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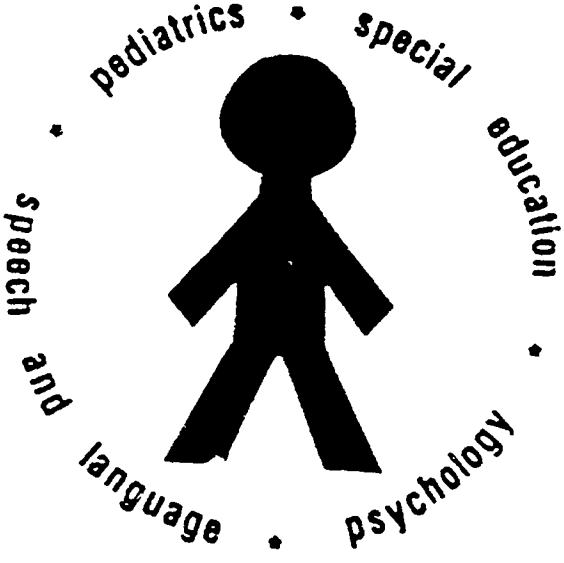
ABSTRACT

This guide is intended for use as a supplemental science teaching aid with students having diverse medical, learning, and/or behavioral problems in either self-contained or regular elementary classes. Its purpose is to teach observation skills and the scientific method, to stimulate thinking, and to increase interest in science and related academic areas. The 29 specific activities presented in the guide are grouped into sections addressing physical, earth, and life sciences respectively. Each section provides a general description of a specific area of science; lists objectives, activities, materials, and vocabularies; and provides supplemental activity ideas. Listed for each activity are the objectives, materials needed, activity steps, and discussion ideas. Also provided are general suggestions about behavioral management, testing and grading, and scheduling and lesson plans. Appendices include: a list of science objectives; safety rules; materials; steps of the scientific method; a description of the language experience approach; a summary of behavior management techniques; sample success notices (for reproduction); a sample contingency contract between student and teacher; and a listing of five teaching resources. (DB)

TEACHING DIFFICULT LEARNERS
SCIENCE: HANDS-ON EXPERIMENTS 1, 2

JENNIFER REEVES TRAGASH
CLASSROOM TEACHER



MULTIDISCIPLINARY DIAGNOSTIC AND TRAINING PROGRAM

UNIVERSITY OF FLORIDA

TEACHING DIFFICULT LEARNERS SCIENCE: HANDS-ON EXPERIMENTS [1, 2]

JENNIFER REEVES TRAGASH
CLASSROOM TEACHER

Monograph #17

May, 1987

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THE UNIVERSITY OF FLORIDA

MULTIDISCIPLINARY DIAGNOSTIC AND TRAINING PROGRAM (MDTP)

The MDTP is administered through a joint effort by Shands Teaching Hospital and the Department of Special Education at the University of Florida. The MDTP staff is composed of professionals from the fields of pediatric neurology, education, school psychology, and speech and language pathology. The MDTP has specified elementary school students with diverse medical, learning, and/or behavioral problems as its primary population. Major resoprisibilities of the MDTP are to use all appropriate disciplines to provide diagnostic and intervention services to school systems referring students, train education and health professionals at the preservice and inservice level, and assist parents of students experiencing difficulty in school.

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PREFACE

This monograph is intended for use as a supplemental science teaching aid in grades one through six. It is not designed to be comprehensive; rather it should be used as a resource that may be duplicated for use with students, and as a guide for developing similar science activities or activities in other areas. The purpose is to teach observation skills and the scientific method, to stimulate thinking, and at the same time to increase interest in science and related academic areas. Specific activity objectives are listed under each activity. The activities presented in this monograph can be implemented in self-contained learning disability, emotional handicap, gifted or Chapter I classrooms, as well as regular classrooms. The activities can be used in a varying exceptionality classroom, however, scheduling difficulties would have to be overcome.

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INTRODUCTION

Science involves not only content, but the development of methods and skills necessary for problem solving. The scientific method can be thought of as a useful outline for solving scientific problems. Children must be taught these methods and skills. However, it is not enough to simply teach the "Steps of the Scientific Method." Children are concrete learners and thinkers. They learn by doing -- by experimenting.

Measuring, comparing, calculating, predicting, combining things, collecting and recording data and experimenting are all basic processes of science and thinking. A teacher must provide materials and opportunities for exploration and investigation by the child. Lack of motivation is often a major problem in special education classrooms. Providing interesting opportunities for scientific discovery can help to reduce this lack of motivation. Science can be used as a vehicle with which to teach math and reading as well as a host of other subjects.

This monogragh is divided into sections which present activities suited for teaching concepts and processes related to observation and measurement in Physical, Earth, and Life Science. Each section provides a general description of a specific area of science, lists objectives, activities, materials, and vocabularies, and provides supplemental activity ideas. (Objectives relating to each acitivity are listed fully in Appendix A.) Safety tips and rules can be found in Appendix B, and a list of materials needed for the activities presented in this monograph is provided in Appendix C.

Teaching science requires extra planning and monitoring of students. It requires enthusiasm on the part of the teacher. However, these extra efforts will help to promote each child's ability to problem solve and to form positive attitudes toward school and self. The benefits of seeing expressions of excitement and motivation to learn on the faces of students far outweigh any additional efforts on the part of the teacher. Teachers are encouraged to try these experiments and/or design other hands-on science activities.

GENERAL OBSERVATION AND MEASUREMENT

Good scientists should be able to ask good questions, communicate information, understand the difference between observation and inference, classify and describe. These skills are part of the ongoing process of the scientific method. Familiarity with the scientific method will aid in helping children acquire these skills (please refer to Appendix D). The following activities address these skills. (Worksheets referred to in these activities can be found in the section of this monograph entitled, "Worksheets").

Vocabulary: scientific method, height, width, length, circumference, metrics, observe, infer, sense.

Activity 1: Peculiar Pine Cones

Objectives: 1, 3, 4, 5, 6, 7, 10

Materials: Bag of pine cones (one for each student), magnifying glasses (one for each group of 4), tape measures, weights and balances,

containers of water, paper and pencils. Note: Sometimes lack of funding requires adaptation of certain materials.

Instructions: (Preclass) Supply each table with the above materials.

Classtime: Divide children into groups with a maximum of 4 per table. Inform children, "Today, you will be a scientist." Walk around the room with bag of pine cones and ask each child to choose a cone. After each child has a cone, give the following instructions: "Write down everything you can tell me about this object. You have 2 minutes and you must think of at least five words. You are not allowed to taste the object nor break it. Please begin."

Class Discussion: After 2 minutes, ask the children to describe their cones. Find out how many used the measuring instruments on their tables. Discuss the 5 sensory properties - Smell, Sound, Taste, Sight, and Touch. Cue students to consider Texture, Hardness, Squeezability, Dryness or Wetness, Coldness or Hotness, Heaviness, Shape, Ability to Float or Sink, etc. Explain the difference between flat words (e.g., circle, square, etc.) and 3 dimensional words (e.g., hourglass, cone, cylinder, etc.)

Try to elicit responses from the students rather than give them descriptions. Stress giving comparisons that can be proven. Tell the students that the fundamental (or basic) concept of observation is that an observation is something you can prove, a provable experience or description. Have them compare their cones (or any other object in a scientific experiment) with something that is readily available. Give examples: "Sharper than my fingernail." Give non-examples: "Sharper than a knife." Ask the students to provide their own examples and non-examples by comparing attributes of their cones with other objects.

Define inference for the class. Discuss the difference between provable and nonprovable (observation and inference).

Collect the pine cones from each side of the class. Place the cones on a table. Have the children try to find their pine cones. Discuss the importance of being a good observer.

Follow-up Activities: (1) Write and illustrate a haiku, story, or poem about your pine cone using the words that describe your cone. (2) Assign a measurement activity from the adopted or supplemental math book.

Activity 1 can also be done with peanuts, rocks, and other small objects. An observation activity of this sort should be done once every three weeks in order to review observation and measurement skills.

Activity 2: More Information Please

Objectives: 3, 4, 5, 7

Materials: 8 to 10 large pictures or objects.

Instructions: (Preclass) Display pictures and/or objects in front of the class. Classtime: Say, "I am thinking of a picture. Which one is it?" Any response from the students will be a guess at this point. The students should at this point ask for "More information, please." You must then narrow the number of pictures down by stating a more specific fact. The students may again ask for more information. The teacher then provides them with another clue, continuing in the same manner until one picture remains.

Class Discussion: This activity teaches the children to observe, compare obervations, think of similarities and differences, and to develop the habit of asking for "more information, please" when they do not have

enough facts to solve a problem. Students may also bring in their own pictures or objects and challenge other students.

Activity 3: Science Makes Sense

Objectives: 2, 3, 4, 5, 6, 12

Materials: Tape recorder, tape of common sounds, cotton, scotch tape, sandpaper, or anything else to touch; various items to taste (lemon juice, sugar, peanut butter, horseradish, salt, etc.); various substances to smell (perfume, ammonia, vinegar, etc.); pictures partially covered so that only a portion of the picture is exposed.

Instructions: This activity can be divided into 5 separate activities or one main activity. (It may be used with preschool through middle school children.) Classtime: Inform the children "Today, you will practice your observaton skills. Each of you will be a scientist." Ask for volunteers. The rules are as follows: The volunteer will be given an item to taste while everyone's eyes are closed. When the teacher announces "Open your eyes," everyone will open their eyes and look at the expression on the volunteer's face. The teacher then will ask for hand raises and guesses as to what the volunteer experienced. After a few guesses, the volunteer is asked to describe the substances taste, feel, smell, etc., without telling what the substance was. The teacher asks for more guesses. This process is repeated with new volunteers and substances until several students have participated and various substances have been experienced.

The whole class can participate in "seeing," "hearing," "touching," and "smelling" activities. Show the class pictures that have only one part exposed. For example, a picture of a sunflower with only one circle in the middle exposed. Students must try to guess what the picture is without

seeing the whole picture. Play tapes of various sounds (e.g., cats meowing, car motors, etc.) and have the students guess what the sounds are. Have them describe the sounds. Allow each child, with eyes closed, to touch an item. Allow students to describe what they have touched and take guesses as to what the item is. Repeat this activity with various smells. Spices, liquids, scratch and sniff stickers may be good "smell" sources.

Class Discussions: Discuss the importance of observation and of making predictions and guesses in science. Caution students as to the dangers of indiscriminately smelling, touching, or tasting unknown items. Find out how many words can be used to indicate how an object feels, smells, looks, tastes, or sounds. Have the students describe their observations comparatively and quantitatively. For example, "How hard?", "How rough?", "How much more?", "How many fewer?".

Follow-up Activities: Students can make a touch book with each page containing an object to touch. Touch words (e.g., hard, hollow, rough) can be recorded below each example.

Have children classify tastes, such as salty, sour, bitter, and sweet by making their own cookbook arranged according to how foods taste. It will have a sweet section, a sour section, etc.

"I Spy" is a good game to practice observation by seeing. To play "I Spy" one student secretly chooses an object in the classroom and whispers the name and location of his object to the teacher. This student then calls on others to guess the object. Students are permitted to ask specific "yes" and "no" questions to determine the location of the object. Whoever guesses the object first becomes the next person to choose a secret object.

Activity 4: Mathematics of a Granola Bar

Objectives: 2, 3, 4, 5, 6, 10, 11, 12

Materials: Raisin, chocolate chip, or peanut granola bars, worksheet 1, rulers, weights and balances (if available), worksheet 2.

Instructions: (Classtime) Distribute worksheet 1 to each student or to groups of two students. (See the section on sample worksheets.) Inform the class that they will practice being scientist by measuring. Show the class one granola bar still in its wrapper. Instruct students to make a guess as to the height, width, etc., of the granola bar (proceed down the worksheet, reading aloud to the class). Have students record their guesses on their worksheets. Pass out granola bars and instruct students to begin measuring to find out the actual measurements of the granola bars. Remind students that they need to measure the granola bar before they count the raisins, etc. Students may eat their granola bars when they finish measuring and recording. This activity can also be done with an orange. You will need oranges, tape measures, bowls of water, and paper towels. (See worksheet 2.)

Discussion: Discuss the importance of measurement and accuracy in science. Compare guesses with actual amounts. Compare individual student's observations on the grancla bars. Relate science to business and industry. Discuss the importance of accuracy in the granola bar industry and in other industries, as well as in school work.

Follow-up Activities: Assign measurement activities from your math book or give a creative writing about granola bars.

Start a classroom industry or business. For example, students can create and sell items such as fuzzy pencils or art projects. Stress accuracy, observation, etc.

Activity 5: Popcorn Prediction

Objectives: 1, 2, 3, 4, 5, 6, 11, 12

Materials: Hot air popcorn popper, salt if desired, worksheet 3.

Instructions: (Pre-Class) Assemble popcorn popper in classroom. Classtime: Distribute worksheets, one to each student or to groups of two students. Inform the students that they will practice being scientists by observing and measuring. Have the students guess how many popcorn kernels it will take to fill the various shapes on their worksheets and record their guesses in the spaces provided. Distribute kernels and instruct students to: (a) fill the spaces with kernels, (b) count the kernels needed to fill the shapes, and (c) record their findings on their worksheets (the teacher may find it necessary with some students to demonstrate this for the whole class using "helpers" rather than require individual students to count kernels). Next ask for guesses as to how many popped kernels it will take to fill the shapes. Proceed to pop the kernels. While corn is popping, review the five senses, observation, and other topics learned in science thus far or have the students work on a related math exercise. After the popcorn is popped, distribute a portion to each student, instruct them to fill their shapes, record answers, and eat their popcorn.

Discussion: Discuss the importance of measurement and accuracy in science. Compare guesses with actual amounts. Ask if all brands of popcorn will pop the same amounts (i.e., will there be the same amount of kernels or "Old Maids" left after popping different brands?).

Follow-up Activities: Measurement activities from math book. Creative writing activities about "Popping Popcorn." Science projects hypothesizing how well different brands of popcorn pop.

Activity 6: Fingerprint Fun

Objectives: 2, 3, 4, 5, 6, 7, 9

Materials: Inkpads, magnifying glasses, worksheet 4.

Instructions: (Classtime) Distribute worksheet and inkpads to each student or to groups of two students. Instruct the students to trace their hand onto the page. Next, instruct students to ink their thumb then press and roll it onto the thumb space on their papers. Repeat for the other fingers on that hand.

Discussion: Have each student examine their prints with a magnifying glass and think of four observations about their fingerprints. Ask "Do your hand/finger prints look like arches or loops or whorls?" Draw the three types of prints on the board or show students a handout depicting the three types. Explain that everyone in the world has his or her own unique set of prints and that there are three types of prints (mentioned above). Have students compare their prints with a friend's. Are any of them similar? How are they different? Discuss the occupation of the forensic scientist. Inform students that they can grow up and use their scientific skills to work for the police department as a forensic scientist.

Follow-up Activities: Plan a field trip to police station to observe the different occupations related to science. Invite a forensic scientist to your class as a guest speaker. Use fingerprints for art activities. Use your imagination!

PHYSICAL SCIENCE

Physical science is the study of relationships between matter and energy. Possible areas of study include states of matter, properties of matter, atoms, molecules, chemical reactions, mechanical energy, electricity and magnetism, heat, sound and light. The study of physical science requires a set of skills in observation, measurement, and experimentation.

Vocabulary: matter, solid, liquid, gas, density, surface tension, crystal, magnet, magnetic field, acid, base, color, light.

Activity 1: Rainbow Liquids

Objectives: 7, 8

Materials: Whole milk, skim milk, food coloring, water, pepper, dishwashing detergent, eye droppers (small and large), round aluminum pans (small and large).

Instructions: (Pre-class) Assemble all materials. Pour whole milk into large containers, skim milk into small containers, and water into separate large containers. If possible, do not let the children know what is in the containers. Refer to the substances as "Mystery Substances." This adds a little suspense and intrigue to the experiment. Place containers on tables with groups of no more than four students per table. Write the two vocabulary words on the chalkboard (density and surface tension).

Classtime: Review the three states of matter (i.e., solid, liquid, and gas). Give examples and non-examples of each. Elicit examples and non-examples from students. Review the scientific method. Ask if anyone

knows the meaning of the two words on the board. Read the words for the class. Take all guesses, but do not give feedback as to the correctness of a response. After students have guessed, inform students that they will find out the meanings after they use the scientific method to experiment. Remind the students of the rules for being a good scientist (e.g., be a good observer, listen carefully to instructions, work well with your fellow scientists, work carefully at all times, etc.). Distribute the rest of the materials to each group and proceed to give the following directions:

Part One:

1. Drop one drop of food coloring into the large container. Observe and record your results either by writing notes in your notebook or by drawing a picture.
2. Using an eyedropper, drop one drop of the Mystery Liquid (detergent) into the center of the food coloring. Observe and record.
3. Repeat numbers one and two with all colors of food coloring.
4. Repeat numbers one through three using small container.

Discuss Results: Students will be very impressed with the results of this experiment. They are observing density. Evidence of density is seen when comparing the skim and whole milk and the reactions of the two when combined with food coloring and detergent. Ask if students can guess the identity of the Mystery Substances. Ask if anyone knows the difference between skim and whole milk. Define density for the class (i.e., how "thick" a substance is). Compare skim and whole milk as to the density of each. The food coloring will disperse more rapidly in the skim milk because of the lower density of the skim milk. (If the experiment

were repeated using water, the food coloring would sink to the bottom of the pan because of the low density of water as compared to milk. In effect there is less to hold the food coloring on top of the milk.) Whole milk contains more fat than skim milk, and therefore is of a higher density and will hold the food coloring in place for a longer time. Ask students to give examples of very dense forms of matter and of less dense forms. Possible examples include pancake syrup vs. grape juice, oil vs. water, etc.

Part Two:

1. Sprinkle pepper on top of the water.
2. Put one drop of detergent in the middle of the pepper.
3. Observe and record results (pepper will rapidly disperse to outer edges of the pan).
4. Repeat above steps one or two more times and observe (pepper will eventually sink to the bottom of the pan).
5. Drop food coloring into the water and observe.

Discussion: Define surface tension (tendency of a surface to hold together (i.e., the bonding on the water that holds the pepper up, but not the food coloring). Milk has a higher surface tension than water and also a higher density.

Modifications: Depending on the learning characteristics of students, the teacher may need to demonstrate the above experiments for the class using student "helpers." Also, the depth to which density and surface tension are discussed will depend on the level of the students. This experiment has been tried successfully with primary students using the demonstration method and with higher elementary and middle school LD and EH students using the hands-on group approach. The experiment takes a

bit of preparation, however this disadvantage is far outweighed by the increased interest in science and learning on the student's part.

Follow-up Activities: Students can use water color paints, markers, etc., to draw pictures of their Rainbow Liquids. Using a Language Experience Approach (LEA) (see Appendix E for further information on the LEA), write a story about the experiment.

Activity 2: Crystal Gardens and Other Crystals

Objective: 9

Part One: The Crystal Garden

Materials: Charcoal, table salt, ammonia, food coloring, water, laundry bluing (can be purchased at Pic N Save), glass bowl, aluminum pan, mixing bowls, measuring spoons, stirring spoons, toothpicks, magnifying glasses.

Instructions: (Pre-class) Assemble all materials.

Classtime: Ask students to define the term crystal. Give examples of crystals (e.g., diamonds, ice, salt). Inform students that they will grow their own crystals. Ask for predictions as to how long the students think it will take to grow crystals on charcoal. Record guesses. Demonstrate the following activity using student helpers:

Part One:

1. Place some charcoal in a glass bowl. Mix 1/4 cup of water, one tablespoon of household ammonia, 1/4 cup of table salt, and 1/4 cup of laundry bluing into a solution in a container.
2. Pour this solution over the charcoal, spreading the thick slurry of salt evenly over the charcoal.

3. Sprinkle food coloring (all colors) over the charcoal.
4. Insert toothpicks in or around the charcoal.
5. Repeat above procedure using charcoal in an aluminum pan.

   Take predictions as to which will grow faster--crystals grown in glass or aluminum. Will there be any other differences?
6. Set pan and bowl in safe place and observe. It is important that the crystals are not jarred or disturbed in any way. Crystals will begin to grow in about two hours. Within 24 hours, you will be surprised with a beautiful crystal garden.
7. After a day or two, take predictions as to how the crystals will feel when touched by the students. Allow students to gently touch the crystals (they will feel like powder). Observe crystals with magnifying glasses.
8. Crystals will continue to grow for a few days and will stay in place for the whole year if desired.

Part Two: Other Crystals

Materials: Salt, sugar, water, glass jars, nails, screws, bolts or anything metal, string cardboard, heat source, magnifying glasses.

Instructions: The teacher may need to perform this additional experiment at home if no heat source is available. The school cafeteria is also a possible resource. Inform students that they are going to grow some new types of crystals. They will be growing salt crystals and rock candy (sugar crystals).

1. Fill a glass jar with hot water. Add salt as long as it keeps dissolving. Have a piece of cardboard ready with a piece of string

hanging from it. The string may be threaded through holes long enough to reach the bottom of the jar. Weight its end by tying to the string a small piece of metal (e.g., a bolt, screw, or nail). Drop the string into the hot solution . Cover the jar with the cardboard and put the jar in a quiet, warm place where it can cool slowly. Observe the salt solution each day for several days.

2. Boil 3/4 of a cup of water in a clean pan. While the water is boiling gently, stir in granulated sugar, little by little, until no more will dissolve. This will probably take about two cups of sugar. Pour the hot solution into a glass jar. Put a silver spoon in the jar while you pour the liquid and it will absorb enough heat to keep the glass from cracking. Remove the spoon. While the solution is still hot, repeat the procedure in number 1 above using cardboard, string, and a metal object. The solution should form crystals that are commonly called rock candy.

Discussion: Observe and compare salt and sugar crystals using magnifying glasses. Compare with crystal garden. Discuss the fact that no two crystals are alike in appearance. Crystals need time and space to grow. They also need the correct solution and temperature to grow into beautiful shapes. The rate of cooling also affects the way they form. Solutions cooling slowly form large crystals while solutions cooling rapidly form small crystals. This could lead to a discussion of the composition of the earth, rate of cooling of volcanic material as it relates to rock crystals, etc. Ask students to think of examples of other types of crystals.

Activity 3: Testing for Acids and Bases

Objective: 10

Materials: raw red cabbage, small sauce pan, large jar, strainer, hot plate or other heat source, small jars or glasses, baking soda, vinegar, liquid soap, salt, lemon juice, orange juice, carrot, soda pop, tomato, milk, worksheet 5.

Instructions:

1. Make a litmus (indicator) solution by tearing up the leaves of a head of raw cabbage and putting them into a small sauce pan. Pour water over the leaves. Place the pan on the hot plate and let it simmer for about fifteen minutes.
2. Using a strainer, pour the cabbage water into a large jar.
3. Now test different substances to see if they are acids or bases.
4. Begin by putting a teaspoon of baking soda into a small jar or glass and some vinegar into another jar or glass. Add a small amount of cabbage water to each jar. In the glass with the baking soda (a base), the water should turn green; in the jar with the vinegar (an acid) the water should turn red.
5. Next, try the cabbage water on other materials observing the color. Use such things as liquid soap, salt, fruit juices and vegetables to decide if they are acids (red) or bases (green).

Discussion: Discuss the meaning of an acid and a base. Elicit responses from students as to why a scientist would need to know the acidity of a substance. How does this apply to everyday life? (The teacher may need to review the district science text in order to become more familiar with acids and bases.)

Follow-up Activities: This activity may lead to the use of litmus paper, which is rather expensive and is used up readily. To save money, use newspaper strips (from the borders where there is no print) which have been soaked in cabbage water. You can use the strips to test things just as you would use litmus paper. The strips will either turn red (acid) or green (base) just as the cabbage water did.

Activity 4: Mystery Magnets

Objectives: 5, 6, 7

Materials: Magnets of different sizes, paper clips, paper, rocks, glass, aluminum.

Part One:

Instructions: Begin the experiment by holding a piece of paper up in front of the class. Hold a magnet behind the paper so that the students cannot see the magnet. Have paper clips on the front of the paper and move the clips using the magnet.

Ask students how the clips are moving. Take guesses and then reveal the magnet. Ask students how a magnet works. Take guesses and proceed to experiment using glass, paper clips, paper, rocks and aluminum to find out which materials a magnet will attract. Observe and record results.

Discussion: Which items did the magnet attract? Why? Explain that a magnet is made of iron, a north pole and a south pole (not the same as the geographical poles). It will attract only other things made of iron. Discuss the magnetic field.

Part Two:

Instructions: Ask the class if the size of a magnet affects the strength of the magnet. Is a big magnet stronger than a small magnet?

The teacher should use magnets of different densities such as a small, thick magnet and a long, thin magnet to show that density is one factor that determines the strength of a magnet.

1. Method One: Hang one paper clip on each magnet, using the clip as a hanger, and count the paper clips it will hold before falling.
2. Method Two: Put a piece of paper between the magnet and the paper clip; continue to place paper between the magnet and the clip until the paper clip falls. Count the number of papers needed and compare.
3. Method Three: Place the magnet on a piece of graph paper. Find the maximum distance at which paper clip can be moved by the magnet.

Students should be broken into three groups for this activity (one for each method). Each group should complete its method using the small and the large magnet. Groups can then compare results.

Discussion: Discuss density as it relates to magnets. Also discuss the life span of a magnet. How long does a magnet stay magnetized? Does this affect the strength of a magnet?

Part Three:

Materials: Compass, piece of cork, needle, magnet, bowl of water.

Instructions: This activity demonstrates how to make a compass.

1. Rub a needle onto a magnet for about 1 minute.
2. Insert needle into cork.
3. Drop cork into water.
4. Observe.

The needle will turn in the water until it faces north. Find north using a compass and compare to the home made compass.

Discussion: Discuss the magnetic field and magnetic poles. Also, the fact that the needle is made of steel (a pure form of iron) so that it can become magnetized with the magnet.

Activity 5: Rainbow Magic

Objectives: 3, 4

Materials: Garden hose and water outlet, prisms.

Instructions: Ask children how we get the colors of the rainbow. Take guesses and proceed with the following activity. Inform students that they are going to make their own rainbows. Give each student or group of students a prism (glass or plastic). Instruct them to hold the prism in front of a light and observe. They should see a spectrum of color, a "rainbow." Take the class outside and show students they can produce a "rainbow" by standing with their backs to the sun and spraying a fine mist of water into the air with the garden hose. (This may need to be arranged in advance with the custodian of the school.)

Discussion: Light that appears white to us, such as sunlight, is actually a mixture of colors. White light can be separated into a spectrum or the colors of the rainbow. Any color can be produced by combining different colors of light. Objects that do not produce their own light appear to have color because of how they reflect light. Consider why grass is green. Sunlight, a mixture of all colors, strikes blades of grass. The grass absorbs most of the colors of the spectrum except green; it reflects green, so the grass appears green. An object that appears black absorbs nearly all colors. Very little light is reflected. Questions to ask: Why do cut diamonds sparkle and show color? (They are reflecting sunlight.)

Follow-up Activities: Draw rainbows using the correct colors of the spectrum (ROY G. BIV stands for "red, orange, yellow, green, blue, indigo, violet" with red being the top of the rainbow). Conduct creative LEA writing activities about rainbows. Read stories or poems to the class about rainbows. Make rainbow mobiles or stained glass rainbows out of tissue paper and cardboard.

EARTH SCIENCE

The earth is one part of an awesome universe. Earth Science deals with the origin of the earth, the earth as a planet, the earth's features, minerals and rocks, and weather and the atmosphere.

Vocabulary: Rock, sedimentary, metamorphic, igneous, core, mantle, crust, volcano, earthquake, cloud, air pressure, constellation, star, universe.

Activity 1: Adopt A Rock

Objectives: 2, 3, 4, 5

Materials: none

Instructions: This activity will raise interest in rocks in general and will lead to activities involving the structure of the earth.

1. Instruct the class to think of as many kinds of rocks as possible. Students are to think of as many words or sayings using the word rock as possible. They are not to think of the usual types of rocks (e.g., sedimentary). Some examples may include Rock Music, Rock Candy, Rocky Road Ice Cream, Hard as a Rock, etc.

2. Inform students that everybody needs a rock and rocks need everybody. So, they are going to adopt a rock. They will need to learn all they can about their rock so they can be responsible parents. Students should find rocks that they feel "comfortable" adopting. Take students outside and allow ten to fifteen minutes for finding rocks. Have them name their rocks.
3. Upon returning to the classroom, ask the students to describe their rocks. This can be either a written or an oral activity. Ask for them to describe the rocks' color, shape, hardness, size, smell, etc. Students should not taste their rocks. Instruct students to share their descriptions with the rest of the class.
4. Ask students if their rock is alive. Does it move? (If not, how do rocks get to where they are?) Does it reproduce? (If not, why are their so many rocks?) Does it respire? (If not, why do we sometimes see rocks that are "sweating?") Kids initially will say that their rocks are non-living. However, after this discussion, they usually will change their minds and report that indeed their rocks are alive. End the discussion with telling kids that rocks are non-living and that subsequent lessons will reveal the answers to the above questions.
5. Instruct students to take one more good look at their rocks, to feel their rocks, etc. On days of subsequent lessons, spread all the rocks on a table and see if students can remember which rock is their adopted rock.

Follow-up Activities and Lessons: This lesson can be followed up with lessons from the school science curriculum, rock classification

worksheets, films about the origins of rock families, etc. Students can write and perform a skit such as "This Is Your Life" about the lives of various rocks (e.g. sedimentary, igneous, metamorphic). Try to bring in samples of different types of rocks; start a rock collection. Ask students to bring in samples of rocks and classify them. Make a rock family tree. Students can paint their rocks and create "rock people."

Activity 2: Earth Delight

Objectives: 1, 2, 3, 4, 5

Materials: Ice cream or Jello of different colors, glass bowl, serving spoons.

Instructions: This activity can be prepared in advance, or if facilities permit, in the classroom (with students participating).

1. Crust: Use green ice cream or Jello and crushed cookies or graham crackers.
2. Mantle: Chocolate ice cream with nuts (rocks) or chocolate, frozen Jello pudding.
3. Outer core: Yellow ice cream or butterscotch pudding frozen with a few cherries or silver candied balls (lava) sprinkled throughout.
4. Inner core: Gray ice cream (made by adding equal amounts, drop by drop, of red and green food coloring to vanilla ice cream) or grape jello and a greater concentration of cherries or silver balls.
5. Layer with crushed cookies at the bottom of the bowl topped with the crust. Be sure to include the mantle and inner and outer core, layered so that the kids can see the various layers of the earth. Compare the layers and then eat them!

Discussion: How did the various layers of the earth get in their places? Discuss theories of the origin of the earth. Discuss earthquakes, volcanos, faults, etc. Relate the discussion to the three types of rocks. This activity can also be done using bread, peanut butter, jelly and lots of imagination.

Follow-up Activities: Have students layer the earth using construction paper or tissue paper. Write and perform skit or play about the origin of the earth.

Activity 3: Home-Made Volcano

Objectives: 1, 2, 5

Materials: Strips of newspaper, liquid starch, black, brown, red and green paint, baking soda, vinegar, red food coloring.

Instructions: Students will make a paper maché volcano. This can be an introduction to learning about volcanos or a follow-up activity.

1. Roll balls of newspaper and stack together in the shape of a volcano. Surround this initial structure with strips of newspaper dipped in liquid starch. Continue coating the structure with strips until the structure resembles a mountain or volcano. Leave an indentation about 2 inches deep in the top of the structure. Allow to dry for about 2 to 3 days.
2. When dry, paint the volcano brown and black. Green on the bottom can represent grass. Paint red lava streaks at the top of the volcano and continue streaks to the bottom.
3. To erupt the volcano, pour baking soda in the hole at the top of the volcano. Then pour vinegar over the baking soda. You can add a

little food coloring at this time to resemble lava. The volcano should erupt at this point.

Discussion: Relate to lesson on layering of the earth. Discuss cause of volcano eruptions. Relate this discussion to rock types.

Activity 4: Cloud Creations

Objectives: 6, 7, 8

Materials: Glass bottle, ice cubes, hot water.

Instructions: Take students outside and observe clouds. Instruct them to try and find different shapes in the clouds. Allow about ten minutes for this activity. Discuss the different shapes and types of clouds. Ask students to notice whether all clouds look alike (this can lead to a later discussion on the different types of clouds and on layers of the atmosphere). Return to class and make your own cloud by filling a bottle with approximately three inches of very hot water and a few sprinkles of chalk dust. Place an ice cube on top of the bottle. As the hot water evaporates, it is cooled by the ice and a cloud is formed.

Discussion: Clouds form when air, which contains dust particles, becomes saturated with water. Emphasize the relation between shapes and how they form. Discuss the properties of air (colorless, shapeless, takes up space, has weight, moves, has a temperature, is matter, has an effect on our environment). How can we prove air exists? Fill a large garbage bag with air, and have students sit on it. Bring a rubber raft to school, fill it with air and use it for a private science reading center.

Follow-up Activities: Visit a T.V. station or other weather facility. Determine what basic information is needed for forecasting. See if weather broadcasts can be made at school.

Have the students collect images of clouds for a week. Photos, paintings, drawings are all appropriate. Bring images to school and discuss different types of clouds. Talk about how high in the atmosphere different clouds usually form. What types are very high. What kinds bring rain storms?

Write poems, haiku, "wise-sayings," etc., about clouds. Create a gallery of images and words. Have students label and classify the images in the gallery according to shapes of clouds.

Make pictures of clouds using construction paper, cotton balls, and chalk. Instruct students to name their creations.

Activity 5: Egg Trick

Objectives: 8

Materials: Hard-boiled eggs, apple juice jar, paper towel, matches.

Instructions: This activity will demonstrate air pressure. You may want to warn the secretary of the school that the fire alarm may be set off during this experiment

1. Twist the paper towel (loosely), ignite the paper towel, and drop it into the jar.
2. Place the peeled egg on the top of the jar. The top of the jar should be somewhat smaller than the egg. The egg will be drawn into the jar because the air pressure on the outside of the jar and egg forces the egg into the jar (colder air is more dense and therefore has greater pressure than warm air).
3. After the fire has gone out in the jar, increase the air pressure inside the jar by blowing air into the jar. Immediately, remove

your mouth from the jar, hold the jar over your shoulder with the mouth facing your back, and the egg will come flying out.

Note: Try this experiment at home first.

Discussion: This activity can lead to a discussion of hot and cold fronts, air pressure systems, weather, etc. Discuss the properties of air mentioned in Activity 4.

Activity 6: Mystery Constellation

Objectives: 9

Materials: Paper cup with the bottom cut out, a paper cup with a solid bottom, tape, straight pin, wax paper.

Instructions: Introduce this activity by asking students what we see in the sky at night. Have students create their own constellations by following this procedure:

1. Distribute a 3 inch by 3 inch square of wax paper, two paper cups, and a straight pin to each student.
2. Instruct students to number their cups with a pencil (cup #1 and cup #2).
3. Cut the bottom out of cup #1.
4. Use a straight pin to poke out the major stars of their constellation on the bottom of their cup. Instruct students to name their constellations.
5. Tape the mouths of cup #1 and cup #2 together.
6. Tape the wax paper square over the open end of cup #1.
7. Hold cups up to a light source such as an overhead projector and look through the wax paper end to see the constellations.

8. Instruct students to trade constellations and try to guess the names of other students' constellations.

Discussion: This is a good way to introduce astronomy. Look at pictures of real constellations and discuss them. Discuss the stars' composition, brightness, distance from the earth, etc.

A variation of this activity is to punch holes in black construction paper to create a constellation. Use a shoe box with both sides cut out. Tape the paper to one side, hold a flashlight behind the paper, and look through the other side of the shoe box. The constellation will be illuminated.

Activity 7: My Place In The Universe

Objectives: 9, 10

Materials: none

Instructions: This is a class discussion designed to give students an idea of their place in our universe. The teacher can lead the discussion and then see if the students can remember the steps of the game. The following script can be used:

1. I'm sitting in a chair.
2. in room _____,
3. at _____ school,
4. on _____ (address of school),
5. in _____ (section of city),
6. in the city of _____,
7. in the county of _____,
8. in the state of _____,
9. which is part of the United States,

10. on the continent of North America,
11. north of the equator,
12. on the planet Earth,
13. which is the third planet from the sun,
14. in the Solar System,
15. in the Milky Way galaxy,
16. which is part of the Universe.

This can be made into a fun game. Students can participate either individually or in teams.

Discussion: This can lead to discussion of planets, the sun, life forms in space, etc.

Activity 8: How Bright is the Sun?/Making Solargrams

Objectives: 9, 10

Materials: Photo paper (inexpensive kits are available--see resource section), objects to place on paper.

Instructions: This activity will demonstrate the brightness of the sun in comparison to lights in the classroom. Have students guess how far away the sun is from the earth and then tell them the answer (93 million miles). Have students guess which will develop first--pictures made under ther sun or pictures made under classroom lights.

1. Distribute 2 pieces of photo paper to each student or to groups of two students.
2. Instruct students to place an object on the photo paper and leave the paper on their desks.
3. Take students outside and repeat this process. You will know the process is complete when the paper turns from blue to white.

Have students wash their paper so as to fix the image of their object on the paper.

4. Return to the classroom and observe the first papers. They will probably not be completed yet. It should take quite a few hours for the inside papers to be fully exposed.

Discussion: This activity will demonstrate the brightness of the sun. Discuss the sun and its relationship to the earth, other planets, and other celestial bodies.

Activity 9: Let's Make Waves !

Objectives: 11, 12, 13

Materials: Glass jars, water, cooking oil, blue food coloring.

Instructions: This activity is a good introduction to oceanography.

1. Distribute jars to each student or group of students.
2. Instruct students to fill their jars about 1/3 full with water. Add blue food coloring.
3. Instruct students to fill jars 1/3 of the way with cooking oil.
4. Shake jars and tip them to create waves.

Discussion: This activity can lead to discussions about ocean life, waves and what causes them, environmental concerns (what happens when we mix oil with water as in an oil spill).

LIFE SCIENCE

Life science is the study of plants, animals, habitats, populations, communications, ecosystems and the human body. The following activi-

ties include descriptions of both ongoing and initial activities related to Life Science.

Vocabulary: Habitat, ecosystem, root, stem, seed, plant, nature, adaptation, food chain, natural resource, pollution.

Activity 1: Scientific Scavenger Hunt

Objectives: 14, 15, 16, 17

Materials: Paper bags, worksheet 6, pencils.

Instructions: This activity can be done at any time of the year. Inform the class that they will be scientists on a scientific scavenger hunt. Define scavenger hunt. Inform the class that this is not a regular scavenger hunt. Rather, they will have to be creative thinkers on this adventure. Read aloud each item on worksheet 6, but give no clues as to possible answers. Take the children outside and proceed to discover nature. At this point the teacher may assist students who are having difficulty thinking or writing.

Discussion: Discuss the fact that everything in nature has a place and a reason. For instance, a stick on the ground could be home or food to many creatures. Discuss habitats and ecosystems. Brainstorm for other items that could be included in a scientific scavenger hunt. Stress creative thinking. Remind students of the importance of being a careful observer. This lesson can lead to a unit on Earth or Life Science.

Follow-up Activities: Make a nature mobile out of sticks, feathers, seeds, insect bodies, wood, leaves, bleached bones, cones, and rusty and weathered things to hang in your classroom. Have the students make identification tags for each of the things on the mobile.

Make leaf rubbings or enclose interesting leaves in contact paper to hang in the classroom.

LEA creative writing activity: Create an animal with its own habitat.

Activity 2: Envirolopes

Objectives: 3, 4, 5, 6, 7, 8, 9

Materials: Envelopes for each student or group of two students.

Instructions: (Pre-class) Label envelopes with the words--root, stem, leaf, and plant. Survey the school grounds and find an area relatively free of poison ivy, poison oak, stinging nettles, or other poisonous plants.

Classtime: Distribute envelopes to children or groups of two. Instruct students to find the item written on the front and put the item in their envelope. When everyone has their item, return to the class.

Upon returning to class, instruct students to take their items out of their envelopes. Group students according to their plant part. Instruct the "root group" to display their roots for the class. Repeat with each group, discussing the characteristics of each item. Discuss the characteristics of the whole plant last as that group displays their findings. Finally, instruct students to make their own plant by combining their plant part with another student's part. Stress creativity. Also, stress the fact that each plant must have all three parts in order to be considered a plant. Have students glue or tape their creations onto construction paper and share with the class.

Discussion: Discuss the three parts of a plant and the function of each part. Possible discussion questions include: Why do we need plants? How do plants work? This could lead to a discussion or follow-up lesson

on photosynthesis. Brainstorm foods made of the various plant parts. For example, carrots are roots, what is sugar cane, etc. If possible, have samples for students to taste. Brainstorm other uses of plants and plant parts other than food.

Follow-up Activities: Write an LEA story or poem about a newly discovered plant or about the life of a plant without one of its parts. Have the students make a class book of different kinds of plants found in your area. Label plants using resources from the school library. Make a cookbook of foods made from different plant parts, including flowers.

Activity 3: Growing Classroom Plants

Objectives: 3, 6, 7, 8, 9

Materials: Potting soil, containers such as used milk cartons from school lunches, various seeds, glass or plastic containers, toothpicks.

Instructions: This can be an ongoing, yearlong activity. Lima beans, sweet potatoes and avocados are all easily grown plants.

1. Lima beans: Introduce this activity by reading Jack and the Beanstalk to the students. Give each student two large lima beans, a plastic ziplock baggie, and a paper towel. Instruct students to thoroughly wet their paper towels (providing a squirt bottle will help with spillage), put their beans on top of the towels, fold the towels once, place in baggies, and seal baggies. Label each baggie with the student's name (this can be done before class using masking tape and markers). Have students guess how fast and how tall their beans will grow. Students should check their baggies each day, watering if necessary. Within 2 to 3 days, the seeds should germinate. Plant the seeds by filling milk

cartons with potting soil and planting the seed with the germinated end in the soil. The seed should be covered lightly with soil. Water daily. The plants will grow within a week. Plants can be replanted outside the classroom and the beans can be harvested as they mature.

2. Avocado plants can be germinated by inserting toothpicks in the sides of the seed, using the toothpicks to prop the seed up over a glass or plastic container of water so that the bottom of the seed is slightly immersed in water. The plant will begin to grow roots first and these can be observed through the glass or plastic. As these plants mature, they can be replanted in pots or in the ground.
3. Sweet potatoes can be grown according to the procedure for avocado plants. These plants will turn into vines or they can be replanted by taking a cuttng of the plant and replanting it in a pot or in the ground.

Discussion: Discuss differences between different types of seeds. Discuss the basic necessities for life (water, sunlight, food). This is a good time to teach the beginning concepts of photosynthesis. Possible questions for investigation include: Do bigger seeds make bigger plants? Will plants grow without sunlight? (This can lead to a discussion of the differences between molds, fungi, and green plants.)

Activity 4: Terrific Terariums

Objectives: 1, 2, 13, 14, 15, 16, 17, 18

Materials: Large glass jar or aquarium, sand, crushed clay, pieces of broken flowerpot, loose gravel, charcoal, topsoil, brightly colored stones, plants, a small piece of a rotten log, bottle cap or clamshell.

Instructions: Begin with a clean jar or terrarium. Put about 3 cm of sand, crushed clay, pieces of broken flowerpots or loose gravel in the bottom of the container to allow for drainage. Throughout the drainage material scatter bits of charcoal to sweeten the soil. Add good topsoil to fill the jar deep enough for the variety and expected height of the plants you are planting in the terarium. Place your plants deep enough in the soil for a good start. Do not overcrowd them. Sprinkle the soil with water but do not saturate. For aesthetic value, add brightly colored stones. Complete the microsystem with a small piece of a rotten log (which may add small insect inhabitants to your world). Sink a bottlecap or clamshell into the soil and fill it with water. Cover the terarium opening with a clinging clear plastic wrap. In one week, the plants should take hold and the sealed terarium should maintain itself. Cactus, violet plants, and mosses are good plants to use. This activity is best attempted in early fall or late spring, when plants and mosses are readily available outdoors.

Discussion: First, have children gather plants from fields and woods randomly. Discuss trying to grow plants with very different requirements for light and water together. Discuss the fact that different organisms have different requirements. Decaying organic matter in the soil in the terarium produces carbon dioxide. The plants give off oxygen to be used by small insects. The plants take water from the soil and transpire it back to the air. It then collects on the glass, runs down the glass, and finally soaks, back into the soil. Everything recycles. Opening the seal once a day or once every two or three days will help compensate for imbalances in water and air. Have the children place insects (such as ants) or worms in

their terarium and observe. Relate life in the terarium to social studies ideas of a community environment or habitat.

Activity 5: Fish Tank

Objectives: 10, 16, 17

Instructions: Any pet store can help to set up a fish tank. You can have something as basic as one bowl with a goldfish or a more elaborate aquarium. Consult your local pet store. An aquarium provides a wonderful opportunity for observing an underwater ecosystem. Students can compare and contrast underwater life and terrarium life.

Activity 6: Ant Farm

Objectives: 10, 16, 17

Instructions: Again, most pet stores and department stores sell inexpensive containers for ant farms. All that is needed is sand, the container, and ants. It is easily maintained; the ants need bread crumbs and small insects to survive. Water for the ants is provided within the food that they eat. This is another great opportunity to observe an animal home.

Activity 7: Butterfly Garden

Objectives: 10, 11, 16, 17

Instructions: Gather butterfly cocoons. If necessary, break a branch off a tree or plant; try to disturb the larvae as little as possible. Place the larvae with a few sticks or plants into a glass jar or see-through container with holes punched in the top for air. Observe and within a few days or possibly weeks, the cocoons will open and release butterflies. Place only one or two cocoons in a jar. When the butterflies hatch, release them outside.

Activity 8: Create An Animal

Objectives: 10

Materials: Clay, toothpicks, buttons, yarn, paper, ribbons, etc.

Instructions: Animals have physical features and behave in ways that make it possible for them to live in some habitats, but not others. For example, ducks have webbed feet; wolves have sharp teeth, and bees and anteaters have long tongues. Hold a contest to see who can make the most imaginative creature able to exist in a specific real or imaginary habitat. Instruct each student or group of students to choose a habitat (e.g., pond, forest, apple, the moon) and make an imaginary creature adapted to live there. The crazier the animal the better. Remind the students that the animal must be able to travel; find water, food, and shelter; and, protect itself from predators and weather. After they have finished, ask a few students to explain how their animals survive. Display the creatures in a "Who?" zoo. This activity can be modified by simply having the children draw and color their creations.

Activity 9: Food Chain Game

Objectives: 12, 13, 14, 15, 16, 17, 18

Instructions: Play the Food Chain Game (see Appendix F). Discuss natural resources and have students identify possible and existing misuses of natural resources. Identify types of pollution and their causes and effects. Discuss examples of events in the world today that could affect or upset the food chain (e.g., offshore oil drilling, strip mining, air pollution, water pollution, noise pollution, etc.). Students can make a scrapbook of current happenings in the world that alter food chains.

Follow-up Activities: Write and illustrate an LEA story entitled "What would happen if our food chain was broken?" or write and present a play on this subject.

Engage class or school in a recycling project. Contact local environmental groups for information regarding recycling programs.

GENERAL SUGGESTIONS

The following sections provide suggestions concerning testing, grading, scheduling, and lesson plans.

Behavioral Management

Prevention of behavioral problems before they occur is necessary for successful execution of hands-on science activities. Classroom management is especially important in teaching science due to the delicate nature of some material and experiments. Peterson and Tenenbaum (1985) discuss four general strategies for managing student behavior. Create a Positive Environment, Be Consistent, Plan for Instruction, and Provide Structure Through Scheduling. Each of these is discussed in greater detail below.

A positive classroom environment in which students can feel accepted and respected should be established. Students should be given ample opportunity to experience success. This may occur in several ways during a given science period. For example, students can be allowed to be active participants in science experiments; they can be "helpers" or they can lead their own experiments. Teachers can play an active role by giving verbal praise contingent upon acceptable or on close approximations of

expected behaviors (e.g., "I like the way Matt is handling his materials" or "John is being a good scientist today; he's doing a good job observing and listening"). Emphasis should be on building self-confidence, encouraging students to maintain on-task behaviors, and promoting positive interactions in the class.

Physical space, instructional arrangements, educational materials, classroom procedures, and classroom rules should be given consideration when developing a plan for science instruction. Time needed to setup of materials and cleanup as well as to provide an explanation of procedure is important to build into your lesson/unit.

Classroom rules should be appropriate, easily understood, and consistently enforced. Evertson, Emmer, Clements, Sanford, & Worsham (1984), define consistency as "retaining the same expectations for appropriate behavior in an activity at all times and for all students (p. 99)". Positive classroom rules can assist in establishing consistency. Students should know what is expected of them at all times. Rules about science materials, safety, and appropriate behaviors can be established with student input. Rules should be meaningful to students. For example, the teacher may want to initiate a discussion on the importance of safety when working with potentially hazardous materials to provide students with a realistic, meaningful reason for rules involving safety.

Finally, students should be provided with a daily schedule listing activities that relate to identified goals. Such a schedule reinforces the established structure, routine, and expectations for classroom behavior. When experimenting in science, students should be provided not only with

a schedule of activities to occur during the week, but also during each science period. Many teachers find students are more alert in the morning than in the afternoon. Therefore, it may be helpful to plan intensive science activities in the morning.

Students are more likely to exhibit appropriate behaviors if these strategies are implemented. (Additional strategies for managing surface behaviors observed in the classroom are listed in Appendix G.)

Testing and Grading

Testing: Each unit should begin with a pretest and end with a posttest. This process provides the student with course evaluation expectations. The pretest should include important vocabulary and five to ten of the most important ideas students should know as a result of the unit. Items for the test can be taken from the district or county minimum standards or standards of excellence, depending on the level of students participating in the unit. Items also can be drawn from the Science text used in the school. The form of the pretest can vary. The pretest can be multiple choice, vocabulary, and/or paragraph form ("everything you know about. . . "). The test can be written or oral (tape recorded, etc.).

Grading: Grading can be based on keeping a daily notebook, testing, reports, class participation, and behavior. Each class should start with a daily question written on the chalkboard that students are required to write in their notebooks (the same questions will appear each day for one week). For the first six weeks, notebook requirements should consist only of having a weekly question and a brief description of the week's experiment. Descriptions of the week's activities can be in the form of a picture, graph or short narrative. As the year progresses, students will

become more proficient in keeping a notebook. Therefore, requirements for the notebook should be increased to include experiments written in proper form (scientific method), worksheets, stories, art projects, relevant newspaper clippings, etc.

Teachers should make weekly written comments in each notebook to provide positive feedback on student performance. Success notices sent home also also be awarded upon completion of each unit. (See Appendix H.)

By the second six week period, each child should develop a unit contract (see Appendix I for a sample contract) with the teacher. Contracts include a list of things that will be accomplished by the student (e.g., "I will know _____ vocabulary words by _____ (date)", or "I will keep a notebook consisting of _____"). The student then writes the grade he/she would like to earn for that unit. Teacher, parent, and student sign the contract. The contract should be reviewed at least biweekly. Students can choose from a list of objectives prepared by the teacher. Students should choose what they will do and how they will achieve the grade. Such a contract puts responsibility on the student.

Extra credit reports can also have certain requirements. For instance, students could write from 5 to 10 questions about a topic that they want to investigate/research. Questions can be turned in to the teacher who then schedules a conference with the student to determine how he/she should go about answering the question(s). In order to answer the question(s), the student should be required to write at least 3 sentences that fit together (per question) so that each question will take the form of a paragraph. This may include interviews, film viewing, etc.

Each unit's requirements (e.g., notebook, worksheets, activities, etc.)

should be adapted to the level and needs of the students in the classroom.

Scheduling and Lesson Plans

Scheduling. The weekly schedule should provide time for hands-on activities (experiments) one time per week as well as small group, individual work, and teacher demonstrations in which "helpers" are utilized. The following is a sample weekly schedule:

Monday - Hands-on Experiments and Demonstrations
Pretest, Vocabulary, Brainstorming, Notebooks

Tuesday - Writing Activity (LEA, Haiku, Discuss Vocabulary, Language Master, Write Plays, Word Banks, Independent Work, etc.)

Wednesday - Art Activity or Hands-on Experiment #2. Review Vocabulary

Thursday - Related Math Activities

Friday - Review, Post-test, Games, Finish Incomplete Activities

One field trip per six weeks would be optimal. Students could submit reports of field trips taken with the class (or with parents on weekends) for extra credit. Also, one guest speaker should be scheduled to appear once every six week period

Lesson Plans. Lessons on the proper scientific procedure should occur 2 to 3 times per week for the first six weeks and once per week thereafter. The following is a suggested format for activities or lessons:

Format for Lesson Plans: An Outline

I. Objective

II. Materials

Format for Lesson Plans: An Outline (Continued)

III. Instructions

A. Pre-Class Organization

B. Classtime Instructions--(Be Specific)

IV. Class Discussion (try to elicit responses rather than giving them the descriptions)

A. Provide Examples and Non-examples

B. Ask for Examples and Non-examples

C. Discuss-Review Vocabulary

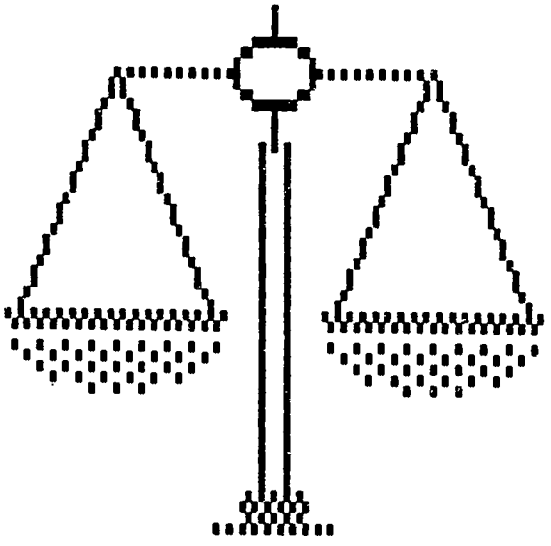
D. Assign Homework

E. Have Follow-up Activity Planned (for those who finish early)

WORKSHEETS

The following worksheets were referred to in the body of this monograph and may be duplicated for teacher use.

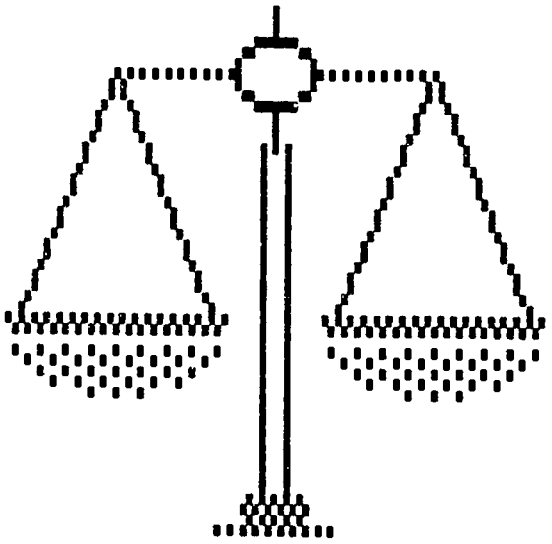
WHAT ARE THE MATHEMATICS OF A GRANOLA BAR?



DATA SHEET

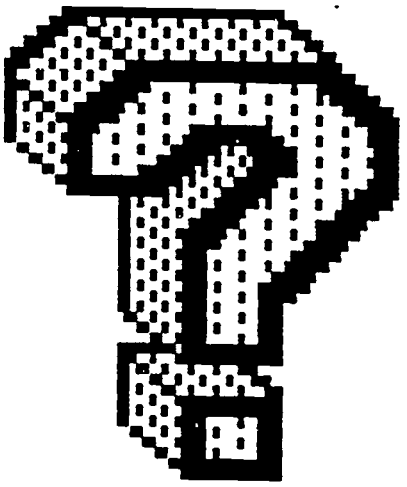
GUESTIMATES		ACTUALS
_____	1. LENGTH	_____
_____	2. WIDTH	_____
_____	3. HEIGHT	_____
_____	4. NUMBER OF RAISINS OR CHOCOLATE CHIPS	_____
_____	5. WEIGHT	_____

WHAT ARE THE MATHEMATICS OF AN ORANGE?



DATA SHEET

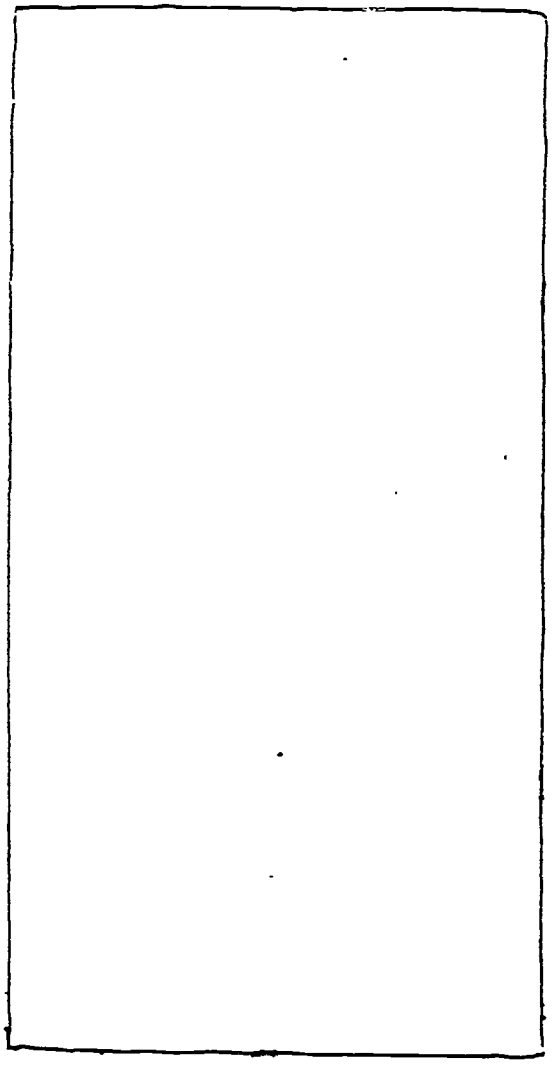
GUESTIMATES		ACTUALS
_____ 1.	NUMBER OF SEEDS	_____
_____ 2.	CIRCUMFERENCE	_____
_____ 3.	SINK OR FLOAT	_____
_____ 4.	NUMBER OF SECTIONS	_____
_____ 5.	MASS	_____

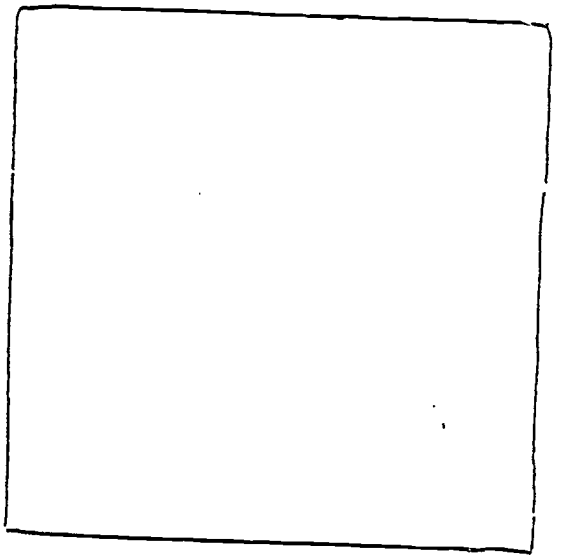


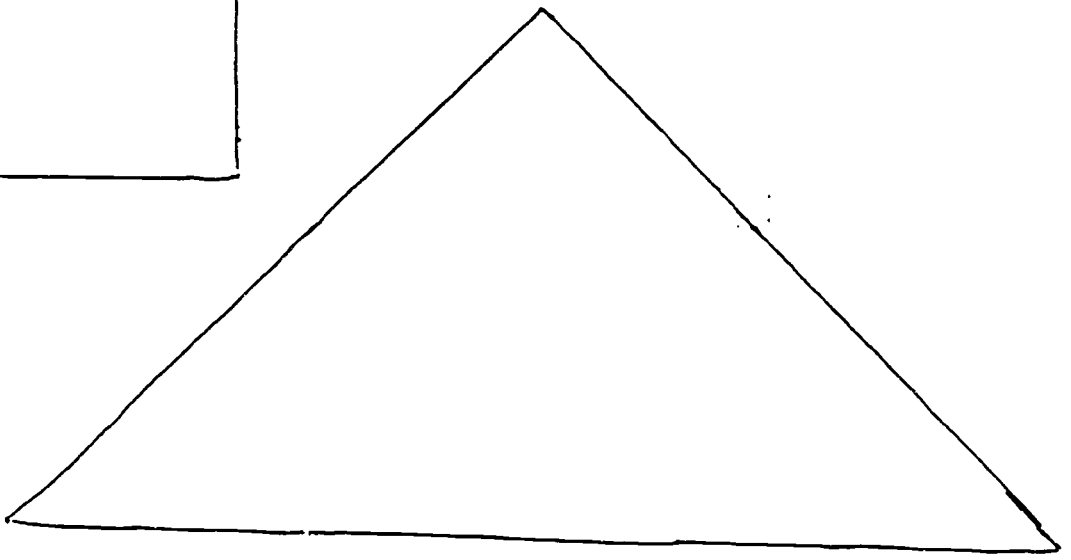
POPCORN PREDICTION

Guess how many popcorn kernels will fill the shape below. Write your guess on the line labeled guess. Then fill in the shape with popcorn kernels. Count the number of kernels needed to fill each shape. Now write the actual number on the line labeled "actual". See how close your guess is to the real thing, then enjoy eating your popcorn (after it is popped of course)!

Teachers may find the following shapes useful for the Popcorn Prediction activity. Individual shapes may be cut and attached to Worksheet 3. Worksheet 3 can then be duplicated for use with students.



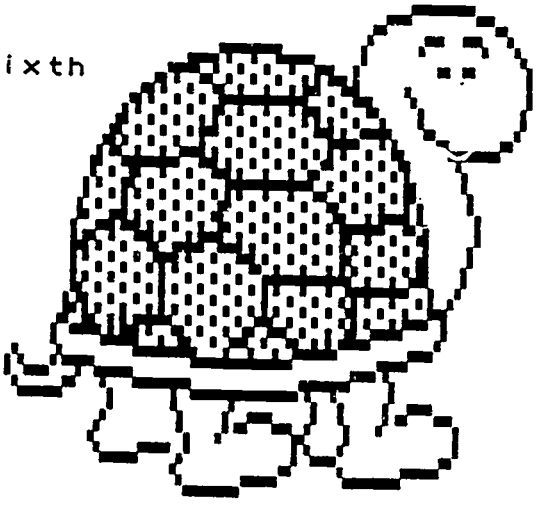




SCIENTIFIC SCAVENGER HUNT

FIND...

1. An animal that has its own oars.
2. A forest dining table.
3. Togetherness.
4. An insect's apartment.
5. Something invisible.
6. A traveler without feet.
7. A highway in nature.
8. A tree that would be in sixth grade.
9. An interesting example of nature.



ACID OR BASE?

SUBSTANCE	ACID	BASE

FINGERPRINT FUN!

Trace one of your hands on this page. Press your fingertips, one at a time on an ink pad. Then make a fingerprint of each finger in the proper space on your hand. Examine your prints with a magnifying glass. Notice the patterns. Compare your fingerprints with a friend's. Notice that every person's fingerprints are different. How are they different? Are any of them similar?

CONCLUSION

Each of the activities and ideas presented in this monograph has been used successfully with various age groups and exceptionalities. However, the teacher must decide and use those activities best suited for his or her students and teaching objectives. As mentioned earlier, the activities presented were designed to represent exercises in each of the four areas of science: observation and measurement, physical science, earth science and life science. Clearly, there are many topics to be explored within each area. Appendix J provides a list of resources teachers may find useful in planning these or other science activities. Hopefully, the activities included in this monograph will motivate both teachers and their students to more fully explore these basic areas of science.

REFERENCES

Clements, B., Emmer, E., Evertson, C., Sanford, J., & Worsham, M. (1984). Classroom management for elementary teachers. Englewood Cliffs, NJ: Prentice-Hall.

Peterson, S., & Tenenbaum, H. (1985). Behavior management: General strategies and specific techniques. (Monograph 7). The Multi-disciplinary Diagnostic and Training Program (MDTP), Gainesville, FL.

APPENDIX A

Science Objectives

GENERAL OBJECTIVES

The activities presented in this monograph were designed to meet one or more of the following objectives. Objective numbers are listed for each activity.

1. Describe orally or in writing a sequence of events occuring in a science activity or investigation.
2. Distinguish between scientific fact and opinion related to a problem.
3. Interpret cause and effect relationships within a scientific problem-solving situation.
4. Apply appropriate questions when a problem is stated.
5. Propose alternative strategies to the solution of a problem.
6. Select appropriate alternatives based upon information gathered in a problem-solving situation.
7. List the steps of the scientific method and explain why scientists use this method.
8. Extract important ideas from reading, listening, watching or participating in an activity.

Observation and Measurement

1. Identify figures as two or three dimensional.
2. Accurately describe an observation made using all senses.
3. Distinguish between qualitative and quantitative observations.
4. Describe an object using qualitative and quantitative descriptions.
5. Distinguish between observation and inference.
6. Identify observations that support an inference.

7. Sort a set of objects according to similarities and differences.
8. Describe orally or in writing a sequence of events occurring in a science activity or investigation.
9. Observe and describe changes.
10. Select an appropriate tool for measuring various physical properties of objects.
11. Record measurement using appropriate scientific notation.
12. Predict the outcome of an event based upon previous observations.

Physical Science

1. Define solid, liquid, and gas.
2. Define matter.
3. Name the colors of the spectrum.
4. Explain the relationship between light and color.
5. Investigate the properties of magnets.
6. Recognize the properties of magnets in terms of polarity and relationship to various metals.
7. Develop an understanding of density.
8. Develop an understanding of surface tension.
9. Define crystal.
10. Develop an understanding of acids and bases.

Earth Science

1. Identify the three layers of the earth and some of their properties.
2. Describe processes of rock formation.
3. Name examples of each rock type.
4. List uses of rocks.

5. Identify how the igneous, metamorphic and sedimentary rocks are formed.
6. Develop an understanding of how clouds are formed.
7. Develop an understanding of cloud types and their relationships to weather.
8. Recognize that both air and water have weight, exert pressure, and occupy space.
9. Develop an understanding of constellations and other celestial bodies.
10. Recognize the relationship of individuals to the rest of the universe.
11. Identify ways in which people benefit from the ocean.
12. Identify renewable and nonrenewable natural resources.
13. Describe how one is a consumer of the various natural resources.

Life Science

1. List the requirements necessary for life, as we know it.
2. Identify characteristics of living and nonliving things.
3. Identify the functions of each plant part (root, stem and leaf).
4. Identify the uses of plants (other than for food).
5. Classify common foods obtained from plants as roots, stems, leaves or fruit.
6. Describe how plants grow and change.
7. List factors that affect plant growth.
8. Describe how plants are adapted to their environments.
9. Describe protective devices of plants for survival.
10. Relate animal adaptations to specific habitats.
11. Identify stages in an insect's life cycle (e.g., egg, larva, pupa [nymph], and adult).

12. Construct a food chain.
13. Compare the importance in an ecosystem to each of the following: soil, water, air, sunlight, temperature, producers, consumers, and decomposers.
14. Discuss attitudes which contribute to living in harmony with the environment.
15. Describe the role of each individual (both directly and indirectly) on the quality of the environment.
16. List factors that can affect an ecosystem.
17. Define ecosystem and habitat.
18. Become familiar with examples of occupations that are primarily concerned with the study or control of specific environments.

APPENDIX B

Safety Rules

SAFETY

The following guidelines can aid the teacher in maintaining a safe science classroom:

1. Perform activities yourself before assigning them to students.
2. Arrange the classroom in such a way that equipment and supplies are easily accessible to students during science activities. Carefully store equipment not in use.
3. Review procedures, safety rules, and clean-up procedures with students prior to each science activity.

The following general safety rules should be emphasized to students before any laboratory work is done. They should also be reviewed periodically.

1. Always obtain your teacher's permission before performing any activity.
2. Always understand an activity thoroughly before beginning any part. If you do not understand something, ask your teacher to explain it.
3. Check glassware for chips or cracks prior to using.
4. Only dispose liquid material in the sink.
5. Always be cautious when using cutting instruments.
6. Always clean your workspace when finished. Return all materials to their proper places.
7. Always use proper containers and utensils for chemicals. Always use protective gloves when working with chemicals.
8. Always keep chemicals away from your face and mouth.
9. Dispose of unused substances as instructed by your teacher.

10. Always clean up spills immediately. Use plenty of water.
11. Keep aisles free of equipment, books, etc. Always walk in the classroom during ongoing science activities.
12. Always know the location of the fire extinguisher, fire alarm, and the nearest telephone. Know how to use them.
13. Report any accident or incorrect procedure to your teacher immediately.
14. Always tie back long hair and wear clothing with sleeves that will not interfere with experiments.

Science activities are safe to perform if you are careful. You must take responsibility for both your own safety and the safety of your classmates.

APPENDIX C

Materials

MATERIALS

The activities included in this monograph are designed so that simple materials can be used. All the materials are available locally and many are available within the school Science Department. Consumables will need to be replaced each school year. Following is a list of the basic equipment and supplies needed for activities included in this monograph.

Nonconsumables:

Plastic funnel
Magnifying glasses
Jars with lids (large and small)
Magnets
Rulers
Aluminum pans (large and small)
Paper clips
Scissors
Measuring spoons and cups Cork
Measuring tapes
Needle
Mixing bowls
Prism
Weights and balances
Tape recorder
Popcorn popper
Eye droppers
Hot plate or other heat source

Consumables:

Zip lock plastic bags
Modeling clay
Pepper/Salt
Food coloring
Liquid starch
Construction paper
Potting soil
Sandpaper
Paper cups
Wax paper
Paper bags
Cotton
Pencils/Pens
Baking soda
Dish washing detergent
Ammonia
Glue
Newspaper
Seeds and beans
Paper cups
Paper towels
Paint
Straight pins
Envelopes
Ink pads
Markers/Crayons
Charcoal
Laundry bluing
String
Nails, screws
Cardboard
Sugar
Toothpicks
Vinegar
Matches
Cooking oil
Pine cones
Rock fragments

APPENDIX D
The Scientific Method

STEPS OF THE SCIENTIFIC METHOD

STEP 1: STATEMENT OF THE PROBLEM

The problem is often worded in the form of a question. For example, "Which brand of popcorn pops the most?"

STEP 2: GATHER INFORMATION

Use observation to help collect all the facts you can find that have to do with the problem. Try to use all your senses. Scientists also read and learn from other scientists in order to gather information.

STEP 3: HYPOTHESIS

This is an educated guess made as a result of putting together all the facts that have been gathered.

STEP 4: EXPERIMENT

This is when you set up a test to tell if your guess was correct. When experimenting, it is important to follow each step of the procedure. You must always use the exact amounts of things written in the directions. You must write down or record in some way the results of what happened in the experiment. The results from an experiment are called DATA.

STEP 5: CONCLUSION

This is when you look at your results or the data from the experiment and answer the question asked in the statement of the problem.

APPENDIX E

The Language Experience Approach

U of F Multidisciplinary Diagnostic and Training Program

Handout #16

Language Experience Approach

The Language Experience Approach (LEA) integrates the development of reading skills with the development of listening, speaking, and writing skills. It is a unique approach in that it is based on the child's own thoughts and experiences. Basically, the child dictates the story to the teacher who writes them down. The child then reads the story that he/she has "written". There are several different ways to elicit the stories. Action picture cues can be used. The child's task is to "tell a story about what is happening in the picture". Topics can be used as stimuli. These topics should be directly related to the child's experiences, for example, a recent field trip, reports of experiments, or news events. Experience is an important factor. The teacher should provide experiences (e.g., discussions, field trips, films) for the children to talk and write about. In addition, picture dictionaries, simple reading word cards, labels on classroom objects, and lists of important or topical words should be available to stimulate ideas and extend the student's story telling and writing and reading vocabularies.

The stories can be done individually or in a group. In the group stories, each member of the group takes a turn at telling a line in the story. This also facilitates the child's ability to stay on topic in speaking and to follow the line of thought.

The Language Experience Approach can also be used for writing creative stories. It is suggested that the child (or group) have the opportunity to tell the story before they write it. For children who have difficulty in creative writing, it has been helpful to give them a specific number of thoughts that need to be told and then written in the story.

In the story-telling, reading, and writing activities, the teacher can modify and discuss word choice, sentence structure, and the sounds of letters and words. Specific skills such as capitalization, punctuation, spelling, grammar, and correct sentence structure can be taught as needed and as appropriate in the story telling and writing.

The motivation and interest of the children is usually higher when they create the material themselves. Progress can be evaluated in terms of the student's ability to express ideas in oral and written form and to understand the writings of his peers. The children can actually bind their stories in a folder then trade them with other students. Each child is encouraged to proceed at his own rate. Progress or growth in writing mechanics, spelling, vocabulary, sentence structure, and ideas will be evidenced in the student's written work.

The Language Experience Approach can be used with beginning readers, in the intermediate grades, or with older students for corrective instruction and motivation. It is suggestd as a supplement to the other reading and writing programs being utilized in the classroom.

References

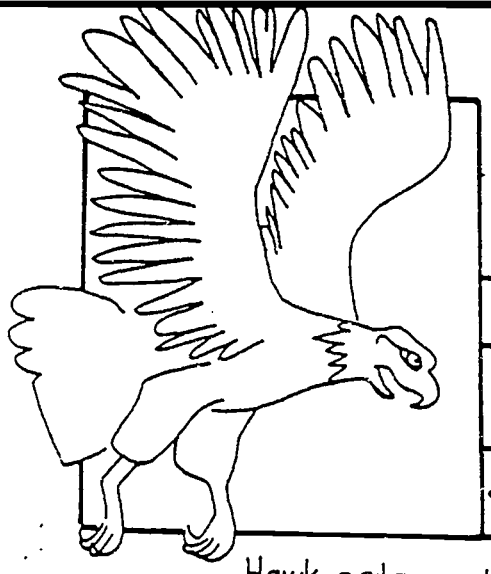
Roach, Van Allen, & Claryce, Allen (1982). Language Experience Activities, Second Edition. Boston, MA: Houghton Mifflin Company.

Mercer, C., and Mercer, A. (1981). Teaching Students with Learning Problems. Columbus, OH: Charles E. Merrill Publishing, Co.

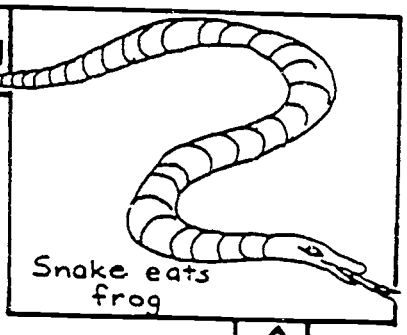
APPENDIX F

The Food Chain Game

FOOD CHAIN HOW PLANTS AND ANIMALS ARE LINKED TOGETHER BY NEED FOR FOOD

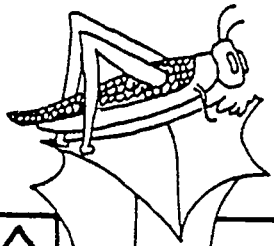


Hawk eats snake

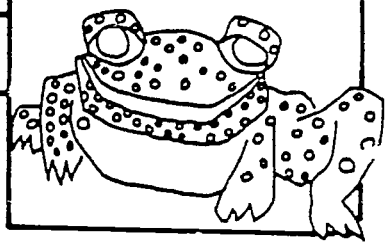


Snake eats frog

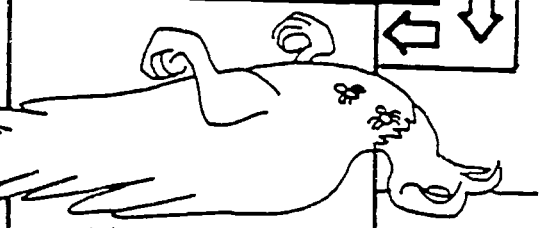
Insect eats plant



Frog eats insect

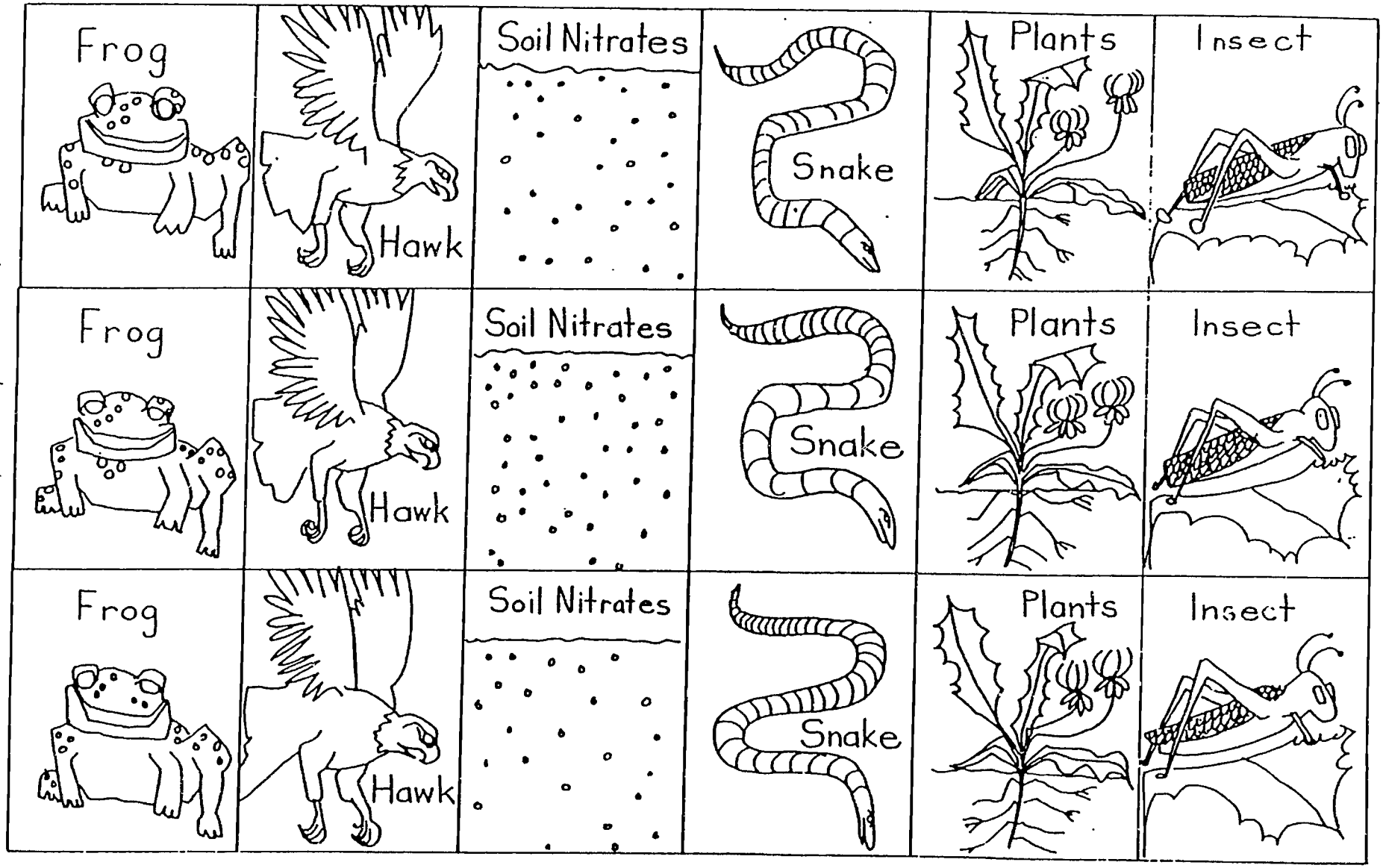


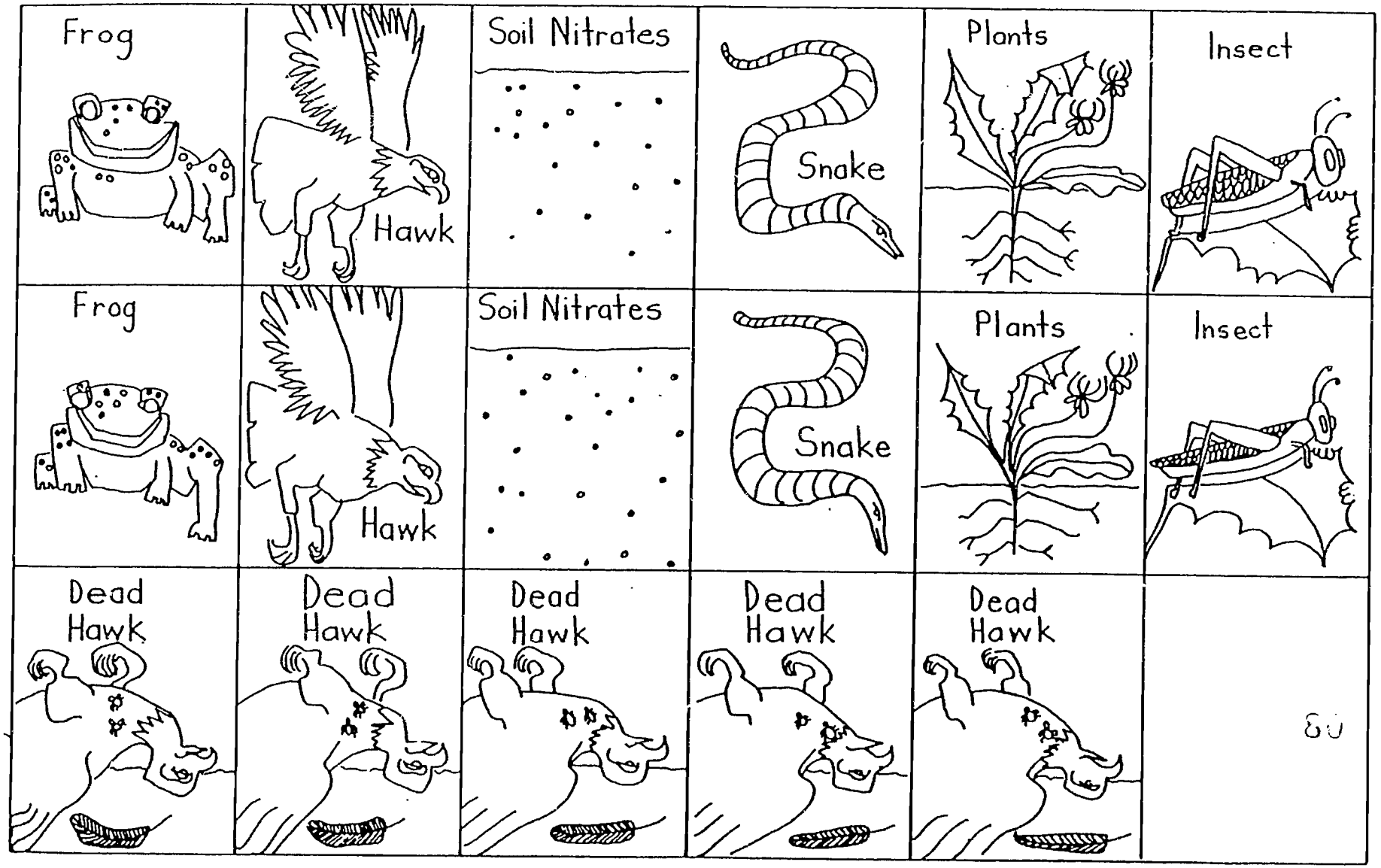
Plant uses Nitrates in taking in certain materials from soil



Dead hawk rotted or eaten

Nitrogen compounds in decomposed (rotted) animals are changed into NITRATES that plants can use.





APPENDIX G

Surface Management Techniques

SURFACE MANAGEMENT TECHNIQUES[1]

1. Planned ignoring: This occurs when the teacher intentionally ignores a behavior, believing that it will decrease. Ignoring is especially potent with students who are trying to "bug" the teacher or gain attention. One problem with using this technique is that while the teacher may be able to ignore the behavior, the rest of the class may not. Ignoring others' inappropriate behavior may, therefore, be a good topic for class discussion and should be reinforced by the teacher when it occurs. Aggressive behavior may be difficult to ignore in that it falls in the "reality dangers" category and the teacher may have to select another technique which is more protective of the student and others.

2. Proximity control: The close physical presence of the teacher is sometimes sufficient to enable a student to regain control. Nothing needs to be said at this time and the teacher does not necessarily need to look at the student. Teacher mobility in the classroom can go a long way toward classroom management. Many teachers have found that they cannot run a classroom sitting at their desks.

3. Signal interference: These are cues or signals from the teacher that communicate disapproval to the student. These signals include coughing, clearing your throat (the student may just think you have a cold, though!), frowns or staring. This technique is best used during the initial stages of the misbehavior and is most effective with students that have a preestablished positive relationship with the teacher.

4. Interest boosting: Many aggressive incidences have occurred when a student's interest in his/her work has declined and restlessness and boredom has set in. When a teacher spots this happening, he/she can engage the student in conversation about something in which the student has an interest. It is felt that doing this breaks into the

[1] These techniques have been drawn from Conflict in the Classroom, Long, Morse and Newman, Wadsworth Pulishing Co., Inc., Belmont, California, 1971.

cycle of boredom/restlessness leading to acting out, and enables the student to settle back into his/her work. Another variation of this technique is for the teacher to go over to the student and display an interest in the work itself.

5. Tension decontamination through humor: A well placed joke at a tense time can do a lot to relieve a tense situation. This shows that the teacher is human and also feels secure enough in his/her role to joke at a time when many teachers get uptight. Sarcasm should be avoided as it usually contains negative connotations about an individual.

6. Hurdle lessons: As was mentioned earlier, aggressive behavior occurs frequently due to the student experiencing difficulty with classroom assignments. Many students exhibit appropriate behavior at this point by asking for help or skipping over to the next problem. Unfortunately, some students do neither and their frustration turns into pestering behavior or outright explosions. The teacher can be helpful in getting the student back on task by solving the real problem with the student. The teacher must notice the early signs of frustration in order for this approach to work.

7. Restructuring the classroom program: "Restructuring is appropriate when it is necessary to drain off high tension or emotion in the classroom. The technique is, as its name implies, simply a change of plan, format, task, or location based on perceived need to drain off tension or high emotion." Restructuring can occur with one student or with the whole class, depending on the situation.

8. Support from routine: The benefits of structure, consistency, and predictability have been discussed earlier. Having an established routine can minimize classroom misbehavior. One common example of problems occuring due to the breakdown of routine is the day before vacations. Everybody is excited and no one really wants to be at school. The teacher feels the same way and tries to ease through the day; the result may be somewhat chaotic.

9. Direct appeal to values: When intervening with a child the teacher can appeal to the student's values in a variety of ways. The teacher might: a) appeal to the relationship of the teacher with the child, for example, "You seem angry with me. Have I been unfair with you?" b) appeal to reality consequences, for example, "I know you're angry, but if you break that aquarium, the fish will die, and you'll have to replace it with your own money," c) appeal to a child's need for peer approval, for example, "Your classmates will be pretty angry if you continue to interrupt them and correct them," d) appeal to the child's sense of the teacher's power of authority, for example, tell him that as a teacher you cannot allow his behavior to continue, but that you still care about him, and e) appeal to the child's self-respect, for example, "I know you'll be mad with yourself if you tear up that paper you worked on all period."

10. Removing seductive objects: When students bring personal property to school this can cause problems. Usually these objects are not related to school work and they claim the attention of other students. Besides being distracting, there is always the problem of another student breaking or somehow being destructive to the object and promoting a fight. Sometimes a student merely touching another student's property can trigger an incident.

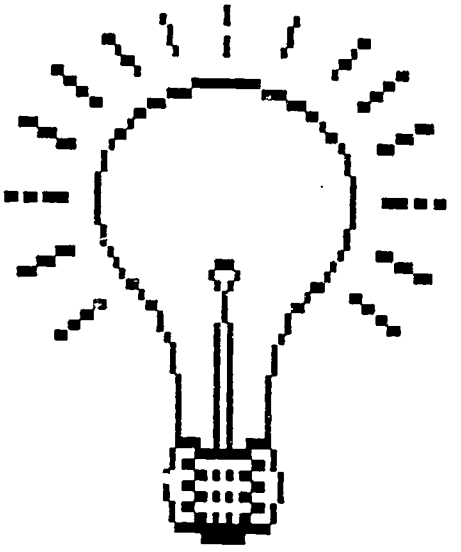
11. Antiseptic bounce: When the student's behavior has gotten to the point where verbal controls may not be effective, the teacher can send the student out of the room. This is a non-punitive action, and the student is simply asked to deliver a message to the office, to get a drink of water, or borrow something from another teacher, etc. This allows the student to save face and avoids a possible serious flare-up.

12. Physical restraint: When a student exhibits aggressive behavior that might cause physical injury to himself/herself or others, it may be necessary to restrain that student.

APPENDIX H

Success Notices

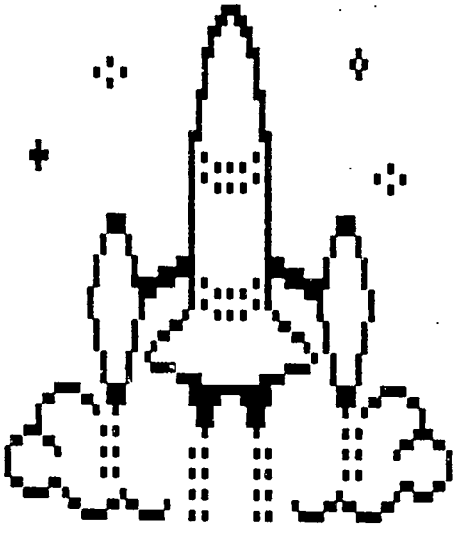
_____



IS A SCIENTIST WITH BRIGHT IDEAS!

_____

HAS

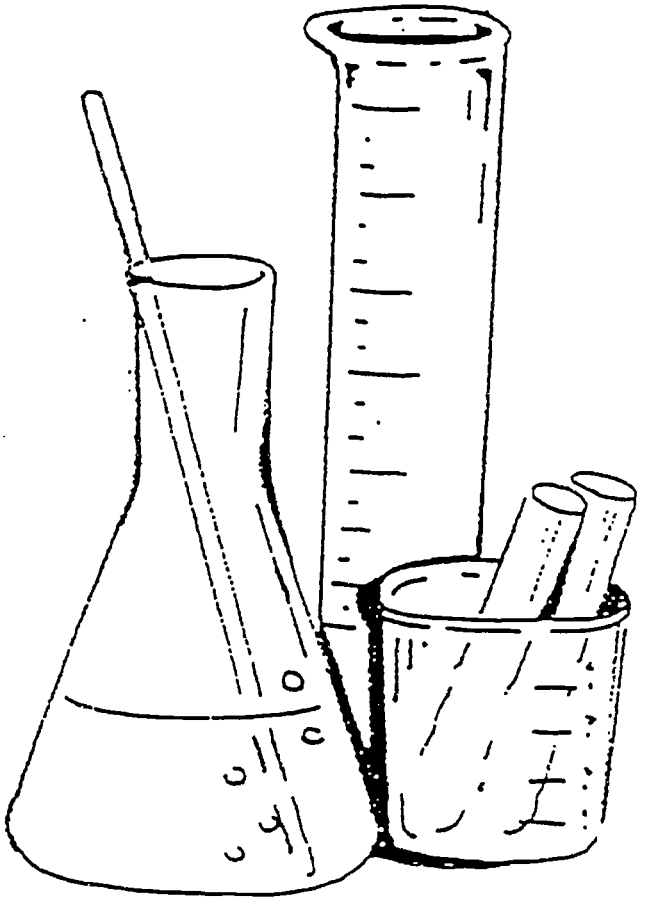


BLASTED OFF INTO THE WORLD OF SCIENCE!

_____

is an

Observant Scientist!



_____ _____

Teacher Signature Date

CERTIFICATE OF RECOGNITION

This is to recognize

_____

as a SUPER SCIENTIST

for

having a Positive Attitude about Science,
having good Observation Skills,
Predicting Outcomes and
Solving Problems.

85

90

_____ _____

Teacher Signature Date

APPENDIX I

Contingency Contract

OFFICIAL CONTRACT

Beginning Date _____
Ending Date _____

Student: I agree to

_____

_____

for a grade of _____ .

Signed: _____

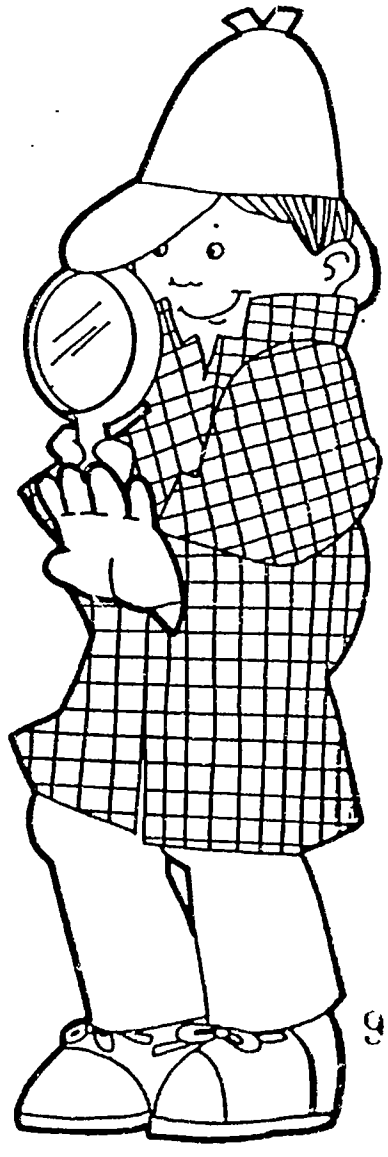
Teacher: I agree to

_____

_____

Signed: _____

Parent Signature: _____



APPENDIX J

Teaching Resources

TEACHING RESOURCES

The following resources and information may prove useful in planning and implementing science activities in the classroom.

1. Creative Science: Ideas and Activities for Teacher and Children, (2nd Ed.) by Alfred Deirto and Gerald H. Krockover.

This is an excellent source of field tested science activities and ideas for use in elementary school classrooms.

2. Nuts and Bolts: A Matter of Fact Guide to Science Fair Projects by Barry Van Deman and Ed McDonald.

This is a well illustrated, well-designed paperback book on science projects. It provides direction for choosing a topic, stating a purpose, doing library research, taking notes, collecting materials, experimenting and measuring, drawing conclusions, writing a report, preparing an exhibit and presenting a project to judges. The writing is creative and readable for sixth through twelth graders. This book can be adapted and used with elementary students. Teachers and parents can obtain ordering information from The Science Man Press, TSM Marketing, Inc., 4738 North Harlem, Harwood Heights, Illinois, 60656.

3. You, The Investigator by Bea Green and Sandi Schlichting.

This book is recommended for use with fourth through eighth grade students. It provides a simple presentation on how to do a science fair project. It is a guide for students working in the classroom or at home. Ordering information can be obtained by writing to Idea Factory Inc., 10710 Dixon Drive, Riverview, FL 33569.

4. Day by Day: 300 Calendar Related Activites, Crafts and Bulletin Board Ideas for the Elementary Grades edited by Bonnie Bernstein.

This book contains field tested ideas and activities dealing with science as well as math and language. Teacher can obtain order information from David S. Lake Publishers, 19 Davis Drive, Belmont, California 94002.

5. Discover Wildlife in Your World is an educator's guide published by the National Wildlife Foundation.

The publication includes stories, games, and activities for students in grades K-12, as well as references and resources for teachers. Ordering information can be obtained by writing to the National Wildlife Federation, 1412 16th Street, Northwest, Washington, D.C. 20036-2266.