that pumps blood through the body. Blood enters the pumping chambers of the heart through a blood vessel called a vein and leaves the heart's chamber through a blood vessel called an artery. The large artery leaving the heart and supplying all of the blood to the body is called the aorta. Later the aorta branches off into smaller arteries. Blood from the arteries supplies oxygen to the cells throughout the body. The oxygen was obtained from the lungs which are closely attached to the heart. Finally the used blood is collected in small veins which merge together into larger veins until the blood is returned to the heart's chambers.

The heart itself is a muscle that must receive its oxygen from small arteries entering the outer edge of the heart. (These small arteries supplying blood to the heart muscle must not be confused with the large vein returning all of the body's blood to the chambers of the heart.) A heart attack occurs when one or more of the small arteries serving the heart become blocked shut. The part of the heart cut off from a supply of oxygen soon dies. If much of the heart dies, the entire body will no longer receive enough blood and will die.

The blockage of an artery can be caused by a blood clot. Children understand blood clots by observing scabs that form over cuts. Only a small blood clot is needed to block the flow of blood through an artery when the artery is reduced in size by a plaque. Cholesterol is a wax-like substance forming a major part of arterial plaques.

Challenge: Measure and plot on your graph the amount of fluid (representing blood) which passes from your pump (representing the heart) through the tubing (representing the artery). Can you guess what will happen if an artery to the heart is slightly blocked while the artery to the rest of the body is not? Can you guess what will happen if an artery to the heart is completely blocked?

Materials and Equipment:

Spray cleaner pump bottle (pin-point nozzle removed) e.g., the type used for solutions that clean glass, appliances, etc.
Red food coloring added to water
3 sections of aquarium tubing:
    1 of 61 cm length and 2 of 30 cm (available in pet store)
1 "T" junction for tubing
2 measuring cups: (1 marked "heart", and the other "body")
4 screws: 5 mm, 4 mm, 3 mm, 2 mm
1 clothespin
1 heavy twist-tie
1 graph per pupil

How-To-Do-It: Before the class assembles, attach the 61 cm tube to the bottle with large twist-tie. The bottle should be filled at this point, with ample supply of red-colored water on hand. Attach the two shorter tubes to the longer one via the "T" junction. Run each shorter tube to a measuring cup. If sufficient materials are available, students should work in groups of four. One will pump; another changes screws; another measures fluid, and the fourth student does the graph plotting.

With each student at his/her designated position, the first student in the group pumps the bottle as many times as his/her heart beats per minute. (Refer to the previous activity "Heart Throbs.") The amount of fluid collected in each measuring cup is then recorded. The 2 mm screw is inserted in the end of the small arterial tube emptying into the measuring cup for the heart muscle. It is secured with a clothespin. Each student in the group rotates positions and repeats the first pumping and recording process, and does the same with the remaining screws following with the 3 mm, 4 mm and 5 mm screws. Graph the amount of fluid in each measuring cup against the use of no screws and screws of increasing sizes.

During the process, make students aware of the difficulty in pumping that arises when greater blockage occurs. If the tubing happens to dislocate from the pump, explain the sensitivity of arteries to blood pressure. If the screw is blown out of the tube onto the heart's measuring cup, discuss how blood clots can move.

Further Challenges:

1) Have students increase heart rate and then repeat the above process. Will the amount of fluid pumped to the heart decrease in the same proportions, with each blockage, as done in the first experiment? Have students make inferences on what happens when the heart works twice as fast as usual.

2) Change the name "heart muscle" on a measuring cup to "the brain." The concept of the stroke could then be displayed. A stroke is caused by a blood clot in an artery of the brain.

3) Have students research the causation of arterial blockage and ways in which lifestyles influence such problems.

4) Study the chambers of the heart, e.g., by dissecting a beef heart from the butcher. Ask the butcher to leave the lungs attached to the heart to allow a study of the way blood becomes oxygenated.

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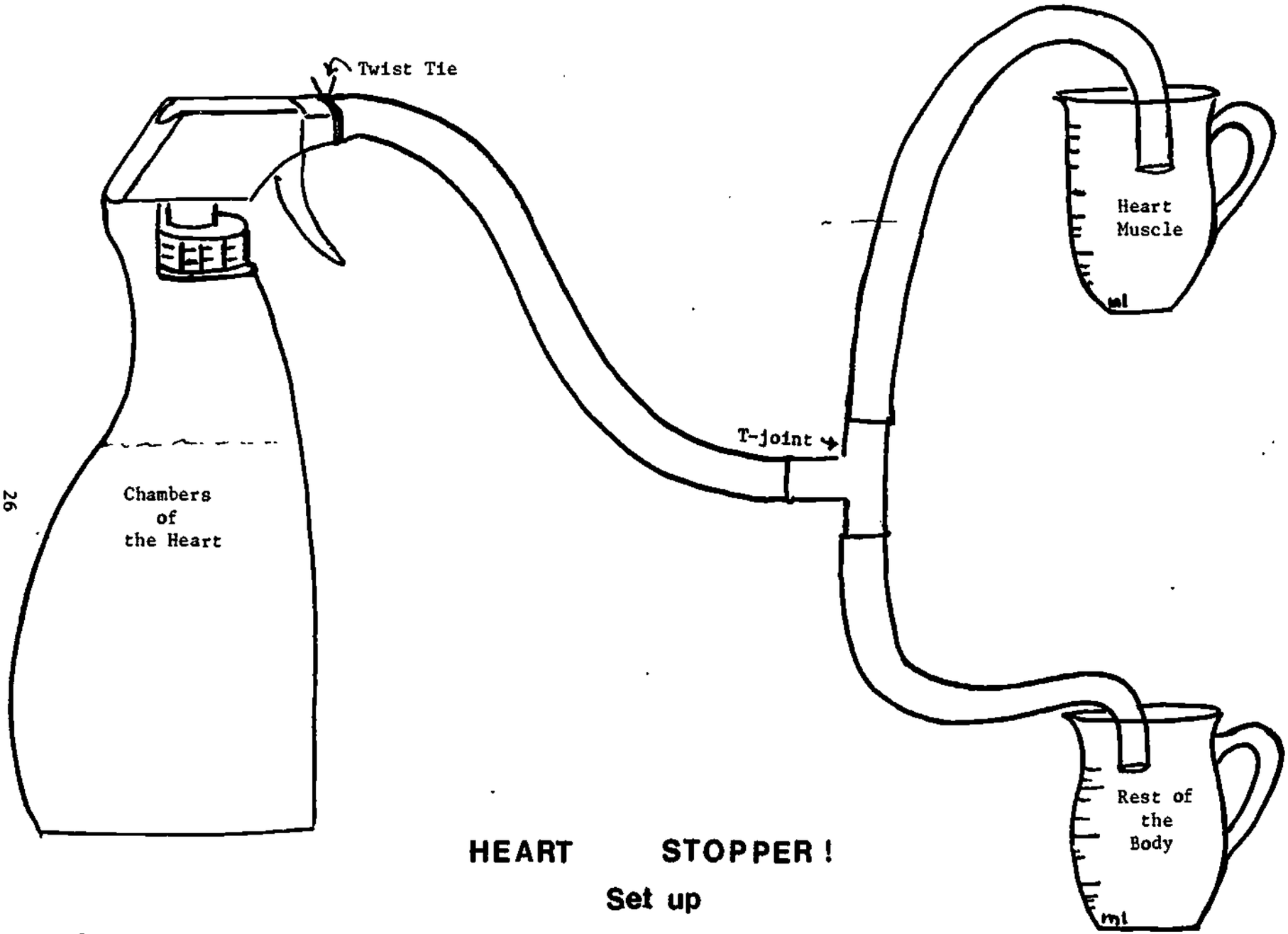


26

HEART STOPPER!

Set up

THE GREAT FRAME UP

by Rose West

Focus: To learn about the bones of human body by building a chicken or turkey skeleton.

Background: Review of human skeleton

1. How many bones are in a human skeleton?
   a. more than 200
   b. between 150 and 200
   c. between 100 and 149
   d. between 75 and 99
   e. less than 75

2. The skull is made up of 22 bones, but only one movable; it is called the mandible or the _____.

3. This bony structure (the skull) protects the _____.

4. To the sternum or the _____ are fastened most of the _____ _____. These bones form the _____ cage.

5. This _____ cage protects _____.

6. Some bones do not look like a "regular" bone, but are flat, like the knee cap or _____.

7. Your knees and elbows have joints that work like _____ so they are called _____ joints.

8. Your shoulders and hips have joints that allow a rolling motion, made possible by the _____ joints.

9. The pelvic bones support and protect the _____.

10. Your spinal column is made up of 33 bones, 26 of which are flexible bones called _____.

11. If your backbone were one solid bone, what would happen to your movements? _____

12. Your spinal column is also a canal or passageway for the _____ _____ which with the brain makes up the central _____ system.

Answers: 1) 200. 2) jaw. 3) brain. 4) breast bone, ribs, rib. 5) rib, lungs, and heart. 6) patella. 7) doorhinges. 8) ball and socket. 9) kidneys, stomach, lower organs. 10) vertebrae. 11) stiffness of movement. 12) spinal cord, nervous.

Challenge: Compare the types of bones from various species of animals by building a chicken or turkey skeleton. Draw bones of the body into an outline of the student's own body.

Materials and Equipment:

Various types of bones. (Save chicken and turkey bones.) Ask the butcher for bones.
Heat source and pan for cleaning off bones
Glue, clay, waxed paper, fine wire, two dowel rods
Butcher paper for drawing body size skeleton
Drawing pencil
Reference books

How-To-Do-It: Using reference materials, discuss the bones, uses, types and locations. Use quiz in the background above.

Challenge the students to attempt to put a skeleton together. If it is possible to obtain the skeleton of a ckicken with the head, this is best. This can be done if you live in an area near a farmer. If not, use the bones from an almost-whole turkey or chicken obtained from the grocery store. A head and feet from clay can be fashioned to take the place of the real thing.

Procedure for putting together the ckicken skeleton:

1. The leg has four bones. The upper bone has a knob at the top. The middle bone of the leg is longest bone in the chicken. Attached to it is a long, thin bone. The fourth bone is at the bottom of the leg and joins the foot. The foot is made of very small bones. (The fourth bone and foot bones are usually not sold in a store.)

Place the bones together. Use glue to secure and attach clay around the joint until the glue dries. For all parts or sections, work on a flat area until all sections are completed. All knob sections of a bone should point outward.

2. The wing bones are laid out. Glue them together. Again use clay to keep the items secure. There will be three larger bones and about six smaller bones for the tip.

3. The large under bone is the breast bone. Two bones attached to the front of the breast bone are called the coracoid bone. Joined to the top of each coracoid, and coming downward in front, is the wish bone. Two more bones, the shoulder blades, are also attached to the coracoid. Attach all of these together as before.

4. The neck is made up of vertebrae. The points on one side get thinner as they go towards the head. Put them together in this order. Arrange the pieces on a small wire bent to desired shape and glue them together.

5. Attach the skull to the neck.

6. The tail vertebrae can be glued together in the same manner as the neck. These vertebrae are smaller than the neck bones.

7. The pelvis is made up of six bones, three on each side. There is also a fused pelvis vertebrae. These attach to the remaining body vertebrae.

8. There are eleven ribs on each side of the body. The ribs with a fork on one end go down from the body vertebrae. Some of these ribs have another little bone stuck to them. Other ribs point up from the breast bone.

Once all sections of the skeleton are assembled, they are put together in an upright manner. Fine wire can be used to hold the skeleton together. Dowel rods at the neck and back area will give extra support.

Procedure for drawing the skeleton of a human:

1. Cut butcher paper that is 30 cm longer than the student.

2. Have the student lie down on the paper.

3. Another student should draw around the student on the paper. (Caution the students not to draw too close to areas like the neck, wrists, and ankles.)

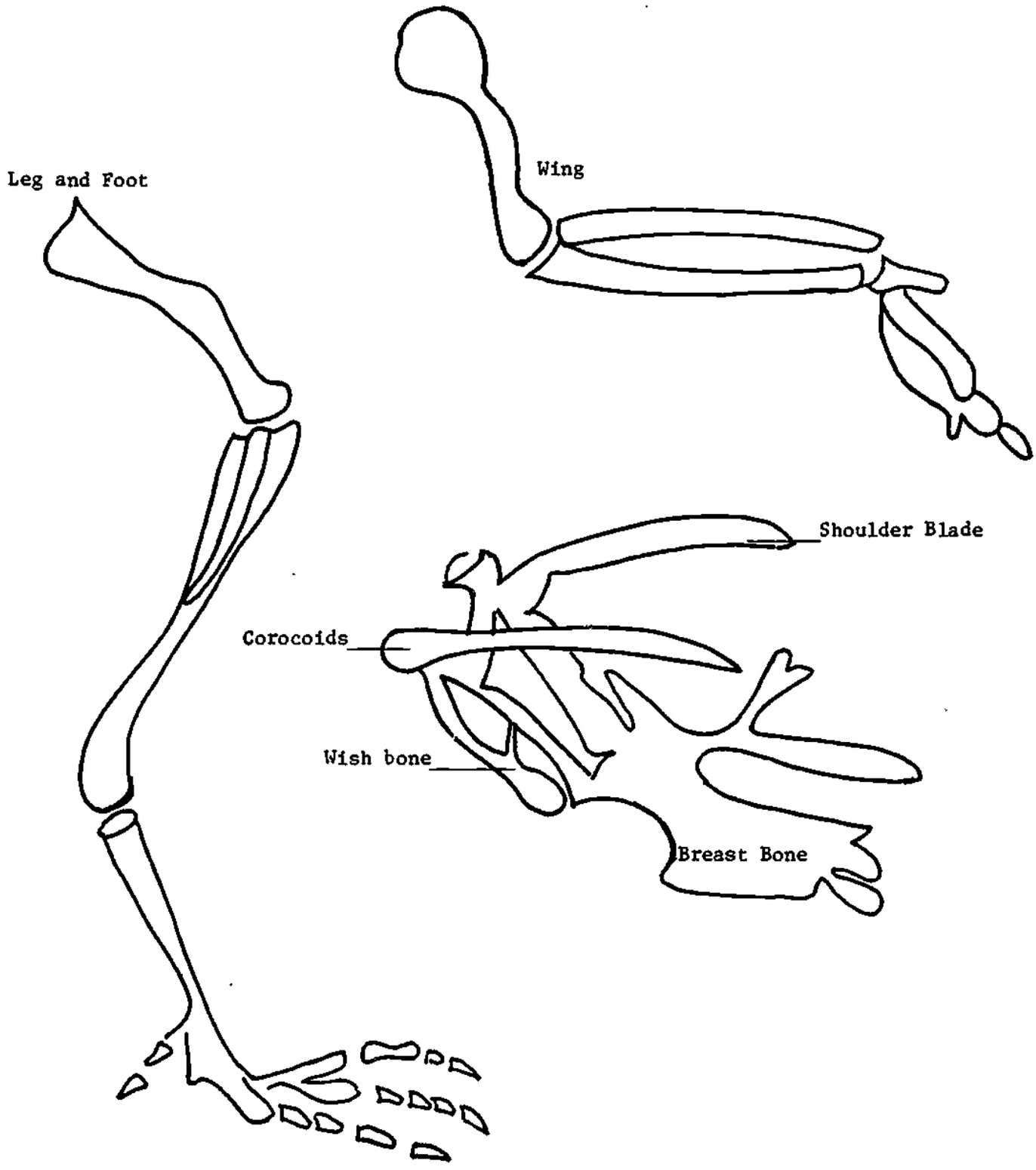
4. Using pictures of the human skeleton the students are to draw in the bones on their pictures.

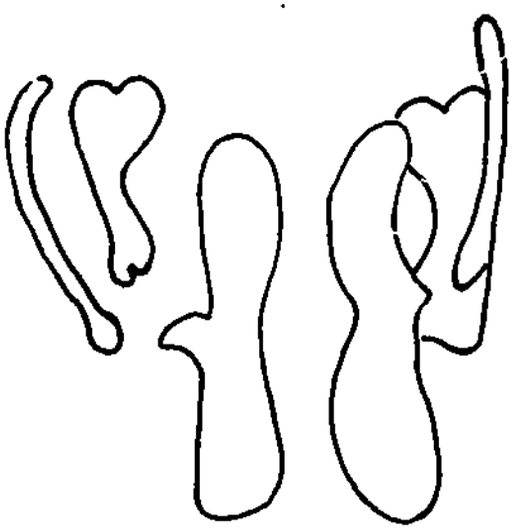
While some students are constructing the chicken skeleton, other students may draw around their bodies and fill in bones. Groups of two work well for drawing bones in the body. Larger groups can be used for constructing the skeleton.

Care is necessary when cooking the bones to remove all meat. If desired, this can be done at home.

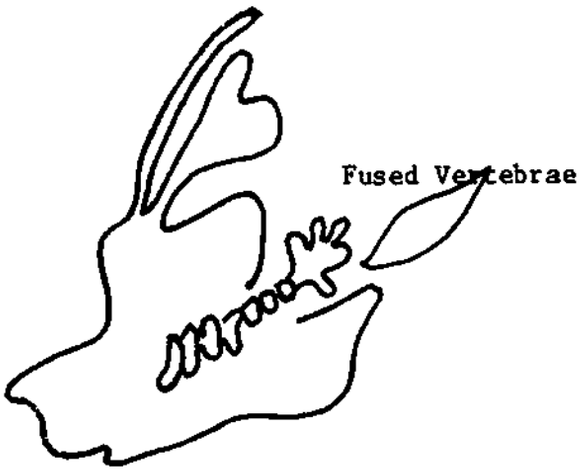
Further Challenges:

After the completion of this activity the study of other systems of the body would be appropriate. Discuss nutrients necessary for healthy bones. Draw other systems of the body on another outline of the student's body. Visit a local museum to compare other types of bones.

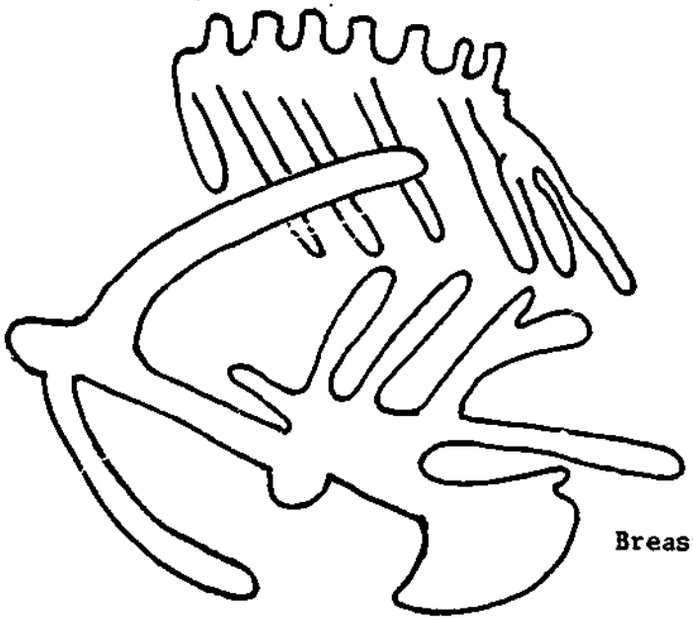

Leg and Foot
Wing
Shoulder Blade
Corocoids
Wish bone
Breast Bone



Pelvis



Body Vertebrae



Breast Bone

TAKING THE SCARE OUT OF THE SKELETON!

by Sheila M. Jasalavich

Focus: Learn how to identify the bones of the human body.

Background: The human skeletal system is made up of more than 200 bones. All of these bones work together to hold the body up and give the body its shape. The skeleton provides the muscles with places to attach so that we can walk, breathe, etc. The skeleton also protects delicate organs in the body. You might say--the skeleton is on twenty-four hour "body-guard" duty.

Challenge: Identify the major bones in your body and assemble paper models of them into a skeleton.

Materials and Equipment:

Skeleton (such as a Halloween decoration)
Large sheets of heavy white paper or thin cardboard
Paper fasteners
Glue
Pencils
Scissors
Biology text, or other reference book
X-rays of bones (if available)

How-To-Do-It: Preliminary activities should include body awareness activities in which children explore, feel, and identify the major bones: skull, vertebral column, sternum, ribs, pelvis, femur, patella, tibia, fibula, humerus, radius, ulna, etc. Observation of x-rays can further enhance the children's concept of bones that make up the skeleton.

Using the Halloween skeleton and x-rays as guides, trace or sketch the major bones of the body on the white paper or cardboard. Using a biology book or reference book and information acquired in preliminary activities, label the bones. Cut out bones and assemble the skeleton using paper fasteners as joints and glue.

Try some of the other activities listed below to become a bones expert!

Further Challenges:

1) Compare your skeletal system and the body of a wooden marionette.

2) Play "Mr. Bones Says...", a variation of "Simon Says" which enables children to locate major bones in their bodies.

3) Make a model of the spinal column or backbone using a long straw and empty spools from thread.

4) Acquire some x-rays of bones from a medical facility and create a game such as "X-ray Vision" to reinforce identification of bones and discover different types of fractures.

5) Find out how casts are made and bones are set.

6) Do Mystery Bones of the Elementary School Science project.

7) Locate and classify the various types of joints in your body. Make models of them.

8) Create on-lays of other systems of the body to add to your skeletal system.

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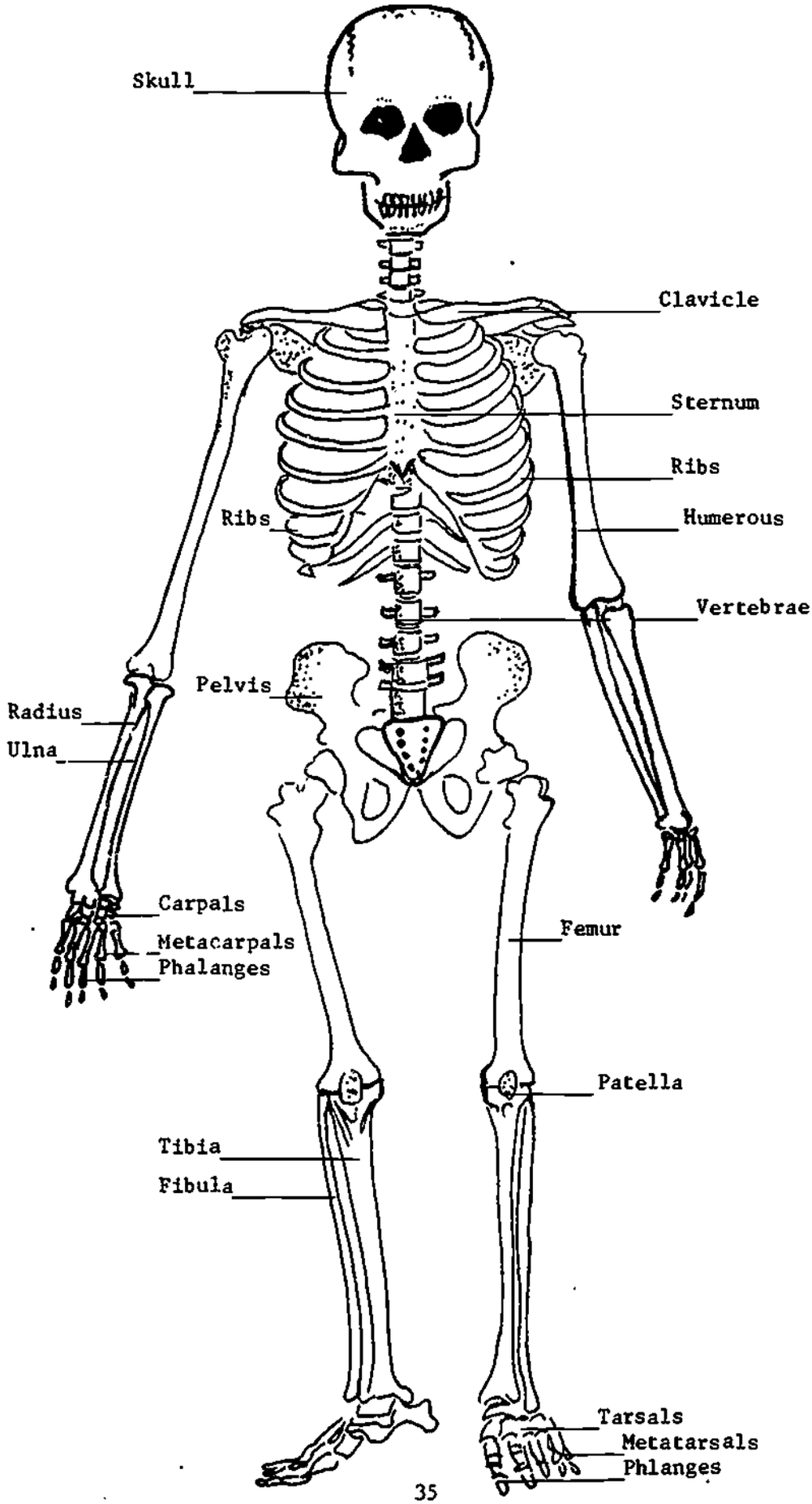
Skull
Clavicle
Sternum
Ribs
Ribs
Humerous
Vertebrae
Pelvis
Radius
Ulna
Carpals
Metacarpals
Phalanges
Femur
Patella
Tibia
Fibula
Tarsals
Metatarsals
Phlanges

SO, YOU THINK YOU'RE STRONG?

by Art Blackwell

Focus: The skeletal system, in conjunction with the muscles, acts similarly to many individual levers. By using a model of the arm (a third order lever) and plotting a graph, students can predict how strong their biceps muscles are when objects are lifted.

Background: A lever is a rigid bar which turns or tends to turn about a point of support or pivot point called the fulcrum. An effort is applied to the lever for overcoming the resistance. The effort arm of a lever is the distance from the fulcrum to the point where the effort is applied. The resistance arm of the lever is the distance from the fulcrum to the resistance. A first-class lever has a longer effort arm then a resistance arm. Such a lever allows the magnification of the effort against the resistance, e.g., using pliers. A second-class lever has the resistance located on the effort arm but closer to the fulcrum than the point of the effort. If the load in a wheelbarrow is considered the resistance, then the effort is at the handles and the fulcrum is at the wheel. A third-class lever has the effort located on the resistance arm closer to the fulcrum than the resistance. Often a shovel is used as a third-class lever when one hand on the handle serves as the fulcrum. The other hand applies the effort relatively close to the fulcrum. The load in the shovel at the end of the lever is the resistance. In this situation the effort is at the mechanical disadvantage against the resistance.

Challenge: Bet your friends that your biceps muscles can lift five times your own weight.

Materials and Equipment:

Spring balance
Meter sticks
Objects of known weights (50g to 500g)
Rubber bands
String

How-To-Do-It: Working in groups of two or three, have students place rubber bands around end of meter stick. (This will prevent stick from slipping from under table top.) Measure two distances on arm and apply rubber bands on meter stick at these distances. Measured from first rubber band:

Distance A = When elbow is bent at 90°, the measured distance from humerus to point where biceps tendon connects to the radius.

Distance B = When elbow is bent at 90°, the measured distance from humerus to palm of hand.

Refer to illustration of mechanical arm.

Tie strings to bosrd and over rubber band at distance A and at distance B to support spring balance and weights respectively. With spring balance secured, lift meter stick with balance while holding meter stick under edge of desk top (at first rubber band position). Record spring balance measurement for various weights at distance B (From 0 to 500g). By plotting their results on a graph students can show that their biceps muscles at distance A require about five times the force of the weight at distance B.

Do a chin up! Are the biceps muscles supporting your weight? This means that they are holding five times your body weight!

Further Challenges:

1) Investigate which muscles form part of a first order lever. Investigate which muscles form part of a second order lever. How do the forces these muscles exert compare with the force exerted by the levers they manipulate?

2) Make a model of these levers. A model of the arm muscle can be constructed by first placing two rulers end-to-end, touching, to form a double length ruler. For example, two rulers (each one meter in length) will, end-to-end, extend for two meters. Tape the point where the two rulers touch to give a model of the hinge (elbow) between the forearm and the upper arm. The biceps muscle can be represented by a partially inflated balloon attached by a string to the top of "upper arm" and by another string from the opposite end of the balloon to a point on the "forearm" near the hinge.

3) One group of muscles is not part of any lever system (e.g., eyelid muscles, the diaphragm). What value so these muscles have?

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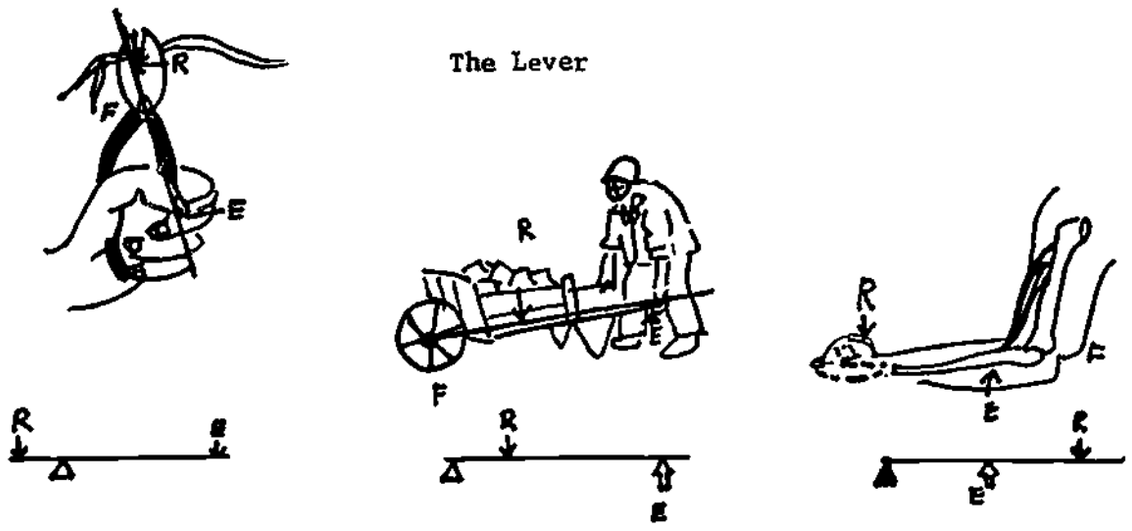
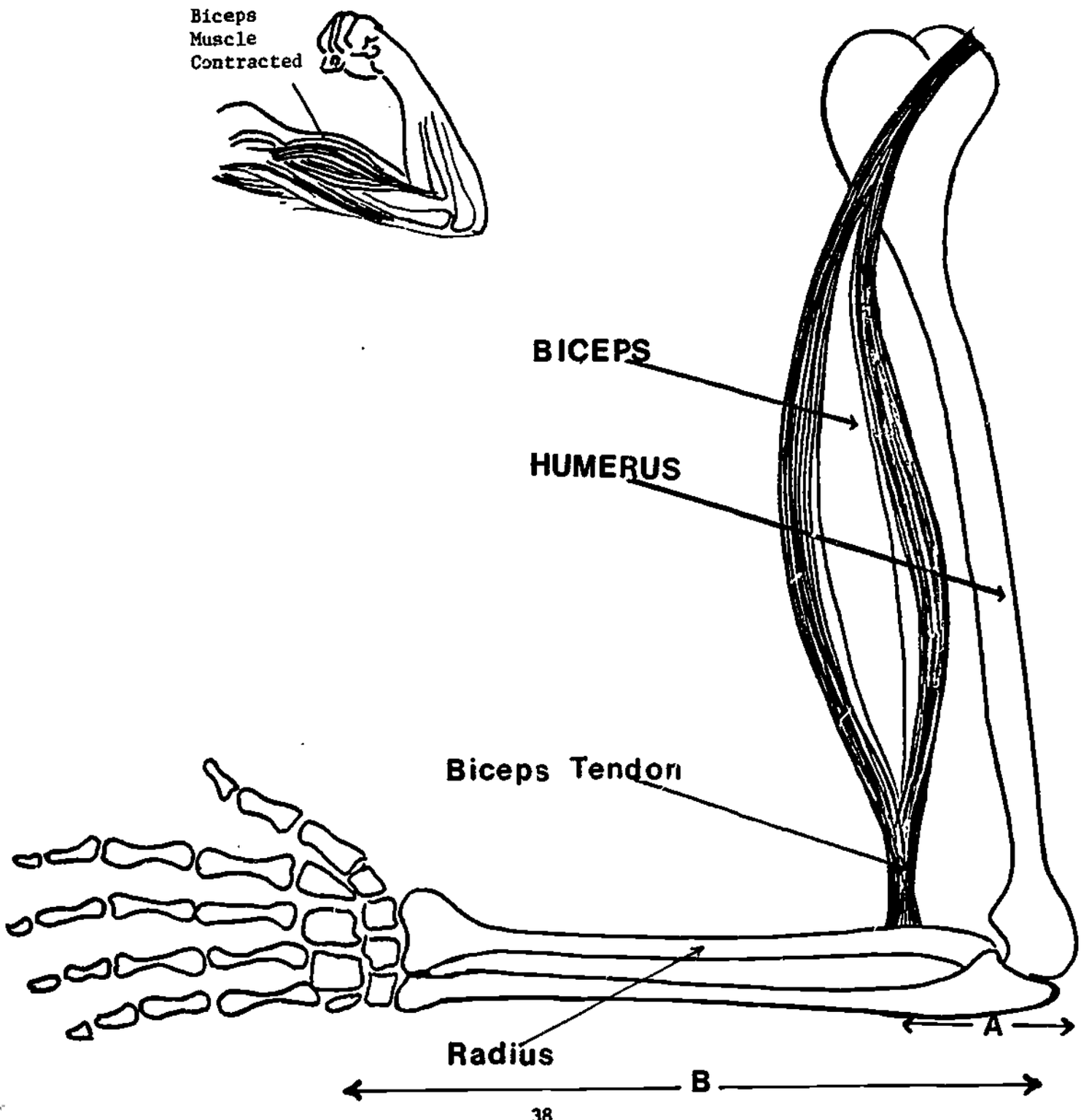
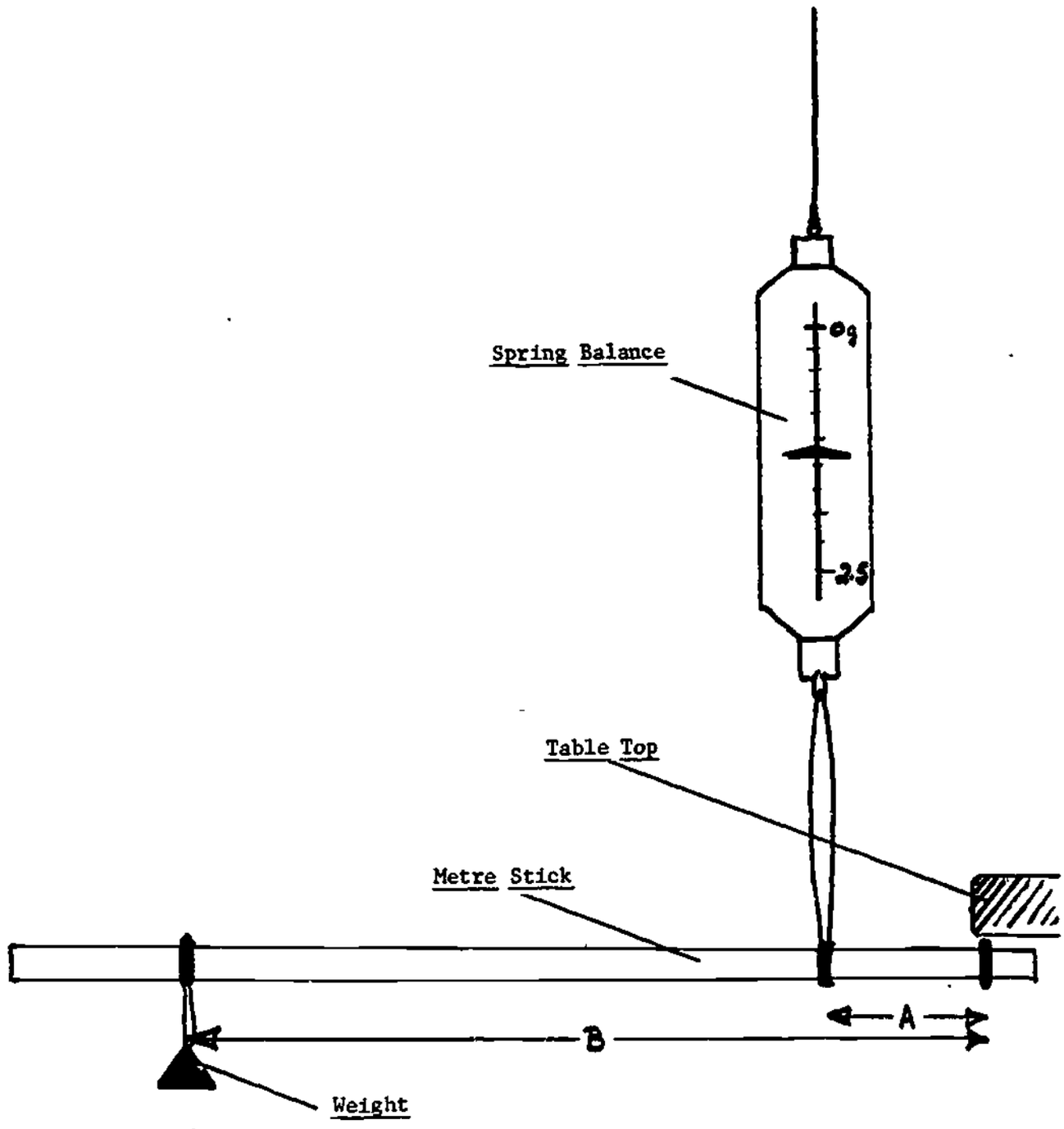


The Arm


Biceps
Muscle
Contracted
BICEPS
HUMERUS
Biceps Tendon
Radius
A
B

MECHANICAL ARM



SWEAT TO STAY COOL

by Alan T. Cutler

Focus: The body achieves cooling through evaporation of sweat, produced by glands in the skin.

Background: It is important for our health that the body temperature remain constant. An increase of only a few degrees can be very hazardous; high fever and heat stroke can kill people.

Challenge: Find where the sweat glands are and how close they are together.

Materials and Equipment:

Iodine
Rubbing alcohol
Corn starch
Cotton wool
Old socks
Writing paper

Optional Equipment:

Fan

How-To-Do-It: A few days before the activity is planned, ask the class to bring in some old clean socks.

To start the activity, have the children remove their shoes and socks and, using the old socks, put a dry sock on one foot and a damp sock on the other. Ask which is cooler. To improve the cooling effect you could use a fan and blow air over their feet.

Before the lesson, make a corn starch solution of one-half cup of water and two teaspoons of corn starch. Into this solution dip pieces of writing paper about 5 cm square and allow to dry. Discuss with the children how effective evaporation is for cooling and why the skin has sweat glands. To find out where the children's sweat glands are, paint a 3 cm square with iodine on the palm of each child and allow to dry. Tell the children to work up a sweat and then press the test papers against the iodined square. The sweat glands will show up as dark spots on the paper. Children can count how many spots they have and compare their results with the others. The iodine can then be removed from the palm with rubbing alcohol which will feel even cooler than water because of its more rapid rate of evaporation.

Further Challenges:

1) Try graphing the results.

2) Compare other parts of the body. Are there as many sweat glands in each 3 cm square?

3) Try to determine the total area of skin covering a body.

4) Find where the various sensors are on the skin (hot, cold, touch, pressure).

5) Take prints of the skin from different areas.

6) Do hairs have sensors?

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Allison, Linda. Blood and Guts - a Working Guide to Your Own Insides. Toronto: Little, Brown and Company, 1976.

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Nilsson, L., and J. Lindberg. Behold Man - A Photographic Journey of Discovery Inside the Body. Toronto: Little, Brown and Co., 1974.

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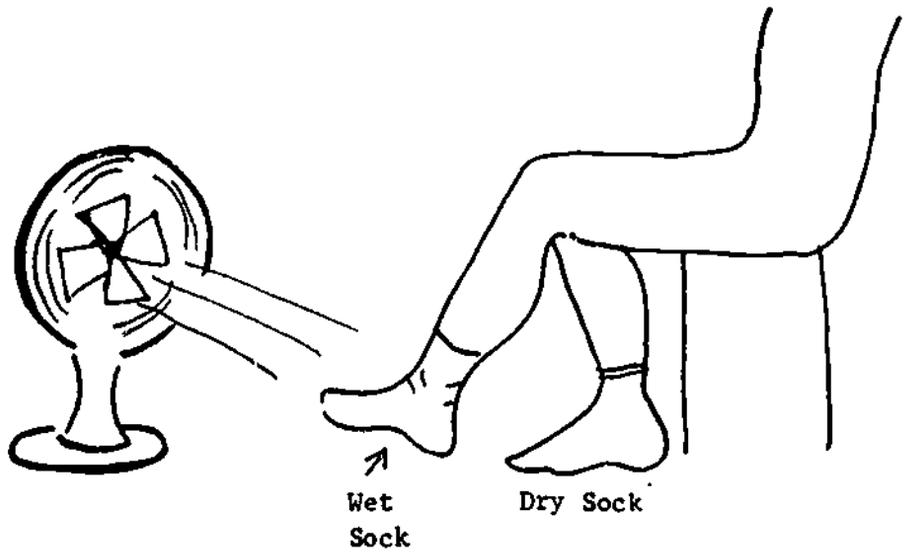

COLD SKIN TEMPERATURES

by Jim Lightfoot

Focus: Temperatures of various parts of the body change differentially when exposed to cold weather.

Background: All the children realize that in the winter it is colder outdoors than it is in a classroom because they can feel it. Yet how many of them realize that different parts of their body cool off much quicker than other areas and that it is important to protect these body parts from winter exposure?

Challenge: Measure the exterior temperatures of body extremities, both in the classroom environment and outside on a cool winter day. Record the data and compare the differences on a graph.

How-To-Do-It:

Begin by asking the children questions such as: What do you like about winter? What do you dislike? --The cold? Why? How do you know it is cold? Can we measure the differences on ourselves between being inside and outside?

Explain the procedure to the class. First, record sheets will be handed out to the class. The the class will be broken up into partners to record the temperatures of various body parts according to the record sheet, e.g., the top of the head, cheeks, etc. Make sure the children hold the thermometers at the tip opposite to the mercury so as not to influence the temperature readings because of their warm hands. The mercury tips of the thermometers should touch exposed skin at the appropriate areas and should be left there for approximately one minute for proper readings. Have the children record the temperatures as they measure them.

Once the indoor readings are done, the children may dress and proceed outdoors. (Pick an appropriate day for the activity, not too miserable, but cold enough to ensure temperature differences.) Similar body temperature readings are made outdoors, perhaps ten minutes after being outside, or, even better, by arrangement before or after school when the children have been outside for some time. Again, readings are recorded as they are completed.

From the record sheet and the graph, the children should learn that different parts of their body cool dramatically when exposed to the winter outdoor temperatures. The hands, head and feet are especially susceptible areas. The discussions and questions can lead to an exploration of several areas--warm clothing in the winter, how to prevent frostbite, winter survival and perhaps concluding with some information and discussion on hypothermia.

Further Challenges:

1) Have the class build snow shelters that would protect them from the cold if they were lost.

2) Conduct similar temperature recordings for a hot day in June and discover what body parts heat up quickest and need protection from the sun.

References:

Campbell, S., and T. Potts. The Snowbook: A Teacher's Guide. Victoria: Province of British Columbia, Ministry of Environment, 1978.

Date: _____ Record Sheet Name: _____

Temperatures °C

Body Parts	Indoors	Outdoors
Top of head		
Cheeks		
Neck		
Palms		
Underarms		
Stomach		
Ankles		

Questions:

1. Which body parts are the warmest? Why?

_____

_____

_____

2. Which body parts are the hardest to keep warm? Why?

_____

_____

_____

3. What does this information suggest about how to keep warm when you are outside in the winter?

_____

_____

_____

_____

CHAPTER III

THE FIVE SENSES

Learning is a change in the individual, due to the interaction of that individual and his environment, which fills a need and makes him more capable of dealing adequately with his environment.

W. H. Burton: in Readings in Human Learning edited by L. D. Crow and A. Crow. New York: McKay, 1963, p. 7.

POINTS ON YOUR SKIN

by Alan Cutler

Focus: Skin is the body's barrier to the environment; it protects the body and also tells us much about it. With the use of nerve endings just under the skin, we can feel such things as cold, heat, pain, texture and weight.

Challenge: Find where the nerve endings or sensors are for touch on the back of the hand. Are they all over, scattered, and with the same pattern on everybody?

Materials and Equipment:

Fine-tipped felt pens
Pen or pencil
Ruler
Pin
Paper

How-To-Do-It: On the back of your hand draw a 6 mm square using the felt pen. Then divide the square into 16 smaller squares. On the piece of paper draw another similar square but larger as this will be the map.

Using the pin, lightly touch the skin inside each small square and if a sensation is felt, mark it on the corresponding square on the map. Compare your results with those of the others. What conclusions can you draw?

Further Challenges:

1) Using the same grid technique on the back of the hand, try to map heat sensors and cold sensors.

2) Try mapping other areas of the skin.

3) Do hairs have sensors?

4) Find how many hairs are in one square centimeter.

5) Make prints using the skin's patterns i.e., finger prints.

6) How could you determine the total area of skin on your body?

References:

Allison, Linda. Blood and Guts, A Working Guide to Your Own Insides. Toronto: Little, Brown, 1976.

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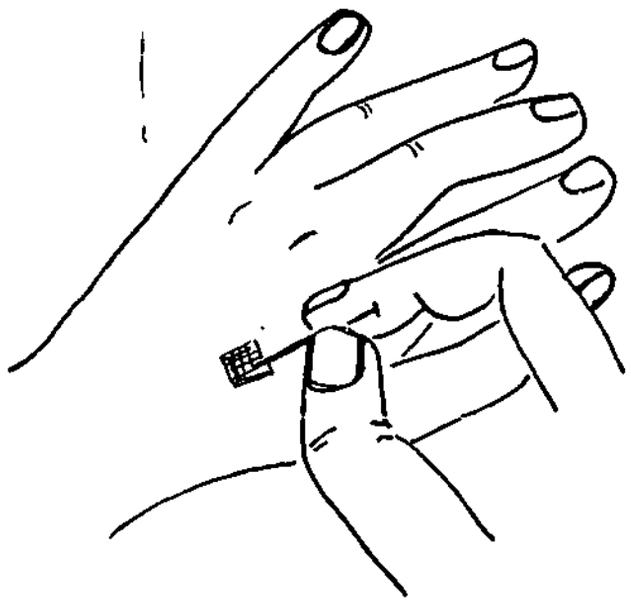

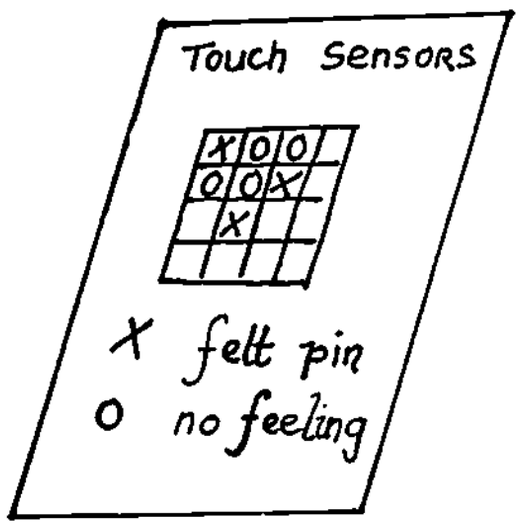

TANTALIZE YOUR TASTEBUDS

by Dawn Storey

Focus: Students will identify sweet, sour, bitter and salty tastes and where the tongue is sensitive to each taste. Certain areas of the tongue react to each of these tastes. The tastebuds in these areas have nerve endings which respond to certain tastes because of a chemical reaction.

Background: The tip of the tongue is sensitive to both sweet and salty tastes. Salt reacts with the tip of the tongue while much of the front part of the tongue can recognize sweet flavors. The middle side edges of the tongue are sensitive to sour tastes. The back of the tongue is where bitter flavors are tasted.

Challenge: Students will test each taste: sweet, sour, bitter and salty on areas of the tongue; they will prepare a diagram of the tongue to illustrate the findings.

Materials and Equipment:

Unflavored gelatin
Salt, sugar, lemon juice, instant coffee
4 saucers
A mirror
Q-Tips
Paper and pencil
Paper towel
Pitcher of water and a glass

How-To-Do-It: Students work together in pairs. Prepare solutions of salt, sugar, lemon juice and instant coffee in unflavored gelatin. (This should be done ahead of time.) Students should rinse their mouths ahead of time and wipe their tongues dry before tasting. It is important to prevent saliva from transferring taste to another part of the tongue.

Tell the students: "First dip a Q-tip in one of the mixtures. Touch the tip, middle, edges, and back of a dry tongue. Having identified the taste, note on the diagram where the sensation occurred and was strongest. Rinse your mouth, dry your tongue and repeat this procedure for each of the remaining solutions."

Ask the students to make a large chart of the results of their tests. Display results and ask students to explain findings. Ask the group to make generalizations about choice of foods based on the results of the taste tests. Discuss the implications for various age groups of people.

Make a large chart of favorite foods. How many of these foods fit the salty or sweet category? Make a large chart of disliked foods. How many of these foods fit the bitter or the sour category? Discuss with the students their reactions to this information. Ask students to list foods which do not fit into the bitter, sour, sweet, salty categories. What other senses influence your taste sense?

Further Challenges:

1) Students may try this experiment on parents to see if there are any differences.

2) Do other culture groups have the same taste responses? Students may try the experiment.

3) Try the taste tests with nose plugged and a blindfold on.

4) Have a taste party of unusual foods. Discuss whether our eyes and imagination affect our taste.

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Gilmour, James, and Ann Gilmour. Understanding Your Senses. New York: Frederick Warne and Co., Inc., 1970.

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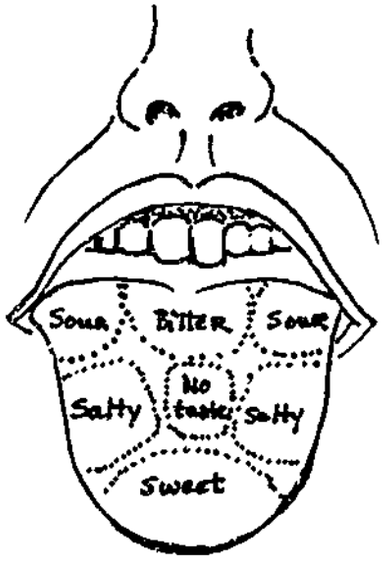

SNIFFING SNOUTS

by Charles R. Ault, Jr.

Focus: Your nose adds mightily to the appearance of your face. It also works constantly to sense the "chemistry" of your environment. The nose detects substances dispersed in the air and your memory records these "smells" in association with thoughts and feelings. Hence, the smell of an evergreen forest may remind you of Christmas tree decor.

Our noses contribute to the variety and richness of our experiences. To people who may have lost their sense of smell, food and drink are often unappetizing. There is no word analogous to "blind" or "deaf" meaning "smell-less," perhaps because we humans no longer rely upon our snouts to sniff danger, recognize others of our species, or locate good food. Our eyes tell us most of what we need to know about the outside world. For most other vertebrate (or "backboned") animals -- from sharks to wolves -- smell provides information essential for survival. In fact, most vertebrate animals invest heavily in complex development of the brain region used to interpret and remember "olfactory experiences" -- in other words, learn smells. Whether water or air borne, smells may signal events happening at a distance: the death and bleeding of another animal, the release of dangerous poison into the environment, the presence of a potential mate, the movement of a feared predator.

Background: How does smell work among different vertebrate animals? Living fishes smell well but do not have an apparent nose. (The smell of dead fish on a beach is another matter altogether!) Most fishes have a "pocket" (or "nasal sac") on either side of the front of their heads. These pockets do not open into the mouth -- fishes do not have to breathe through their noses! Skin divides each pocket in two. Water enters through one hole and exits through the other. This structure delivers water -- with whatever chemical messages it may be carrying -- to a small area of folded tissue. In this tissue are "olfactory cells." The exposed tips of these cells project microscopic, fingerlike hairs into the nasal sacs and sense substances present. From the other ends of these olfactory cells, a nerve fiber connects to the "Olfactory bulb" of the brain which must interpret sensations. No other sensory system has a more ancient history than this type of cell. Indeed, the same basic arrangement exists in people. Slimy mucous protects the delicate sniffing tissues. (Mucous is the stuff of "runny" noses. Do you suppose fish get "swimmy" noses?)

The nasal sacs of amphibians open through the front roof of the mouth. Openings permit air-breathing. Frogs can breathe when their bodies and mouths are submerged, for example. So can an alligator, lying low in the swamp like an old log. Reptilian passages for air are more complex. Longer ducts and bigger chambers cause air to enter the mouth through the roof of the back of the mouth and encounter a much greater area of smell-sensing surface than exists in amphibian snouts.

Perhaps you have heard that snakes and lizards smell with their tongues. Actually, they have two sacs similar to nasal chambers.

These sacs (or Jacobson's organs) are located to the front of the openings into the mouth from the nasal chamber. Olfactory nerve cells line these sacs, too. Snakes and lizards "taste" the air with their tongues, but only discover what might be present after inserting their tongue -- one prong of the fork on each side -- into the two olfactory sacs.

Some of the extinct duckbill dinosaurs (hadrosaurs) had elaborately enlarged nasal chambers in their skulls. A hollow horn as long as 6 feet topped the head of Parasaurolaphus (see Figure 1). This chamber probably allowed Parasaurolaphus to snort with true dinosaur fury, or perhaps bugle like a bull elk in mating season. Maybe the tremendous amount of surface area gave Parasaurolaphus a sharp sense of smell.

No such fancy headgear is known from the fossil record of the hollow-tailed dinosaurs (coelurosaurs). This group includes likely ancestors for modern birds whose adaptations for flight include remarkable powers of vision. Flight places little premium on smell, and bird nasal chambers are small. The outside openings are located at the base of the beak. Internal structure resembles reptilian patterns. Marine bird "noses" accomplish an additional task necessary to the survival of salt-water drinkers: special glands get rid of excess body salt. Nearly all birds are "smell-blind" (or "smell-deaf"?) Some vultures may be able to sense the odor of rotting carcasses. For a vulture, locating carrion has obvious advantages.

Mammals are the "smelliest" of all vertebrate groups. Mammals keep a constant, relatively warm body temperature. Mammal snouts "condition" entering air to near body temperature. Thin sheets of bone, covered with sensitive tissue bearing numerous olfactory cells, wrap round and round inside mammalian nasal chambers. Smell sensing occurs in the upper nasal chamber; the lower parts carry air more directly for breathing (see Figure 2). "Scrolled" bone in a mammal skull snout enhances smell sensitive surface area tremendously. Mammals almost talk to each other with smells. What skunks have to say is unprintable.

Primate mammals such as monkeys, apes, and people have little or no muzzle to their faces. In humans, snouts are gone, but noses remain. Short snouts bring the eyes forward and close together on the head. Thus, fields of vision from each eye overlap greatly and enhance depth perception. We, and others in the primate family, have highly developed visual abilities. Primate brains have reduced "smell centers" and enlarged "visual centers." Perhaps the keen, distance-determining eyesight found among most primates came about as an adaptation to dwelling in trees. Presumably, a creature swinging gracefully from branch to branch must know exactly where to reach and when to duck.

Our nasal sense is mammalian, and that means sensitive. Upper nasal passages contain many delicate olfactory cells and nerves. Scrolled, thin sheets of bone enhance surface area. Our snouts are no match for bloodhounds, but humans can certainly detect a wide variety of smells

even in very minute concentrations. Our noses are most sensitive to changes in smell. After a short time, our sensation of the intensity of a new odor weakens. Basic types of taste -- sweet, sour, bitter, salty -- are well recognized and easily associated with regions of tastebuds on the tongue. These four taste types combine to give an enormous range of tastes, but flavor variety depends on combining taste and "aroma" (i.e., smell).

Basic odors are not easily categorized. According to one current health textbook (Otto, Julian, Tether, Nassif, 1980), there are "seven primary odors": 1) camphoraceous as in mothballs, 2) musky as in some plant roots, 3) floral as in roses, 4) pepperminty as in peppermint leaves, 5) ethereal as in nail polish, 6) pungent as in lemons and 7) putrid as in rotten eggs.

Like any tissue lining the interior cavities of the body (lungs, mouth, etc.) nasal tissue is very delicate. Toxic or corrosive fumes, acrid smoke, hot gases or high concentrations of aromatic substances may harm nasal membranes, "burn" eyes, or damage lungs. Bitter cold and sharp objects pose threats to the nose too. Exposed nose skin freezes easily in severe subzero weather, especially if exposed to brisk winds. The nasal chamber connects to the mouth cavity and to passages from the inner ear (Eustachian tubes connect the inner ear to the upper throat). Hence, blowing a pinched or blocked nose with the mouth closed can increase air pressure all the way to the inner ear. This technique relieves discomfort from unbalanced pressure on the ear while changing altitude when flying or while diving deeply when swimming. However, always take care when blowing a runny nose not to force mucous up the tubes to the inner ear. Because nose, ears and throat connect, common cold (and other) infections can spread from one area to the other. Prolonged infections or ones accompanied by fever are always good cause to contact a physician.

Challenge: What can you smell? What memories do different smells evoke? Make a creative writing exercise out of "sniff and tell." For example, why do dead things smell so awful? How does recognition of putrid odors help us survive and stay healthy?

Materials and Equipment:

Any household items with noticeable smells. (Caution: aromatic petroleum distillates can produce harmful vapors. Read all labels of commercial household products carefully. Neutralize the discomfort of a whiff of ammonia with a sniff of vinegar.)

Kitchen odors from kitchen things: especially extracts of vanilla, licorice, peppermint, banana, lemon, etc. as well as spices and strong smelling foods.
Cardboard tube and paper
Mini-marshmallows

How-To-Do-It: Can you "overload" your sense of smell? Try to tell the difference between peppermint and licorice (or other pairs of extracts/spices) after repeatedly smelling each. Does your ability to sort objects by smell alone (eyes blindfolded) change as you continually try to do so?

Make a model mammal snout with a cardboard tube and a sheet of paper. How should the paper be inserted to model the way mammalian nasal chamber structure maximizes surface area?

Try eating with your nose pinched closed. Can you tell foods apart by taste alone as well as by taste plus aroma? Younger children may enjoy identifying foods and objects by smell while blindfolded.

What do you think the primary odor categories should be? Can you think of smells of ten interesting nasal kinds? Try to analyze a complex smell into simple combinations of primary odors.

Do you suppose you could track an animal by scent? Take a large bag of mini-marshmallows. Divide the marshmallows into at least six groups. Put a few drops of a different kind of extract on all of the marshmallows of each group. You have banana-smelling marshmallows, licorice-smelling marshmallows, vanilla-smelling marshmallows, or whatever-the-extract-is marshmallows. Designate a banana rabbit, licorice rabbit, vanilla rabbit, etc. Each rabbit takes the marshmallows with the right scent. On the playground, the rabbits begin from a common point and hop away. After ten hops, each rabbit leaves a marshmallow pellet on the ground. Rabbit trails should cross-cross several times as they spread out. Designate packs of banana-rabbit-eating coyotes, vanilla-rabbit-eating coyotes, etc. From the starting point, send each pack of coyotes after its favorite rabbit. Can the pack members keep the scent and stay on the trail? Have them replace marshmallows on the ground where found as they chase after the rabbits. Be sure to have the rabbits out of sight when the coyote packs begin the hunt.

Further Challenges:

1) Start a classroom skull collection. Compare the structure of nasal areas among different animals. Determine snout length/head height ratios. How well does this number allow you to compare the sense of smell for different animals?

Examine openings in the skulls. Pass pipe cleaners through openings to see where they lead. Can you trace nasal and inner ear passages into the mouth area?

2) Noses are a permanent facial feature and some people are very sensitive about the appearance of their noses. Health discussion should focus on how nose hairs, mucous, and shape protect our breathing system by filtering and conditioning air. Remind children

to wear protective face masks when working around sawdust, fibrous substances (such as insulation), any other materials that in the air might overwhelm the nasal filtering system. Remind younger children never to place sharp objects in their noses. Infections occur easily inside damaged noses.

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Otto, James H., Cloyd J. Julian, J. Edward Tether, and Janet Z. Nassif. Modern Health. New York: Hold, Rinehart and Winston, 1980.

Romer, Alfred S. The Vertebrate Body. Philadelphia: W. B. Saunders Company, 1962.

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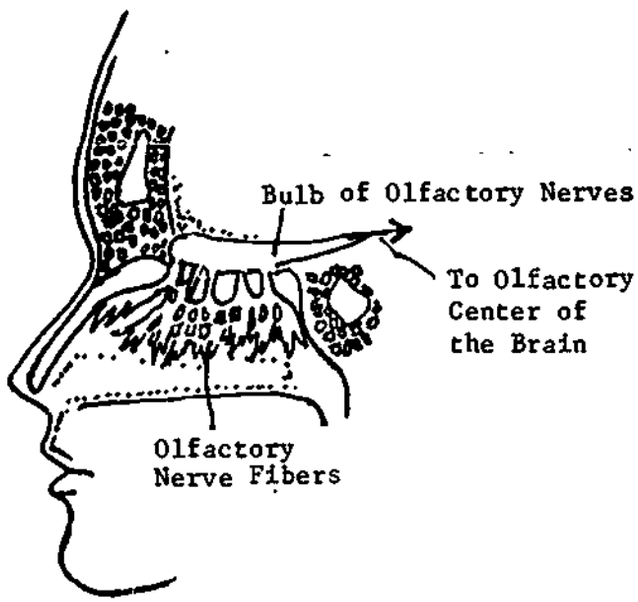

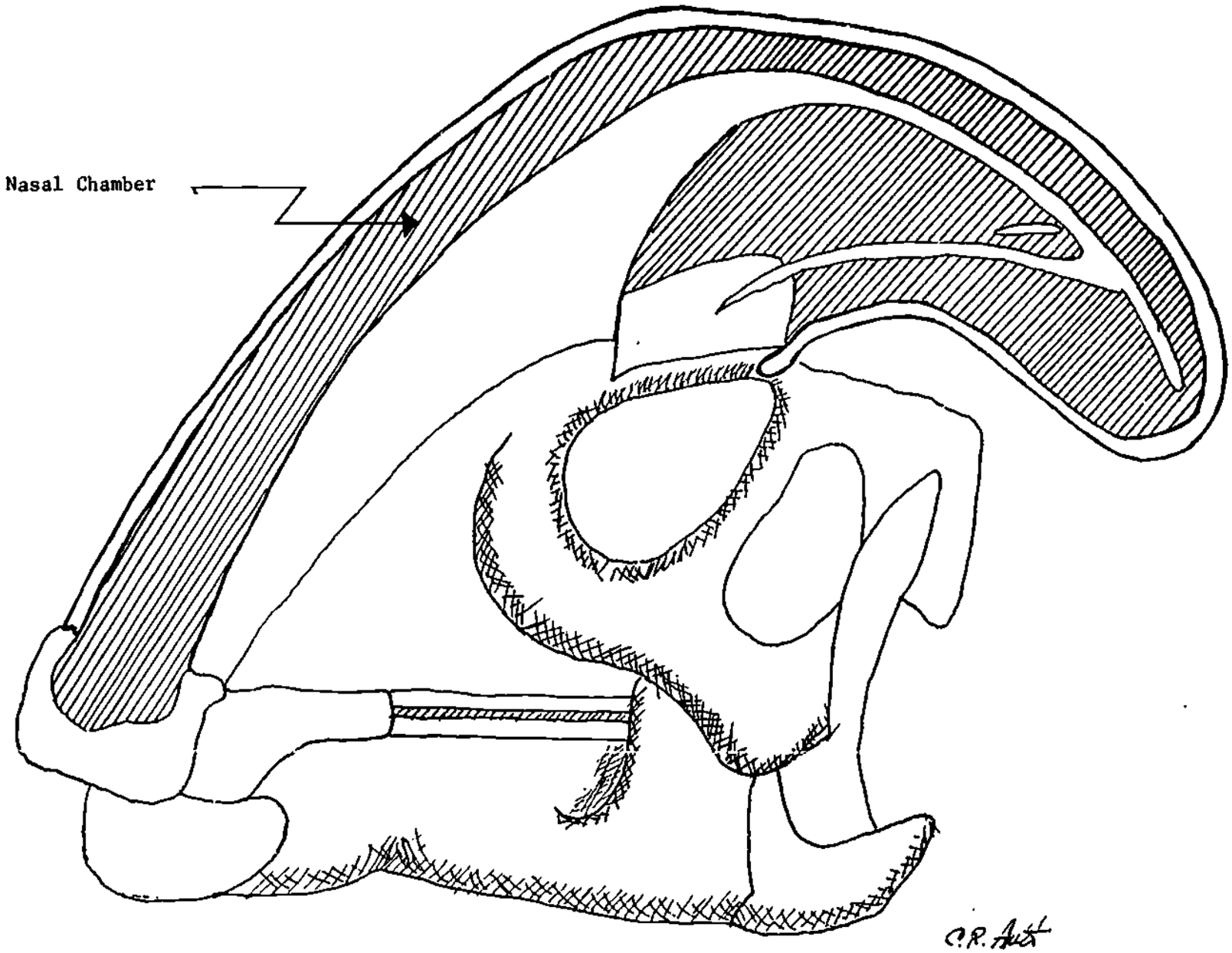

Figure 1. Enlarged nasal chamber of a duckbill ("hadrosaur") dinosaur (adapted from Lambert, 1983).

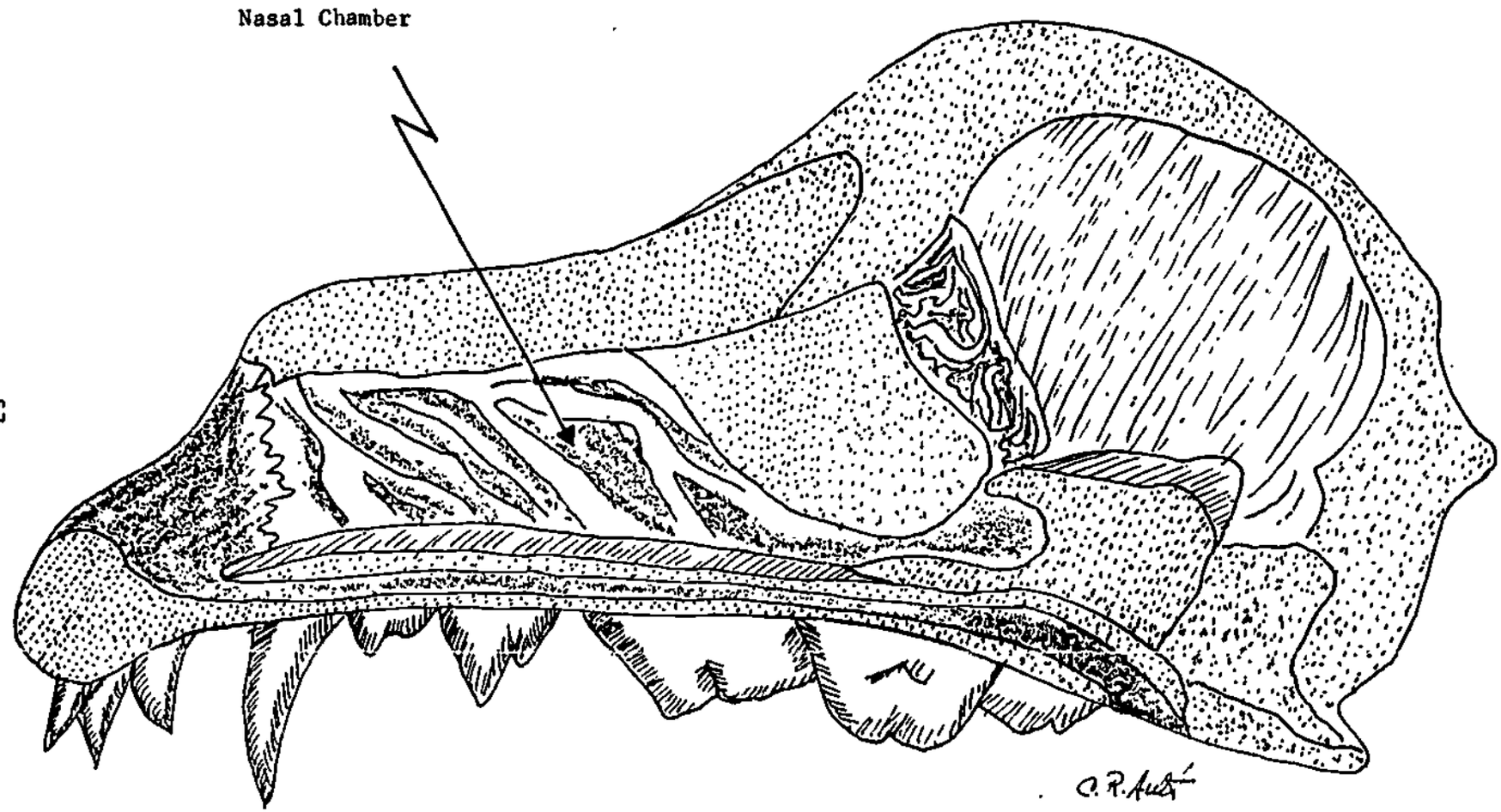

Figure 2. Dog snout with nasal chamber (shaded) divided by thin, "scrolled" bone, typical of mammals. Note lower passage opening directly through the roof of the mouth (adapted from Romer, 1962).

EYE FOOLED YOU!

by Sheila M. Jasalavich

Focus: The eye is a complex sense organ. The sensitive lining at the back of the eyeball is called the retina. The activity which follows allowa you to experience a nifty optical illusion. It also enables you to discover that the retina holds an image for a short time.

Challenge: Create your own Eye-Foolers. Infer how the eye works by experimenting with Eye-Foolers.

Materials and Equipment:

8.5 cm x 13.5 cm pieces of paper
Pencils
Scotch tape
Crayons or markers (if desired)

How-To-Do-It: Take an 8.5 cm x 13.5 cm piece of paper and fold it in half. The folded edge is the top of your paper. Sketch the beginning of an action on one side of the paper and the end of an action on the other side. Some examples might be: an opened eye and a closed eye, a muscle man with the barbell in his hands below his chin and a muscle man with the barbell raised above his head. Use your imagination to create some comical Eye-Foolers.

After you have sketched the pictures on each side of your folded piece of paper, color them. Take the folded piece of paper and slip it over the tip of your pencil. Tape the bottom of each side of the picture to the pencil.

Twirl the pencil back and forth between your fingers. What do you see? How do you know the retina holds an image for a short time?

Twirl the pencil slower and faster. Does this affect what you see?

Infer how your eye is handling the stimulation of an Eye-Fooler. Can you think of any other situations with the same principle at work?

Further Challenges:

1) Create a flip book or filmstrip and watch something move or grow right before your eyes.

2) Discover other functions of the eye such as: the effect of light on your pupil, finding your blindspot, investigating your side vision, etc.

3) Compare your eye and a camera.

4) Play with some graphic optical illusions.

5) Pantomine situations which illustrate defects of the eye such as: nearsightedness, farsightedness, etc.

References:

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Nussbaum, Hedda Edicot. Charlie Brown's Super Book of Questions and Answers About All Kinds of Animals ... From Snails to People. New York: Random House, 1976.

Victor, Edward. Science for the Elementary School. 4th Edition. New York: Macmillan, 1980.

COLOR TRICKS

by Florence A. Stronck

Focus: The eye can be tricked by after-images.

Background: After-images, or simultaneous contrast, result from the fact that, for any given color, the eye simultaneously requires the complement of that color, i.e., red and green. The nerve ends of the human retina (rods and cones) are tuned to receive any of the three primary colors--red, yellow and blue--which constitute all colors. If a person stares at red, the red will fatigue the red-sensitive parts, so that a sudden shift to white (which again consists of red, yellow and blue) results in a mixture of yellow and blue. This mixture of yellow and blue equals green or the complement of red.

Materials and Equipment:

Construction paper in black, yellow, white and red. Solid color sections may be cut from magazines.
Scissors
Tape or glue
Ruler
Compass, i.e., dividers for drawing circles (optional)

How-To-Do-It: From red and white paper, cut out 2 equal circles (5 cm or 2 inches in diameter) and mark their centers with a small black dot. Paste the red circle to the left and the white circle to the right on the blackboard or a piece of black paper or cardboard about 8 inches high and 16 inches long (20 cm by 40 cm) and place them in a horizontal position.

Stare at the red circle for half a minute. Then shift the eye to the center of the white circle on the right. The eye will see green or blue-green! This effect is called after-image or simultaneous contrast.

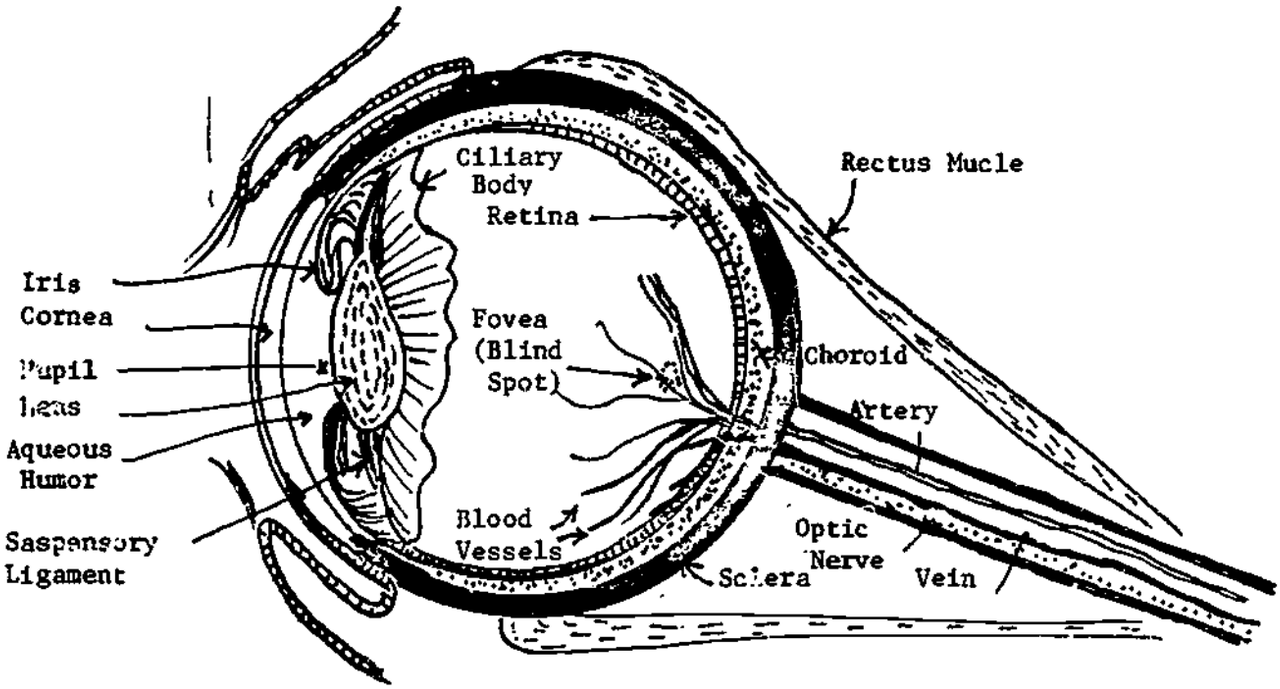
Further Challenges:

1) Make two white squares about 6 inches by 6 inches (15 cm by 15 cm). Cut 9 yellow circles and make them about 2 inches (5 cm) in diameter. Place the 9 yellow circles touching each other in the left square and place a small black dot in the very center of the center circle. Place a black dot on the white square placed to the right and place both squares (including the square containing the 9 yellow circles) on a black ground. Stare at the left square (affixing the eye on the black dot in the middle) for half a minute, then shift the eye to the right square. What do you see? Instead of seeing the complement of yellow, which is purple, one sees diamond shapes or shapes left over from the negative spaces of circles on the left. These left-over shapes are seen in yellow, and is known as contrast reversal.

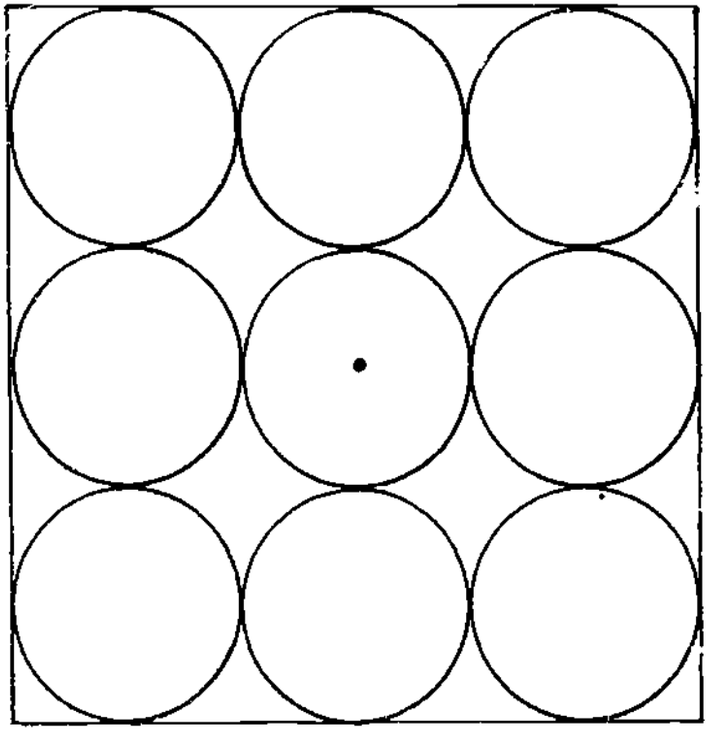
2) Experiment with other colors to recognize complementaries.

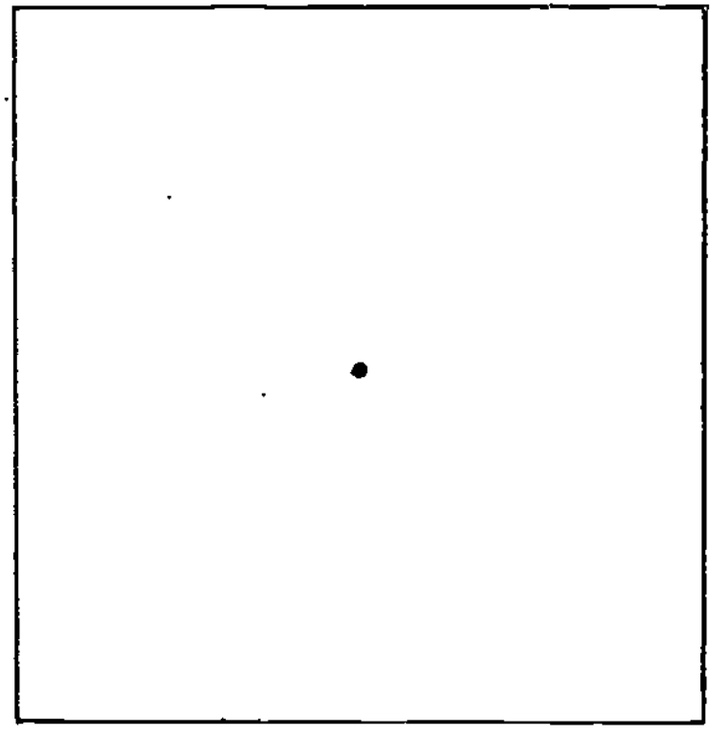
Reference:

Albers, Josef. Interaction of Color. New Haven, Connecticut: Yale University Press, 1971.



Contrast Reversal





Squares should be white

Circles should be yellow

Background is black

LENSES FOCUSING LIGHT RAYS

by David R. Stronck

Focus: Lenses focus light rays.

Challenge: Use a magnifying lens to focus light on a spot and to enlarge images.

Materials and Equipment:

Magnifying lenses
Rulers (ideally transparent plastic rulers)
Newspapers
Tape or tacks
Overhead projector (optional)

How-To-Do-It: The topic may be introduced by placing a transparent plastic ruler or any transparency on an overhead projector. Let a student turn the knob for focusing the ruler's image on the screen. After all agree that the ruler's image is clear and sharply defined, lift up one end of the ruler slightly from the lighted plate; let the other end of the ruler remain on the projector's lighted surface. Now have a student turn the knob to allow different parts of the ruler to have a clear image. Explain that the overhead projector has lenses that allow the light to be focused.

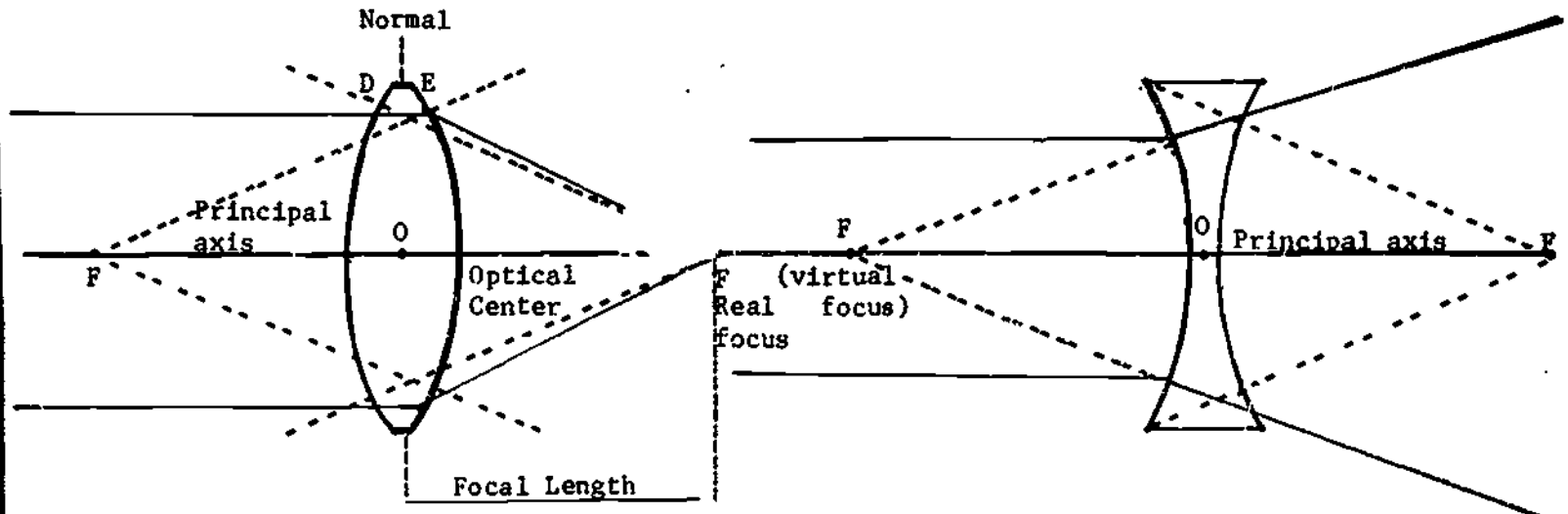
Each student may use a magnifying lens to observe the process of focusing an image. The students may look at any object, e.g., a seed, a tiny rock, etc. Tell them to measure the length of the object and also the length of its image when focused by the magnifying lens. How much larger is the image?

About ten percent of children in the schools have eye problems requiring the use of glasses. Students wearing glasses can demonstrate to others the effectiveness of these lenses. Tape or tack a newspaper with headlines to a wall. At a measured distance from the wall, have the students read the letters. How far away from the newspaper may they stand and read the letters with their glasses on and without their glasses? Let all students attempt to read the letters from the distance used by those with corrective glasses. (Eds: Use discretion with this activity; some children may be sensitive about wearing glasses.)

Further Challenges:

1) A magnifying lens can focus the rays of strong sunlight to produce enough heat at a spot to burn paper. Try this activity on a warm sunny day about noon.

2) In a darkened room, shine the light of a flashlight or candle through a magnifying lens. Let the light fall as a spot on a piece of paper. Measure the distance between the lens and this spot. Try different lenses and measure the distances. Do all lenses have the same focal length?


Normal
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THE STEREOPHONIC HANGER

by Karen K. Lind and Sharon G. Moore

Focus: Sound vibrates and is transmitted in many different ways. One medium through which sound can travel is a solid such as wire, yarn, thread and string. With a hanger and two pieces of yarn, the children will produce sound waves that will travel through the wire and the yarn to the ears where the sound waves cause the eardrum to vibrate. The message is then sent by way of the auditory nerve to the brain where it is translated into sound.

Challenge: Can you build a musical instrument out of a clothes hanger and two pieces of yarn?

Materials and Equipment:

A wire clothes hanger
Spoons, nuts, other metal objects that can hang from yarn
Thread, yarn, string
Pencil or other object for tapping the hanger

How-To-Do-It: Listen to recordings of the various sounds that musical instruments make. Try to have someone demonstrate the sounds made by a piano, violin, or other stringed instrument if possible. The ask, "How do you think these sounds were made?" Let's see if we can make some sounds with our hanger and yarn.

Tie a piece of yarn around each end of a hanger. Wind the other end of the yarn around each index finger. Hold the hanger by your index fingers and hit it against your desk. How well do you hear the sound that the hanger makes?

Place your index fingers in your ears. Hit the desk again with the hanger. How well do you hear the sound now?

Ask your partner to tap on the hanger with a pencil while you listen to the sound that is made. How well do you hear the sound? Take the yarn out of your ears. How well do you hear the sound now?

Remove one finger from your ear. Does the sound change as your partner taps on the hanger? Why? Knot the thread and place the knots in your ears. Is there a change in the sound? Why?

Ask your partner to hold the thread after the hanger is struck. What happens to the sound?

Try hitting the hanger with various objects and see if there is a difference in the sound that is made.

Change the shape of the hanger. What happens to the sound?

The children can investigate various methods of hitting the hanger, trying different materials as sound conductors from the hanger to the ears, experimenting with other metal objects such as spoons, nuts, and bolts to see if they produce sound. The children will want to try to make sound with nonmetal items. They should be encouraged to explain how the musical hanger works and what makes the hanger stereophonic.

As the children experiment with their partners, ask them to keep a record of the differences in the sounds that are made.

Further Challenges:

1) The Stereophonic Hanger is a fun introduction to a unit on sound and how it is transmitted to our ears. Children can investigate the sounds produced by a tin can telephone, a rubber band banjo, and other items.

Ask the music teacher to show the children various musical instruments. Invite a piano tuner to demonstrate the use of the tuning fork.

2) The children can create their own instruments from materials that are available at school (rubber bands, matchboxes, paper cups, etc.) or from materials they may find at home. Then have a sharing time and look at what they have made. Explain to the class how she/he created the instrument. Why did she/he create it in this way? How does it make sound? How do ears hear sound?

Who has the instrument that makes the most noise? Least amount of noise? Which instrument is the most musical? Which makes the highest noise? The lowest noise? Largest instrument? Smallest? What type of materials are the instruments made out of?

3) Write a fictional story about the musical instrument that you have created. You might want to include in your story the following ideas: Who would receive the most joy and/or benefit from your instrument? Why? What type of person would want to play your instrument? Take your instrument on an adventure?

4) Begin a collection of home-made sound-producing instruments and observe how they produce sounds and how they can cause changes in sounds.

References:

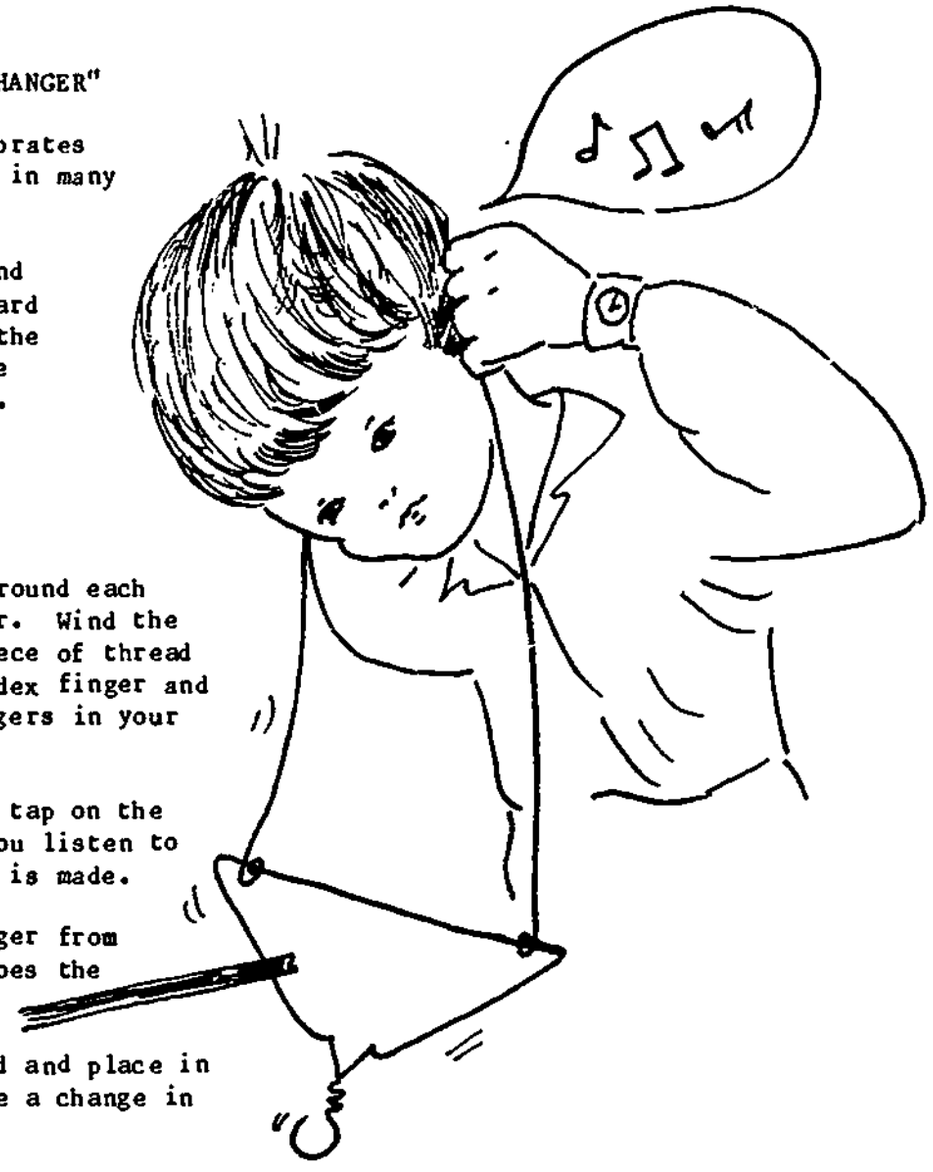
Gibson, W. B. Magic with Science. New York: Grosset and Kunlap, 1973.

Strongin, H. Science on a Shoestring. Menlo Park, California: Addison-Wesley Publishing Company, 1976.

"THE STEREOPHONIC HANGER"

Concept: Sound vibrates and is transmitted in many different ways.

The ear vibrates and produces sounds heard in the brain when the string vibrates the air into your ears.



Directions:

1. Tie a thread around each end of a hanger. Wind the end of each piece of thread around your index finger and place your fingers in your ears.

2. Ask someone to tap on the hanger while you listen to the sound that is made.

3. Remove one finger from the thread. Does the sound change? Why?
   Knot the thread and place in ears. Is there a change in sound? Why?

4. Change the shape of the hanger. What happens to the sound? Why?

5. Tie the thread behind your head, wind the thread around your fingers and place in your ears. Does this method change the sound?

6. Ask a friend to hold the thread after the hanger is struck. What happens to the sound?

7. Try materials other than a hanger. Note the sounds made by spoons, paper clips, and other objects.

8. How does the stereophonic hanger work?

A HEARING GAME

by David R. Stronck

Focus: Both ears are needed to recognize the direction of a noise's source.

Background: While playing some hearing games, students may demonstrate behaviors that may cause teachers to suspect hearing problems. Such problems should be reported to the school nurse or principal.

Challenge: Can a blindfolded student point toward the person making a sound?

Materials and Equipment:

Baby food jars with caps
Paper clips
Cloth towels
Flashlight with batteries

How-To-Do-It: A volunteer is seated in a somewhat darkened room. The volunteer practices pointing a beam of light from the flashlight at objects in the room. Then the volunteer is blindfolded.

If chairs can be easily moved, form a semicircle with the chairs in front of the volunteer. If desks cannot be easily moved, have the volunteer sit in a chair placed near and facing the center desk of the front row; leave that front and center desk unoccupied by any student. Give out baby food jars, each containing a paper clip, to students in the chairs of the semicircle (or in the desks of a somewhat semicircular arc around the volunteer's chair.)

One student at a time will shake a jar making a rattling sound with the paper clip. The volunteer will attempt to point a beam of light that will hit the noise-maker. If the light hits the noise-maker, give ten points. If the light misses but falls within one meter (or yard) of the noise-maker, give five points. No points are given for a greater miss. The students may devise another system of awarding points.

After several trials, the volunteer will use another towel to pad one ear and reduce most of that ear's ability to hear. After some trials with the left ear padded, switch the padding to the other ear. Does the padding reduce the score? Is the reduction of score the same for both ears?

Further Challenges:

1) Have one volunteer step out of the classroom, while the other students select an object to be discovered by this volunteer. The volunteer will then return to the classroom and be guided to discover the object only by the noise from the shaking the jars containing paper clips.

The seated students will shake the jars vigorously when the volunteer approaches the object. When the volunteer moves in the wrong direction, the shaking will stop.

2) Collect some unbreakable common objects in the classroom, e.g., an eraser, a ball, a pad of paper, a roll of tape, etc. Place these objects behind a cardboard (or wooden) sheet that measures at least 60 cm (2 feet) in height. Behind this sheet and unseen by the students, drop an object from the height of the sheet to a desk or table top. From the noise made by the dropped object; have the students attempt to identify the object. If two objects are dropped at the same time, can two noises be identified?

CHAPTER IV

GROWTH AND DEVELOPMENT

A child's principal business is to grow and develop toward optimum in health -- in mental and physical fitness and social and emotional maturity.

Warren E. Schaller: The School Health Program. Philadelphia, PA: Saunders, 1981, p. 203.

HOW MANY HANDS IN A FOOT?

by Rochelle F. Cohen

Focus: Changes in height are often used to describe human growth. Size, in terms of height, is often used for arranging, or ordering groups. In this activity students are asked to go beyond the obvious for measuring and arranging themselves. This investigation into unique ways to measure and compare will lead to the development and reinforcement of skills in classifying, comparing, measuring, estimating, number concepts, recording and observing. It will also serve as a testing ground for lateral thinking and creativity.

Challenge: How many different ways can you arrange yourselves using size and measuring as your bases?

Are there patterns that relate to size of extremities, height, weight, and growth over time?

How many factors can you come up with and show data support for, that affect growth of an individual?

Do people stop growing? Do they shrink? When and why?

Materials and Equipment:

Notebooks for recording observations over time
Graph paper for graphing results
Large roll of butcher paper for life-sized outlines for comparison studies
Markers
Scissors
Rulers, meter sticks, strings, etc.
Scales for weighing
Tape for marking heights or measurement on a wall
Polaroid camera for comparison studies

How-To-Do-It: Start the activity by asking: "How many of you are tired of being placed by size or last name? There are many other ways of grouping and arranging individuals. How many ways can you arrange yourselves using measurement-size as a standard, but you may not use the ordinary solutions you are familiar with." Give these boundaries: "you may use any equipment or objects found in the room for measurement or comparison. Work in groups of five determined by a traditional method."

After the class has successfully completed their first discovery method into arranging ask them to use another standard for ordering themselves. Groups may be rearranged each time using the newly discovered format. For example, a group will compare size of feet using the length of one person's hands as the standard of measurement.

Continue challenging them to find different ways of arranging themselves--length of legs, circumference of heads, etc.

Distribution of measuring devices should occur as groups find the need for them. Recording materials should be available as needed. The production of graphs as a recording instrument should be encouraged.

The groups will find different forms for arranging and measuring themselves. In addition, they will begin to develop an understanding of the variety of growth patterns within their own group, and develop a degree of competence in the skill areas suggested.

Further Challenges:

1) Is there a relationship between one's height and other measurable factors? Do taller people have longer legs?

2) What are the differences in growth rates between people in your class? Do all the smaller people show the same growth patterns?

3) Do taller people come from families with taller people? Is heredity a factor? How can we find out?

4) Is nutrition a factor in growth? How can we find out?

5) Is exercise a factor in growth? How can we find out?

HOW WE GROW

by John F. Hall

Focus: Children will learn to make careful measurements and graphs by studying their growth during the school year.

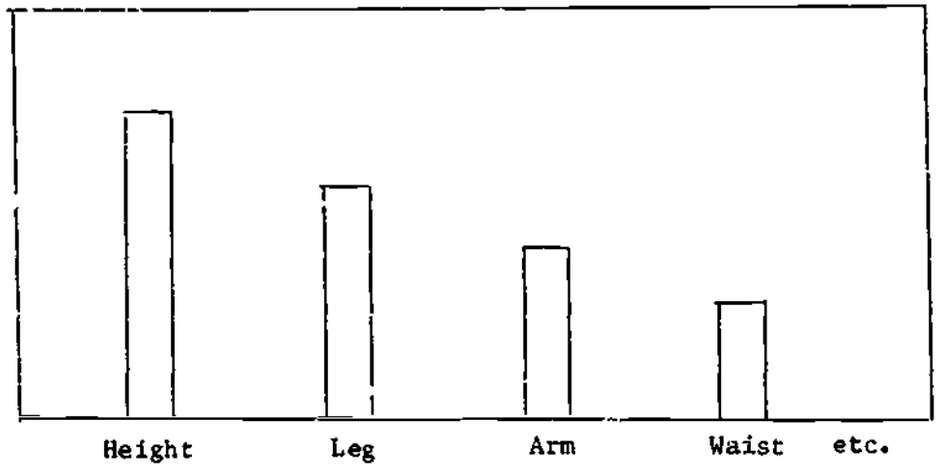
Challenge: How much did you grow during the school year? Which part of your body grew the most: arms, legs, waist, or height? How did your growth compare with others in the class?

Materials and Equipment:

Ticker tape, string or ribbon
Heavy paper or some sort of poster materials
Scissors
Glue
Crayons or colored paper

How-To-Do-It:

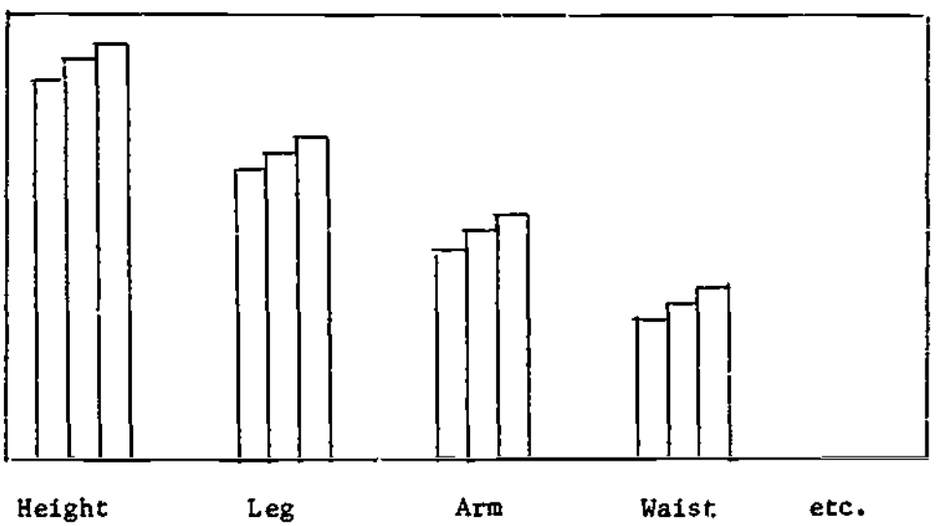
The activity could logically begin with a discussion of children's natural interest in bodily growth. How much do you think you will grow this year? What part of your body will grow the most? How can we find out? The discussion could then lead to the use of ticker tape, ribbon, or string to measure height and body dimensions such as arm length, leg length, waist, etc., at the discretion of the teacher. Units of measurement could be introduced at this point, depending on the background of the pupils. Pieces of tape or ribbon equivalent to a child's measurements could be colored (if desired) and glued on a large piece of poster paper. Units of measurement could be or not be included in the graph, depending on the pupil's background and the teacher's discretion.



Alternatively, pieces of colored paper could be cut out to represent pieces of string used in the measurements.

Children could best be organized into groups of three to five for this activity. This will not only enable children to help each other in making measurements, but will encourage a comparison of measurements.

The activity should be repeated at approximately three month intervals. Successive measurements would be added to each child's graph.



A similar graph could be made to compare different children's growth.

These activities could be concluded with a comparison of graphs; a discussion of how much growth has taken place in a year; what parts of the body grew the most, and which children grew the most.

Reference:

Elementary Science Study. Match and Measure. New York: McGraw-Hill, 1971.

TESTING YOUR STRENGTH

by Vincent B. Sindt and C. Kent Allen

Focus: How many times have you observed the children in an elementary or middle school comparing their strength? Have you ever thought of turning this common occurrence into a scientific experiment? This is an activity in which the children will build a simple strength tester and then take measurements before and after exercise, in different body positions, and with different parts of their bodies.

Background: There are many simple ways in which children can test the strength of their grip. One simple device is essentially a plastic squee bottle of the type used for c... ining ketchup or mustard. A straw or rubber tubing can be attached to the nozzle of the squeeze bottle. The cap is unscrewed to allow filling the squeeze bottle partly with water. When the cap is replaced, the child can squeeze some of this water through the nozzle into the tubing (or straw) and finally into the measuring container, e.g., measuring cup or graduated cylinder. The amount of water that is expelled from the squeeze bottle is the measure of grip strength. After each squeezing, the expelled water must be replaced to fill the squeeze bottle back to the previous level. Using pressure on water is helpful as an introduction to the concept of blood pressure.

The strength tester described below is a more accurate, reliable and convenient way to test for strength.

Challenge: Follow directions to construct a simple strength tester. Compare the strength of your two hands. Compare your strength before and after exercise.

Materials and Equipment:

Clear pine, birch or other flexible and inexpensive wood to make spacers, handles and pointer.
Cardboard, thin panelling, or heavy posterboard to make back of the device where the scale is marked.
White wood glue such as Elmer's or Weldwood.
Coping saw or small handsaw, file, sandpaper, scissors, C-clamps, pencil and ruler.

Construction Techniques:

The following directions apply to a typical device that can be used in an elementary school. If you find that your children can't squeeze the device for any readable deflection, you can either reduce the thickness of the top handle or make it longer. If on the other hand, the device is too flexible for your students, you can thicken the top handle or shorten it.

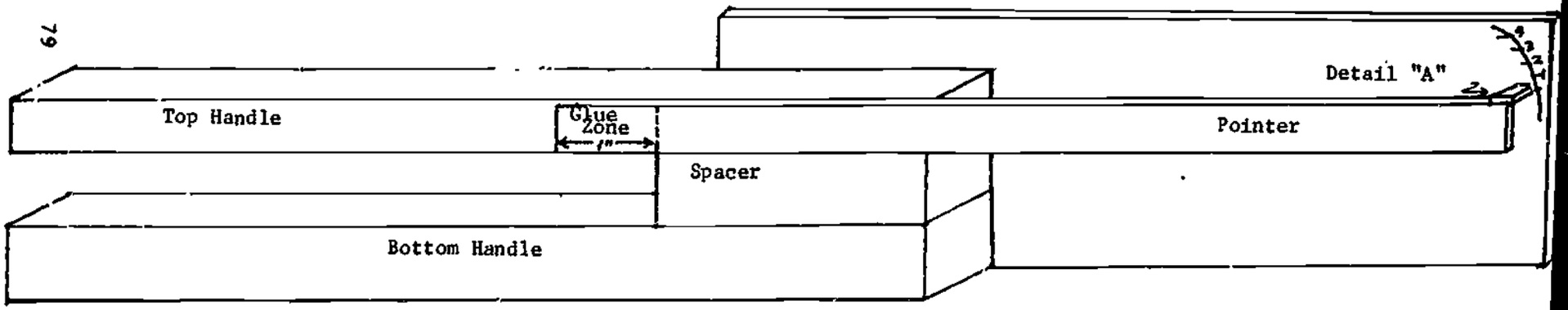
Step 1. Cut the two handles 10" long. One of them is 1/2" x 3/4", the other is 3/4" x 3/4". Use the 1/2" handle for the top.
Step 2. Cut the handle spacer 3" long from the same material as the bottom handle.
Step 3. Cut a thin strip of wood and glue a small piece of wood or toothpick to the end of it to use as a pointer.
Step 4. Cut the back portion of the device where the scale will be marked.
Step 5. Glue the spacer between the two handles and clamp. Be sure to let the glue dry completely (overnight, if possible).
Step 6. Glue the back part of the device in place and clamp. Let dry for at least 1/2 hour.
Step 7. Glue the pointer strip into place, being careful not to glue it outside the "glue zone." If glue gets on the pivot part of the handles, the pointer will not move.
Step 8. The scale can be calibrated by setting 1 lb., 2 lb., 3 lb., etc. weights on the top handle and marking where the pointer is.

How-To-Do-It: After the device has completely dried, have the children explore how to squeeze it to see different readings on the scale. Ask them if they can get the same readings with both hands. Which hand is stronger? Have the students obtain a reading before exercising and after. Have them compare the differences with each other. Have the children switch devices and see if they get the same scale readings. Discuss the differences.

Further Challenges:

1) Squeeze the device by bending at your knee or elbow, between your extended arm and body, or other creative positions. Explain the differences.

2) Change the construction of the device by adding different sized handles or wider spacers. Try other experiments such as grasping the handles with both hands, squeezing it between your fingers, etc.


Top Handle
Glue Zone
1"
Spacer
Bottom Handle
Pointer
Detail "A"

BE THE COACH

by Larry Flick

Focus: Watching people break records in competition often raises the question of how much better can the human body get? Trying to understand this question means probing the capacities and limits of the human body through a better grasp of how the body works.

Background: Using information related to individual athletic competition, such as the graphs included, discuss how records can regularly be broken from year to year. What factors influence improvements in performance? (Some we thought of are practice, nutrition, coaching techniques, training equipment, competition, environment, knowledge of the body's capacities, body structure.)

Challenge: Choose a physical task and investigate ways to improve students' ability in this task.

Materials and Equipment:

Any simple, safe activity will do. You may have facilities for doing some things more conveniently than others. This activity is written for the standing long jump. The necessary materials include:

A suitably soft surface to jump on (e.g., tumbling mat, grass, or sand). A method of measuring the distance. Each group of children doing the investigation will need a data sheet constructed to include all the variables discussed when initiating the activity.

How-To-Do-It: Choose a task (standing long jump).

Select a group of people to study. This could be just your class to begin with.

Discuss the type of data that seems important for producing top performance in this activity. Stress that while competition often improves performance in some situations, we are interested in improving everyone's performance and not just the best jumper.

In small groups or as a whole class, record the results of three trials. Should a person take all trials at once or should trial one be done by everyone first, then trial two, etc.?

Within each group, generate a list of the ways performance on this task might be improved. Pose the question: Are there limits to the amount of improvements that can be made in this task? For instance, is there a limit to how strong your leg muscles can get? What is it about muscles that makes them stronger and may also keep them from getting stronger?

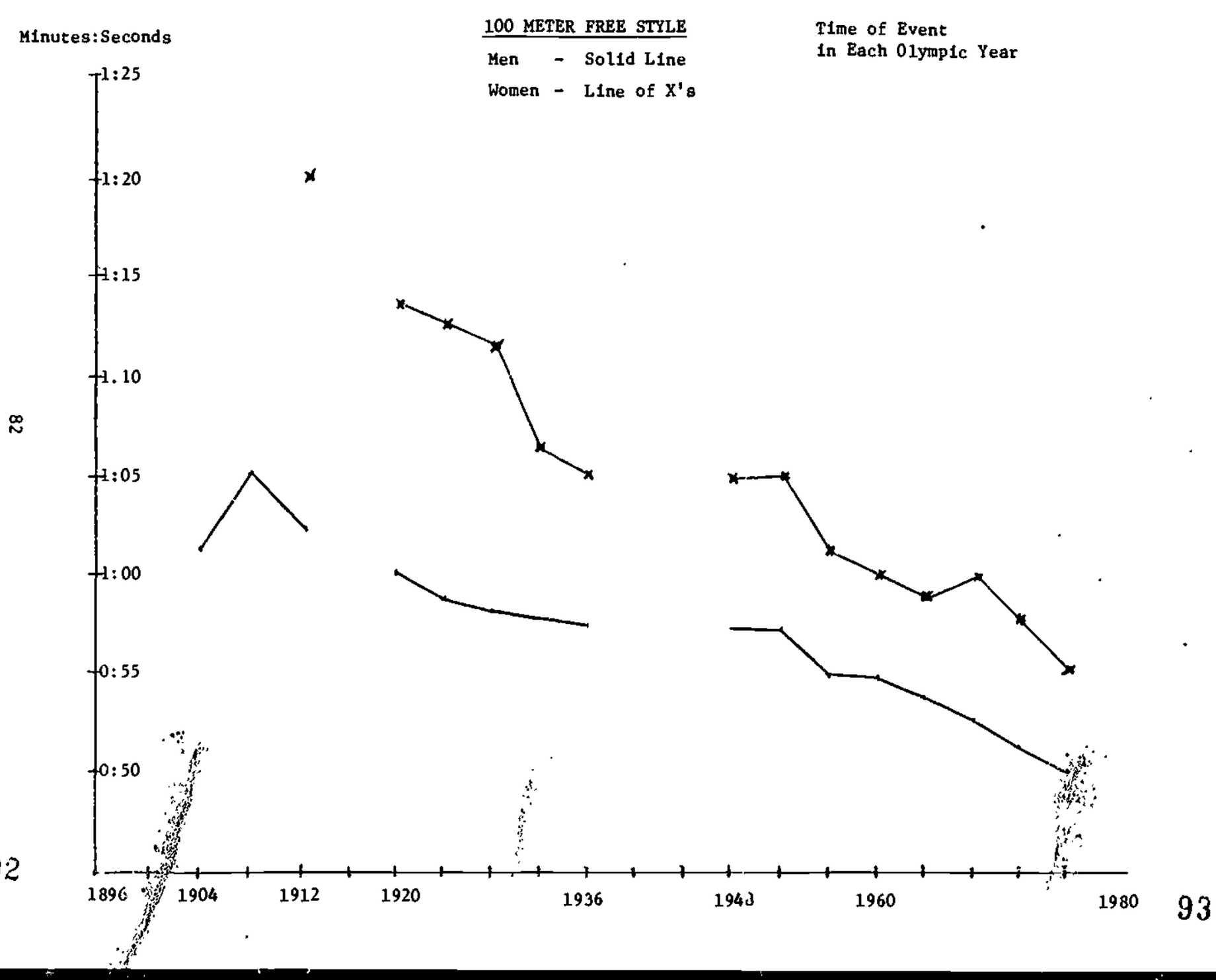
This activity should be concluded with a discussion of the open endedness of these questions.

Further Challenges:

Do the project again with another group. What professions would be interested in research on the limits of the body? Are the limits for women different than for men? (Women were not included in the Olympics until 1912. If you move the graph for women back the 16 years to where the first time for men is recorded, you will see that the graphs are quite comparable.) What are some of the psychological factors that might improve or retard performance?

Difference in Seconds between men's record and women's record in Olympic 100-meter free style

Date	Difference
1912	18.8
1920	12.2
1924	13.4
1928	12.4
1932	8.6
1936	8.3
1948	9.0
1952	8.9
1956	6.6
1960	6.0
1964	6.1
1968	7.8
1972	7.4
1976	5.7
1980	4.4


100 METER FREE STYLE
Men - Solid Line
Women - Line of X's
Time of Event
in Each Olympic Year
Minutes:Seconds
1:25
1:20
1:15
1.10
1:05
1:00
0:55
0:50
1896
1904
1912
1920
1936
1948
1960
1980

CREEPIE CRAWLERS

by John Hall

Focus: Living things pass through different stages in their life cycles.

Challenge: What are the different stages in an insect's (e.g., butterfly or moth) life cycle? What different stages do human beings go through as they grow up? How are we similar to insects? How are we different?

Materials and Equipment:

Caterpillars
Jars
Leaves
Pictures of insects and people at different stages (if desired)

How-To-Do-It: The activity could begin with a discussion of the stages animals go through in growing up, e.g., puppies and adult dogs, kittens and cats, etc. The challenge then would be given that we are going to find out about the stages that an insect goes through in its life. Children would then be instructed to bring in caterpillars in jars with an ample leaf supply. This activity is best done in the spring when caterpillars are most plentiful. One caterpillar and jar for a group of three or four children should be ample. Observations should be made at regular intervals, such as twice a week, and recorded in a log or chart. Changes in behavior or appearance should be noted. The length of the caterpillar could also be recorded. A simple bar graph could also be made, if desired.

Hopefully, a transition from larva to pupa to an adult moth or butterfly will be observed. This doesn't always happen, however, and other examples of pupas and moths or butterflies might have to be brought in. An effective way to conclude the activity is to make a large chart comparing the stages of an insect's life with a human life, for example:

	STAGE		
INSECT	Larva	Pupa	Adult
HUMAN	Child	Teenager	Adult

Descriptions, drawings, and/or pictures cut from magazines could be included in such a chart. It should be emphasized that both insects and human beings grow and go through different stages, but insects go through discrete and totally different stages, while human beings grow and develop continuously.

Further Challenges:

If frog eggs can be obtained during the spring months, observations of the frog lifecycle could be compared with insects and human beings.

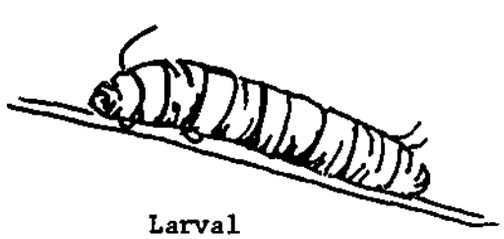
References:

McClung, Robert M. Caterpillars and How They Live. New York: William Morrow, 1965.

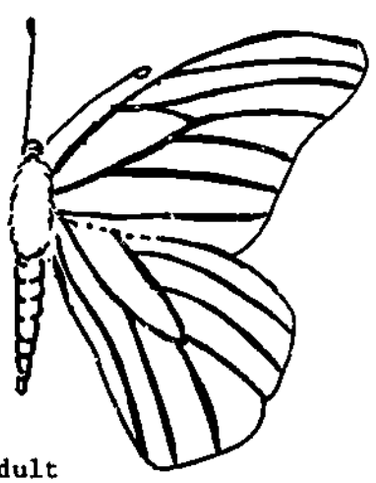
Eeckhoudt, J. P. A Butterfly is Born. New York: Sterling, 1966.

Paulus, Trina. Hope for the Flowers. New York: Paulist Press, 1972. (A creative story about caterpillars which could be integrated with language arts.)

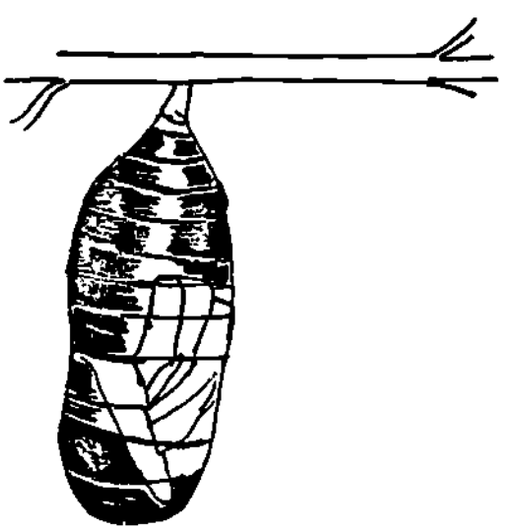
Tarrant, Graham et al., Butterflies. Los Angeles: Intervisual Communications, 1982.



Larval



Adult



Pupa

GUPPIES AND OTHER FASCINATING FISHES

by David R. Stronck

Focus: Children can observe the life cycles of small fishes.

Challenge: Observe the behavior and growth of guppies, goldfish, or exotic fishes.

Materials and Equipment:

Four-liter (gallon) glass or plastic container
Water (If tap water is used, let it stand overnight to remove chlorine.)
Gravel or sand for the bottom of the container
Algae
Fish food (from a pet store)
Dip net

How-To-Do-It: Appoint students to feed the fish daily with very small amounts of the fish food. The fish should clean up all of this amount in about five minutes. Excess food leaves rotting material that will contaminate the water. Algal plants provide some of the fish's nutrient needs. The water should be changed whenever it appears cloudy or smells. Keep the tank out of direct sunlight.

Explain to the students that guppies can be raised at room temperature. Male guppies are usually smaller and more brightly colored than females. Before having the young, a female becomes obviously fat. Children can see a dark spot on the guppy's abdomen where the young are developing.

Use a dip net to transfer a pregnant female to another tank. The young are born live (not laid as eggs). Because adults often eat the young, it is important to move the mother fish back with the other adult fish after the young are born. Students can observe the entire life cycle of a guppy from birth, growth, courtship, fertilization, and gestation.

Further Challenges:

1) Care for goldfish. They are scavengers that do well on live foods, e.g., Daphnia and brine shrimp. Goldfish are hard on water plants, e.g., Duckweed, Anarcharis, Vallisneria. The female lays ten to twenty eggs at one time; the eggs may hatch in four to fourteen days.

2) Study the life cycles of some exotic fishes. Egg-layers include Angelfish, Catfish, Zebrafish, Barb, Betta, Gouramis, Tetras, and Medaka. Exotic live bearers include Swordfish, Mollie, Moonfish, and Gambusia.

Reference:

Pels, Gertrude. The Care of Water Pets. New York: Harper and Row, 1955.

GERBILS AND OTHER BREEDING PETS

by David R. Stronck

Focus: Children can observe the nuturing of warm-blooded animals.

Challenge: Observe the behavior and growth of gerbils, mice or rats in a cage.

Materials and Equipment:

Pets or donated surplus gerbils, mice, or rats (or rodents purchased from a pet store or biological supply house)
Rodent cages (homemade or commercial wire cages or an unused aquarium with a wire-mesh top)
Water bottle with a gravity flow (from a pet store)
Exercise wheel (from a pet store)
Dirt, hay, paper towels, and wood chips for the floor of the cage
(Do NOT use newsprint; it is toxic to the animals.)
Sunflower seeds and whole grains, e.g., corn, wheat. and oats
Fresh fruits and vegetables, e.g., apples, lettuce, and celery
Fresh milk for pregnant mice
Rock salt

How-To-Do-It: Explain to the students that rats can breed eight times a year with average productions of seven young within 21 days of pregnancy. Young rats mature in two months. The gestation period for mice is 20 days; for gerbils, 25 days. Young gerbils need three months to reach maturity.

Pregnant females should be separated from the males. During nesting periods, small rodents prefer small containers (boxes) with a small opening for entry. All young are born blind and hairless. During the nursing period, do NOT allow any handling of the young or mothers. (Gerbils differ from mice and rats by selecting a mate for life.)

Have the children make daily observations, feedings, and maintenance of the water supply. At least weekly, the floor of the cage needs cleaning.

Further Challenges:

1) The same cage can be used for chameleons, a lizard that adapts its coloration to the environment. They must feed two or three times a week and want moving natural foods, e.g., flies, mealworms, small beetles, or sow bugs. Spray water on some leaves in the cage for their water supply. Chameleons usually do not reproduce in captivity, but they will grow and shed old skin. Their diet encourages discussion of population interactions: predator/prey relations.

2) Children are fascinated by watching chickens hatch from eggs. These observations can be made while on a field trip to a farm or hatchery.

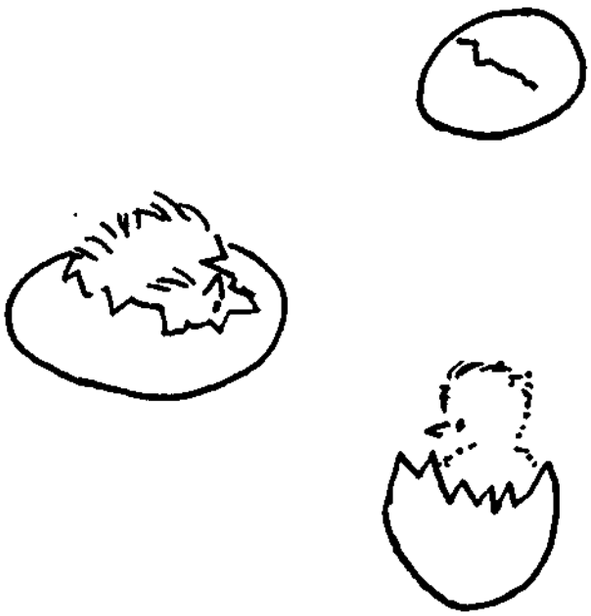
References:

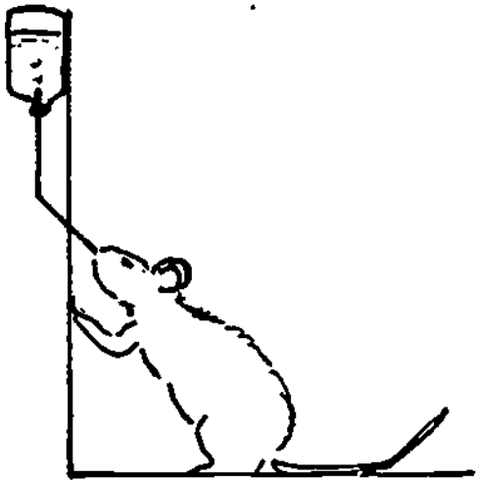
Elementary Science Study. Animals in the Classroom: A Book for Teachers. New York: McGraw-Hill, 1970.

National Science Teachers Association. How to Care for Living Things in the Classroom. Washington, D. C.: National Science Teachers Association, 1973.

Simon, Seymour. Discovering What Gerbils Do. New York: McGraw-Hill, 1971.

For details on incubating chicken eggs for hatching, write to -- Marsh Farms, P. O. Box 7, Garden Grove, California 92642.





CHILD'S PLAY

by Marilyn Flick

Focus: The concept of development will become clearer when students can observe the abilities of different ages of infants.

Challenge: Arrange for infants from 1 to 18 months to visit the classroom. The students will perform simple tests of their motor, social, and language development.

Materials and Equipment:

Collect ahead of time the items needed for tests on the infants. Depending on the plans, you will need:

Ball
Picture books
Blocks
Raisins
Cups of juice
Stairs
Simple toys

Also, be prepared with paper towels, a clean floor covering, trash container for disposable diapers, and other items you might think of for infant emergencies.

How-To-Do-It:

A small group of students could be assigned to each infant (the more infants the better). Mothers should be encouraged to stay and help out. Students should have a list of tests to perform and should record the infant's name and age in months on the observation sheet. If there is enough time and enough infants, each group can test more than one infant. Have the students record how the infant does on each test. Some tests to include are:

Which best describes the infant's abilities: holds head up, rolls over, sits, crawls, pulls to standing, walks, goes up stairs, runs, jumps?

What does the infant do with a ball: pick it up, roll it, kick it, throw it, catch it?

Which best describes his/her "speech": makes non-crying sounds, laughs, says "mama" or "dada", names other objects, puts two words together.

If you offer the child a raisin, does he/she: look at it, use his whole hand to pick it up, use only his/her thumb and finger?

What does he/she do with blocks: hold them (try 1, then 2, then 3), bang them, build a tower (how high?), a train, a bridge?

Try some games: peek-a-boo, pat-a-cake, hide and seek (simple form) can he/she drink from a cup?

Hide a toy under a cloth or paper. What happens?

Other tests, perhaps involving specific toys.

As a follow-up, have the students compare what the infants could and could not do at different ages.

Further Challenges:

1) Observe a group of children in kindergarten or first grade and make comparisons within an age group.

2) Have mothers bring their infants for a series of lessons on diapering, feeding, bathing, safety and playing with children.

FAMILY PORTRAIT

by Marilyn Flick

Focus: The concept a child holds of his/her family and its individual members will show in this simple technique of drawing a picture. By comparing his/her drawing with those of other class members, the student learns how families are alike and how they are different.

Background: Some "typical" characteristics may be seen in the group of drawings. Students usually draw the members of their family each doing his/her own thing rather than together as a family, suggesting that families are not seen as a cohesive unit. Mothers, whether they are employed outside the home or not, are usually shown doing housework. There is more variety in what fathers are doing--hobbies, sports, professions, yard work, etc. But the traditional roles are still the norm in the children's drawings. If a student leaves out a parent, a brother or sister, or himself, this is usually intentional and gives a clue to the child's feelings. Students themselves will often be able to draw some conclusions about the pictures after the discussion gets started.

The teacher should use discretion about displaying the pictures at the end of the activity. Some students may be embarrassed or threatened by this, especially after the class discussion. The teacher should help lead the class to the conclusion that normal families very rarely form a close-knit group of full-time mother, provider father, and happy children who play well together. Therefore, no family should be pinpointed as "abnormal."

Challenge: Draw a picture of everyone in your family doing something.

Materials and Equipment:

Unlined paper
Pencils

How-To-Do-It: After giving a clean sheet of paper and pencil to each child, simply give the instruction written as the challenge above. Stress that the student's art ability is not being graded and that the content of the drawing is completely up to the student. Provide enough time for the students to complete their pictures.

The students should then be divided into pairs or small groups and will take turns sharing and explaining their pictures to the others in the group.

A class discussion should follow, covering questions like these:

Did you draw each member of the family alone in separate rooms or all doing something together?

What were most of the mothers doing?

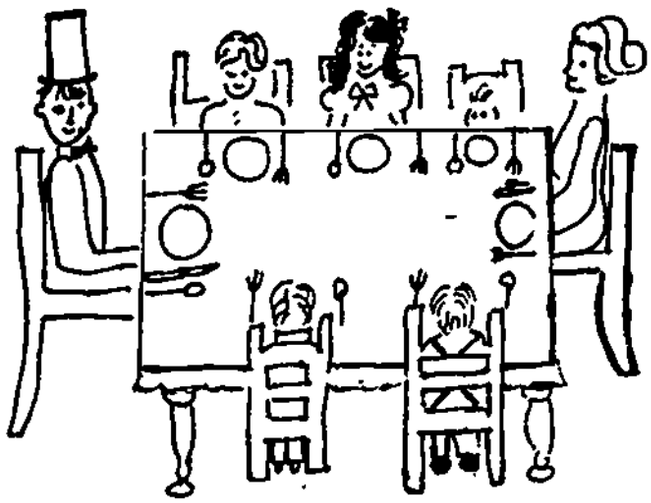
What were most of the fathers doing? How many showed their fathers doing "tough" jobs?

Did you lesve anything out of your picture?

What are the brothers snd sisters doing?

Further Challenges:

1) Draw a picture of your family at the dinner table. Draw a picture of your family watching TV.



TV FAMILIES

by Marilyn Flick

Focus: There are a variety of family types shown on TV. All of these programs help teach children about the variety of family forms that exist in real life and, with a little training in critical viewing, may help them to see through some stereotypes and some very unreal or idyllic portrayals of families.

Challenge: List and categorize all of the TV family shows.

How-To-Do-It:

As the students brainstorm, list all the TV family shows on the chalkboard. Encourage them to include the old reruns. Then lead the class in categorizing the different American family situations represented on TV. Some categories we suggest are:

a) families of specific ethnic groups
b) urban/suburban/rural families
c) small families/large families/childless families
d) two working parents/homemaker mother
e) lower class/middle class/upper class
f) families in various historical settings
g) single-parent families; combined families
h) extended families
i) others

Help the class to draw conclusions from the list. Some questions you might ask are:

> Are any of these families just like yours? Why or why not?
> Are any types of families misrepresented on TV, in your opinion?
> Is there a type that is not shown? Do you think there is a reason for that?

Further Challenges:

Tell the students: "You are a network programming executive. Devise a new family drama with a fresh angle on family life. Suggest a title, outline two sample episodes, and write a persuasive argument for why you feel your show would succeed in the ratings."

Reference:

Current Lifestyles November 1979.

TV JOURNALS

by Marilyn Flick

Focus: By comparing TV families with their own, children will gain more insight into the similarities and differences between TV and real life.

Challenge: Keep a TV journal on two family dramas.

How-To-Do-It: Give the students the "challenge" and ask them to analyze the way family issues are portrayed. The time limit is determined by the teacher. Have the students keep a log of incidents on the show which show:

How family responsibilities are divided

The closeness of the family relationships

The specific family conflicts and how they are resolved

The family's values or rules

Family traditions

Typical family mealtimes

Others you may think of

Either in a class discussion or in a written assignment, ask the students to draw some conclusions from what they observed. Some questions to consider might be:

Did the mother and father play the "traditional" roles?

How do brothers and sisters get along in the shows you watched?

Was there a chief decision-maker or did the family work together on solving problems?

Is it realistic to have a family conflict tied up neatly in 30 or 60 minutes? Or did you see any evidence of that?

Do children seem to have more freedom in TV families than in real life?

Further Challenges:

1) Do the activity "TV Families."

CHAPTER V

NUTRITION AND FOODS

Much of what the nation sees, hears, reads, and believes about nutrition is not only untrue but can actually be destructive.

Ronald M. Deutsch: "The Nutrition Boomerang." School Health Review, 5 (4): 2, May/June 1974.

ALFEE ALPHABET FOODS

by Carol Glass and Phyllis Yager

Focus: Children should learn the taste of a wide variety of nutritious foods and should be encouraged to select more nutritious foods.

Background: In general, parents are happy to cooperate with supplying food for children's snacks in the class when they understand that other parents will be making similar contributions. Small groups of four to five children can prepare a snack for the entire class by using the food supplied by a few parents. The children may also bring from home old magazines with pictures of food.

Challenge: Identify foods that begin with each letter of the alphabet. Over several days, eat some of these foods in class. Classify them according to their nutritional value, e.g., as (1) highly nutritious fresh, whole, usually raw foods, such as fruits; (2) acceptable but sometimes fatty foods such as hamburger or cheese; and (3) junk foods that have too much sugar or salt such as candy and potato chips.

Materials and Equipment:

Kitchen items, including bowls, plates, knives and glasses
Foods as suggested in the list below
Old magazines containing photographs of various foods

How-To-Do-It: Organize the children into small groups for preparing the snacks from the list below. The puppet "Alfee" can introduce the children to the names of the foods. Have the children eat samples of the foods.

Alfee's Alphabet Foods for Classroom Tasting:

A - Apricots	B - Banana
C - Carrot	D - Dates
E - Egg Salad	F - Fruit Salad (oranges, applies, etc.)
G - Grapefruit	H - Hamburger Balls
I - Inches of Celery	J - Juice of Apples
K - Kiwi Fruit	L - Lemon
M - Macaroni and Cheese	N - Nuts, e.g., Dry Roasted Peanuts
O - Olives	P - Plums or Prunes
Q - Quick by Nestles	R - Raisins
S - Sandwich of Turkey, etc.	T - Tomato
U - Uncooked Cauliflower	V - Vegetable Stew
W - Waffles or Walnuts	X - X-rated Junk Foods, e.g., candy
Y - Yogurt (unflavored)	Z - Zweibach

Cut out photographs of foods from magazines. Have the children name the foods and classify them according to their nutritional value. The major goals are to encourage the children to eat a greater variety of nutritious foods and to avoid the junk foods.

Further Challenges:

1) Using materials from the National Dairy Council's Kit Food - Early Choices, have the children identify foods according to the four basic food groups: (1) Milk, (2) Grains, (3) Meat, and (4) Fruits and Vegetables. Food processing, especially the addition of sugar and salt, can create junk foods in any of the food groups, e.g., (1) ice cream in the Milk Group; (2) cookies in the Grain Group; (3) hot dogs in the Meat Group; (4) and chocolate-covered candied cherries in the Fruit and Vegetable Group. Continue to classify foods according to their nutritional quality after they have been located in the four basic food groups. An excellent poster on this topic is available from the Center for Science in the Public Interest, 1755 S St., NW, Washington, DC 20009.

2) Using pictures of foods, have the children organize on paper plates menus for breakfast, lunch and dinner. Discuss the nutritional value of their selections. Encourage changes in selection despite their original food preferences.

Reference:

Nutrition Action, magazine published by the Center for Science in the Public Interest, 1755 S St., NW, Washington, DC 20009.

WHERE DOES MY SANDWICH GO?

by Mildred Moseman

Focus: Our digestive tract allows the breakdown of foods into sugar, starch, fat, protein, vitamins, minerals and fiber.

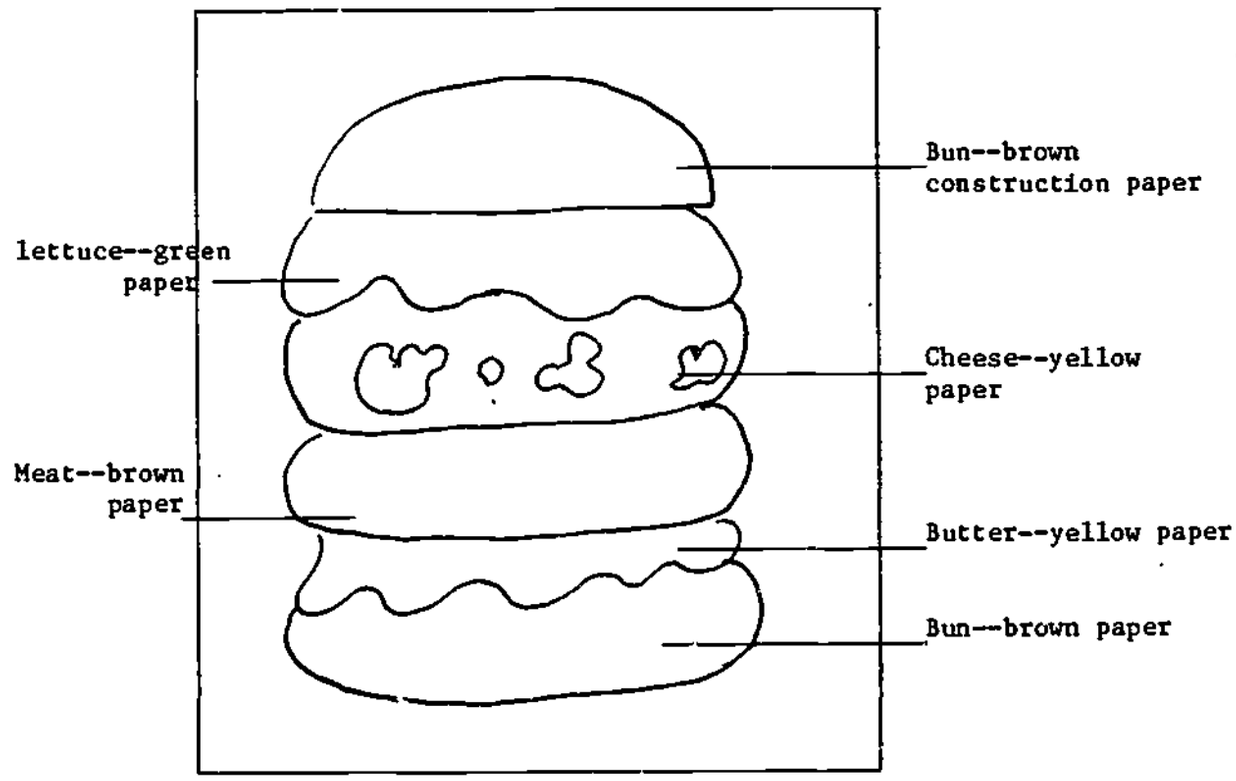
Challenge: How does the body take care of a "Dagwood" sandwich so that it can be used by the various cells of the body?

Materials and Equipment:

Animated transparency showing digestion of food: HB-101 "The Human Digestive System" by Photo Motion Corporation, Morrison Bldg., King of Prussia, PA 19406.

Sheets of paper 9" x 12"
Scraps of various colored construction paper
Wrapping paper
24" x 18" newsprint

How-To-Do-It: Begin with an art lesson. Each student makes a big sandwich on a 9" x 12" sheet of manilla paper, being sure he/she has some proteins, minerals, fats, starches minerals, and vitamins.

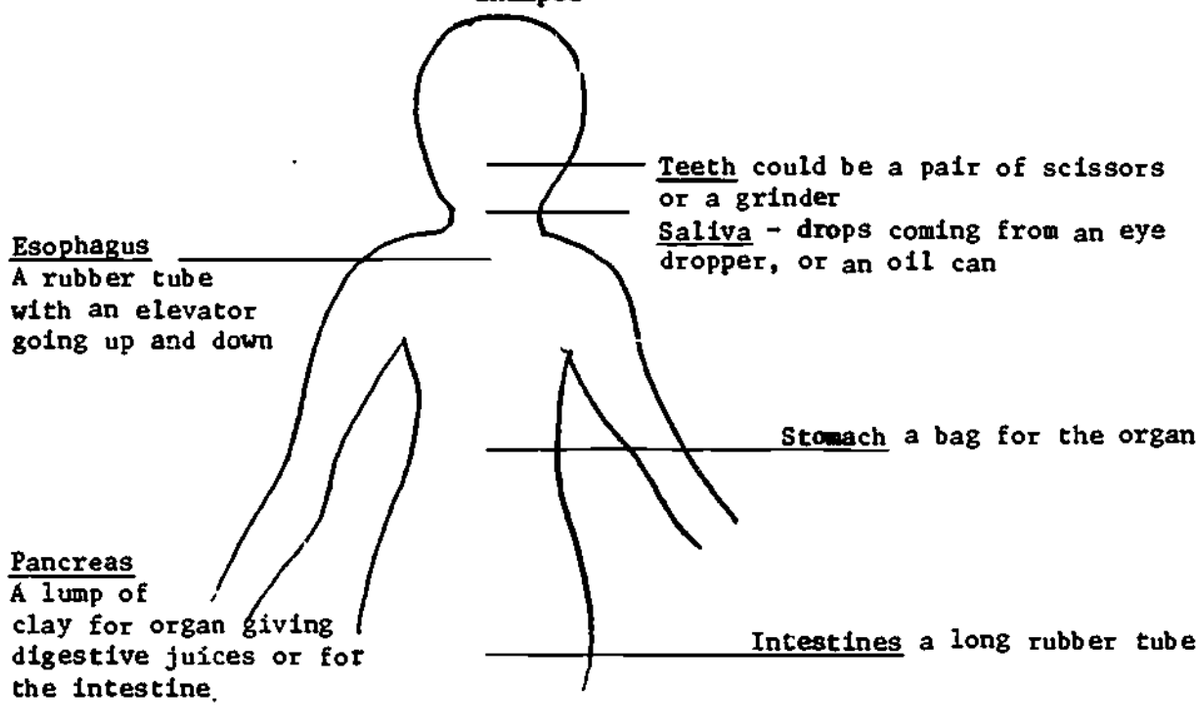


Discuss the necessary food nutrients and determine if each student's sandwich contains all.

Watch transparency to show how each food nutrient is digested by the particular part of the body -- in other words, learn about the digestive system.

Make the shape of the body on wrapping paper by having a student lie down and have another student (his/her partner) trace around the body. Then put in various organs of the digestive system beginning with the teeth in proper proportion, using marking pens and construction paper. Then carefully label all parts, putting the duty of each in parenthesis. This can be done on an 18" x 24" sheet of newsprint or another piece of paper in which the actual body size and shape has been drawn. They are now ready to make a mechanical person or robot with mechanical parts to do the jobs of the parts their body did. These can be cut out from a magazine or drawn using marking pens and construction paper. Children can really let their imaginations go.

Example



Further Challenges:

1) To review the "digestive system" have the children play Digestive Bingo. The children make their own bingo grids with five squares across and five squares down. The center square is free and can be marked with a star. Have the children copy names of different parts of the body they have just been discussing. Emphasize that students scatter the names around on the sheet so that each student doesn't get Bingo at the same time. Give each child a handful of markers. Then call definitions or a description of the organ's function.

As students find matching terms on their sheets, they cover them with a marker, until someone completes a row, a column, or a diagonal. When a child wins, each clears his/her sheet, and a new game begins.

2) Discuss proper and nutritious food for snacks, e.g., fresh fruit. Junk foods contain excessive amounts of sugar, salt or fat.

3) Discuss the dangers of foods containing too much salt. Collect labels of foods and observe how difficult it is to avoid salt.

4) Make up an imaginary play. For example, a boy has been given a trip to the moon in the year of 2000. Before going home he is taken to the spaceteria. When he goes to the cashier to pay he is scolded because his foods-planetary chips, galaxy bars, and interstellar pop are bad for him. Tell what happens in the rest of the play when the nutrient squad is called in.

5) Make posters to illustrate related concepts:

Begin Your Day with a Hearty Breakfast to Launch Your Spacecraft.

A Bag of Health (showing proper food)

Your Body Is Like a Spaceship--It needs fuel to go

A Whale of An Idea! Eat Proper Food

Open Up for Good Food (an open mouth showing lips and teeth with good food between)

You Are What You Eat

6) Make up a play using paper sacks as masks to represent foods. Cut two holes for eyes. Use crayons or paints to draw a food, e.g., carrot, apple, etc. over the surface of the bag.

WHAT IS A FOOD TEST?

by Mildred Moseman

Focus: If you can find out which nutrients are in foods you eat, you can plan a diet more easily that gives you the right amount of each nutrient.

Challenge: How can you find out what nutrients are in foods?

Materials and Equipment:

Lugol's solution or iodine
Eye droppers
Benedict's solution
Test tubes
Lamp to produce a flame
Pack of Clinistix
Brown paper bag
Indophenol
A variety of foods, e.g., bread, corn syrup, peanut butter, egg, lemon, apple

How-To-Do-It: Testing foods for Starch:
Drop a small amount of lugol's solution or iodine with eye dropper on the bread. If it turns blue-black, you know that starch is in the food. Test more foods with iodine. Make a list of all foods that react with iodine and turn blue-black. Make another list of foods that do not contain this nutrient.

Testing for Sugar:
Put a small amount of corn syrup into a test tube. Pour in enough Benedict's solution to equal or exceed the corn syrup. Heat the test tube gently over a flame. If the solution changes from blue to green, to yellow, to orange and finally to brick red, then glucose sugar is present.

Buy a pack of Clinistix at a drug store. You do not have to heat the food when you use this test. Read directions on package. Test as many foods as you can for sugar. Test some foods that do not have a sweet taste. Clinistix changes color when there is sugar in a food. Compare the colors with the color chart on the package. This will show you which foods contain the most sugar. Make a list of which foods contain sugar and which do not.

Testing for Fats or Oils: (lipids)
Rub the food, e.g., butter, peanut butter, on a piece of the brown paper bag. This may make a spot on the paper. If there are no fats or oils in the food, the spot will dry up. Fats and oils leave a translucent spot. Test as many foods as you can for fats at home. Make a list of all the foods you can find that contain fat.

Testing for Proteins:
Biuret solution can be used to test foods for proteins. It is a light-blue liquid and when mixed with protein it changes in color from light-blue to purple. The darker the purple, the more protein in the food. Try testing some egg white.

Testing for Water:
Put a small piece of food, e.g., from an apple, in a dry test tube. Heat the test tube gently. If food contains water, small drops of water will form inside the tube.

Further Challenges:

1) Make a list of all the foods you ate today. Use a food calorie chart to find out how many calories there were in the foods. Add the calories together to find out how many calories you had all day. Boys, ages 12-15, need 2800 calories each day; girls, 2400.

2) Enriched foods are foods that have had vitamins added to them. Try to find some labels from foods that have been enriched. What was added to these foods?

3) Make a list of all foods you ate yesterday. Check to see whether you got the proper amount of foods according to the recommended dietary allowances.

4) Collect food labels. List the nutrients that are named on the labels. Which foods contain the most nutrients?

FOOD FOR A CELL

by Sharon Moore

Focus: The food you eat must be changed into a form your cells can use. It must be broken down into very small particles in order to pass through the cell membrane. Even food which you chew very well isn't broken down enough to pass through cell membranes. Food is broken down for use by your cells in the process of digestion.

Challenge: Find out what type of food can pass through your cell membranes.

Materials and Equipment:

3 test tubes
2 rubber bands
2 jars
2 squares of plastic wrap
Graduated cylinder or small measuring cup
2 stirring rods
Test tube holder
Corn syrup
Starch (boiled)
Iodine solution
Benedict's solution (available at (Drug stores)
Hot water
Goggles or glasses
Metric ruler
Burner or hot plate
Matches
Scissors
Paper towels
Masking tape

How-To-Do-It: Put one ml of water and five drops of boiled starch in a test tube. Gently shake the tube to mix the liquids. Then add a drop of iodine solution to the tube. What happens?

Put 20 ml of hot water and 10 ml of boiled starch in a small jar. Stir the liquids to mix. Label the jar "starch." This starch is nearly the same as starch in a starchy food such as crackers.

Put 20 ml of hot water and 10 ml of corn syrup in another jar. Mix this solution with a clean stirring rod. Label this jar "sugar." This sugar is the kind of sugar in your body's blood, i.e., glucose.

Now prepare two test tubes as follows. Measure one ml of water in a clean graduate and pour the water into one test tube. Do the same for the other test tube. Cut two squares of plastic wrap about 7 cm x 7 cm. Cover the open ends of each test tube with plastic wrap. Hold the wrap in place with rubber bands. Make sure the rubber bands are tight enough not to allow leakage.

Turn one test tube upside down in the jar labeled "starch" and the other one in the jar labeled "sugar." Allow the tubes to remain in this position at least 24 hours.

After 24 hours remove the test tubes from the jars. Wipe the test tubes off and remove the plastic wrap. Use iodine to test the water in the tube from the "starch" jar. What happens?

Add 10 ml of Benedict's solution to the water in the test tube from the "sugar" jar. Hold the test tube with a test tube holder and place it over a burner. If the solution turns orange when heated, it contains sugar. What are the results of your investigation?

The plastic wrap acted like your cell membranes. What substance was able to pass through the 'membrane?" What might happen to starches if they weren't digested? Would starches be of any use to us if they weren't digested? Into what form are starches changed by the process of digestion? Are the sugar molecules larger or smaller than the starch molecules?

(Eds: This activity illustrates osmosis which is the diffusion of molecules through a semipermeable membrane. The membrane used should be tested before the activity is conducted to be sure that the sugar will move through at a fast enough rate to give a positive reaction in the time allotted.)

HAVING A GRAPE TIME

by Rose West

Focus: Learning the nutritional value of grapes
Using grapes to make juice
Using grapes to make raisins

Background: Grapes give their best nutritional value when they are eaten whole, and completely raw. Drying is the food process causing the least harm. Boiling in water causes the greatest loss of nutrients, e.g., loss of vitamins C, E, and B_6. Adding sugar begins a transformation into candy--a junk food.

Grapes contain a nutritive value which helps protect against heart disease. Grapes contain a congener called polyphenol which serves as a protective function to the heart.

Grapes also contain potassium, magnesium, sodium, calcium, iron, phosphorus, cobalt, silicon, and chromium - all of which are necessary for maintaining human functions. Iron is absorbed into the body quickly in grape juice. Chromium and silicon are important to a healthy heart and tissue growth.

When grape juice becomes wine, it can aid in dieting, as well as gaining weight. When taken with a meal, wine will surpress the appetite. When dry table wines are taken 15-20 minutes before meals, they will stimulate the appetite.

Grapes, grape juice, and wine were ordered by court doctors in ancient times for hemophiliacs of royal families. Perhaps they did not understand their value to the blood and heart, but merely knew it helped the patient.

Challenge: Compare the nutritional value of raw grapes to other grape snack foods. What happens to grapes when they are dried? How can juice be made from grapes?

Materials and Equipment:

(For grape juice)
1020 g. (4 1/2 cups) grapes
155 ml. (2/3 cup) water
120 g. (1/2 cup) sugar
Gram scale and weights
Metric measuring cup or regular measuring cups
2 large kettles and lids
Cheesecloth or strainer
Rubber band
Heat source
Wooden spoon

(For raisins)
Cardboard box
Foil
Light source
Knife
Slotted tray
Grapes (seedless are best)

How-To-Do-It: Begin the activity with a general discussion of snack foods. Encourage the students to bring in snack food packages to read the contents. Library research can be done to obain the nutritional value of grapes (other fruits can be considered also if desired.) Compare the findings.

Place the students in groups to make the juice and raisins. Groups of 5 or 6 are best. Several groups can make juice while others do the raisin box construction. Then the students can reverse roles.

Procedure for juice making:

1. Wash the grapes; measure out 1020 grams.
2. Combine the grapes with 155 ml. water in a large kettle.
3. Cover. Heat to boiling. Continue to cook slowly until very tender (about 30 minutes).
4. Remove from heat and strain through the cheesecloth. This mixture is then strained into the second kettle. Use a rubber band to hold the cloth shut. (If desired, a regular strainer may be used and the grape juice pressed through with a wooden spoon.) A Foley food mill works well also.
5. Let the juice stand for 24 hours in the refrigerator. Using the first kettle, strain again.
6. Combine grape juice and 120 grams of sugar. Heat to boiling.
7. Pour the concentrate into small containers.
8. When it is time to drink the juice, add water to the mixture of concentrated juice to desired taste.

Procedure for raisins:

1. Line the inside of the box with foil.
2. Cut the grapes in half and remove seeds if necessary. (If whole grapes are used, they should be boiled in water for 2 minutes.)
3. Place the grapes on the foil directly or on a slotted tray which has been placed on the foil.
4. Place the light source over the box. A brighter light will work faster.
5. Dry until the grapes become raisins.

Care must be taken when making the grape juice, since a heat source is used. It would be helpful if a senior citizen, parent or older student could be asked to aid on this day.

Further Challenges:

1) How is wine made? Does it have nutritional value? How does wine affect the body?

2) How is jelly made? How does the nutritional value of jelly compare to that of grapes or grape juice?

3) Compare different types of juices to grape juice to obtain nutritional information.

4) Sugary grapes:

Materials: Whole grapes, one egg white, sugar
bowl, egg beater, plate

Procedure: Beat the egg whites slightly with the egg beater.
Roll the grapes in the egg white mixture.
Roll the grapes in sugar.
Place the grapes on a plate and allow the egg white mixture and sugar to dry.
Eat and enjoy.

Reserve some of the grapes and compare the taste to those of sugar grapes. Compare the nutritive value of sugar grapes to unsugared grapes. Compare the caloric value of the two types of grapes.

5) Purple Cow

Materials: 400 ml. (2 cups) milk
200 jl. (1 cup) grape juice
450 ml. (1 pint) vanilla ice cream
Shaker or blender
Measuring equipment

Procedure: Combine milk, juice, and one-half of the ice cream in the shaker.
Shake until well blended. Passing the shaker around the classroom for all to take a turn will use every person's energy.
Serve in small paper cups, one per student. Top with the remaining ice cream.
Granish with a grape or sugary grape if desired.

Compare the use of human energy to electrical energy by using a blender for another batch of purple cow. Trace each energy source back to is origin.

6) Other science activities with grapes:
Growing grapes from seeds.
Propagating grapes.
Comparing the growth of grapes to other fruits.
Making Grape jelly.

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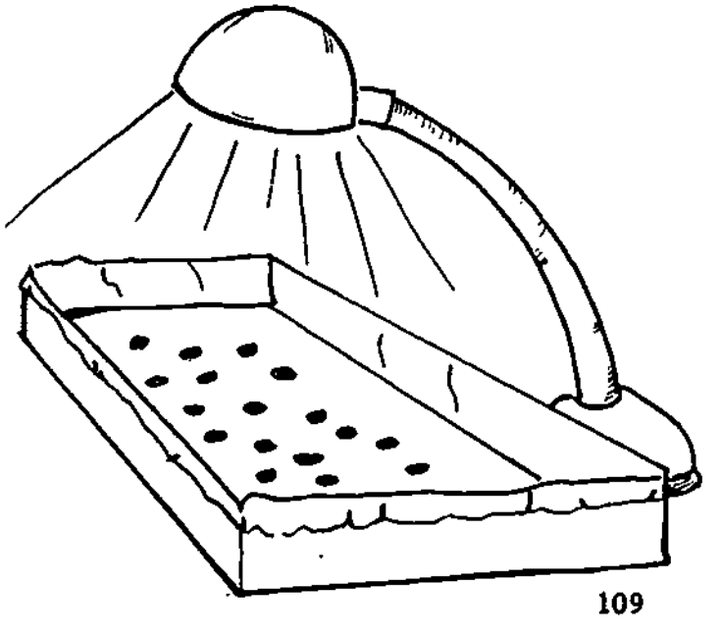


CONSUMERS' FRUITY CHOICES

by David R. Stronck

Focus: Fruit beverages range from highly nutritious freshly squeezed juices to totally synthetic junk food pop.

Challenge: Rank preferences for the taste of various beverages of the same fruit.

Materials and Equipment:

Paper cups for each student
Containers for mixing powders or frozen concentrates with water
Squeezer for oranges, lemons, or other fruit
Marking pen
(If grapes are used, refer to the list of items in the activity "Having a Grape Time.")

For each selected fruit, e.g., orange, grapefruit, lemon, apple, or grape, provide a beverage made from --

1. the fruit as fresh and whole for squeezing;
2. the frozen concentrate of the same fruit (without added sugar);
3. a processed form of the same fruit juice with added sugar, as found in some bottled or canned beverages, in some frozen concentrate mixes, and in the cooking directions for making grape juice in "Having a Grape Time;"
4. a synthetic powder mix with the artificial flavoring of the same fruit and much sugar (or sugar substitute);
5. a carbonated pop of the fruit's flavor.

How-To-Do-It: Explain to the students that foods are most nutritious when they are fresh, whole, and raw. The freshly squeezed juices of fruits are highly nutritious. The least valuable nutrition will be found in beverages that contain only artificial flavoring of the fruit with large amounts of sugar or sugar substitute. Teachers should encourage the children to taste fruit juices and to avoid pop and other sugar-dominated drinks.

Have some of the students cooperate in preparing the beverages, e.g., by squeezing the oranges, etc. Make approximately five different forms of beverages with each kind of fruit. For example, if you select oranges, prepare (1) freshly squeezed orange juice, (2) orange juice made from frozen unsweetened orange juice concentrate, (3) canned orange juice, (4) mixture of water and powder containing much sugar with artificial orange flavoring, and (5) an orange-flavored pop.

Label containers merely "A, B, C, D, and E." Have in each container one of the fruit beverages as listed above. From these containers,

the students will take samples in small paper cups. They will rank their preferences on a scale from one (for first choice) to five (for the last selection). After collecting the preference data from all of the students, reveal the contents of each container, e.g., container A has freshly squeezed orange juice. Discuss the significance of selecting beverages of poor nutritional quality.

Further Challenges:

1) Sample eating raw whole fresh fruits of many types, e.g., pineapple, kiwi, pears, bananas, etc. Rank preferences among these fruits.

2) Make a fruit bowl mixture containing slices of various fruits. After sampling from this mixture, have the students compare this snack with others that they may suggest, e.g., ice cream, cake, candy, etc.

3) Have the students produce some fresh fruit juices and sell them at cost to other students. The goal is to produce posters and other advertising methods to promote the consumption of more nutritious foods.

Reference:

Moyer, Greg. "Trashing Nutrition at USDA." Nutrition Action, 9 (6): 5-8, July-August 1982.

SUNBEAMS AND OUR FOOD AND DRINK

by Vincent B. Sindt and Judith Z. Ellsworth

Focus: It's amazing to consider all of the ways that sunshine affects our food and water supply. There are, of course, the obvious influences such as plant growth and weather changes. It is important for students to know about these changes, but this activity will deal with the less apparent results of the interactions that occur when our food is exposed to sunlight or when our drinking water is evaporated in the sun.

Challenge: Find out about all of the changes that happen to foods when sun shines on them. Learn about how water changes in sunshine.

Materials and Equipment:

Shoeboxes with cheesecloth taped across the top
Dishpan
Transparent Plastic wrap
Drinking Glass
Small Rocks
Tape
Sliced apples
Carrots
Bananas
Onions
Lettuce
Cabbage
Cheese

How-To-Do-It: Ask the students to place several pieces of the sliced food into the shoebox. Leave the top exposed to the sunlight and air but cover it with cheesecloth to keep insects from entering the box. Have the students make a list of the materials in the box and carefully record the changes as they occur. List changes in color, texture, taste, smell, etc. Be sure to record when any of the foods wilt, curl up or shrivel.

Make a chart of the changes observed in the shoebox. List whether or not those differences caused changes in tastiness, or appetizing appearance. Use a reference (such as the Complete Handbook of Nutrition) to determine what changes occur in the food and vitamin content. Ask the students to add to the list those changes that they feel are good changes and those that are bad. Now suggest some of the things that people do to avoid the bad changes.

Use the solar still to evaporate some of the water out of the school drinking fountain or sinks. Make accurate observations of the water that condenses and of the residue left in the pan. Make a chart of the changes such as clarity of the water, residue, taste before and after, bubbles, etc. Check with the local water department to see what substances are in the tap water and what is done to make it safe.

Further Challenges:

Invent a way to determine whether it was sunlight that caused the changes in the food or whether it was being exposed to air and warm temperatures. If it was sunlight, what is it about sunbeams that cause these changes? Find out what causes wilting and shriveling. Dry or dehydrate some of the food and determine the differences. Dry some food in the sunlight and in darkness, and find out about the differences. What causes the bubbles in the water in the still? How does the sun make sun tea?

References:

Null, Gary, and Steve Null. Complete Handbook of Nutrition. New York: Dell Publishing Co., 1973.

MacManiman, Gen. Dry It You'll Like It. Seattle, WA: Madrona Publications, 1973.

THE COST OF GOOD FOOD

by David R. Stronck

Focus: Through wise food selection, we can spend less money while greatly improving the nutritional quality of our diet.

Challenge: Use the Dietary Guidelines for Americans to identify some foods of high nutritional quality and others of poor nutritional quality. Contrast the cost of these foods.

Materials and Equipment:

Wrappers or containers with labels describing the nutritional content
Newspaper ads from grocery stores
(The items above can be omitted if the class makes a trip to a grocery store.)
Hand calculator (optional)

How-To-Do-It: Discuss with the students the guidelines published by the U. S. Department of Agriculture joined with the U. S. Department of Health, Education, and Welfare (1980):

1. Eat a variety of foods.
2. Maintain ideal weight.
3. Avoid too much fat, saturated fat, and cholesterol.
4. Eat foods with adequate starch and fiber.
5. Avoid too much sugar.
6. Avoid too much sodium.
7. If you drink alcohol, do so in moderation.

Distribute to the students many wrappers or containers that include labels describing the nutritional content. (A visit to a grocery store can eliminate the need for collecting such wrappers and containers.) The first item listed in the series of nutrients is the most abundant in the food; the second item is the next most abundant; finally the last item listed is the least abundant ingredient. If a food has sugar (or equivalent names for sugar, e.g., glucose, dextrose, sucrose, etc.) listed first, it is a junk food that should be avoided. Other junk foods are ones that are high in fat or salt. Have the students identify examples of junk foods.

The most nutritious foods are usually whole, fresh, and raw, e.g., pears. In place of eating a candy bar, a child could select an apple for a snack. Similarly fresh orange juice could serve as a much better beverage than a bottle of pop. Raw carrots should replace the hors d'oeuvre of potato chips. Fish, chicken or turkey (without their skins) contain relatively little fat and are therefore nutritionally superior to hot dogs which contain twice as much fat as protein. Using these examples, have the students organize a series of contrasting foods, i.e., pairs of foods where one is highly nutritious and the other is a junk food. The foods in each pair serve similar purposes, e.g., a snack, a main meat course, a beverage, etc.

Using ads from newspapers (or using prices given at a grocery store). calculate the costs of the contrasted foods. Caution the students to compare equal serving sizes, e.g., the weight of a hot dog compared with an equal weight of chicken. Total the costs of the junk foods and the costs of the highly nutritious foods. Which cost more? Although the cost differences may not be great, the nutritional values may be enormously different.

Further Challenges:

1) Use the series of contrasted foods as a checklist for identifying preferences in food selection. Ask the students to identify their number of preferences among the junk foods and their number of preferences among the highly nutritious foods. Any preferences among the junk foods should be discussed because good nutrition will occur especially when people deliberately choose more nutritious food. We must learn to reject the appealing flavors of sugar, salt, and fatty foods.

2) Use library materials or materials from the Dairy Council to provide more details on the nutritional contents of the foods that have been contrasted. Do the junk foods provide more calories than the highly nutritious foods? Which provide more fat, protein, vitamins, and minerals?

References:

Stronck, David R. "The Need for Nutrition Education." The American Biology Teacher, 38 (1): 19-23, January 1976.

Stronck, David R. "The Surgeon General's Request for Nutrition Education." The American Biology Teacher, 43 (5): 278-279, 283, May 1981.

Stronck, David R. "Adolescents' Attitudes Toward Their Diets." The American Biology Teacher, 43 (7): 397-399, October 1981.

U. S. Department of Agriculture and U. S. Department of Health, Education, and Welfare. Nutrition and Your Health: Dietary Guidelines for Americans. Washington, D. C.: Superintendent of Documents, Government Printing Office, 1980.

CHAPTER VI

POLLUTION AND DISEASES

The chemicals to which life is asked to make its adjustment are no longer merely calcium and silica and copper and all the rest of the minerals washed out of the rocks and carried in rivers to the sea; they are synthetic creations of man's inventive mind, brewed in his laboratories, and having no counterparts in nature.

To adjust to these chemicals would require time on the scale that is nature's; it would require not merely the years of a man's life but the life of generations . . . almost five hundred (chemicals) annually find their way into actual use in the United States alone. The figure is staggering and its implications are not easily grasped -- 500 new chemicals to which the bodies of men and animals are required somehow to adapt each year, chemicals totally outside the limits of biologic experience.

Rachel Carson: Silent Spring. Boston: Houghton Mifflin, 1962.

POLLUTION IN A JAR

by Gilbert L. Twiest

Focus: Pollutants in an environment usually have an effect on populations of organisms in that environment. Often a pollutant will cause a decrease in population size. The effects of pollutants on a large population of organisms can be studied very nicely using hay infusions.

Challenge: What are the effects of various natural and man-introduced pollutants on a population of protozoans in a hay infusion?

Materials and Equipment:

Microscope
Microscope slides and cover slips
Eye droppers
Jars from 1-5 liters in size
Hay or dead grass
Pond water and various kinds of pollutants

How-To-Do-It: First you must have several hay infusions. They are very easy to make. Use a container between one and five liters in size. A gallon pickle jar, a quart jar or a two-liter plastic pop bottle with the top cut off will work nicely.

Fill the container almost to the top with water; almost any kind will do. If it is city water or chlorinated, let it stand for 24 hours to allow the chlorine to dissipate.

Add a handful of any kind of hay. It it is rich hay, such as alfalfa or clover, use less; about 5 grams per liter. If you can't get "real hay," just cut some old dead grass from the side of the road and use more of it; 10 or 15 grams per liter.

Cover the container with a loose-fitting lid. The lid should retard evaporation but allow carbon dioxide out and oxygen in.

Place the hay infusion on a windowsill or in some other out-of-the-way place. Do not move it around. A scum will form on top of the water after a week or two and it should not be disturbed. The infusion will smell like cow manure at this point if all is going well.

Sample the water from the edge of the jar just under the scum. Use an eyedropper to take a few drops from this area and examine them with a 40-100 power microscope. Protozoans should be present. If you get only a few kinds of small protozoans, innoculate your hay infusion with a few ml or more of muddy pond water. Water from a temporary grassy-bottom pond is best.

If you are interested in growing specific types of protozoans, purchaae them from a biological aupply houae. You may also purchase a mixed culture for a very reasonable price, $4.00 or $5.00. Uae these commercial culturea to innoculate two or three different hay infusions to be sure you develop a good one.

Pure cultures may be grown by boiling the hay and water firat, letting it cool and then innoculating with a pure culture.

In order to study populations in a hay infusion, you must be able to sample them conaistently. An easy way to do this is to take two drops of water from a different spot on the top edge of the hay infusion each day. Put the drops of water on a slide, cover them and view them under a microscope. Count the numbers of each type of protozoan in five random fields of view. Total the five samplea and divide by five to get an average number. Uae five separate fields of view for each type of organism. Be sure to include the fields or view which contain no organiams in your total so your averages will not be biased.

To study the effecta of a pollutant on a population of protozoana, use two similar hay infusions. Introduce a natural pollutant such as clay or salt or a man-introduced pollutant such as acid rain, petroleum products, detergents or pesticidea into one of the hay infuaions.

Be aure to use an amount of pollutant which is similar to that which may be found in the environment. Sample the hay infusions and compare the numbers of organisms in the polluted and nonpolluted hay infusion over a period of time. The results should indicate the effect of the pollutant on the various populations of protozoans.

Further Challenges:

Hay infuaions can also be used to study various environmental factors such as light, heat, type of water, etc. on population growth. Further, protozoan succesaion in a hay infuaion over a period of time can be investigated.

Reference:

Needham, James G., P. S. Galtsaff, F. E. Lutz, and P. S. Welch. Culture Methods for Invertebrate Animals. New York: Dover Publications, Inc., 1959.

HOW IS WATER POLLUTED?

by Mildred Moseman

Focus: Once upon a time, when going on a picnic, you could drink from a spring in a creek in the woods. The water was bubbling clear. We need clean water.

Challenge: Today the same stream may be muddy looking, smelly, and filled with trash. What has happened? What can we do? What are some of the pollutants in our streams and lakes?

Materials and Equipment:

Eight bottles filled with water; in each is placed one of the following pollutants:

Silt	Warm water
Salt	Garbage
Oil	Detergent
Algae	Rust

12" x 18" sheet divided into eight parts

How-To-Do-It: Number the jars from one through eight. Put the name of the pollutant on three of the jars so children can more easily identify these particular ones, e.g., salt, oil and detergent.

Have the children divide paper into eight parts and number each part to correspond with each of the jars.

Place the jars around the room. Divide pupils into eight different groups. Each group goes to a jar and tries to identify the pollutant without discussing his/her findings with anyone else. The name is placed on the section corresponding in number to that on the jar. After a designated period of time the groups progress to the next jar with all groups having a chance at identifying the pollutant.

The person with the most correct identifications is declared the "E P A Specialist" and is awarded a special badge.

Through discussion, each one properly labels the pollutants. The children may do research on the danger of each pollutant, placing information in the rest of the space on their sheet in the corresponding section.

Further Challenges:

1) Finish the unit on water pollution by finding various polluted areas in the locality.

2) Discuss the problem with the proper officials to get action and clean-up.

3) Write letters to town officials.

4) Write editorials to local newspapers explaining the problem.

STOPPING THE MOLD

by John F. Hall

Focus: Mold growth can be eliminated by decreasing humidity and by the use of detergents. This can reduce or eliminate mold-caused diseaaea.

Challenge: What is the effect of moisture on mold growth? Does mold grow better under open or closed conditions? How does soap or detergent affect mold growth? How can we best stop diseases caused by fungus growth?

Materials and Equipment:

5 small dishes or jars
Cellophane or plastic covering
Rubber bands
5 pieces of old bread
Soapy water

How-To-Do-It: The activity could be introduced with a discussion of mold that grows on food. Mold-caused diseases could also be mentioned, such as "athlete's foot." The challenge should then be given that we are going to do an experiment to find out how we can stop the growth of mold. Students might work best in groups of five - with each student responsible for preparing one of the dishes. Each dish or jar will contain a small piece of bread. The first dish will be uncovered. The second will be covered. The third will be uncovered and containing enough water to soak the bread. The fourth will be covered and contain enough water to soak the bread. The fifth will be uncovered and will contain soapy water. The idea of a controlled experiment should be emphasized, i.e., to have a "fair test" nearly equal pieces of moldy bread should be used under a variety of conditions. Dishes should be of equal size and clean. Equal amounts of water should be added when called for; a few drops should be ample.

Observations should be made a regular intervals, such as once a day. Results should be tabulated for the entire class, ranking the dishes from most to least mold growth.

Applications to human health should be made, i.e., we can avoid mold-caused diseases such as "athlete's foot" by washing with soap, drying well, and avoiding clothes which are too tight.

Further Challenges:

1) Mold growth could be atudied on other foods.

2) What is the effect of temperature on mold growth?

APPLES, ORANGES, BASEBALLS AND ME

by Karen K. Lind

Focus: Children do not always realize that the skin is a living organ that covers and protects the body. Microorganisms can enter our body through cuts or scrapes in the skin and can possibly cause infection. Your students may find a new reason for thoroughly cleansing their cuts and scrapes after conducting this experiment. The differences in the degree of spoilage in the puncture wound that has been treated with antiseptic compared to the untreated puncture wound will be obvious and convincing.

Challenge: Using sterile needles and dirty needles, puncture the skin of an apple or an orange. What changes do you think will occur in several days time? Put iodine on some of the cuts and see if there will be a difference in the degree of spoilage.

Materials and Equipment:

Apples, oranges, other foods with obvious skins
Ten or twelve sewing needles
Soil and other types of dirt
Matches, candles, labels
Iodine and other antiseptics (IODINE IS POISONOUS)
Balls of various types (a baseball or golf ball)
Ball of yarn
If possible, a baseball or golf ball that has been cut in half

How-To-Do-It: Hold a ball of yarn in your hand. Let the children feel it and ask what the outside of the ball of yarn might be called. Do the same thing with the baseball, golf ball, and other objects. (It would be especially good to have a cut baseball or golf ball on hand.) The outside of the ball of yarn is called the surface or the covering. Can you tell where the surface of the ball is? Yes, it is the outside of the ball. Are there other surfaces that you can see? Can you find the surface of the floor? The surface of your desk? What happens if the surface becomes damaged?

The students will now prepare to do an experiment to see what happens when the surface of an apple or an orange is damaged by a puncture wound. Ask: "How is the covering of an apple or an orange similar to your skin? How is it different?" Let's see what happens when the surface of an apple is injured.

Initially the children form into six groups of four children each. This number can vary as can the possible combinations of needles, iodine, antiseptic, and dirt.

Possible Combinations: The Sterile Needle Group
The Sterile Needle with Iodine Group
The Sterile Needle with Dirt Group
The Sterile Needle with Dirt and Iodine Group
The Dirty Needle Group
The Dirty Needle with Iodine Group

Label one apple the control apple. We will not injure this apple. Sterilize your needle by holding it in the flame of the candle (very briefly). Then puncture your apple in several places. The groups who are using dirty needles will not have to do this step. If your group is using iodine, cover your cuts with iodine after puncturing your apple. If your group is going to use dirt, dip your needle in the soil that you have brought in from around the school building before puncturing your apple.

Place the seven apples in a place where the sun will shine on them most of the time. Keep a record of changes in the apples. What do you think they will look like in one day? two days? longer? How will they be different? Why?

Each group may make a booklet for charting the progress of their apples and the microorganisms within. Draw and record the daily changes in your group's apple. Discuss the possible reasons for these changes with your group and record the ideas that you discuss. Which other groups have apples that resemble your apple? Can you think of any possible reasons for this? Note your reasons in your booklet.

After several days cut all of the apples in half (including the control apple). Remember iodine is POISONOUS. What changes do you see in the apples? How are they alike? Different? Which apple looks the worst? Which one looks the best? Did sterilizing the needle with the flame of the candle make any difference? What do you think that the sterilizing process did to the microorganisms? What do you think would happen if the surface of your body were punctured? What would be the best action to take if this happened to your skin?

Further Challanges:

1) If apples were used in this experiment, try using oranges and other foods such as bananas, grapefruit, cantalope, etc.

2) Try using different types of dirt in this experiment. Fingernail dirt? shoe dirt? desk dirt? etc. What type of dirt has the most microorganisms? How can you tell?

3) What would happen if we did the experiment again and placed the apples in a cool place? Let's compare injured apples in a warm place to injured apples in a cool place. What if the apples are not injured? Will temperature make a difference?

4) Experiment with different types of injuries to foods with an obvious surface covering. Try puncturing, scraping, cutting, slicing, etc. Is there any special wound that will let the most microorganisms find their way through your skin and into your body?

5) Try different types of commercial antiseptics. Do they all help fight microorganisms equally well?

6) Can you think of other times and places where sterilization would be important to your body's safety?

Reference:

Carin, A. A., and R. B. Sund. Teaching Science Through Discovery. Columbus, Ohio: Charles E. Merrill Publishing Company, 1970.

SMALL: THAT'S ALL!

by Ralph M. Fraser

Focus: Unseen Micro-organisms can cause problems.

Background: You wash those hands and come to the dinner table! We hear this often. We may comply and wash our hands or brush off a cookie that falls on the floor, but why do we do this? Why, if our hands "look" clean, do we have to wash them? The answer is very simple. Even though our hands, the table top or the air we breathe look clean, they are covered or filled with tiny one-celled organisms or living things which can only be studied through a microscope. One such group of organisms is called bacteria. Because bacteria are very small and composed of one cell only, they can easily squeeze in or rest on gaps in the complex tissues of a large animal such as man, where they may in some cases cause disease. Studying the micro-organisms that exist unseen in our air and on surfaces can motivate students to inquire about bacteria-related diseases and possible ways of preventing bacteria transmission.

Challenge: The tiny invisible creatures around us are always looking for nice cozy places to live and grow. See how many you can catch on your potato pieces by just leaving them out in the air. It's very important that you do not touch your potato with your hands. Do you know why? What will happen to the organisms if you give them a bath in boiling water? What will happen if you don't?

Materials and Equipment: Based on groups of four students.

One or two 4-burner hotplate (school stove will suffice)
One or two large canning pots (hot water method)
Four canning jars with lids and seals
One large boiled and unpeeled potato for each student
One small potato (uncooked and unpeeled) to be shared by two
One household metal bread knife for each student
Enough paper towels for each student to hold a possibly warm knife
Sturdy rubber bands of different colors for jar identification
Disinfectant (dettol)

How-To-Do-It: Explain to the class that they will be comparing four jars containing potato that has been affected in different ways. Using our newly sterilized knives, we will take an uncooked piece of potato and expose it to the air for 3-5 minutes. We will then place this exposed portion in the first sealing jar and screw the lid on tightly.

We will very carefully cut with our resterilized knives, a piece of cooked potato, expose it to the air for 3-5 minutes, then place it in the second jar and screw the lid on. (Sterilize knives by heating blades on the hotplate.)

Again with a resterilized knife, we cut a piece of cooked potato and again expose it for 3-5 minutes. We put this in the third jar, then submerge most of the jar in a pot of boiling water for 15-20 minutes. Seal the hot jar with a hot lid, after turning off heat.

With resterilized knife we cut a piece of cooked potato and expose it to the air. We carefully dip the surface of the potato into a disinfectant and seal it in the fourth jar.

After the above four steps are completed, the jars are placed on a shelf for a one-to-two week period. Students are to keep a daily record of observable changes in the jars.

Generally after explaining the procedure, now might be a good time for assumption making. Have the students make some hypotheses on the outcome of each step after a two-week period. After these hypotheses have been made, continue with the experiment.

At this point, each group has four jars resting at room temperature in the room. Teachers should encourage students to watch closely for any changes in their samples and to keep written notes of these observables. At the end of two weeks, the cultures are to be looked at through glass only! Differences in color, shape and size are to be noted and discussed. Students should be encouraged to make inferences on their finds, and to try to identify visually what they have. Caution: All organisms must be destroyed when observations are finished.

Further Challenges:

In this experiment, students cultured microorganisms from the air only. Hopefully students now understand the multitude of unseen things that exist there. Inferences should be made on these unseen things and their relationship to disease. We really have no control over the air we breathe, and are open to many floating diseases. We can, however, control the things we touch and where we place our hands. Students could be shown under strict control, the bacteria that exist on surfaces of student use. Potato sections could be innoculated with rubbings from fountain tops, toilet seats and pen tops with a repeat being done on the above experiment. This, however, ia not recommended in the classroom. The resulting unknown bacteria could be deadly if exposed in school.

THE PLAQUE PLAGUE

by Sharon Glover

Focus: There are various ways people care for their teeth after eating; some are more effective than others.

Challenge: Measure the effectiveness of these ways of cleaning the teeth: rinsing the mouth with water, eating crisp raw carrot, eating raw apple, brushing and flossing.

Materials and Equipment:

Soda crackers (five or six per student)
Carrot sticks (two or three per student)
Raw apple (one half per student)
Toothbrushes (one each)
Dental floss
Hand mirrors (one for every two or three students) - the students may help by providing some of these materials from home
Disclosing tablets (two or three per student) - containing a harmless coloring agent (available from dentist or toothpaste producers)
One copy of the following chart for each student:

Amount of Red Stain / Type of Cleaning	None = No Red at all	Little = Very little red, and only between teeth	Some = More red showing but still mostly in cracks and corners	Much= lots of red between teeth and some on flat tooth surfaces	Excessive Amount = Teeth coated with red all over
No Cleaning					
Rinsing					
Carrot sticks					
Raw apple					
Brushing					
Flossing					

How-To-Do-It: Explain that each student will be participating in a test to discover the best method for cleaning teeth. Discuss or review the composition and destructive capacity of plaque. Proceed as follows:

Each child eats a soda cracker, and then chews one-half of a disclosing tablet, swishing it around in his/her mouth. The child uses a mirror to compare the amount of plaque clinging to his/her teeth and gums with a guide provided, and enters the appropriate evaluation in his/her chart.

A soda cracker is eaten; the mouth is rinsed with water; one-half disclosing tablet is chewed; evaluation done.

A soda cracker is eaten; a raw carrot stick is eaten; one-half disclosing tablet is chewed; evaluation is done.

A soda cracker is eaten; raw apple is eaten; one-half disclosing tablet is chewed; evaluation is done.

A soda cracker is eaten; teeth are flossed; one-half disclosing tablet is chewed; evaluation is done.

Further Challenges:

1) Make a bar graph showing the effectiveness of the various methods of cleaning. Discuss the results of the test.

2) Make posters that emphasize the conclusions the students reached after this activity.

TOOTH SLEUTH

by Charles R. Ault, Jr.

Focus: Tooth form and dentition patterns suggest adaptations to diet and possible degree of common ancestry for different animals. "Tooth Sleuths" examine dental patterns in their own mouths, compare their dentition to that of other students and contrast human dental patterns with the dentition of other animals. Developing knowledge of tooth functions and stimulating interests in teeth as clues to unraveling evolutionary mysteries fosters awareness of the importance of teeth. Attention to their proper care should follow.

Background: Complete adult human dentition consists of 32 teeth. There is an invariant pattern to the basic types of teeth that make up this total. Cusps are the raised peaks particularly evident on the large back teeth. Individual teeth of one type may vary in size and cusp details. The completeness of dentition may vary from individual to individual.

A first set of teeth erupt in a child's mouth from about 6 months to three years of age. These 20 "milk" teeth (also called lacteal, deciduous, primary, or "baby" teeth) are replaced, beginning at approximately age 6, by a second, permanent set.

The permanent teeth include true molars: the large-crowned, many-cusped, grinding teeth that erupt at the back of the mouth while a child (1st molar), adolescent (2nd molar) and young adult (3rd molar or wisdom tooth). There are twelve molars in all--three on each side of the upper and lower jaws.

The twelve molars are adapted to the task of grinding and grating food prior to swallowing. The other 20 permanent teeth fall into three categories: incisors, canines, and premolars. There are two incisors, one canine and two premolars on each side of the upper and lower jaws.

Incisors have one, straight, narrow edge and are the most forward teeth in the mouth. They are the cutting teeth in humans and many other mammals. Their loss makes biting into crisp, hard food a challenge! This fact is usually discovered by children at about age seven when they lose their first set of incisors.

Canines (the eyeteeth or cuspids to the dentist) have a single pronounced point and a second, less noticeable cusp behind it. Canines pierce and grip food, allowing us to tear it into pieces.

Next, proceeding toward the back of the mouth, are the premolars or bicuspids whose two cusps are nearly equally developed. These teeth function to crush food.

A convenient form of notation, the "dental formula," records the number of teeth of each type. The dental formula for the typical adult human is:

$$\frac{2 \cdot 1 \cdot 2 \cdot 3}{2 \cdot 1 \cdot 2 \cdot 3}$$

which means that for one side of the mouth two incisors, one canine, two premolars, and three molars are standard on the upper and lower jaws. The dental formula for the milk dentition would be:

$$\frac{2 \cdot 1 \cdot 2 \cdot X}{2 \cdot 1 \cdot 2 \cdot X}$$

Interestingly, the true molars are more similar to the adjacent premolars of the milk dentition (the "milk molars") than to the permanent premolars. In effect, molars are the last teeth of the first set of teeth to erupt and are simply not replaced.

At present only one type of hominid walks the earth and we call these creatures "people." Fossils record several types of creatures possibly ancestral to anatomically modern human beings. Some physical traits observable among people today have an ancient fossil history. Others do not. Teeth and jaw fragments are the most likely parts of the body to be preserved as fossils. The exception is the teeth of people who consume large amounts of sugar! There is a cusp and valley pattern, termed the Y-5 pattern, found on molar teeth nearly 30 million years old. A molar having the Y-5 pattern as opposed to a 4-H condition appears in the illustration. Most people today have molars with Y-5 cusp pattern, as do many apes and chimps. Old-world (African and Asian) monkeys and baboon molars typically have a four cusp "H" pattern.

Challenge: Determine the dental formula for each side of your mouth. Which types of teeth are present?

Compare the forms of your tooth types with the corresponding forms observed in other mammals. Try to hypothesize diet from tooth form. Brainstorm some analogies between common tools and basic tooth types. Human teeth are considered "generalized" and well suited for a highly variable diet. Which teeth do you use for different foods? Can you imagine some foods a particular kind of animal could not eat? What foods can you not eat because of the kind of teeth you have?

Count the major cusps (peaks) on your molar teeth. Describe the valley patterns. Are you a Y-5er?

Materials and Equipment:

Small mirrors
Cardboard
Crisp fruit, e.g., apples
Crayons or markers
Drawing materials

Optional Materials:

Plastic models of mammal skulls, jaws, teeth--including humans
Mouthwash
Zoo or natural history museum field trip
Photographs revealing mammal dentition
Pictures of mammal skulls and jaws

How-To-Do-It: Have the students examine their teeth in mirrors or have partners who look into each other's mouth. Identify incisor, canine, premolar, and molar teeth. How many are there of each? Record the number of each kind of tooth as a dental formula: 2 . 1 . 2 . 2 for two incisors, one canine, two premolars, and two molars on the upper right side, for example. A complete dental formula would include the number of each type of tooth on the lower jaw as well. Try to account for departures from the standard, adult human dental formula amoung your classmates. Some may have immature dentition; others may have teeth pulled or lost.

For each molar count the high cusps. Sketch one or more molars if you can and indicate where there are valleys. How many people in the class found the Y-5 pattern? (See illustration.)

Examine photographs of other mammals. Look carefully at the teeth and skulls. Which mammals have very large canines? What do you suppose they are used for? Look for the bone-crunching teeth in the mouth of a carnivore (meat-eater). The last premolar shears against the first and only molar in cats to accomplish this task.

Observe mammals or pictures of mammals known to graze primarily on grass, e.g., horses, cows, elephants. Contrast their molars with the molars of carnivores, e.g., cats, dogs, and browers or twig-eaters such as deer. As the very high crowned molar tooth of a grazing animal wears, alternating layers of cement, dentine, and enamel become exposed. These layers wear at different rates, proportional to hardness. The amount of crown worn away is a rough function of age. Refer to illustration of the cross section of a molar tooth.

Determine the dental formula as best you can for several different species of mammals. Are some types of teeth missing entirely? For example, cats have no upper jaw molars. Classifying teeth that are extremely modified for special functions, greatly reduced, or absent is difficult. Work from the front of the mouth backwards. Use the generalized descriptions of human dentition in the "BACKGROUND" section as criteria for classification. The teeth of reptiles and fish are not differentiated into the same categories as mammalian teeth are, therefore, not discussed in this activity. Most importantly, look closely at tooth forms and imagine the consequences for diet and survival of departure from observed forms.

Human dentition is "generalized," meaning that we have teeth suited to a wide variety of tasks. Compare the shape and use of your teeth to specific teeth in other mammals. What animal seems to have teeth very similar to human teeth? (Pigs! -- in fact, pig teeth are difficult to distinguish from human teeth when found isolated from pig skulls and jaws.) Do such animals eat many of the same foods as humans?

Further Challenges:

1) Bite into an object which will preserve teeth marks. Cardboard will do but an apple is better. Use a marker or crayon to draw a smooth line through the center of the teeth marks. Discuss the shape of this curve. Is it one half of a circle? Does the arch have

parallel sides? The proper name for the curve is a "parabolic arc." A parabolic arc is the shape followed by water squirted from a hose or the path described by a baseball in flight.

2) Chimp and gorilla teeth do not form parabolas. Look at some pictures of apes. Can you tell what the shape of their bite might be? Watch them the next time you visit the zoo. Their dental arcades are "U-shaped."

In what other ways are chimp and ape teeth unlike yours? Are there any obvious differences between male and female ape teeth? (Canine size is apparent.) Do similar differences exist between male and female human teeth? (No.) How are canines used by apes, especially the males? Watch for threatening gestures and menacing looks.

Chimps are our closest living evolutionary relatives, as determined by shared dental traits and many other physical traits as well. Nearly ten million years ago there existed small forest dwelling creatures in what is now Europe, India, Pakistan, and North Africa. These creatures left behind only fragments of their jaws and teeth, primarily molars. The teeth clearly exhibit the Y-5 cusp pattern. The sockets for incisors and canines are small. Older, related fossils show some moderately enlarged canines. These jaw fragments do not allow for certain reconstruction of the dental arcade either as a parabolic or U-shaped arch. If a complete jaw fragment were discovered proving that this creature had a parabolic dental arcade or a U-shaped dental arcade, what would you conclude about its status as a human ancestor candidate? Were humans evolved from an ape-like ancestor or were apes evolved from a human-like ancestor? What additional fossil evidence would the class like to uncover to resolve this riddle?

Comparing anatomical differences can be threatening to some individuals and discussion of evolutionary relationship may raise value laden issues.

3) All living people are anatomically modern human beings. Differences among student dentition are examples of variety within the human family. Cases of tooth loss, poor dental hygiene, and orthodontia (braces) or uncorrected malocclusion (crooked teeth) must be dealt with sensitively.

Adult teeth are permanent. Hard objects can break a tooth. How are teeth protected in different sports? (Helmets, face guards, mouth pieces.) Have any students had to have a broken tooth repaired? Have the students design new ways to protect teeth.

4) Some foods are necessary nutritionally to the growth of teeth. They provide phosphorus and calcium to harden growing teeth and to keep healthy the bone anchoring the roots of teeth. What foods are good sources of these materials? (Milk and dairy products; green, leafy vegetables.)

Some foods harm teeth chemically, either directly or indirectly. Acids in foods or acids released by bacteria feeding on leftover bits of food clinging to teeth (especially sticky, sugar-rich foods) can remove calcium from tooth enamel. A sufficiently weakened tooth begins to decay. A sugar rich diet can even bring about decay of baby teeth before they have erupted completely. What care can help to prevent decay? (Brushing, rinsing with clean water, flossing to remove food from the gumline.)

5) What care do students give to the teeth of their pets? Have they ever asked a veterinarian about pet tooth care?

References:

Forgac, Tab and the National Dairy Council Development Team. Food...Your Choice, Level 4. Rosemont, IL: National Dairy Council, 1981.

Isaac, Glynn, and Richard Leakey. Human Ancestors: Selected Readings from Scientific American. San Francisco: W. H. Freeman and Co., 1979.

Otto, J. H., J. J. Cloyd, J. E. Tether, and J. Z. Nassif. Modern Health. New York: Holt, Rinehart and Winston, 1980.

Poirier, Frank E. Fossil Evidence: The Human Evolutionary Journey. St. Louis: Nosby, 1981.

Romer, Alfred S. The Vertebrate Body. Philadelphia: W. B. Saunders Co., 1962.

Rosen, Stephen I. Introduction to the Primates Living and Fossil. Englewood Cliffs, New Jersey: Prentice-Hall, 1974.

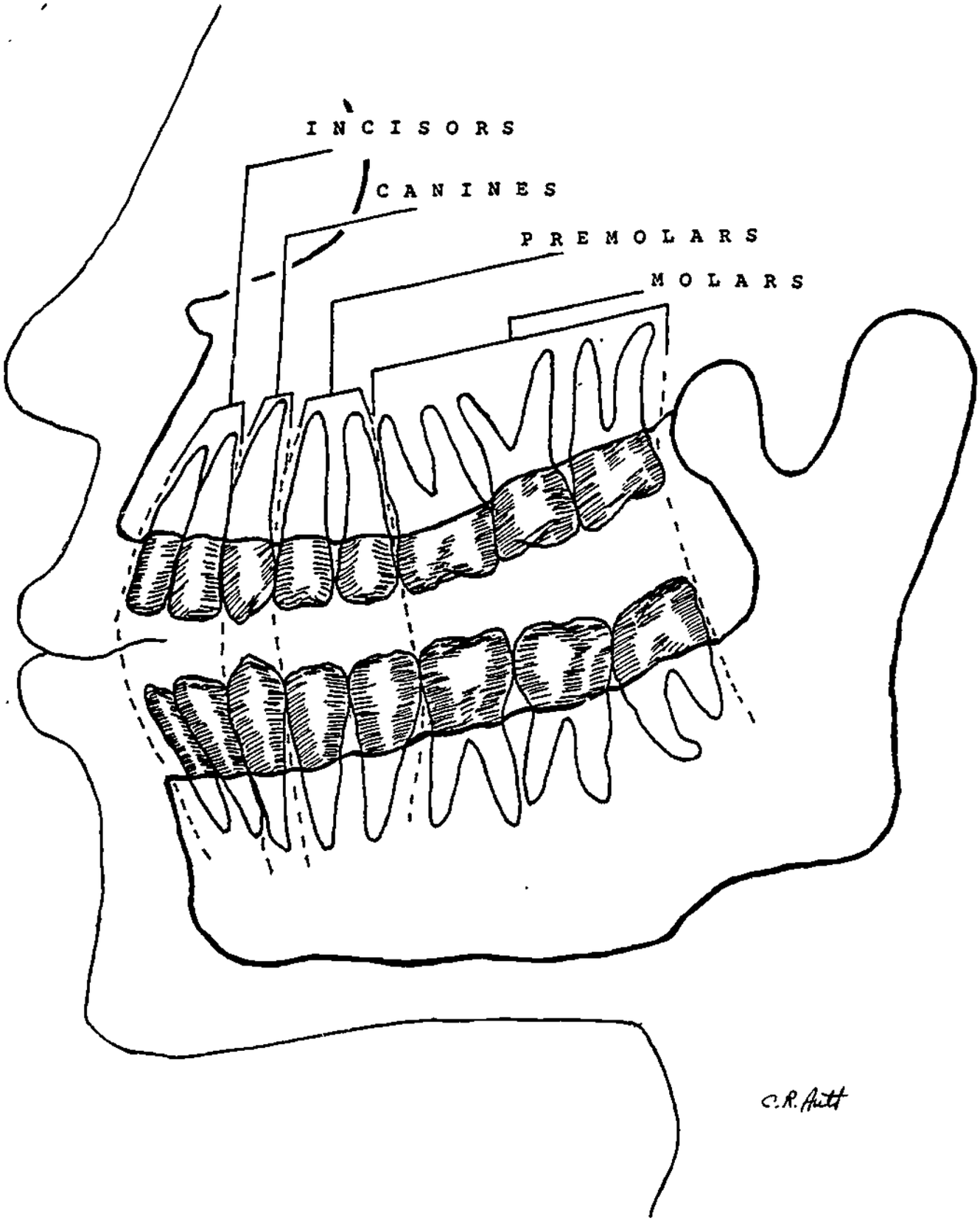


Figure 1. Adult human dentition. Crowns of teeth are shaded (adapted from Forgac, 1981).

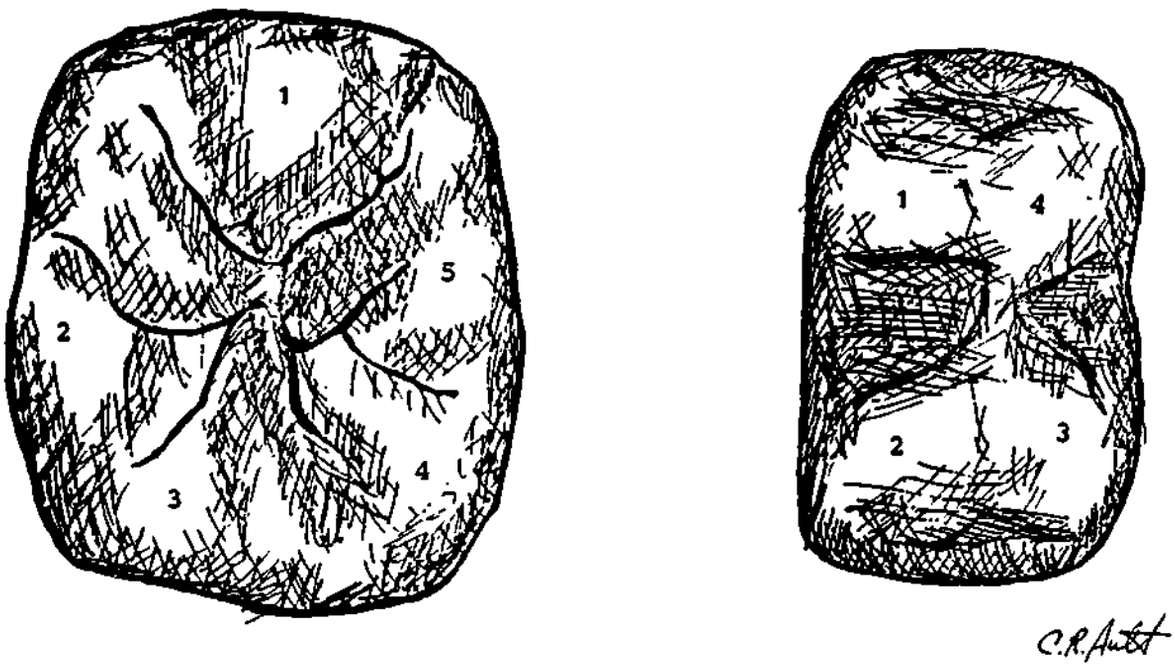


Figure 2. Comparison of Y-5 and 4-H molar cusp patterns. Human molars with Y shaped valleys and 5 major cusps (numbered) on left. Old world Resus monkey with 4 major cusps (numbered) in an H pattern on right (Adapted from Rosen, 1974).

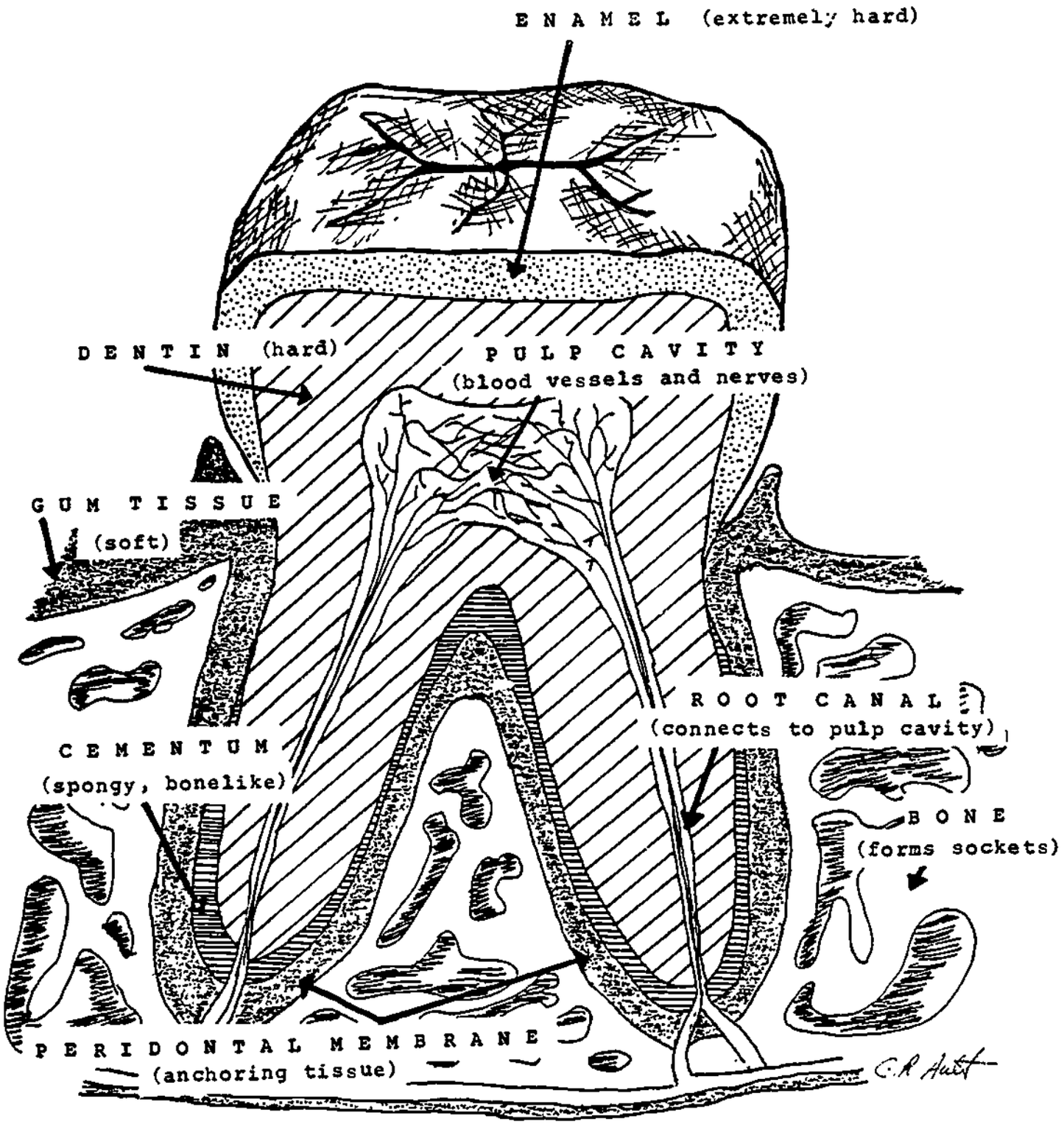


Figure 3. Cross section of a molar tooth set in a socket of bone (adapted from Otto, et al., 1980).

AWFUL AIR PARTICLES

by David R. Stronck

Focus: Although we don't see or feel particles in the air, they can harm plants and animals.

Challenge: Collect particles from the air and describe them.

Materials and Equipment:

White facial tissue paper
White cloth
String or rubber band
Furnace air filter (optional)

How-To-Do-It: Give each student a sheet of clean white facial tissue. Tell them to find an undisturbed place in the room where dust and other particles have settled out of the air. Have each student wipe his/her selected spot with one wipe for 30 cm (or 12 inches). Window ailla, the tops of doorways or book shelves, and even the top of an unused table may provide much aettled dust. Let the atudents compare their dirtied tissues to identify who found the most particles. What color are the particles? What do they look like under a magnifying lens?

Discuss with the students what happens if we inhale much dust. Sneezing is a way to expel dust from the nose; coughing expels dust from the lungs. Mucous protects the linings of our nose and mouth from harmful particles. Tears protect the eyes from irritants.

Further Challenges:

1) The automobile is a famous source of air pollutants. Attach a clean white cloth by a string or rubber band to the exhaust pipe of an automobile, preferably an older car with a cold engine. Start the engine and let it run for one minute. Examine the impact of the exhaust on the cloth. Can students identify what happens to plants exposed to much emissions from autos? Are there examples of damaged plants at a busy street?

2) A amall furnace air filter can be purchased from many hardware or building supply stores at a low cost. The filter can be weighed and examined before it is used. Then it can be mounted by tape in any place that has much air circulation, e.g., at an open window, at an opening for a duct where air is taken into the furnace, etc. After aeveral weeks, the filter can be weighed and examined again. If microscopea are available, the shapes of the particles can be well recognized.

SUNNY SENSES AND FEELINGS

by Vincent B. Sindt and Judith Z. Ellsworth

Focus: Many people don't stop to realize the effects of the sun on their physical and emotional well-being. We come into contact with the sun (or lack of it) through our senses daily. This activity will provide children with the opportunity to explore and become more aware of these sensory experiences and how they affect our lives.

Challenge: Find out how the sunshine affects objects on the schoolground, how the sun affects people, and how sunny days affect the way people feel.

How-To-Do-It: Go into the schoolyard on a sunny day and ask the students to touch as many different objects (sand, soil, swings, etc.) as they can think of. Ask them to list their objects from hottest to coolest and share their findings with others. Examine the objects to see if there are common characteristics (i.e., color, texture, luster, etc.). Group objects according to hotness and compare the groups.

Ask the students to list or find pictures of clothing for warm and cold weather. What are common characteristics for these garments and how do they relate to the groups of objects found in the first activity?

Brainstorm ideas of good and bad things that the sun does for our bodies. Make a chart with two columns of these things. Look carefully at the sun's effects and check to see if any of them might change as the seasons change (i.e., heat of the sun in the winter compared with summer). Also check to see if any of the effects could be listed in both columns (i.e., growing plants, vegetables and weeds). Look even further to see if any of the items on the list might change columns from one country or geographic region to another. Discuss ways that we try to capitalize on the good things, and avoid and prevent the bad.

Make a three column chart for the class where the students can mark: (1) the date, (2) whether the day is sunny or not, and (3) an indication of their feelings (by smiling faces, etc.). Keep the records for at least a month and examine the chart to see if more students are happy on sunny days or cloudy. Discuss how the weather effects us.

Further Challenges:

Find and discuss examples of physical adaptations of people due to the intensity of the sun (eye adaptations, skin color, etc.). Go to an area where there are animals and listen for the sounds on sunny days and cloudy. How does the sun effect animal behavior? Find out about animals and people that are active in the sunlight and those that prefer the darkness. Experiment with shadows.

References:

Brown, Bob. 666 Science Tricks and Experiments. Blue Ridge Summit, PA: Tab Books, 1978.

Elementary Science Study. Light and Shadows. St. Louis, MO: McGraw-Hill Publishing Co., 1975.

CHAPTER VII

DRUGS, POISONS, AND SAFETY

We are a drug-using society. A large segment of our population looks to drugs to alleviate a host of physiological and social discomforts. Young and old alike are inundated with commercial sophisms eulogizing drug products. Within this persuasive and cultural millieu, drug abuse is spawned. Education, to be effective, must first recognize the complex historical, social, and psychological setting as a powerful stimulus to the use and abuse of drugs.

> Marvin R. Levy: Guidelines for Drug Abuse Prevention Education. Washington: Bureau of Narcotics and Dangerous Drugs, 1970, p. 1.

If an epidemic were suddenly to strike this country, killing over 100,000 people, disabling, permanently or temporarily, over 10 million others, and injuring over 51 million others (according to Accident Facts, published by the National Safety Council), it would be recognized at once as a serious threat to the national economy and social structure. A state of emergency would be declared, and the nation as a whole would mobilize with an all-out effort to combat the problem. The general public still tends to remain apathetic when accidents annually take a toll in human resources equivalent to the ravages of this hypothetical epidemic in spite of great efforts to make the public aware of the necessity of taking action to control accidents.

> A. E. Florio and G. T. Stafford: Safety Education. Hightstown, NJ: McGraw Hill, third edition, 1969, p. 3.

THE SMOKING MACHINE

by Sharon Moore

Focus: Smoke from cigarettes causes lung damage. This smoke can even harm the lungs of nonsmokers. Emphysema and lung cancer are much more prevalent in smokers than in nonsmokers.

Challenge: Find out how smoking can change your lungs.

Materials and Equipment:

2 liter soft drink bottle with cap
Rubber tubing to fit a cigarette or modeling clay
(tubing should be about three inches long)
Cotton balls or cotton batting
Cigarette
Matches

How-To-Do-It: Rinse the bottle. Make a hole in the cap the size of the tubing. This can be done with a corkscrew or by hammering a large hole through the cap. Put the tubing into the hole or use some modeling clay around the hole. Place a ball of cotton in the neck of the bottle. Make the bottle "breathe" by pressing and loosening your grip alternately. Light the cigarette and then begin pumping the bottle.

Observe the bottle as it smokes the cigarette. What does it look like? Can you imagine your lungs looking like the bottle does? After the smoke settles, observe the cotton. What does it look like? What do you think cigarette smoking does to a person's lungs?

Further Challenges:

1) What would happen to the cotton if your bottle smoked more than one cigarette? Can you imagine what would happen if it smoked a pack a day as some people do? (Don't try this. Remember--cigarette smoke is bad for you whether you do the smoking or not!)

2) What would happen if you rubbed this cotton from the bottle on the wet leaf of a plant? How would insects react to the leaf?

3) What will happen to an ant or other small insect if touched by the cotton wad after it is exposed to cigarette smoke and made moist with some water? Why do tobacco plants produce nicotine (a chemical found in cigarette smoke)?

ANA. .ZING THE ADS

by David R. Stronck

Focus: Some people may begin smoking or drinking alcohol excessively because they have been persuaded by advertisements.

Challenge: Can you recognize the deception in an ad?

Materials and Equipment:

Ads for tobacco and liquor in magazines

How-To-Do-It: First explain to the students advertising techniques used in food ads. For example, some food ads stress the theme of "Why Pay More?" Others describe their product as "new and improved," or "traditional, old-fashioned, and natural." At very little cost to the producer, a small amount of vitamins are sometimes added with a great increase in the price of the fortified food. Perhaps the ultimate deception in advertising is to persuade children to select junk foods in order to get prizes, awards, or gifts.

Then, suggest some commonly used advertising techniques found in ads for tobacco and liquor:

1. endorsed by a celebrity
2. endorsed by ordinary people
3. endorsed by scientists with data
4. associated with healthy people
5. associated with the wealthy or powerful
6. having a good taste
7. sexist
8. appealing to patriotism or sentiment

Ask the students to identify the deceptive elements in various ads. Discuss the need for wise consumers who can recognize deception.

Further Challenges:

1) Consider the advertising techniques in food ads, especially ads for junk foods, i.e., foods with excessive sugar, salt, or fat.

2) Consider peer pressures that persuade some youngsters to smoke or drink alcohol. Have the students identify typical statements made by peers attempting to persuade another to smoke or drink. Analyze the deception in such statements, e.g., "Cigarette smoking won't hurt you." What should be appropriate responses to such pressures?

Reference:

Holden, Susan. "Why Television Is Fattening." Nutrition Action, 9 (4): 9, May 1982.

NAME CALLING

by Marilyn Flick

Focus: The insulting names and labels children call one another help reveal the sensitive side of personality. Children often display an uncanny ability to find just what things are most upsetting to others. These derogatory exercises used by children to aggravate each other say much about the things that people do not like to have anyone attack.

Challenge: The students will brainstorm and categorize all of the names used in derogatory name calling.

How-To-Do-It: The simplest method to carry-out the activity is to ask the class to volunteer names as you write them on the board. (You will need to remind them that you will have to exclude the vulgar ones.) This usually begins slowly but, as names are mentioned and others are remembered, you will probably have trouble getting them to stop. Also, you might instead have students write the names on paper and collect them to group on the board.

Help the students to see that most of the labels tend to fall into categories that reveal some general areas where people are likely to have high sensitivity. Here are some examples of categories and names that fall under them:

Intelligence	Appearance	Normality	Gender
"Dummy"	"Fatso"	"Creep"	"Sissy"
"Stupid"	"4-eyes"	"Jerk"	"Baby"
"Idiot"	"Skinny"	"Freak"	"Pervert"
"Dopey"	"Carrot-top"	"Punk"	"Tomboy"

Further Challenges:

1) What other categories could be included?

2) Students devise a ranking system to indicate which names are most insulting.

3) Discuss those names that will mean different things to different people.

(Eds: This might be an appropriate point to discuss ways of dealing with people who engage in name calling.)

SYMBOL SEARCH

by Jennifer Charlish

Focus: In February 1972 it became required by Canadian law that hazardous household products must, in English and French, display the following information: hazardous symbols and words, the name of the hazardous chemical, explanation of the pntential problem, and the first-aid treatment. This activity is to make children aware of the hazard symbols and their implications.

Challenge: To discover the four symbols and the three shapes of these symbols that are used to label hazardous products.

Materials and Equipment:

15 to 20 empty containers that have hazardous symbols on them
Pens, paper, and hand-out sheet giving the symbols
Some containers that should be labelled with hazard symbols, but aren't (the hazard should be written somewhere on the container)
If these are unavailable, make a list of hazard statements:

1. Warning: do not store near heat or open flame.

2. Extremely flammable.

3. Warning: contents will explode if hested.

4. Warning: harmful if swallowed.

5. Contents may irritate skin.

6. Caution: use in a well-ventilated room away from flame.

7. Fatal if swallowed.

How-To-Do-It: Talk with children about products that are labelled "keep out of reach of children." Get them to explain why this is done. Tell them that other symbol systems have been developed to warn people of hazards. Ask if they can think of some (traffic signs, etc.). Explain to children that they will be looking at one of these systems. Have them make a chart with three columns like this:

PRODUCT	HAZARD	SHAPE and SYMBOL USED
1.		
2.		

Then give them the empty containers and ask them to fill in their chart. Children may work in pairs for this activity.

Once they have finished, have a class discussion and have them draw conclusions of what the four symbols and the three shapes mean from their charts. Hand out the sheet explaining the symbols and kinds of hazards, and have the children write their explanations of the symbols and shapes.

Have the children decide how to label some unlabelled containers (if these are unavailable, have the children choose which shape and symbol they would put with each hazard statement). Accept answers as long as they can be justified.

Further Challenges:

1) Explain why hazards are printed in symbols and words.

2) Under parents' supervision, have the child make a chart of the products and the hazard symbols on them.

3) Under teacher supervision and with the permission from the janitor, make a chart of the projects and the hazard symbols on them that are found in the school.

4) Could do the exercise again looking for "what to be aware of" and the first-aid treatment. For example, where is it found? How does it relate to the hazard symbol?

References:

Canada Department of Consumer and Corporate Affairs. How to Recognize Hazardous Products (pamphlet), 1972.

Hazardous Product Symbols (chart), 1972.

The Adventures of Binkley and Doinkel (cartoon), 1971. Ottawa.

FOUR SYMBOLS TELL THE KINDS OF HAZARDS:

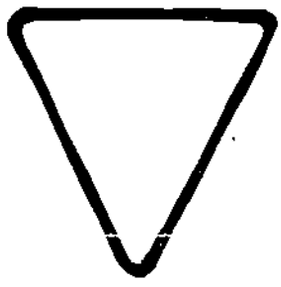
POISON

FLAMMABLE

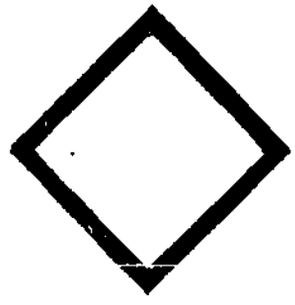
EXPLOSIVE

CORROSIVE

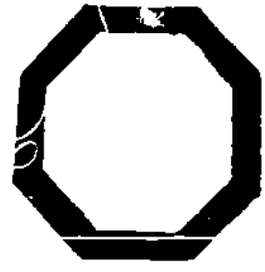
THREE SHAPES TELL THE DEGREES OF HAZARD:



CAUTION

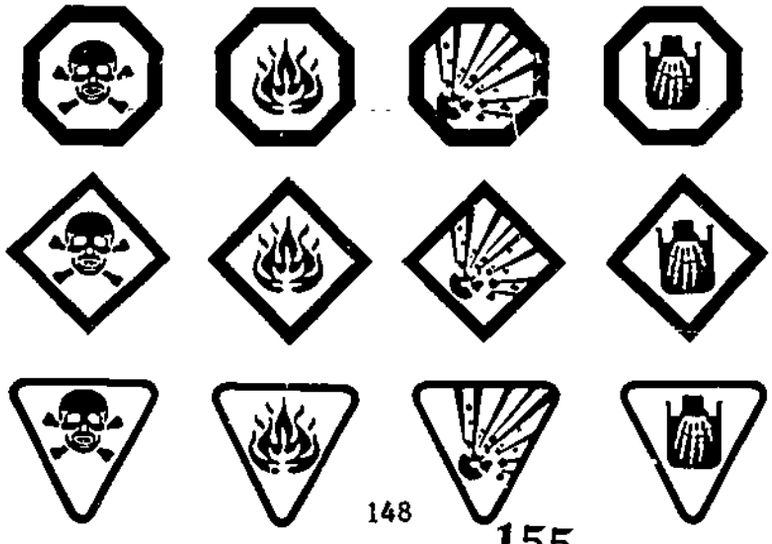


WARNING



DANGER

PUT THEM TOGETHER AND THEY LOOK LIKE THIS:



REACTION TIME

by Mildred Moseman

Focus: We need fast reaction time.

Background: You are running down the beach after the man selling ice cream. You are hot. He's leaving. You run faster and faster. Suddenly you look down and see your foot about to step on a piece of broken glass. Can you avoid it in time?

Challenge: Who haa the fastest reaction time?

Materials and Equipment:

Penny
Meterstick

How-To-Do-It:

One Hand Slapper: You need a partner for this hand-slapping activity. Hold your hand out with the palm up. Have your partner rest his/her palm on yours. If you hold out your right hand, your partner should rest his/her hand on your outstretched hand. The idea is for you to turn your hand over fast enough to slap the back of your partner's hand before it is removed. This activity is testing your hand-turning speed or rate against your partner's reaction time.

Two Hand Slapper: Try the one-hand slapper with two hands. Try to turn both of your hands over before your partner can remove his/her hands. Which hand has the better reaction time when your hands are above your partner's?

Penny Drop: Hold your right arm out and keeping the back of your hand up, put a penny on the center of the back of your hand to the side so that the penny slides off. Try to catch the penny. Do this five times and keep track of how many catches you make. Do it another five times (graph results--do you improve?) Try it with your left hand. How does the reaction time of your left hand compare with that of your right hand?

Catching a Falling Stick: Hold your hand out with your thumb and forefinger separated. Have your partner hold a meterstick or yardstick (vertically) at one end so that the other end of the stick is between your thumb and forefinger. Keep your eyes on the bottom of the stick and ask your partner to release the top end at any time. Try to catch the measuring stick between your thumb and forefinger. The diatance that the stick falls before you catch it gives you an idea of your reaction time. Switch positions with your partner.

Further Challenges:

1) Do research on your father's reaction time trying to stop a car at a designated spot with a number of practices; at different speeds.

2) This project can go on iuto determining pulse rates, breathing rates, and air intake.

Reference:

Holmes, Neal J., John B. Leake, Charles D. Oveatt, and Peter W. Nichols. Science - People Concepts, and Processes. St. Louis: Webster Division, McGraw-Hill Book Co., 1974.

ADVENTURES IN TRAVELING SAFELY

by Jennifer Charlish

Focus: In British Columbia it is required that all people in a motor vehicle must wear seat belts at all times. This activity is to give children a chance in a simulated game setting to practice remembering to put on a seat belt.

Challenge: To participate in the seat belt game and to generalize some common sense safety belt rules that should be applied in real life.

Materials and Equipment:

Game boards and cards (a small version of the gameboard is given below with the directions for the cards).

How-To-Do-It: Get the children to play the game. The rules of the game are:

1) Select a marker and place it on the house. Decide who will go first.

2) First person draws a chance card and follows the directions. Before the player moves, he/she must "fasten a seat belt" by taking a seat belt card. If a player forgets to do this, he/she loses a turn. Anytime the car stops, the driver gets out of the car. Therefore, the seat belt has to be re-fastened. When the chance card has been followed, it is placed face up on the bottom of the deck.

3) If a player's marker lands on an exit, he/she may choose to take that route to the park.

4) If a player's marker lands on a detour, he/she must follow the detour road.

5) First marker at the amusement park is the winner.

After the children have finished the game, have a class discussion. Let the children explain when seat belts should be worn, why they should be worn, and who should wear them.

Further Challenges:

1) Have the children make a chart and record who uses their seat belt and who doesn't every time they get in the car. Teachers could then have them graph the results and give "seat belt use" report cards to their family.

	Date	
Mom		
Dad		

Place a check mark if they wore a seat belt.
Place an X if they didn't
Place a - if they weren't in the car.

References:

U. S. Department of Transportation, National Highway Traffic Safety Administration. The Seat Belt Game. Washington, D. C., U. S. Government Printing Office.

Chance Cards: At least one of each of these cards should be made. If more are needed, then choose some of these to be duplicated.

1. You were in an accident. Everyone was wearing a seat belt. Move five (5) spaces.
2. Move two (2) spaces. Stop at a store to get groceries.
3. Police road block. Someone was not wearing a seat belt. Miss your turn.
4. Move three (3) spaces. Stop to get gas.
5. Move two (2) spaces. Stop to make a telephone call.
6. The light changed. You had to stop fast. Someone was not wearing a seat belt. Miss your turn.
7. Move three (3) spaces. Stop to fix your flat tire.
8. Move two (2) spaces. Stop to pick flowers.
9. Police road block. Everyone was wearing a seat belt. Move five (5) spaces.
10. Move three (3) spaces. Stop to look at the view.
11. Move three (3) spaces. Stop to go for a swim.
12. Move two (2) spaces. Stop to get an ice cream cone.
13. The light changed. You had to stop fast. Everyone was wearing a seat belt. Move five (5) spaces.
14. Move two (2) spaces. Stop to watch people fish.
15. Move three (3) spaces. Stop to have a picnic lunch.
16. You were in an accident. Someone was not wearing a seat belt. Miss your turn.
17. Move three (3) spaces. Stop to pick up a friend.
18. Move two (2) spaces. Stop to take pictures.

19. A child ran out in the road. You had to stop fast. Everyone was wearing a seat belt. Move five (5) spaces.

20. Move two (2) spaces. Stop to clean windshield.

21. Move three (3) spaces. Stop at the drugstore for bandaids.

22. Move two (2) spaces. Stop to buy a drink of pop.

23. A child ran out on the road. You had to stop fast. Someone was not wearing a seat belt. Miss your turn.

Seat Belt Cards: These rhymes can be reproduced and put on the back of the seat belt cards. Approximately 65 cards will be needed.

Belts are worn just everywhere
Even in planes that fly in the air.

Here's a belt for you and me
Now, how safe you'll be.

No matter where you are
Buckle-up in the car.

Astronauts wear safety belts
traveling very far
Also, when they're in a car.

Safety belts are for kids like you and for Mommy and Daddy, too.

Buckle safety belts on a trip - that's a very good tip.

To ride safe and sound wherever you go
Fasten the belts on the way to and fro'.

Accidents happen near and far
So buckle the belts in your car.

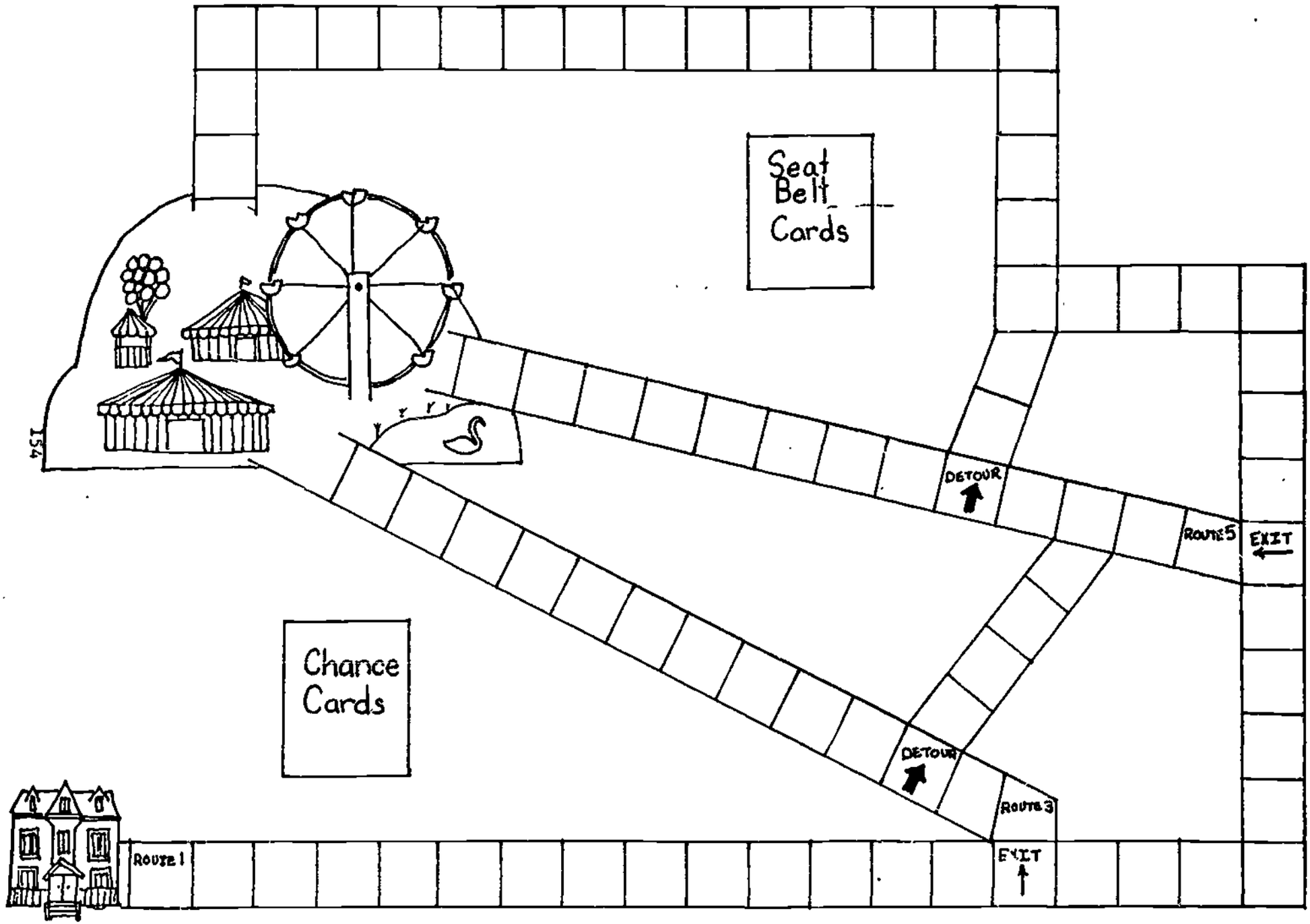
If safety belts are always on
You'll be safe as long as you're gone.

Safety belts should be worn by others, your mothers and fathers, your sisters and brothers.

Whenever you go fast or slow
Buckle-Up!

Men wear safety belts in a fast car race
You should wear yours when you sit in your place.

When you leave the car just for a minute
Buckle the belt when you're back in it.



adapted from U.S. Dept. of Transportation

MAPPING THE SAFEST ROUTE

by David R. Stronck

Focus: Children on bicycles should avoid streets that have much traffic.

Challenge: Count the number of vehicles using streets that are routes to the school and identify the best routes to the schools.

Materials and Equipment:

Paper and pencil

How-To-Do-It: Use a map of the city showing the location of the school or make your own map of the local streets around the school. Assign each student a specific street corner. Before (or after) school hours, each student will spend exactly three (or five) minutes at the corner and count the number of vehicles that pass during those minutes. Using these counts, identify the streets that are least used and therefore safest for bicycle traffic. Have the students share this information with others in the school by constructing posters showing the best routes to school.

Further Challenges:

1) Marilyn J. Flick suggests that students consider some humorous epitaphs that describe how some people have died foolishly because they ignored safety precautions:

Dublin cemetery:

Here lies the body of Mike O'Day
Who walked maintaining the right-of-way
His right was clear, his will was strong
But he's just as dead as if he'd been wrong.

A Pennsylvania man:

Here lies the body
Of Jonathan Blake
Stepped on the gas
Instead of the brake.

Boot Hill Cemetery in Tombstone, Arizona:

Here lies
Lester Moore
Four slugs
From a forty-four
No Les
No more.

Have the students compose their own epitaphs or humorous ones to encourage safety.

References:

Write to the following for information --

Aetna Life Affiliated Companies, Education Department, 151 Farmington Avenue, Hartford, CT 06115.

American Association of Poison Control Center, c/o Academy of Medicine of Cleveland, 10525 Carnegie Avenue, Cleveland, OH 44106.

American Automobile Association, Traffic Engineering and Safety Department, Falls Church, VA 22040.

American Insurance Association, Safety Department, 85 John Street, New York, NY 10038.

Bicycle Manufacturers Association of America, 1101 15th Street, N.W., Washington, DC 20005.

Ford Motor Company, Information Department, Dearborn, MI 48127.

National Fire Protection Association, Public Relations Department, 60 Batterymarch Street, Boston, MA 02110.

National Recreation Association, 8 West 8th Street, New York, NY 10011.

National Safety Council, 444 North Michigan Avenue, Chicago, IL 60611.

National Society to Prevent Blindness, 79 Madison Avenue, New York, NY 10016.