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ABSTRACT

This report documents a program for improving science knowledge, attitudes, and higher order thinking skills through experiential science. The hands-on approach used successfully in the program is described, and evidence of student improvement is also presented. The targeted population consisted of students in the first, third, and fourth grades in a single unit district in two rural, middle class communities, located in central Illinois. The problems addressed were evidenced by teacher observation, test scores, anecdotal records, and student surveys. Analysis of probable causes through research literature revealed a lack of teacher training in experiential science, current testing tools not coordinating with teaching methods, and teachers not being given necessary time to plan and prepare appropriate science activities. In addition, teachers, administrators, and community were unwilling to change from content-oriented teaching to hands-on methods, as well as content-oriented textbooks and curriculum not offering hands-on activities to substantiate experiential learning. Also, constraints on supplies and money hindered implementation of hands-on science. Furthermore, technology required to implement hands-on science activities was still in its infancy. Test scores, teacher observations, and anecdotal records indicated a lack of scientific knowledge and procedures, and limited enthusiasm for the subject area. A review of solution strategies suggested by literature, combined with an analysis of the problem, resulted in the selection of the intervention: a program implementing a hands-on science approach. Post intervention data indicated an increase in students' knowledge and the use of higher order thinking skills. Researchers also noted an improved attitude toward science. Appendices include surveys and tests used by the researchers and classroom materials. (Contains 25 references.) (Author/WRM)

IMPROVING STUDENTS' KNOWLEDGE AND ATTITUDES OF SCIENCE THROUGH THE USE OF HANDS-ON ACTIVITIES

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This report described a program for improving science knowledge, attitudes, and higher order thinking skills through experiential science. The targeted population consisted of students in first, third, and fourth grades in a single unit district in two rural, middle class communities, located in central Illinois. The problems addressed were evidenced by teacher observation, test scores, anecdotal records, and student surveys.

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CHAPTER 1

PROBLEM STATEMENT AND CONTEXT

General Statement of the Problem

Children who have participated in experiential science units at the elementary level display enthusiastic learning, transfer of knowledge, and higher order thinking skills. Hands-on science incorporates the multiple intelligences, as well as creates ownership for individual students. These behaviors are evidenced by better retention of knowledge indicated by higher test scores.

Units without developed hands-on activities do not create this same environment. Evidence of this situation is reflected through test scores, teacher observation, anecdotal records and through student surveys.

The classrooms targeted include two fourth grade classrooms at site A, a first grade, a third grade, and a fourth grade classroom at site B. These two sites are part of the same district.

Local Context of the Problem

Site A

The targeted school is part of a unit district in a small midwestern city. The sole public elementary school serves the city as well as the largest pre-kindergarten through grade four school in the county. The school was established in 1910. Four building additions have been added to meet the current enrollment of 500 students. The school is now considering another addition to meet increased population and technical needs of its students. This school is organized into self- contained classrooms.

The average class size is 22 students. The racial ethnic background is 97.8% White, 1.2% Hispanic, and 0.6% Asian/Pacific Islander and Native American (American Indian/Alaskan Native), and 0.4% African American. Low income students number 19.0% of the total student body. Student attendance is 96.4% while the student mobility rate is 15.5% (School Report Card, 1996).

The primary mission of the school is to provide learning success for all students through a variety of programs. There is a gifted program with part-time coordinators and an at-risk program. There is daily instruction for students in physical education for grades one through four. The students in grades one through four also have music instruction twice a week and have the library facility scheduled twice a week. A fully staffed library is available for all students and faculty. A Title I Reading Program is available to meet student needs. A teacher assistance program has been implemented to assist students with problems in areas of health, behavior, academics, and attendance. A peace maker program is implemented to modify playground behavior. A wide range of educational classes are offered including programs for learning disabilities, physical therapy, speech, early childhood education, Headstart, Bright Beginnings, and a program servicing at-risk preschoolers.

The targeted school employs over 30 people to provide quality instructional support to the students. Eighty-three percent of the educational staff is certified. Staff development classes are offered to teachers for college credit. A principal administrates the building.

Site B

The targeted elementary school is in a small midwestern village, part of a 113 square mile unit district. It houses approximately 70 students, grades one through four, in five self-contained classrooms. These students feed into the district middle school and high school. The half-day kindergarten for the school is located in a neighboring village.

One hundred percent of the students are White. Low-income students comprise 23.9% of the student population. Student attendance is 95.5%, while student mobility is 27.8%. The average class size of the targeted school is 16 students (School Report Card, 1996).

The school at Site B employs approximately 12 people who provide quality instructional support to the students. The five classroom teachers include a half time special education instructor. In addition, a music educator provides instruction twice weekly, and a speech therapist offers intervention several hours per week. A Title I reading teacher aids students on a daily basis. The librarian staffs the library two half days each week and instructs students there. A social interventionist works with individual children, as well as their families when needed. The principal administrates this building, as well as the building in the neighboring village.

The building of the Site B school is an old two story remodeled brick structure, built originally as a community high school in 1920. It became an elementary school in 1947. Many parents and grandparents of the present students attended elementary school and/or high school at this location.

District

The primary mission of the school district is to provide learning success for all students. Emphasis is placed on creating an effective school climate by positive, caring reinforcement of each student's efforts, a business like atmosphere with learning as the important business, as well as a neat attractive, well maintained physical environment. There are also well defined priorities for teaching and learning and explicit standards for behavior. The parents are involved in the life of the school. This is a building-based educational program.

The unit district is made up of three elementary schools, a middle school, and a high school. The high school and middle school have an average enrollment of 500 students in each building and provide a quality education with competitive college prep courses. Approximately 80% of the district's graduates enroll in some form of higher education upon graduation.

The pupil/ teacher ratio for the elementary buildings is 21.3:1. The average teaching experience is 14.5 years, while 48.1% of the teachers hold a master's degree and above. An average teacher's salary is $36,636, while the average administrator's salary is $57,589. The district's operating expenditure per pupil is $4,110 per year, significantly lower than other schools in the state (School Report Card, 1996).

The curriculum of the school has an objective based approach. Content areas include fine arts, language arts, mathematics, physical education, science, and social studies. Each content area has objectives that are grade level oriented. Every content area has a primary resource to aid in teaching toward the objectives. Often a secondary resource is utilized to provide reinforcement. The curriculum is constantly being reviewed and/or revised in an effort to provide the students with the most relevant instruction possible. Fine Arts is a current area of focus. A fine arts committee has supplied a textbook for each teacher that provides ideas and art projects that enrich education in the fine arts. Other educational opportunities include dance, drama, and art. The fine arts projects are recognized during various times of celebration.

Teachers and administrators make curricular decisions with parental input in the form of a Citizen's Advisory Committee (CAC). Experienced teachers have developed local assessments in each content area, which include Criterion Reference Tests (CRT), used to correlate curriculum to students' learning.

The State Board of Education has conducted an educational audit of the schools. An evaluation of the data has indicated that this school has met and exceeded the requirements.

Community A

The city was settled by a religious sect from Kentucky. They were interested in farming, religion, and education. A church was organized in 1832, followed by an academy in 1848. The academy later became a liberal arts college, which is still part of the community today. This college is the alma mater of President Ronald Reagan. This city is the county seat with the courthouse located in the city square. Across the street is a small modern community hospital providing medical services to the communities in the surrounding area.

The community is made up of 46% German heritage and is 94% Caucasian. The community has 4,306 inhabitants. It offers many newer subdivisions for those who wish to live or build a home in a more rural setting. The community is located midway between two large metropolitan areas. The nearby cities provide educational and cultural facilities, a public funded junior college, several universities, large scale hospitals and a variety of retail services.

The median household income is $33,964. The two area nursing homes, the local hospital, a large trucking firm, and two major car dealerships are the main sources of employment. Many residents travel to the cities for other employment. Farming and farm related businesses are still major sources of employment. A variety of local medical and retail services are available.

City hall has a staff consisting of the mayor, city clerk, treasurer and a full time city administrator. The police department has four full time police officers. It has 25 volunteer fire department persons trained in emergency rescue techniques.

The area churches reflect the attitudes and beliefs of many varied denominations. Some churches have existed as long as the town itself, while others are new congregations. All share in the mission of caring for the spiritual needs of the community. An example of this mission is a house for the homeless that churches have sponsored and built together.

Communication between the school and community continue to be an issue of concern. Efforts to improve this are made by publishing school news and information in the local weekly newspaper and in a district newsletter. Efforts are also being made to invite the community to school functions and to utilize the expertise and talents of the community. Teachers are encouraged to take an active part in community affairs and be available to be utilized for non-school functions.

Wide community use of facilities includes many school functions in addition to youth sports activities, local scouts, a PTO carnival, adult recreation and local church activities. These activities foster a school/community partnership.

Community B

The village community of Site B was established in 1888 with the arrival of the railroad. Area cattlemen requested the railroad company to build siding and stock pens so that cattle could easily be shipped from the area. Businesses soon began to serve the growing agriculture community. Shortly, following the development of the village, the religious community was founded. Education was of primary importance to the early settlers of this community. In 1894, a petition was circulated on behalf of the public school. The first one-room schoolhouse was built that same year.

The village of about 450 residents is nestled between two large cities. Four small agricultural related businesses employ some community people. However, the majority of the people travel to the two nearby cities for work. The community is comprised of 100% Caucasian individuals of the median age of 34.8. Household income averages $33,333. Two unique aspects of this small rural community are a volunteer fire department established in 1954 and a community library begun in 1978.

Strong religious ties, with their roots in the late 1800s, continue to play an important role in the community. These ardent religious values have a direct impact on the school. These values are demonstrated by parents' attendance and participation in school related events. Parents express genuine interest and concern for the welfare of their children. This commitment enhances the community and school of Site B.

National Context of the Problem

The need for improving the way science is taught in the elementary school is well documented (Spickler, Hernandez-Azarraga, & Komorowski, 1997 as cited by Maben, 1973; Mechling & Oliver, 1983; Mullis & Jenkins, 1988; Tilgner, 1990). According to Lederman (1996), "The problem is easily traced to the poor training of primary school teachers, but also to constraints on supplies, preparation time, and above all, professional development." Early in the twentieth century John Dewey recognized that children needed first-hand experiences to learn (Broman 1982 as cited by Stooksberry, 1996). Currently the National Science Education Standards call for teachers to plan an inquiry-based science program for their students. Results of the National Education Goals Report (1994) reflected the following:

> In 1990, most students were not receiving the kinds of instruction needed to apply science ideas outside of the classroom, such as conducting and writing up science experiments, using computers, or producing oral or written science reports. Moreover, many teachers reported that they did not have adequate facilities or supplies to pursue these types of instruction.

Focus needs to be on direct scientific inquiry in a cooperative, problem-solving environment (Bruder, 1993 as cited by Christensen, Jones, Knezek, Moore, & Southworth, 1996). Hands-on science is the name of the student-centered approach to science education (Lenk, 1992; Shair, 1990 as cited by Christensen et al., 1996). For approximately 20 years, the inquiry-based thematic approach has been developing (Young & Pottenger, 1992 as cited by Christensen et al., 1996).

CHAPTER 2

PROBLEM DOCUMENTATION

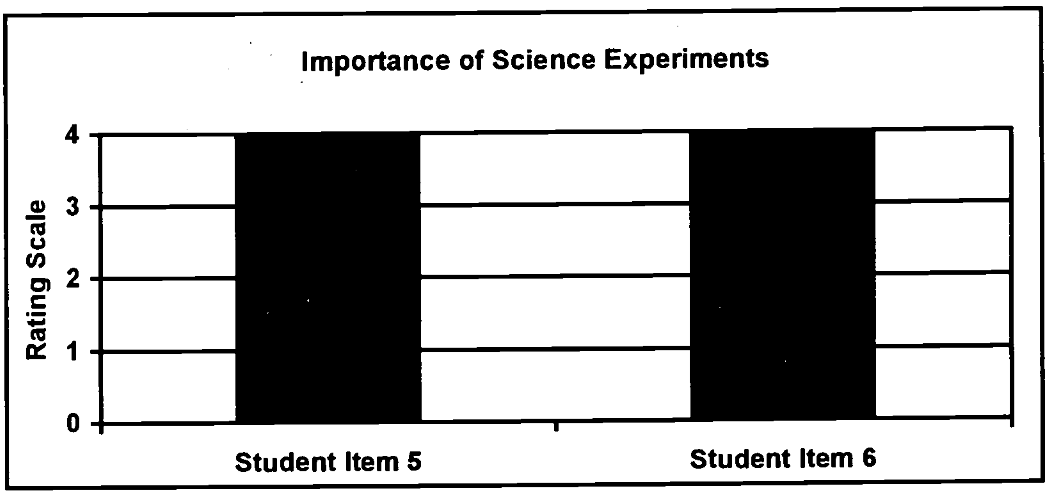
Problem Evidence

The groups targeted for this research include first, third and fourth grade students. This group includes regular education, as well as special education students. The children exhibited difficulties in science with retention of knowledge and higher order thinking skills. They also displayed a lack of enthusiasm for the subject area. Evidence for this problem includes test scores, teacher observations, and surveys.

In order to document this problem, students completed a survey and a pretest in late August. (Appendix A) The survey reflected their attitudes toward science. The pretest consisted of items that measured the students' capabilities in the targeted areas of science. In addition, the parents completed a similar survey, reflecting their perceptions of their children's attitudes toward science. (Appendix A) This information provided a baseline of students' abilities in the targeted area. The following graphs show the results of the baseline data. An interpretation and analysis of this information follow each graph.

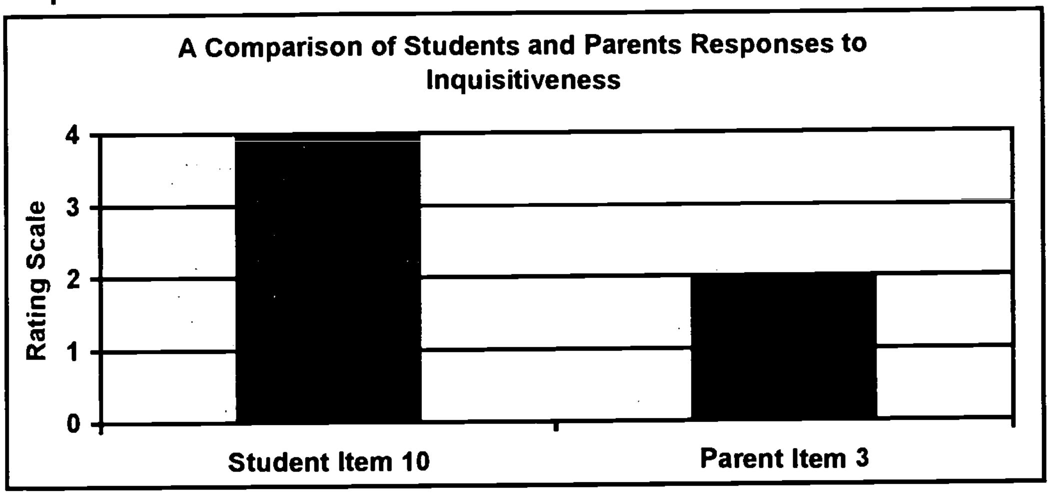
The following graphs present the compilation of students' attitudes toward science. The rating scale was four through one with four being the highest and one the lowest. Teachers gathered this information through a student survey administered during the first week of school. The teachers observed that the students had difficulty understanding the term "science" in the survey, particularly at the first grade. Therefore, this lack of understanding may affect the results of this survey.

Graph 2-1



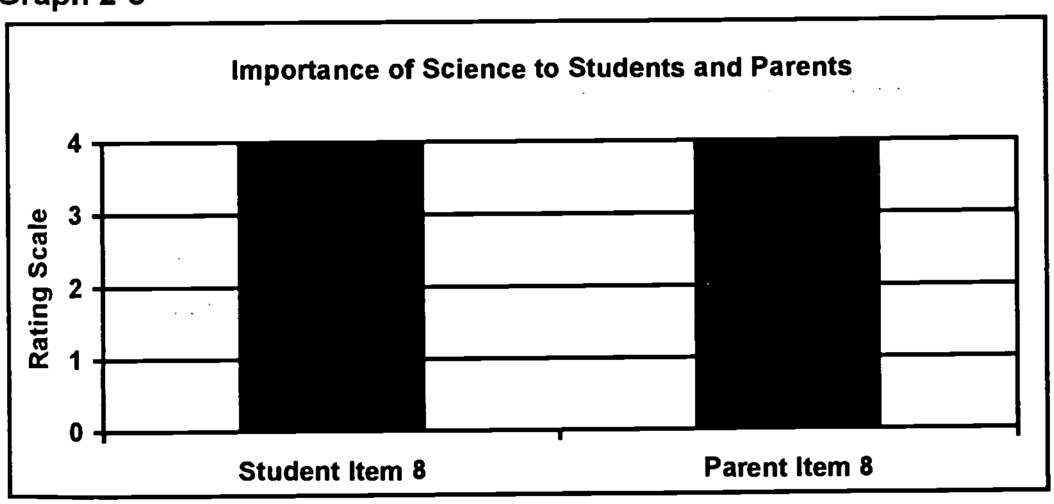
Student survey item 5 reads, "I like to do science experiments." The mode for this item was a four. Parent survey item 6 reads, "Doing science experiments and activities is the best way to learn science." The mode for this item was a four. These results indicate that both students and parents value activity-based science.

Graph 2-2



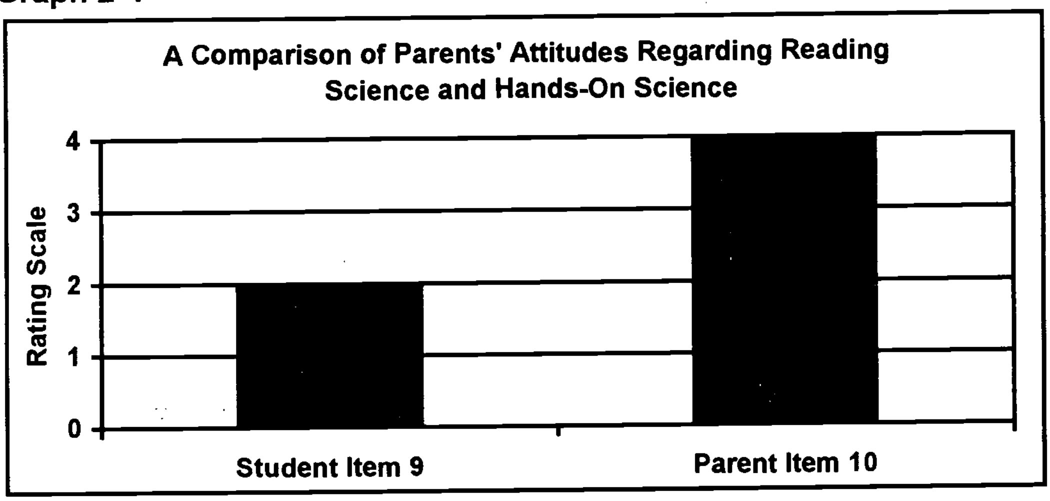
Student survey item 10 reads, "I like to find answers to my own questions about science." The mode for this item was a four. Parent survey item 3 reads, " My child asks science related questions at home." The mode for this item was a two. These results possibly indicate a lack of communication and/or limited parent involvement concerning science.

Graph 2-3



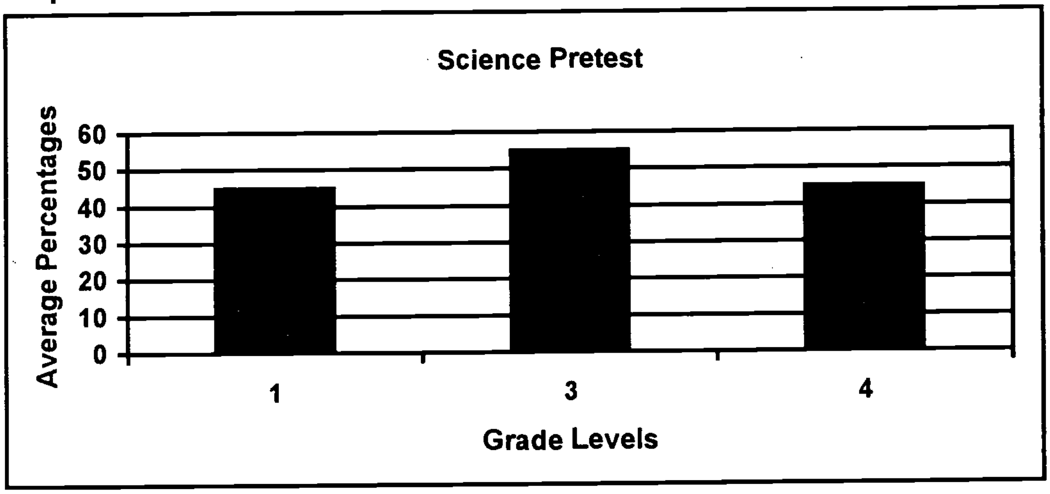
Student survey item 8 reads, “Science is important to me.” The mode for this item was a four. Parent survey item 8 reads, “Science is important to me as a parent.” The mode for this item was also a four. These results indicate that science is important to both students and parents.

Graph 2-4



Parent survey item 9 reads, “My child would learn better by reading about simple machine.” The mode for this item was a two. Parent survey item 10 reads, “My child would learn better by making a simple machine.” The mode for this item was a four. These results indicate that parents support learning through hands-on activities.

Graph 2-5



Graph 2-5 represents the average test score of each grade level science pretest. The teachers administered these tests during the first week of school. Included in the evaluation was material that to be covered during the first semester of the school year.

Probable Cause

The literature suggests several causes of the problem. One cause lies within the teachers. There is a lack of teacher training in experiential science (Lederman, 1996), and teachers are not given necessary time to plan and prepare appropriate science activities (Morey, 1990 as cited by Haury & Rillero, 1994). Another cause involves the curriculum. Content-oriented textbooks and curriculum do not offer hands-on activities to substantiate experiential learning (Stooksberry, 1996). Also, current testing tools do not coordinate with teaching methods (Tetenbaum, 1992). In addition, teachers, administrators, and community are unwilling to change from content-oriented teaching to hands-on methods (Costenson & Lawson as cited by Bonja, 1987). Because of this attitude, constraints are put on money and supplies to even implement hands-on science (Lederman, 1996). A final cause of the problem is that the technology required to implement hands-on science on a worldwide scale is still in its infancy (Christensen, Jones, Knezek, Moore, & Southworth, 1996).

Lack of teacher training in experiential science has attributed to students' limited knowledge and unenthusiastic attitudes. Because elementary teachers have training in many different subject areas, they do not have a concentrated field of study. Therefore, these teachers lack in-depth preparation in science content, as well as the skills needed to implement hands-on science. Teachers feel that the emphasis in the elementary grades needs to be placed in reading (Jones, Mullis, Raizen, Weiss, and Weston, 1992 as cited by Vesilind & Jones, 1996) and math, so they do not value additional training in science education. To complicate matters, there is a lack of money available for teacher training. "Reform is particularly difficult, given that most elementary teachers have little preparation in science content or pedagogy " (Weiss, 1994 as cited by Vesilind & Jones, 1996, p. 375).

Teaching hands-on science requires thorough planning, gathering materials, and setting up the activities, as well as organizing content presentations. There are so many demands on teachers' time and energy that science is not a priority (Lederman, 1996).

Content-oriented textbooks and curriculum do not offer hands-on activities to substantiate experiential learning. Textbooks continue to dominate the curriculum. They claim to be inquiry oriented but offer few opportunities for teachers to teach using the inquiry method (Yager, 1997). Teachers tend to be overly concerned with communicating facts and figures, as well as concepts and principles. Experiments are used about 10% of the time in classrooms (Mitman, Mergendollar, Marchman, Packer, 1987). Science taught only from textbooks seems to result in a lack of enthusiasm on the part of students, as well as teachers.

Current testing tools do not coordinate with experiential teaching methods. Teachers are using paper and pencil type tests to evaluate retention of facts, when they should be using a variety of alternative assessment tools to allow students to demonstrate their understanding of science by solving authentic, real-life problems (Christensen, 1997). The goal is to assess the processes of science, along with content material. "Today's assessment strategies must be aligned with the emerging vision of "science for all," with all students engaged in science experiences that "teach the nature and process of science as well as the subject matter" (NCSESA, 1993 as cited by Haury & Rillero, 1994, p. 134). Assessment involves more than testing. It combines techniques such as teacher observation and authentic assessment. These strategies more closely match the learning activities and outcomes that we hope to achieve in the science classroom (Kober, 1993 as cited by Haury & Rillero, 1994).

Teachers, administrators, and community are unwilling to change from content-oriented teaching to hands-on methods. Presenting science facts through science reading is the only approach that these individuals have ever known. They are comfortable with this model; therefore, it will be very difficult to supplant (Christensen, 1997). Teachers, administrators, and parents grant science a low priority. They base future success on students' ability to read, write, and compute. These skills demand their highest priority. Science is outside of the basic educational expectations. With this philosophy, the time and energy allowed for science is definitely less than for reading, writing, and math (Christensen, 1997). In fact, statistics support this contention.

According to a report by Jones, Mullis, Raizen, Weiss, & Weston, 1992, 95% of the schools reported reading as a priority, whereas only 45% identified science as a priority. NAEP (National Assessment of Educational Progress) found that 49% of fourth graders have science instruction less than once a day, with 6% never studying science (Vesilind & Jones, 1996).

Constraints on supplies and money hinder implementation of hands-on science. Science materials are expensive. Equipment accumulates slowly. To further complicate matters, storage is limited (Hernandez-Azarraga, Komorowski, & Spickler, 1997).

Technology required to initiate hands-on science activities is still in its infancy. Resources to connect schools with current science information is limited to 5% of the elementary classroom in the United States (Auletta, 1994 as cited by Christensen, Jones, Knezek, Moore, & Southworth, 1996). Until schools make current technology a priority, Goals 2000, which calls for American students to leave grades 4, 8, and 12 with competency in science, and for U.S. students to be first in the world in science and mathematics, will not be realized (National Education Goals Panel, 1991 as cited by Vesilind & Jones, 1996).

In conclusion, we contend that a combination of factors influence the lack of enthusiastic learning, students' inability to transfer knowledge, and the limited use of higher order thinking skills in the science curriculum. These include a lack of teacher training, insufficient planning time, inadequate textbooks, poor testing tools, unwillingness to change instructional paradigms, financial constraints, and limited technology. These factors have worked together to hinder the process of scientific learning. As a result of these concerns, hands-on science is not being incorporated into the science curriculum.

Chapter 3

THE SOLUTION STRATEGY

Literature Review

Teacher experience and research indicates that children who are involved only in a content-based science curriculum display little enthusiasm, show limited transfer of knowledge, and do not demonstrate the use of higher order thinking skills (Jaus, 1977; Kyle, Bonnstetter, Gadsden, & Shymansky, 1988; Kyle, Bonnstetter, McCloskey, & Fults, 1985; Rowland, 1990 as cited by Haury & Rillero, 1994). The literature presents a variety of suggestions for improving students' attitudes toward and knowledge of science. These suggestions include staff development, hands-on activities, teacher collaboration, and assessment.

Initially, teachers need to learn and understand the scientific inquiry-based method. There are several ways to accomplish this understanding. These include workshops, classes, and participation in professional associations (Janet Carlson Powell, Senior Staff Associates, BSCS, Colorado Springs, CO, as cited by Haury & Rillero, 1994). Many workshops are available to educators. Two possibilities would be "Hands-On Science" presented by Teacher Created Material, Inc., and AIMS (Activities Integrating Mathematics and Science). The Hands-On Science seminar stresses a shift in emphasis from recall to reasoning. Therefore, this seminar provides teacher training which includes numerous lessons and activities that use a hands-on approach (Hale, 1993). The AIMS workshop trains teachers to use a constructivist approach, to infuse all levels of thinking, and to incorporate reflections (P. Lund, AIMS instructor, personal communication, July 8, 1997). Illinois State University offers a class entitled Science Workshop for Elementary Teachers. After taking this class, one third grade teacher was convinced to modify her instruction from strictly textbook reading to incorporating activities with the content material. Furthermore, her attitude toward science instruction changed. She now feels that science and math deserve the same amount of time (J. Simpkins, Davenport Elementary, Eureka, IL, personal communication, July 15, 1997). Professional organizations provide teachers with information about current trends, workshops, and conferences. In addition, these groups present an opportunity for the exchange of ideas. A sampling of these associations includes National Science Teachers Association, Illinois Science Teachers Associations, and the Central Illinois Science Exchange (J. Kendal, Kelly Avenue School, Peoria Heights, IL, personal communication, July, 14, 1997). According to Bonja (1987):

> The key rests in the hands of the elementary teachers. They build the foundation on which all other levels are constructed. They must learn to understand what the process of scientific inquiry is; they must have sufficient understanding of the models involved and they must become better skilled in the techniques of inquiry teaching. Only then can education meet the future head-on. (p. 7)

In addition, teachers need to use hands-on science along with content-based instruction. Research indicates that hands-on inquiry-based science instruction is a proven effective teaching strategy (Silversten, 1993 as cited in Vesilind & Jones, 1996). Students construct meaning and understanding by performing science experiments. Piaget developed the theory of constructivism which contends that knowledge is not taught but rather constructed by the child (Read, Gardner, & Mahler, 1993 as cited by Stooksberry, 1996). Overall recall of facts improves with the discovery approach because it expands a student's basic thinking structure through "trial and error" exploration of prior personal experience (Hale, 1993). This approach encourages students to be engaged in a learning community where the teacher is the facilitator, not the only source of knowledge and information (Christensen, 1997). Hands-on science sparks children's natural curiosity about the nature of things and encourages them to be lifetime learners (Raizon & Michelsohm, 1994 as cited by Vesilind & Jones, 1996). Elementary students are at the concrete stage of their cognitive development; therefore, hands-on activities are critical for their science learning (Loucks-Horsley, 1990 as cited by Vesilind & Jones, 1996).

A program of well-planned activities and experiences provides many positive results. It causes students to rely on the evidences they see instead of authority, whether it be published or personal. Most students live in an adult-dominated world with limited opportunities to practice decision making. This approach allows students active participation and the opportunity to come to their own conclusions. Hands-on experiences also allow everyone to be involved in discussions, regardless of their previous background and personal exposure. This compels students to use higher order thinking skills to interpret observed events rather than memorizing correct responses. Questioning of observed events encourages students to become independent learners and reduces their dependence on authority (Robert C. Knott, Ed.D. Science Curriculum Improvement Study 3, University of California, Berkely as cited by Haury & Rillero, 1994).

Some parents express a concern about science teachers using only hands-on activities, and not providing a balanced mix between textbook and activities. The concern is that students lack opportunities for concentrated work, such as memorization, note taking, and worksheets. Parents perceive that teachers are afraid of frustrating students by giving them seatwork (Vesilind & Jones, 1996). We feel this narrow point of view does not meet the needs of students entering the 21st Century.

Teachers' experiences in the classroom verify the importance of using hands-on science. Hands-on experiences are essential. They keep students enthusiastic and engaged (J. Kendal, Kelly Avenue School, Peoria Heights, IL, personal communication, July, 14, 1997). Even poorly taught hands-on science is more interesting to students than a strictly textbook-based program. Knowledge gained through scientific discoveries made by students results in greater retention of information (J. Crow, Metamora Grade School, Metamora, IL, personal communication, July 15, 1997 and J. Simpkins, Davenport Elementary, Eureka, IL, personal communication, July 15, 1997). An experienced teacher in PRISM (Project Based Research Instruction in Science and Math) finds many benefits for her students by utilizing hands-on activities in her classroom. She has observed that students have higher level thinking skills, advanced problem solving skills, and a willingness to take risks. In addition, students continually find more than one way to solve a problem (J. Kinney, Lincoln Grade School, Washington, IL, personal communication, July 15, 1997). Students in the Hands-On Science program are also encouraged to use higher order thinking skills. Along with acquiring the basic facts, students engaged in the scientific process need to analyze, synthesize, and evaluate (Hale, 1993). These critical thinking skills enable students to apply the process of learning to life situations (Sister Judith Mary Frederick, fifth grade teacher, St. Mary's Elementary School, Sandusky, OH as cited by Haury & Rillero, 1994). An AIMS instructor, who is also an elementary classroom teacher, finds using hands-on activities allows more students to be successful and strengthens their understanding of science concepts (P. Lund, July 8, 1997). In conclusion:

> The case for hands-on or inquiry-based science is extremely powerful.... Too frequently, elementary teachers believe they can speed children's levels of conceptual development and short-circuit the time children need to link new knowledge with existing conceptual understanding, by relying heavily on lectures and readings (Loucks-Horsley, 1989 as cited by Vesilind & Jones, 1996, p. 376).

Furthermore, teachers need time to collaborate with each other. The literature suggests that teachers observe other teachers using hands-on science, as well as talk with teachers who use this method (Henline, E., as cited by Haury & Rillero, 1994). Time is a critical variable that can either promote or inhibit this process. Professional staff time to brainstorm the creation of new activities is necessary. Teachers need time to investigate, plan, and practice strategies to use in the classroom. To follow up, monitor, and adjust classroom modification also requires collaboration (Vesilind & Jones, 1996). Lederman (1996) believes the following:

> That the pioneering new teaching styles in math and science can have a strong influence on the rest of the liberal arts curriculum if we can only give teachers time to talk and learn from one another. In fact, I believe we must be allies and work together for a renaissance of education across all subjects. (p. 26)

Finally, implementation of performance-based assessment must accompany the activity-based instruction. Because hands-on science is experiential and interactive, it is a logical progression from engaged learning to performance-based assessment of that learning. The result of this assessment is a form of evidence judged with a rubric, which indicates what students think, understand, and can do. Since science involves the study of dynamic systems that are constantly changing, the more traditional and inactive environment of paper and pencil tests does not allow for engaging activities that represent the full range of science (Chidsey, et al. 1997).

Another advantage of performance tests is the easy integration into the curriculum, rather than being separate from ongoing instruction (Shavelson, 1991 as cited by Berliner & Casanova, 1993). The formative nature of this assessment improves instruction, rather than grade students. Therefore, students are involved in the production, not simply the reproduction of new knowledge (Archbald & Newmann, 1988 as cited by Burke, 1994). Our goal is to prepare students for the future rather than simply for a test.

Brown and Shavelson (1994) note three features of performance assessment in the following:

> First, the assessment should present students with a concrete, meaningful task. Next, the assessment should include a response format with which students

communicate their findings. Last, the assessment scoring system should capture not just the "right" answer, but the reasonableness of the procedure used to determine the answer. (p. 60-61)

In order to give students a fair chance to show their understanding of the subject matter, teachers may choose from several different types of assessments.

sketch an answer

work in groups or pairs

complete take home tests, requiring a connection to the world outside the classroom

design or construct a project

act out a concept

plan and carry out an experiment

use multiple intelligences to communicate knowledge (rap, poem, song)

include student portfolios

There are important points to consider when using performance assessments. One is for teachers and administrators to realize the need for teacher training in preparation and interpretation of authentic assessments. It is difficult to interpret authentic assessment results in a standardized manner because results may be interpreted differently by different instructors (Haury & Rillero, 1994). Another consideration is an awareness that paper and pencil tests have a contribution to make. However, test scores derived solely from this type of test may not assess true student understanding. Although students can successfully pass a paper and pencil test, they may not be able to apply a concept (Anderson & Smith, 1987 as cited by Berliner &

Casanova, 1993). Therefore, teachers should use all tools at their disposal to assess students fairly (Burke, 1994). In addition, Egeland (1997) stresses that assessment must match the curriculum. This ensures that a dual system of teaching does not result: one that teaches for standardized tests and the other for performance-based assessment.

In conclusion, assessment strategies must coincide with the current vision of science for all, with all students engaged in real-life situations that teach the process of science as well as the content (NCSESA, 1993 as cited by Haury & Rillero, 1994). Teachers need to be cognizant of and selective about what is really important for students to know now and still need to know 25 years from now (Burke, 1994).

The literature review substantiates the need for staff development in current trends of science education, the use of hands-on activities, the need for teacher collaboration, and the implementation of performance-based assessment. These solutions will promote student enthusiasm, increase successful transfer of knowledge, and develop the use of higher order thinking skills. Students develop critical thinking and discover scientific concepts by doing and experiencing science. Memory fades, but self-discovery stays with students throughout their lifetime.

> I hear and I forget
>
> I see and I remember
>
> I do and I understand
>
> Chinese Proverb

Project Objectives and Processes

As a result of the use of hands-on science activities to improve students' knowledge and attitudes during the months of late August through December of 1997, the targeted elementary students will show an increase in enthusiasm, transfer of knowledge, and higher order thinking skills as measured by surveys, observation checklists, anecdotal records, and a posttest. In order to accomplish our goal, the following processes are necessary:

1. Teachers will select three science units to be targeted.
2. Lesson plans will include students working as a whole class, in cooperative groups, with partners , and individually.
3. Hands-on activities will be selected to coordinate with the units targeted.

The following are components of our intervention:

1. A comprehensive pretest, covering the targeted science units, will be given to students on the first day of our intervention to determine their prior knowledge.
2. Parents and student surveys, regarding attitudes toward science, will be given in late August.
3. A parent volunteer form will be sent home.
4. The four-step scientific method will be presented.
5. Science units will be introduced through a variety of methods.
6. Content related material will be presented.
7. As a classroom, in cooperative groups, with partners, or individually, students will do activities related to the various science units. Students will use a

variety of materials and manipulatives to carry out the activities.

8. Assessments in each unit will be on going.
9. At the conclusion of 16 weeks, students will be given a posttest identical to the pretest. It will show if there is retention of the knowledge. The parent and student surveys will also be given again to determine if there has been any change in attitude.

Action Plan for Intervention

The following action plan was designed to incorporate hands-on activities with science content materials. The targeted population is elementary students in first, third, and fourth grades. The improvements sought as a result of the intervention are increased knowledge and improved attitude and enthusiasm for science.

This plan is organized according to science units. Each grade level will be following this format to teach their determined units.

Unit Plan

1. Introduce a unit (possible choices)

   -Video

   -KWL (What I Know)

   (What I Want to Know)

   (What I Learned)

   -Literature

   -Field Trip

   -Graphic Organizer

   -Hook (i.e. attention getting device to promote thinking and questioning)

-Bulletin Board

-People Searches

2. DR-TA Directed Reading - Thinking Activity (Stooksberry, 1996)

   -Used to give students opportunities to increase levels of comprehension, check for prediction, clarify word knowledge, make judgments and extend thought (Stooksberry, 1996).

3. Hands-on Activities and/or Experiments

   -Related to subject matter

   -May include scientific method

   -Higher order thinking skills involved

   -Cooperative group work

4. Assessment Tools for Hands-on Projects and Cooperative Work

   (Possible choices)

   -Teacher observation checklists

   -Student interviews

   -Rubrics

   -Anecdotal records

5. Unit review (Possible choices)

   -TGT (Teams, Games, Tournaments)

   -People Search

   -Review Games

   -Sidewalk Chalk to review concepts

6. Assessment of Content (Possible choices)

-Performance-based assessments

-Traditional paper and pencil test

-Student interviews

-Projects with rubrics

-Writing activities

a. Learning logs
b. Reflective journals
c. Story writing
d. Essays
e. Reports
f. Poems, raps, and songs
g. Paired writing

Methods of Assessment

In order to assess the effects of the intervention, after a 16 week period, students will again be given the same test and survey administered in August. The parent survey will also be readministered. The percentage indicating the number of correct answers on the test will be compared. The tests will reflect students' retention of knowledge. The surveys will reflect any changes in attitude. In addition to comparing the pretest and posttest scores, as well as surveys teachers will be reviewing all additional assessment tools. These methods will help determine if the interventions were successful.

CHAPTER FOUR

PROJECT RESULTS

Historical Description of the Intervention

The objective of this project was to improve students' knowledge and attitudes of science through the use of hands-on activities. The targeted classrooms were comprised of three fourth grade classes, one third grade class, and one first grade class.

The implementation of hands-on science activities was selected to improve students' knowledge of and attitudes toward science. Many activities were utilized to promote hands-on learning. (Appendix B)

The teaching of cooperative learning skills occurred at the beginning of our intervention. The skills needed to be taught prior to working in base groups. The lessons stressed specific skills, such as taking turns, listening, talking quietly, praising each other's ideas, encouraging each other, staying on task, compromising, and reflecting. The aforementioned skills gave structure to the hands-on activities that followed.

The steps of the scientific method were introduced and continued throughout the intervention. All four steps were reinforced using multiple intelligences, including bodily/kinesthetic, musical/rhythmic, visual/spatial, and verbal/linguistic. Examples include hand signals, rap, posters, bulletin boards, and writing in scientific journals. The knowledge of these steps established the framework for the science hands-on experiments.

Each student kept a science journal. (Appendix C) The science journal was used in a variety of ways and for various purposes. First grade used it as a compilation of the activities and experiments performed in the classroom. In addition, third grade students wrote reflections upon completion of projects. They also included vocabulary words and definitions. Third and fourth graders used their journals for all experiments to record each step of the scientific method.

Hands-on activities served as the core of our intervention. Each grade level targeted three units from the district's science curriculum to be taught. Science activities and experiments were then chosen to correlate with the objectives in these units. These selected science units were introduced in a number of different ways, including graphic organizers, literature, videos, and field trips. Following the introductions, teachers modeled each step of the scientific method to prepare the students for the upcoming experiments or activities. Students performed the experiments in cooperative learning groups. While the base groups were working, teachers used observation checklists to determine the effectiveness of the cooperative group work and implementation of the scientific method. (Appendix D) A reflection followed providing the link between the curriculum objectives and the activity.

The concepts in each unit were reviewed before formal assessment was given. Methods used to review included people search, rap, drama, artwork, and games. By using the multiple intelligences, the skills and objectives for the unit were reinforced and cemented. (Appendix E)

The researchers achieved assessment of the units in their intervention in a variety of ways. Teachers elected to use one or more of the following methods: performance-based assessments, rubrics, student conferencing, and written tests. (Appendix F)

A science pretest was given prior to our intervention. This test was administered to determine baseline knowledge of the subject area. Following the intervention, the same test was given as a posttest. (Appendix A) A discussion of the test results is below.

Presentation and Analysis of Results

Cooperative learning was an essential element in our intervention. Many benefits of cooperative learning surfaced. One advantage of teaching cooperative skills is that it took less time to organize the groups and actually begin the activity, since the students were already familiar with their roles and responsibilities as group members. We also observed that children were better able to work with a variety of personalities and abilities, thus accepting each other's uniqueness. It was exciting to observe the special needs students who were active participants, gaining confidence in their abilities through the support of others. In addition, all students were focused and engaged in the hands-on learning. Due to the less threatening cooperative environment, there was greater participation by all.

On the other hand, there are some aspects to be considered when doing cooperative learning. Accelerated students find it difficult to be a part of a cooperative group, because they prefer to be totally responsible for the end product. Furthermore, because of the enthusiasm and total involvement of all students, classroom noise is a reality. The teacher must be flexible and accept a certain degree of noise. This flexibility must also carry over when groups are not cohesive. Therefore, the amount of time spent in organization directly effects the success of the groups.

Numerous positive results were noted, affirming our basic premise that hands-on science would improve knowledge and attitudes. The knowledge gained was reflected in the children's ability to transfer information obtained in the classroom to daily situations. For example, several first graders expressed interest in sharing activities with their parents. A few months after completing a unit on electricity, a fourth grade teacher set out various items, such as electrical wire, batteries, light bulbs, wheels, and connectors. These items immediately sparked interest in several students. Taking these materials and using their prior knowledge, they built a car that actually moved across the table. Increased knowledge was also demonstrated by the students through improved thinking skills and thought provoking questions. A third grade student exhibited his thinking by wondering if placing half of an apple into a covered jar would produce the same results as a plant surviving in a terrarium. He observed moisture forming in the jar, and he was thrilled when his hypothesis proved correct.

Not only did the successes demonstrate higher order thinking skills, but failed experiments created new hypotheses, alternative avenues to explore, more questioning, and collaborative problem solving. This type of transfer was repeatedly seen at all levels. Their science journals, including reflections, were written evidence of their increased knowledge. The journals reinforced the understanding of the scientific method to such a degree that by fourth grade this teacher directed activity developed into a student responsibility. Surprisingly, teachers found they, too, had a better understanding of the concepts they were teaching.

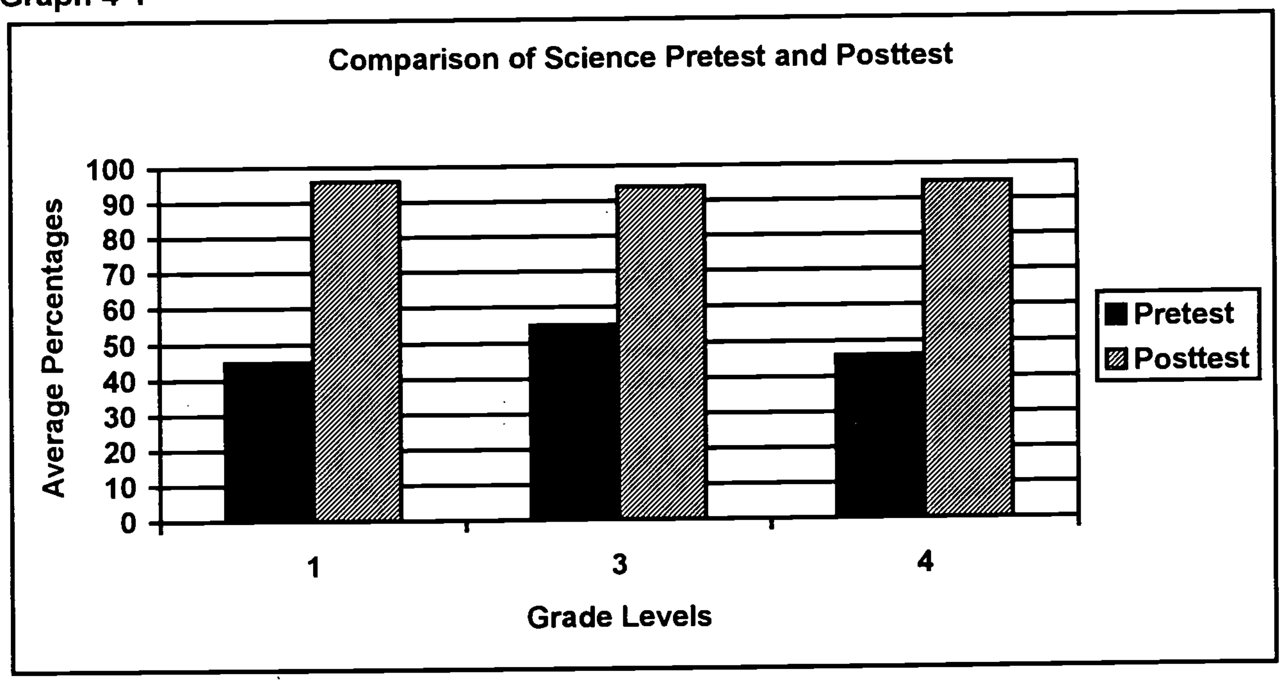
An attitude of enthusiasm prevailed throughout the intervention. Feedback from parents at our September Open House already affirmed the enthusiasm that was developing. Parental support continued as the intervention progressed. In addition to verbal support, parents willingly sent supplies and volunteered time in the classroom. (Appendix G) With the introduction of each new unit the children's enthusiasm flourished. Independently, students shared resources from home that included literature, reference materials, Internet articles, videos, as well as supplies. This positive attitude of enthusiasm served as a catalyst, keeping students involved in science.

On the contrary, there were some negative aspects to providing a hands-on science atmosphere. Our experiences during this research support the findings in literature that time, energy, materials, and money present concerns. It became difficult to include all academic teaching areas in our day while focusing intensely on experiential science. The time spent in finding and organizing activities, as well as locating materials resulted in the over expenditure of teacher energy. Once materials were gathered, storage became an additional problem. Since classrooms have a tight budget, funding for extra activities was limited. Teachers found that they had to spend personal money to support the interactive science program.

In deference to the literature, we found that classroom disorder and absenteeism were obstacles. We had to be prepared for unexpected spills, damaged worksheets, and general clutter. At the same time, absenteeism on the part of the student as well as the teacher was a major obstacle to overcome. It was virtually impossible to recreate for the absent student the missing classroom experience. Moreover, it was unrealistic for a substitute teacher to step in and manage the activities.

The intervention seemed to be a success as reflected by the posttest. The posttests, identical to the pretests, were given following the interactive science activities.

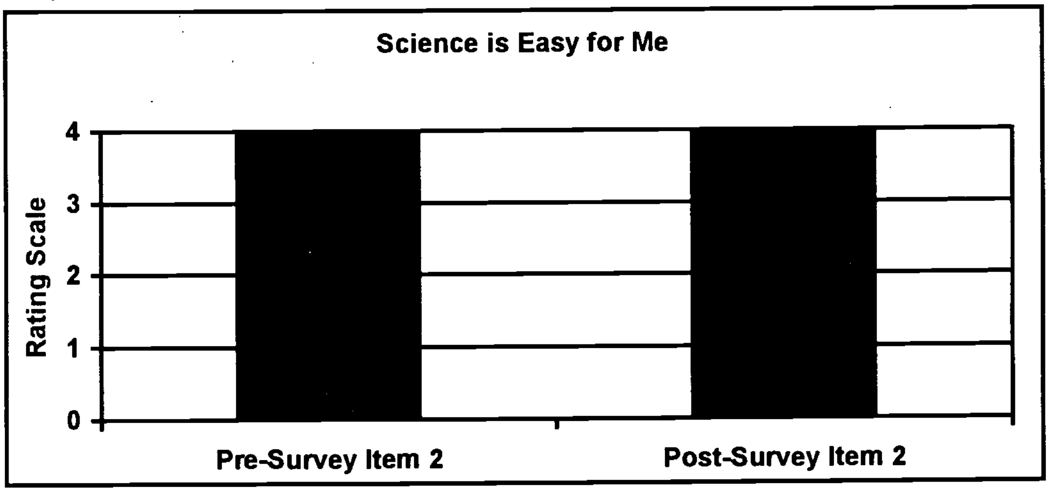
Graph 4-1



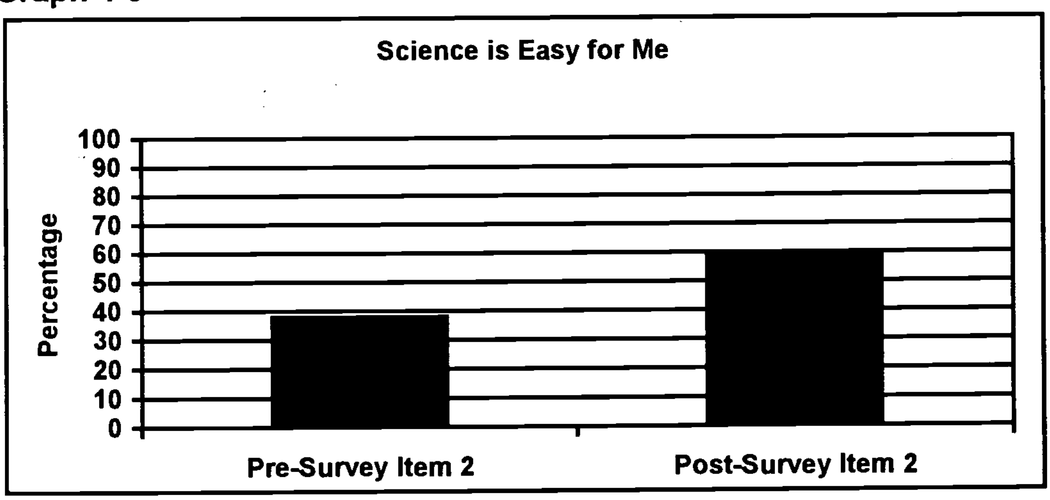
Graph 4-1 compares pretest and posttest scores at each grade level. There was a notable percentage increase in test scores. Perhaps this improvement indicates that the students retained the information learned during the four month intervention.

Teachers gave the post-survey, identical to the pre-survey, to the students at the end of the intervention. The following graphs compare the students' previous and current attitudes toward science. The rating scale was four through one with four being the highest and one the lowest.

Graph 4-2

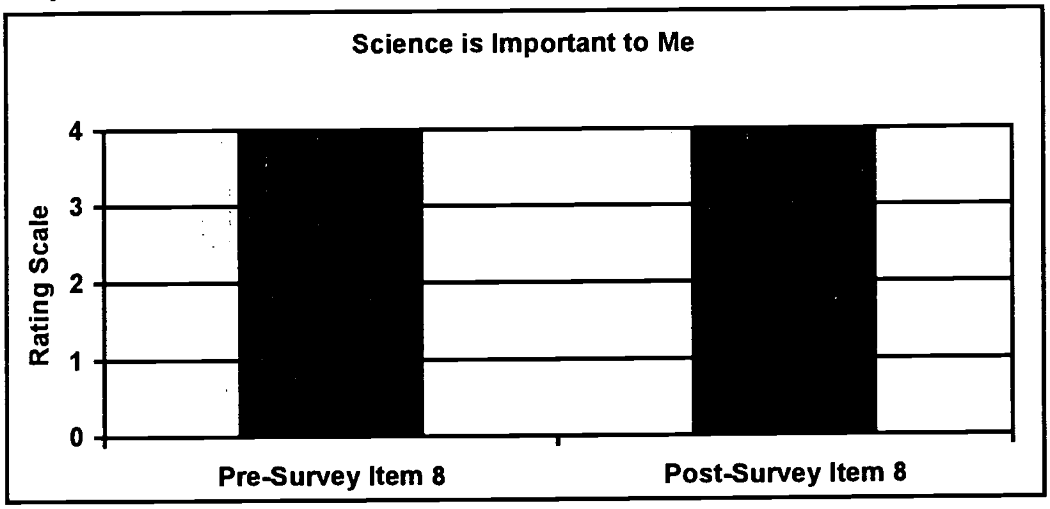


Graph 4-3

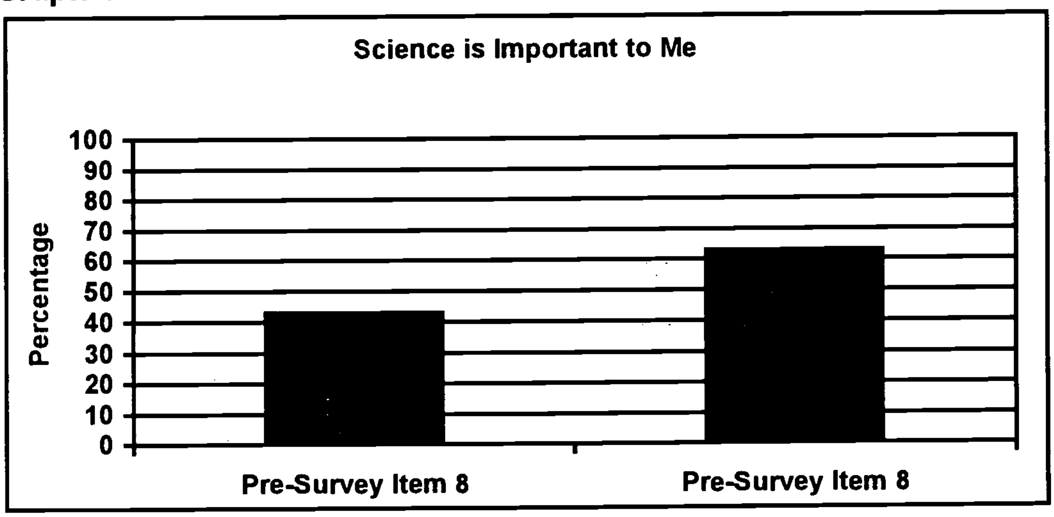


Student survey item 2 reads, "Science is easy for me." While the mode remained at four, there was a marked increase in percentage of positive responses. This could indicate that students gained confidence in their ability.

Graph 4-4

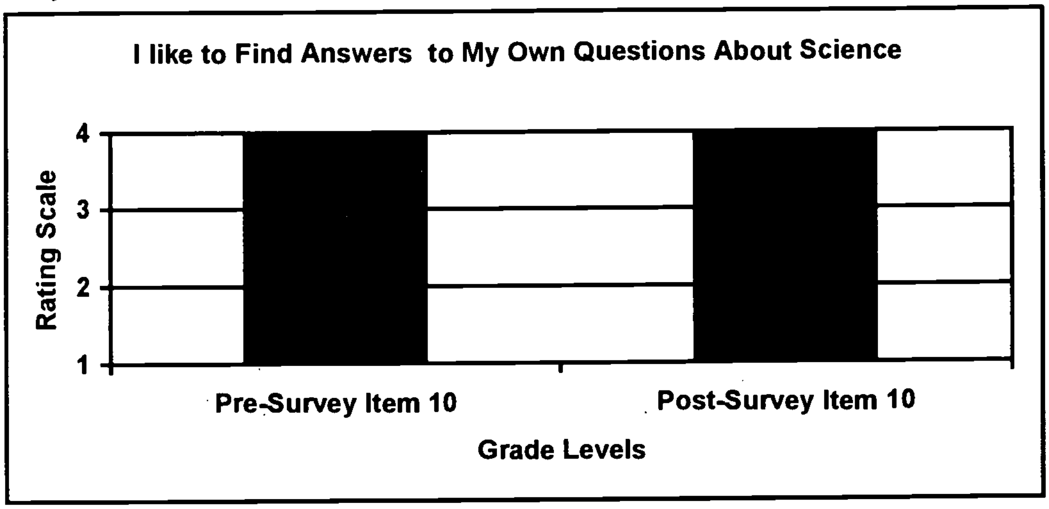


Graph 4-5

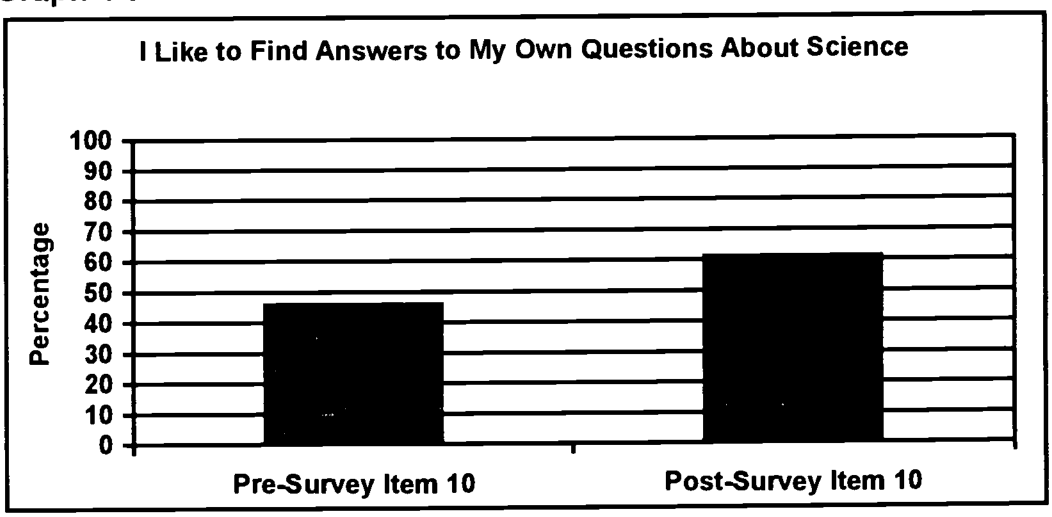


Student survey item 8 reads, "Science is important to me." Again the mode remained at four; however, there was a 20% increase in affirmative responses. This could be a reflection that the students found relevance between science and the real world.

Graph 4-6

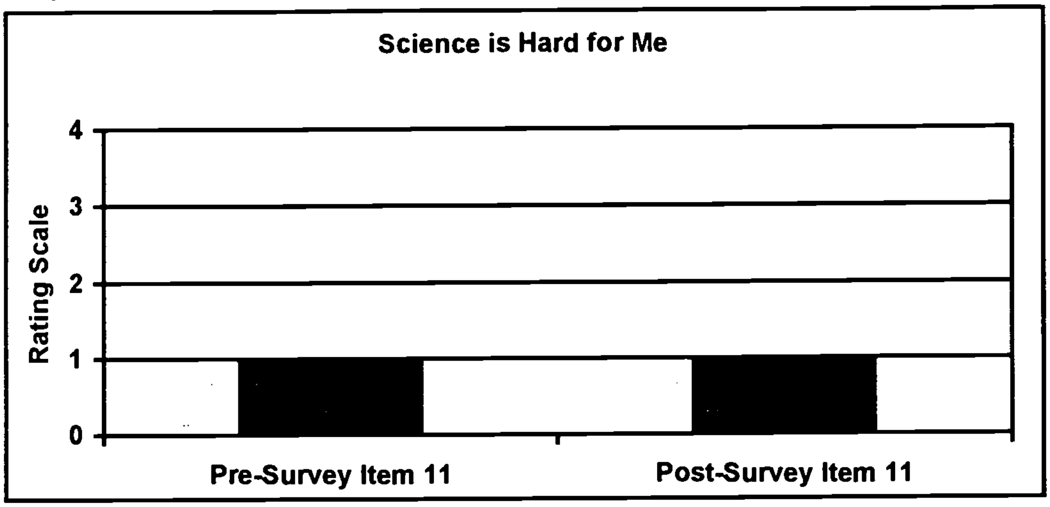


Graph 4-7

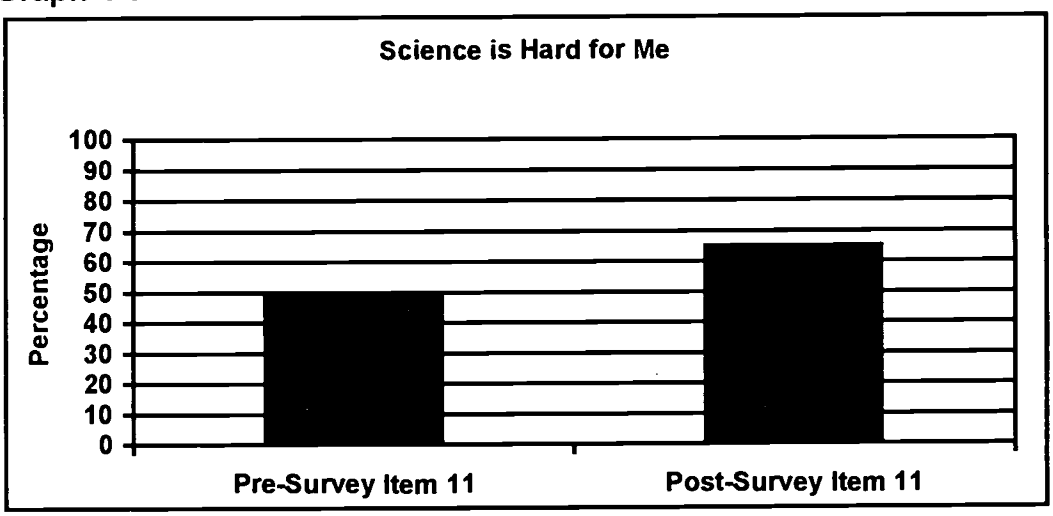


Student survey item 10 reads, "I like to find answers to my own questions about science." Once more, the mode stayed at four, while the percentage of responses in this mode increased substantially. The hands-on activities seemed to have sparked their curiosity.

Graph 4-8



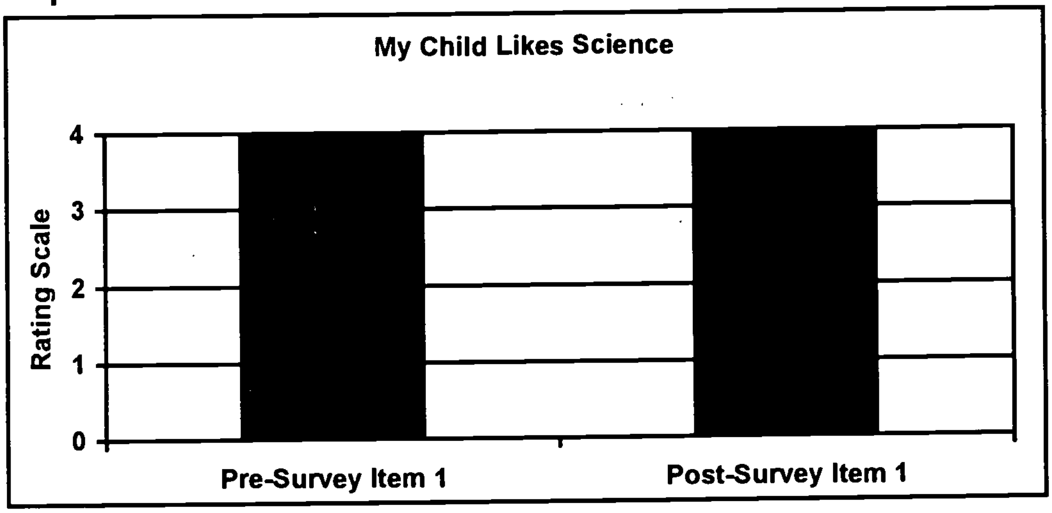
Graph 4-9



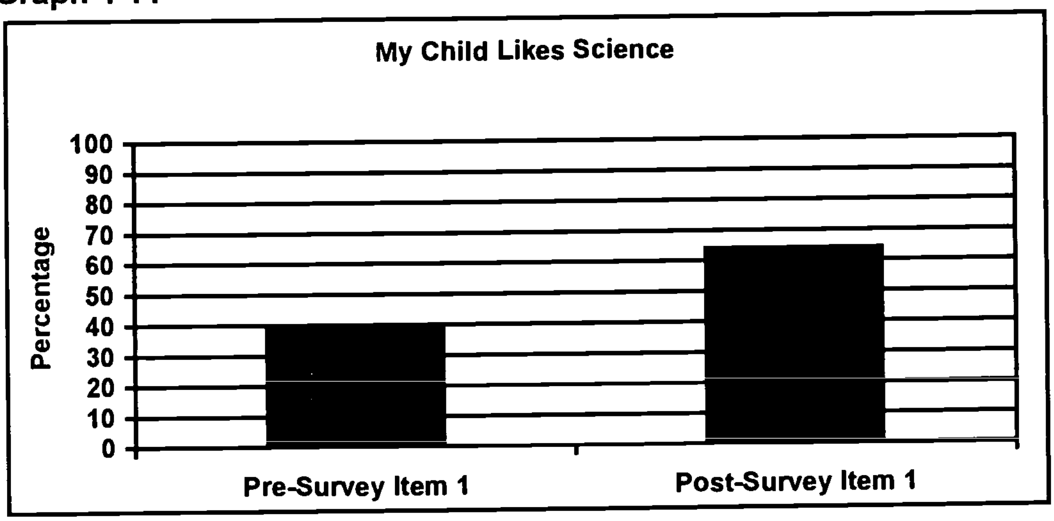
Student survey item 11 reads, "Science is hard for me." The percentage of increase in the mode of one possibly indicates that students are becoming more adept at understanding science. Graphs 4-3 and 4-9 reflect that students who felt science was hard for them prior to the intervention now feel that science is easy for them.

The following graphs compare the parents' previous and current perceptions of their children's attitudes toward science.

Graph 4-10

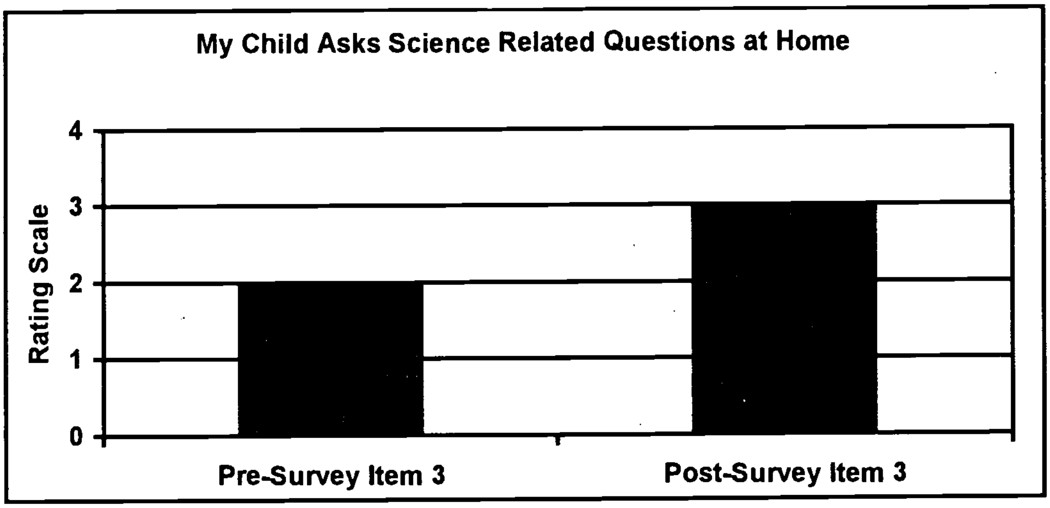


Graph 4-11



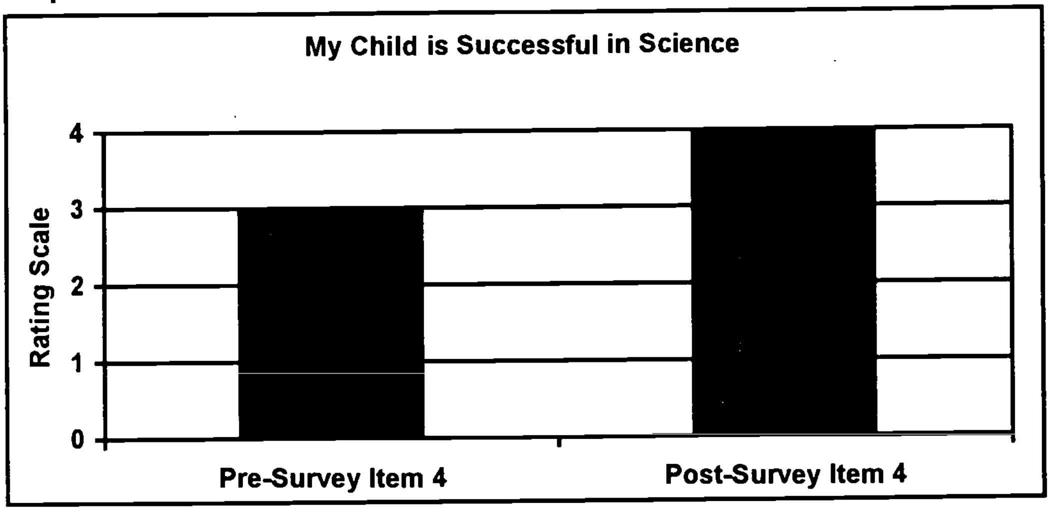
Parent survey item 1 reads, "My child likes science." The mode remained at four, but there was a dramatic increase in the percentage of responses. Apparently, the children's enthusiasm for science carried over into the home.

Graph 4-12



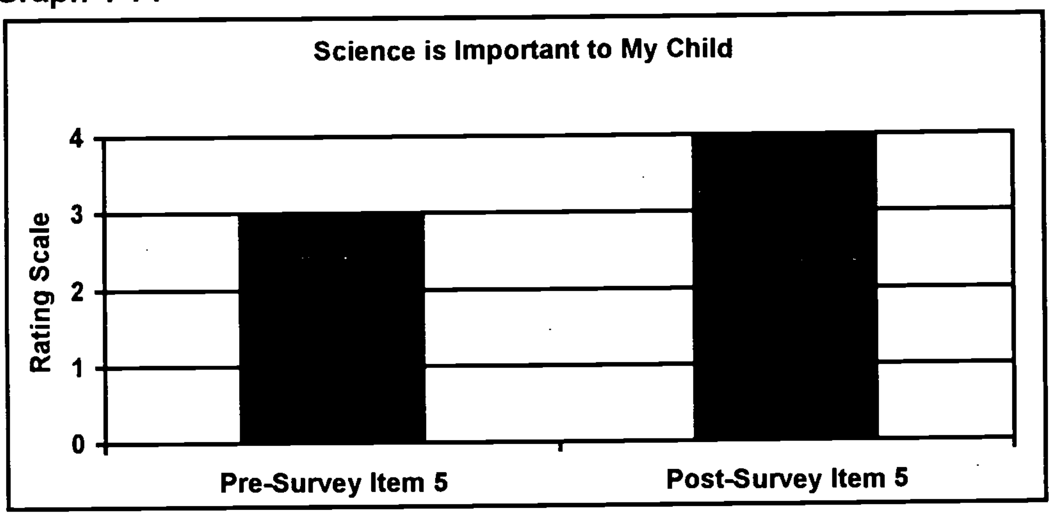
Parent survey item 3 reads, "My child asks Science related questions at home." The mode moved from a two to a three, evidently showing that science conversations are increasing in the home. This contention is supported by the following parental comment: "My son is very inquisitive at home. He always wants to know 'where did that come from?' or 'how does it work?' He also likes to share his ideas for new inventions."

Graph 4-13



Parent survey item reads, "My child is successful in science." The mode changed from a three to a four, possibly a result of an improvement in science grades.

Graph 4-14



Parent survey item 5 reads, "Science is important to my child." This item had a mode of three and now has a mode of four. The following parent comment supports the change in attitude. "I wish I had enjoyed science more, as a kid, and would therefore be able to inspire enthusiasm in my son. Nevertheless, it seems to be a top priority in his education and that's important to me. Keep up the good work!"

Conclusions and Recommendations

Based on the presentation and analysis of the data on improving students' knowledge and attitudes of science, the students showed marked growth in both knowledge and attitude. The use of cooperative groups provided the necessary structure for our activities. Using cooperative skills allowed all children to engage actively in hands-on exercises.

Previously our science units were taught using primarily textbook reading and workbook paper and pencil assignments. Also, the scientific method was mentioned but not reinforced. Since hands-on activities were limited, parent involvement was non-solicited in the past. Our cooperative group word skills were not refined until we made this a priority due to our hands-on activities.

An increase in knowledge was exhibited through test scores, science grades, and journaling. The posttest scores supported our original contention that students will have increased knowledge. In addition, the performance-based assessments also affirmed an increase in knowledge and understanding. Furthermore, students, including special needs students, showed marked improvement in science grades. Also, in their science journals third graders wrote a personal reflection of what they learned from a particular activity. This journaling demonstrated a deeper understanding of the subject than previously observed. Fourth graders moved from teacher guided journaling of the scientific method to recording steps of the scientific method autonomously.

Students and parents reflected a more positive attitude toward science because of our intervention. Teachers observed an improved attitude through written and verbal affirmation. The following comments appeared on our parent post-surveys.

"... to learn by doing is a very important aspect in truly learning and remembering and understanding science concepts."

"We think the simple machine project was a success for our daughter. She has an interest in science and this helped to develop that more."

"My son loves science and has greatly benefited by hands-on learning."

"Hands-on learning is the best and something they (the children) rarely forget."

"Very proud of improvements and energy given to students and enthusiasm."

In addition to the written comments, many verbal affirmations were expressed by administrators, colleagues, and students. At the same time, the teacher researchers also observed a change in attitude, an increase in confidence, and heightened enthusiasm in the classroom.

For educators desiring to implement an experiential science program, the teacher researchers recommend carefully organizing and specifically teaching cooperative learning skills. Initially, of utmost importance is organization. Teachers must begin slowly. The researchers recommend that only a few units be expanded each year into interactive science lessons. Subsequently, this would provide an easy transition from textbook-based to experiential science. Planning ahead involves first determining activities to be used for each unit, gathering necessary materials, and storing these items in a convenient location. In addition, consideration must be given to the need for parent volunteers. Securing their assistance well in advance ensures that the necessary support will be available when needed. Equally important is the early teaching and continual reteaching of the cooperative learning skills. The researchers stress that this foundation provides the key link in achieving a successful interactive science program.

The advantages of the intervention cannot be fully appreciated by simply analyzing the surveys and test results. The researchers have observed a caring, sharing, questioning environment that goes far beyond the realms of science. To completely understand the intervention success, the reader must develop and carry out hands-on science.

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Appendices

Appendix A

Pre-surveys

Pretests

Post surveys

Posttests

Student Survey

Please indicate your attitude toward science on the following scale: 4 is the highest and 1 is the lowest.

1. I like science.
   4 3 2 1

2. Science is easy for me.
   4 3 2 1

3. I like to read about science.
   4 3 2 1

4. I like to watch the teacher do science demonstrations.
   4 3 2 1

5. I like to do science experiments.
   4 3 2 1

6. I like to do science experiments in groups.
   4 3 2 1

7. I like to do science experiments by myself.
   4 3 2 1

8. Science is important to me
   4 3 2 1

9. Science is important to the world.
   4 3 2 1

10. I like to find answers to my own questions about science.
    4 3 2 1

11. Science is hard for me.
    4 3 2 1

Parent Survey

Please indicate your child's attitude toward science on the following scale: 4 is the highest and 1 is the lowest.

1. My child likes science.

   4 3 2 1

2. My child talks about science at home.

   4 3 2 1

3. My child asks science related questions at home.

   4 3 2 1

4. My child is successful in science.

   4 3 2 1

5. Science is important to my child.

   4 3 2 1

6. Doing science experiments and activities is the best way to learn science.

   4 3 2 1

7. My child is interested in science related activites outside of school.

   4 3 2 1

8. Science is important to me as a parent.

   4 3 2 1

** Answer the following two questions as if your child were learning about simple machines in science.

9. My child would learn better by reading about simple machines.

4 3 2 1

10. My child would learn better by making a simple machine.

4 3 2 1

Science test- 1st Grade

Name__________________

Date___________________

1. What is the first step in the scientific method?
   a. hypothesis
   b. conclusion
   c. question
   d. experiment

2. Which is one of your five senses?
   a. talk
   b. sleep
   c. touch
   d. walk

3. What part of the plant holds it in place?
   a. stem
   b. leaf
   c. seed
   d. root

4. What force pulls everything to earth?
   a. friction
   b. air
   c. clouds
   d. gravity

5. What step follows the hypothesis?
   a. conclusion
   b. experiment/data collection
   c. question
   d. state the problem

6. Which sense uses your nose?
   a. sight
   b. touch
   c. smell
   d. taste

7. What part of the plant makes the food?
   a. stem
   b. flower
   c. seed
   d. leaf

8. What will magnets attract?
   a. aluminum
   b. wood
   c. plastic
   d. metal

9. What is the **best** way for a scientist to decide if something is true or not true?
   a. vote on the idea
   b. do an experiment
   c. ask other scientists
   d. read many books

10. Pretend you're eating a new food. Which sense would let you know you don't like this food?
    a. touch
    b. hear
    c. taste
    d. sight

11. Water and food move through which plant parts?
    a. root
    b. leaf
    c. cone
    d. stem

12. What is a force?
    a. push
    b. jump
    c. throw
    d. hop

13. How many steps are in the scientific method?
    a. 3
    b. 5
    c. 2
    d. 4

14. To group colors, which sense would you use?
    a. smell
    b. sight
    c. taste
    d. touch

15. Which plant part grows into a new plant?
    a. stem
    b, flower
    c. seed
    d. root

16. What will happen when you try to put two north poles of a magnet together?
    a. they will repel
    b. they will attract
    c. nothing
    d. they will get warm

17. What is the last step of the scientific method?
    a. conclusion
    b. experiment/data collection
    c. question
    d. hypothesis

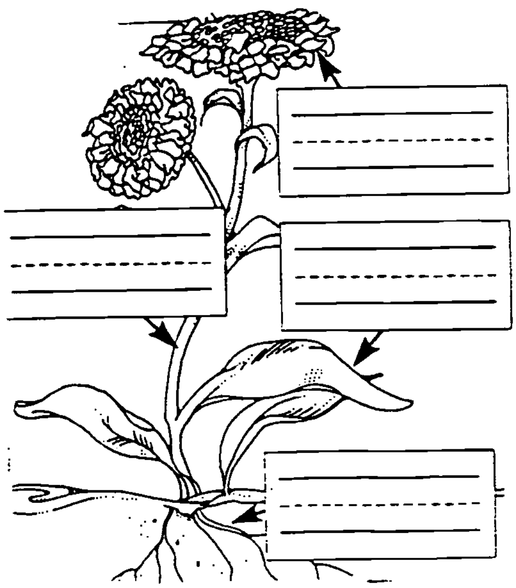
18. Your sense of smell can help you learn about this?
    a. ruler
    b. flower
    c. cup
    d. pencil

19. What part of a carrot do you eat?
    a. stem
    b. root
    c. seed
    d. leaf

20. What does repel mean?
    a. pull together
    b. jumping
    c. don't like
    d. push apart

21. Label the following plant. Use the words from the word bank.

stem	leaf
root	flower
seed	cone



SCIENCE TEST Grade 3

Name ____________________
Date ____________________

1. What is the first step in the scientific method?

   a. hypothesis
   b. conclusions
   c. question
   d. experiment

2. Circle the four forms of condensation:

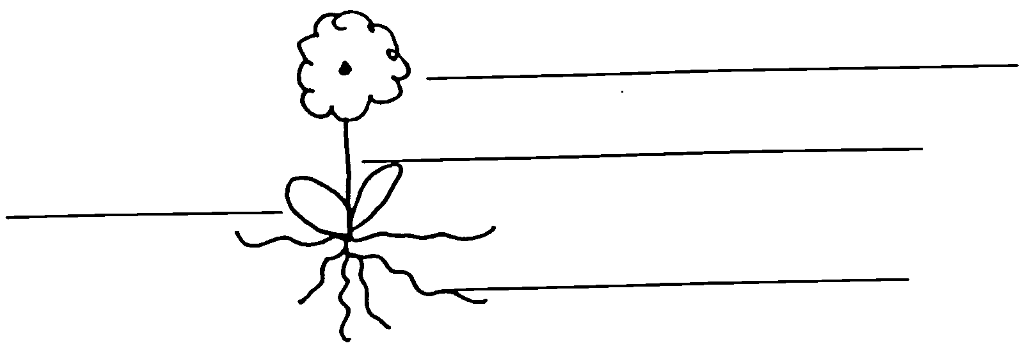
   dew rain clouds sleet hail frost snow fog

3. Write the name of this simple machine that I am showing you. Choose from this list:

   screw lever wheel and axle inclined plane pulley

   ____

4. Label each of the four parts shown on this plant.



5. What is the best way for scientists to find out if their ideas are true?

   a. vote on the ideas
   b. conduct experiments
   c. ask other scientists
   d. read many books

6. What happens to solid water when the temperature goes above 0%C?

   a. It melts.
   b. It becomes an iceberg.
   c. It floats.
   d. It becomes a glacier.

7. Write the name of the simple machine that I am showing you. Choose from this list:

   pulley   wheel and axle   screw   inclined plane   lever

   ____

8. Circle the 2 plant parts that make seeds:

   roots   flowers   leaves   stems   seeds   ground   cones

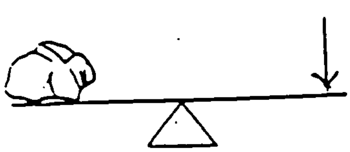
9. A scientist would not use one of the following steps to do an experiment. Which one is it?

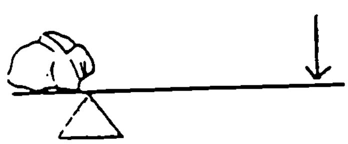
   a. collect information
   b. gather opinions
   c. make predictions
   d. observe the problem

10. In the water cycle what comes after evaporation?

   a. precipitation
   b. storage
   c. condensation

11. With which lever is it easier to lift the rock? Circle the answer.





12. Circle 4 things that this plant needs to keep growing.

water seeds warmth
soil food light

13. What is the last step in the scientific method?

a. conduct an experiment
b. draw conclusions
c. ask a question
d. write a hypothesis

14. Put an X beside the sentences that are true.

_____ Water as a solid is ice, snow, or frost.
_____ Liquid water does not change when it is taken out of a container.
_____ Solid water has a definite shape.
_____ Liquid water takes the shape of its container.

15. Which simple machine is used to hold objects together?

a. wheel and axle
b. inclined plane
c. screw
d. pulley

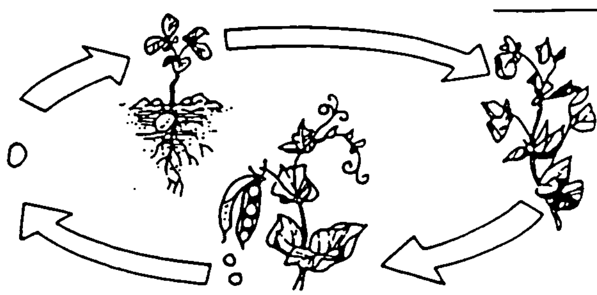
16. Label each part of the plant life cycle with these words:

```
adult plant

seed

seedling

making seeds
```



17. Which step follows the hypothesis in the scientific method?

    a. conclusions
    b. statement of the problem
    c. question
    d. experiment

18. In the water cycle what comes after precipitation?

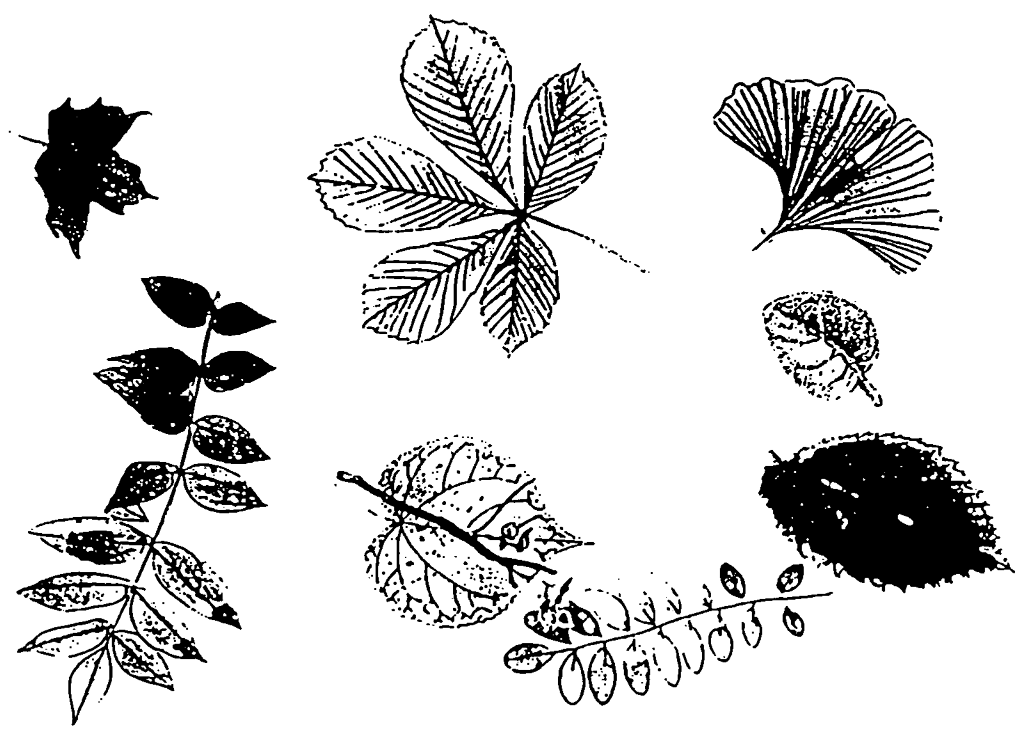
    a. evaporation
    b. storage
    c. condensation

19. Write the name of the simple machine that I am showing you. Choose from this list:

    inclined plane   lever   screw   wheel and axle   pulley

    ____

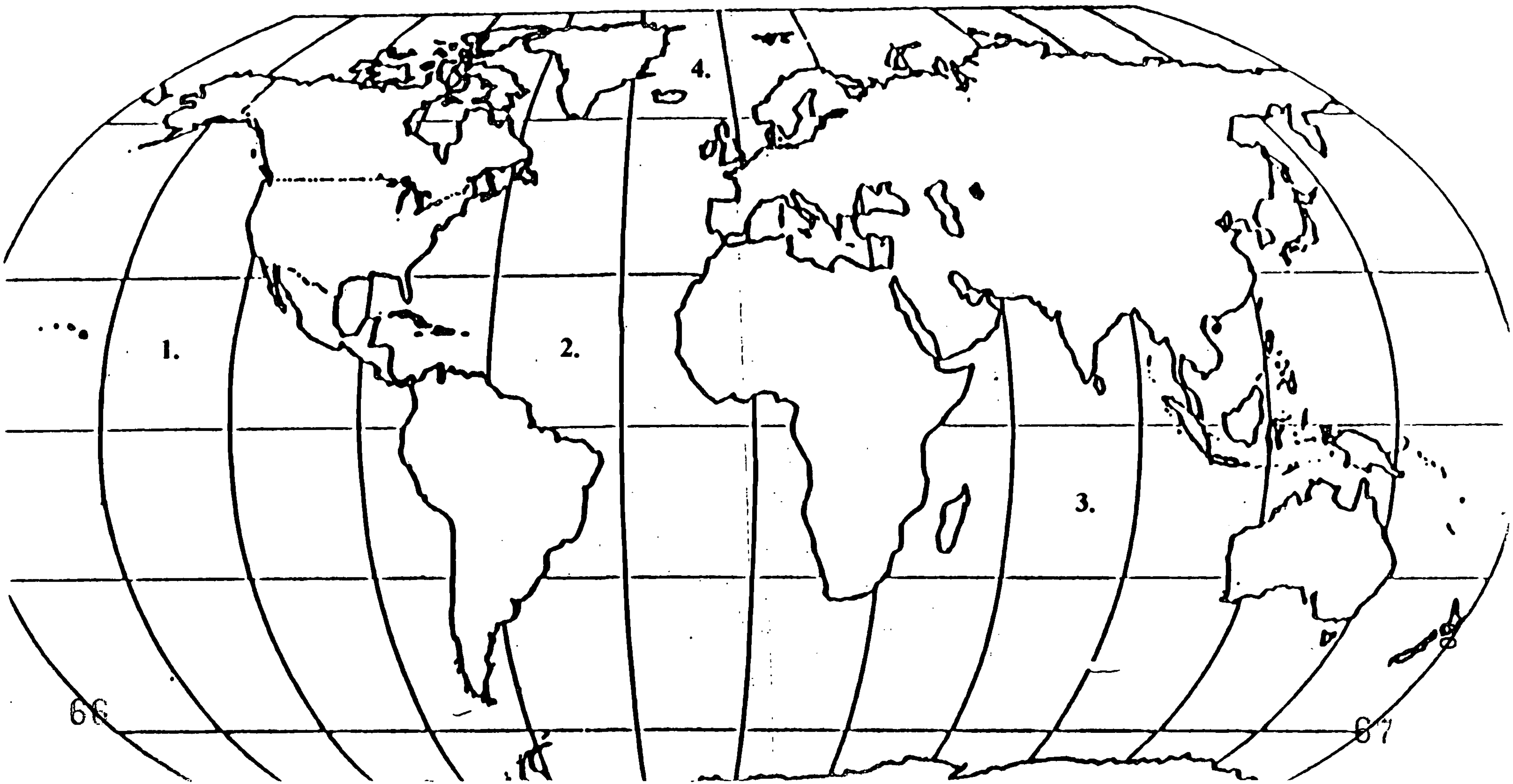
20. Put a red circle around each simple leaf. Put a blue circle around each compound leaf.



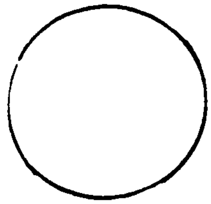
SCIENCE TEST

LABEL THE FOUR OCEANS

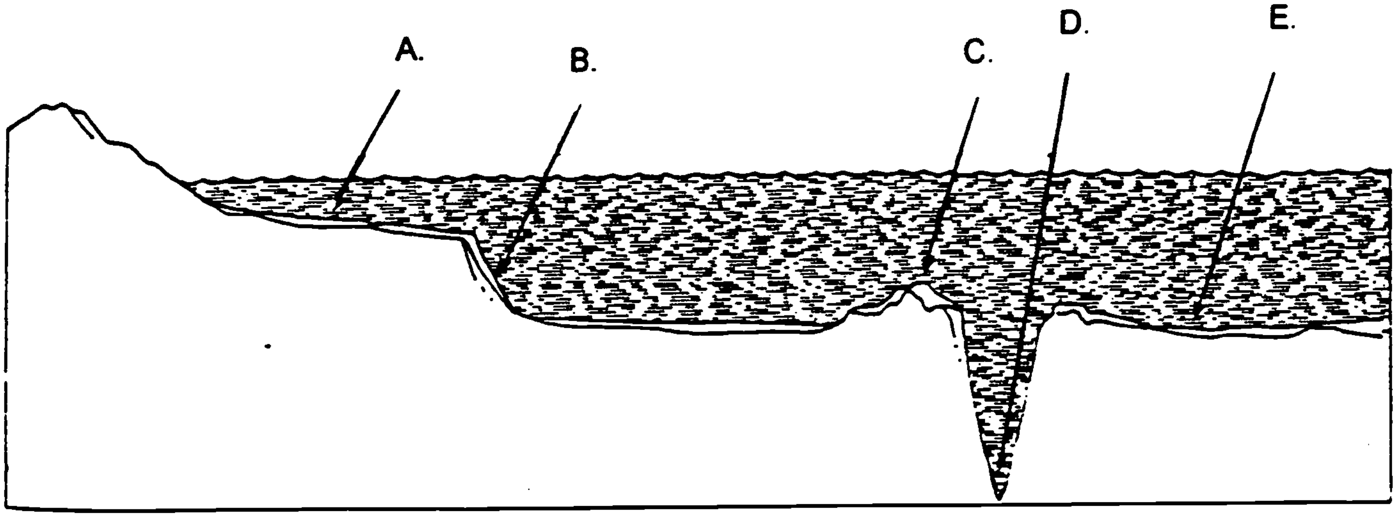
NAME ______________________



5. Fill in the circle to show how much of the Earth's surface is covered by water.



6. Circle the letter that shows where most ocean life is found.



Questions 7 and 8 refer to the pictures below. **Please follow the directions.**

A. 

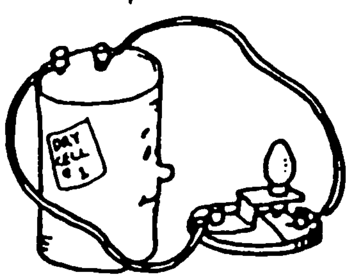
B. 

7. In picture A, the poles are going to (**attract or repel**) each other. (Circle your answer.)

8. In picture B, the poles are going to (**attract or repel**) each other. (Circle your answer.)

9. Rubbing a balloon on your head will produce which type of electricity?
   a. current electricity
   b. static electricity

Look at the pictures below. Label each circuit open or closed.

10.  ____________

11.  ____________

12. A penny is an example of a good (**conductor or insulator**) of electricity. (Circle your answer.)

13. According to the food pyramid, what foods should you eat the most?
    a. fats
    b. vegetables
    c. meats
    d. grains

14. The building blocks of the body are:
    a. system
    b. cells
    c. organs
    d. tissue

15. Tell which organ is in the digestive system.
    a. stomach
    b. lungs
    c. heart
    d. muscles

16. This system changes food so it can be used by the body.
    a. muscular system
    b. respiratory system
    c. digestive system
    d. skeletal system

17. Your nose, mouth, trachea, and lungs help you to breath in oxygen and out carbon dioxide. These are part of which system?
    a. muscular system
    b. respiratory system
    c. digestive system
    d. skeletal system

18. What is the first step in the scientific method?
    a. hypothesis
    b. conclusion
    c. question
    d. experiment

19. What is the **best** way for scientists to develop ideas to see if they are true?
    a. vote on the ideas
    b. conduct experiments
    c. ask other scientists
    d. read many books

20. One of the following is a step that a scientist would **not** use to do an experiment.
    a. collect information
    b. gather opinions
    c. make predictions
    d. observe the problem

21. What is the last step in the scientific method?
    a. conduct an experiment
    b. draw conclusions
    c. ask a question
    d. write a hypothesis

22. What step follows the hypothesis in the scientific method?
    a. conclusion
    b. state the problem
    c. question
    d. experiment

Appendix B

Student Activities

Plant Activities

Grade 1

Adopt A Tree

Learning Objective:

Students will be able to list the basic characteristics of a tree from their own observations.

Key Question:

What is a tree?

Teacher Information:

Trees give us food, shade, wood for building things, and a fun place to play. Students will increase their knowledge and understanding of trees as one tree becomes special in their world. Remember, a tree is just a giant plant.

Materials Needed:

- a tree
- paper
- crayons
- string
- clear plastic bag
- newsprint
- bucket
- water
- corn starch
- blender
- embroidery screen
- wax paper
- rolling pin

Procedures:

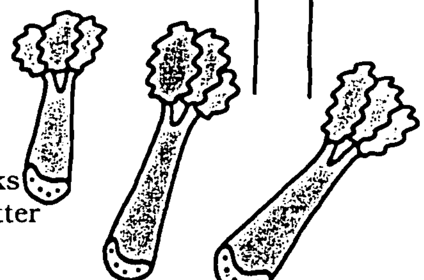
- The following activity should be continued over the school year. It can be done as a whole class, group, or individual activity. Begin by adopting a tree (or trees) near on the school grounds. If there are no trees nearby, bring a potted tree to your classroom or try to have a tree planted on the school grounds. Ask students to tell what they think a tree is. Record all statements on an experience chart and discuss these. This will help you discover what they know and need to learn.
- Have students visit their adopted tree and give it a nickname. Research to find out its common name and scientific names. Have students describe its physical characteristics (size, leaf shape, bark color, etc.) Is it alive? How can you tell? Is it asleep or awake? How can you tell? Have students describe odor, sounds, textures. Point out that trees, like all plants grow toward the light. Are there differences in the shape of the tree or size of the leaves on the sunny areas of the tree as compared to the shady parts? (Smaller trees often come from shady areas which get less sunlight.)

Objective: To observe stems and stalks transporting water.

Stems and Stalks

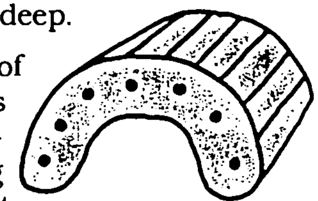
Rainbow Celery

You need: stalks of celery with leaves
food coloring (4 colors)
4 glasses of water
plastic knife
extra celery stalks for snacks
cream cheese or peanut butter



Steps

1. Explain that a stem holds a plant up and carries water and minerals to its leaves. Remind children that stems come in many sizes and shapes. Ask them to give examples of different kinds of plants and describe their stems (for example, green beans–long green stems, oak trees–thick woody trunks).
2. Show children a celery stalk. Explain that the stalk connects the celery plant's short stem to its leaves. Tell children that they will do an experiment to see how water travels from the stem to the leaves.
3. Place one color of food coloring in each of four glasses. Add enough to make the color very deep.
4. Cut off an inch from the bottom of each celery stalk, and let students examine the tiny holes on the bottom. Explain that they are looking at the bottom of the tubes that carry water and minerals from the stem to the leaves.

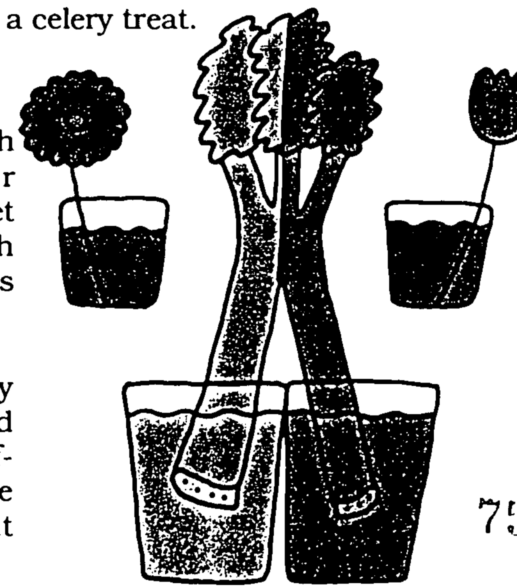


4. Have children place one stalk of celery in each color. Ask them to predict what will happen. (The water will travel through the stalk to the leaves.) If you wish, have children fill out the Science Experiment Worksheet on page 47.
5. Wait several hours or until the next day. Then examine the celery. Point out the streaks of color running through the celery. Have children attempt to wash off the color to prove the streaks are inside.
6. Finally, fill the extra stalks with cream cheese or peanut butter and enjoy a celery treat.

Variations

A. Try this experiment with carnations, tulips, or Queen Anne's lace. Let children experiment with different colored flowers and food colorings.

B. Split one piece of celery halfway up the stalk, and put each half into a different color of water. The two colors will meet at the top.

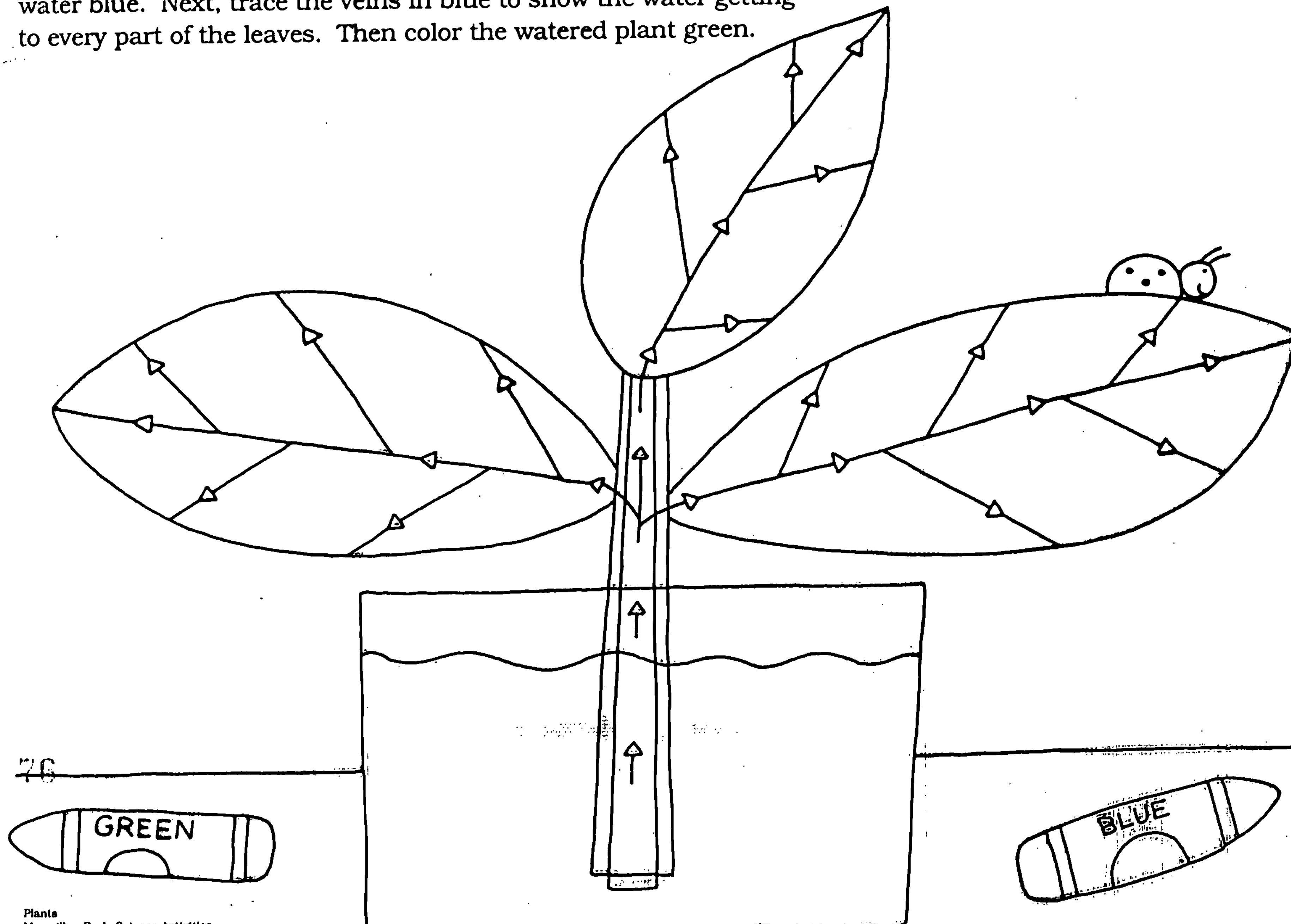


Plants
Macmillan Early Science Activities

Thirsty Leaves

Name ______________________

Help the water in this plant's stem get to the leaves. First, color the water blue. Next, trace the veins in blue to show the water getting to every part of the leaves. Then color the watered plant green.



Magnet Activities

Grade 1

Objective: To discover that magnets are strongest near their poles.

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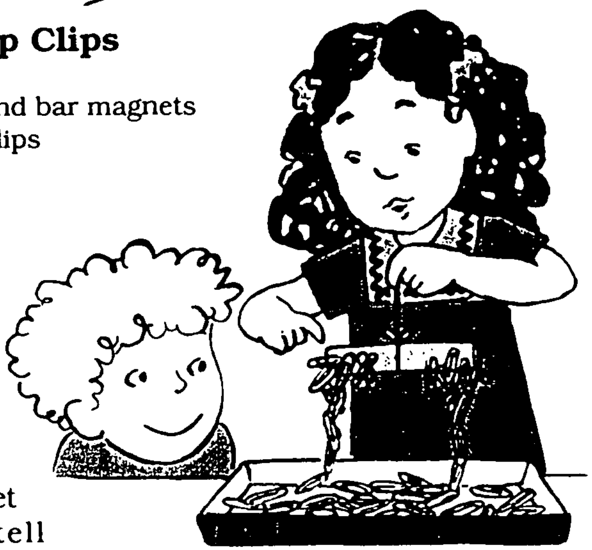
The Strongest Parts

Pick-up Clips

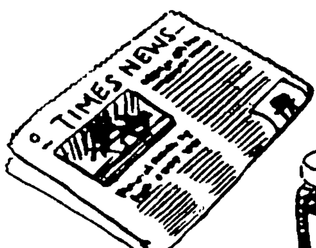


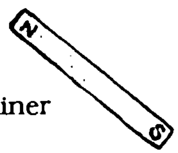
You need: several horseshoe and bar magnets
packages of paper clips
shoe-box lids
string

Steps

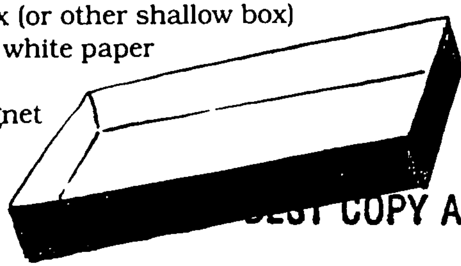
1. Allowing two to four children to experiment together, pour a package or two of paper clips into each box lid.
2. Give each child a magnet tied to a string and tell students to see what happens when they lower their magnets into the box and then take them out. Where do they see the most paper clips? Which parts of the magnet do students think are the strongest? Which part is the weakest? (Have students show their results on copies of page 16.)
3. Have students take one paper clip and move it along a magnet. Ask them to describe what they feel. (The magnet's pull is strongest at the ends.) Explain that the strongest parts of a magnet are called the *poles*.

Gather Around



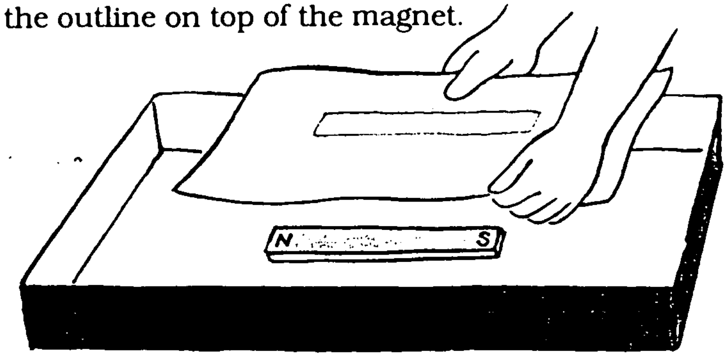


You need: a salt shaker or other container filled with iron filings
newspaper
a shirt box (or other shallow box)
a sheet of white paper
a pencil
a bar magnet

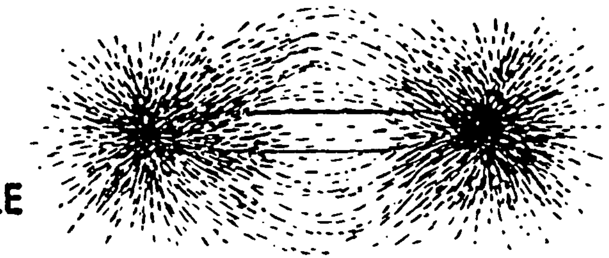


Steps

1. Tell the class that you will perform this demonstration for them. Explain that iron filings can be dangerous because they can get into people's eyes or mouths. Caution students not to touch them. (Note: When working with iron filings yourself, always be sure to spread newspaper over your work area so filings that fall can be rolled up in the newspaper and thrown away. The edges of the box will also keep iron filings from scattering.)
2. Trace the outline of the bar magnet on a sheet of paper. Then place the open box on a table or desk, with the bar magnet in the center and the paper with the outline on top of the magnet.



3. Sprinkle iron filings over the magnet outline. Shake the paper gently until you see a pattern like the one shown below. (The pattern the filings create shows the magnet's *lines of force*.) Point out how the filings gather around the ends, or poles. This is where the magnet is the strongest. (Note: Poles are discussed further on pages 31-35.)



79

80

jective: To learn how to make a
gnet.

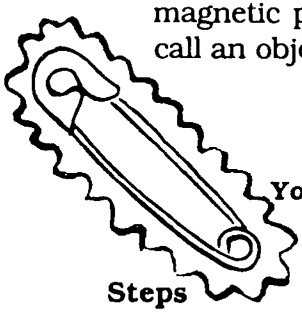
I Made a Magnet!

Break the Chain

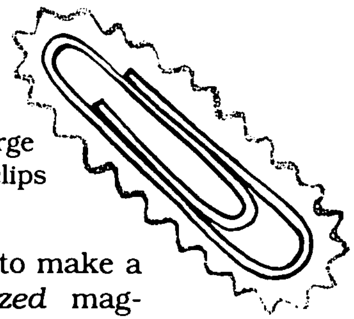
You need: magnets
paper clips

Steps

1. Give each child or small group a magnet and three paper clips, and show them how to make a three-paper-clip chain with the magnet.
2. Ask students what they think will happen if the second and third clips are removed from the magnet. Will they still stick together? (No) Have them try it and see what happens.
3. Explain that while a magnetic object is touching a magnet, it becomes a magnet. But it loses its magnetic power when removed from the magnet. We call an object that acts like this a *temporary magnet*.



Homemade Magnets



You need: magnets
magnetic objects, such as large safety pins and large paper clips

Steps

1. Tell the class that you will show them how to make a "homemade" magnet. Using a *non-magnetized* magnetic object, show the class that it will not pick up another object. Then stroke the object with one pole of a magnet. Be sure to stroke from one end of the object to the other *in one direction only*. As few as five or six strokes may be enough to magnetize a paper clip, but twenty strokes will make your new magnet stronger. Show the class that now the object will pick up a paper clip or a safety pin of smaller size.
2. Repeat the procedure with an object made of non-magnetic material to show that only magnetic objects can become magnets.
3. Have groups of children make their own magnets. Then let them see how many different objects their new magnets can pick up.
4. Let small groups go around the room and see how many objects in the classroom they can magnetize by stroking them with one pole of a magnet. Have them test each object by seeing whether a paper clip will stick to it.
5. Remind the class that the paper clip in the chain would not hold another paper clip after it was removed from the magnet. Ask them what they think would happen if the paper clip were left touching the magnet for a much longer time. Leave several paper clips in contact with magnets overnight. The next day, students will see that these objects have become magnets.

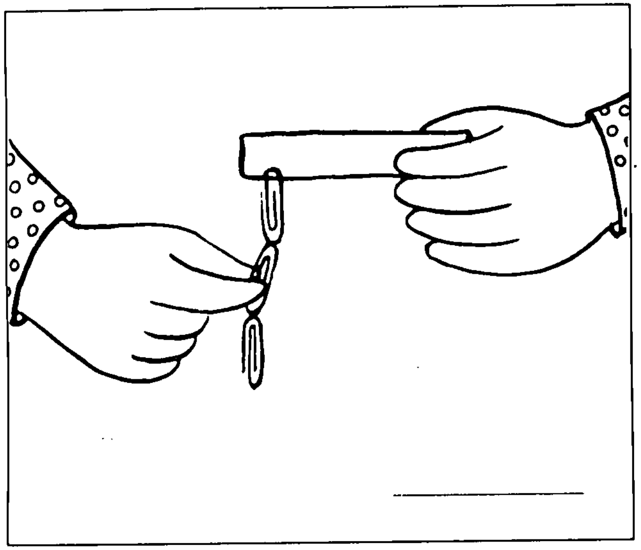
Follow-up Activity

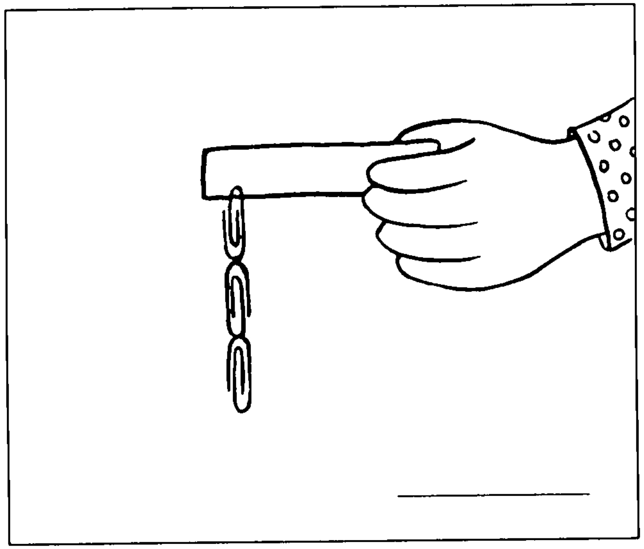
For a further explanation of why an object can be magnetized, see page 48.

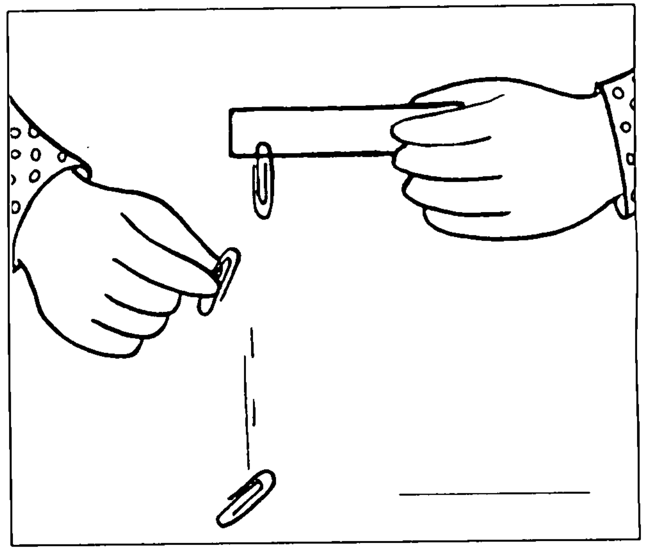
One-Two-Three

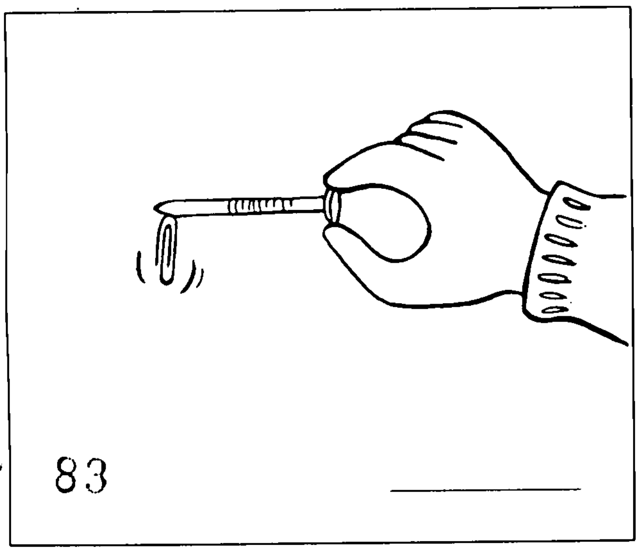
Name ____________________

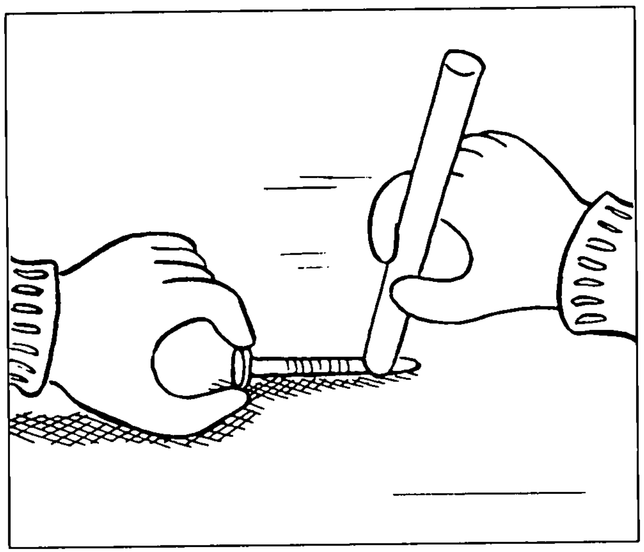
Number the pictures in each row. Write **1** to show what happened first. Write **2** to show what happened second. Write **3** to show what happened third.

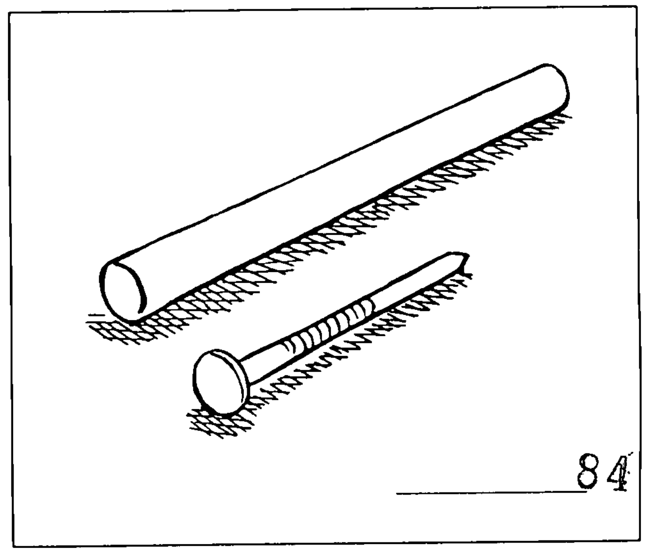












83

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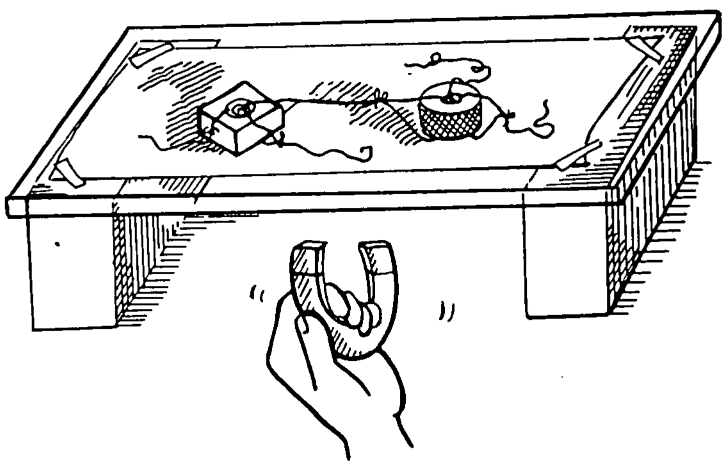
MAGNET PAINTING

MAGNETISM



MAGNETISM is a property of some metals such as iron. Many objects around the house like washers, nuts, bolts, and screws are partly made of iron and will be attracted to a magnet. The force from the magnet can be felt right through many materials, like Plexiglas. When the magnet is moved under the Plexiglas, objects with iron in them will be moved around above the Plexiglas.

MATERIALS:
blocks
piece of Plexiglas (11" x 14" or 28 cm x 36 cm or larger)
strong magnet
metal objects such as washers, nuts, bolts
embroidery floss (or thread)
tempera paint
paper
tape

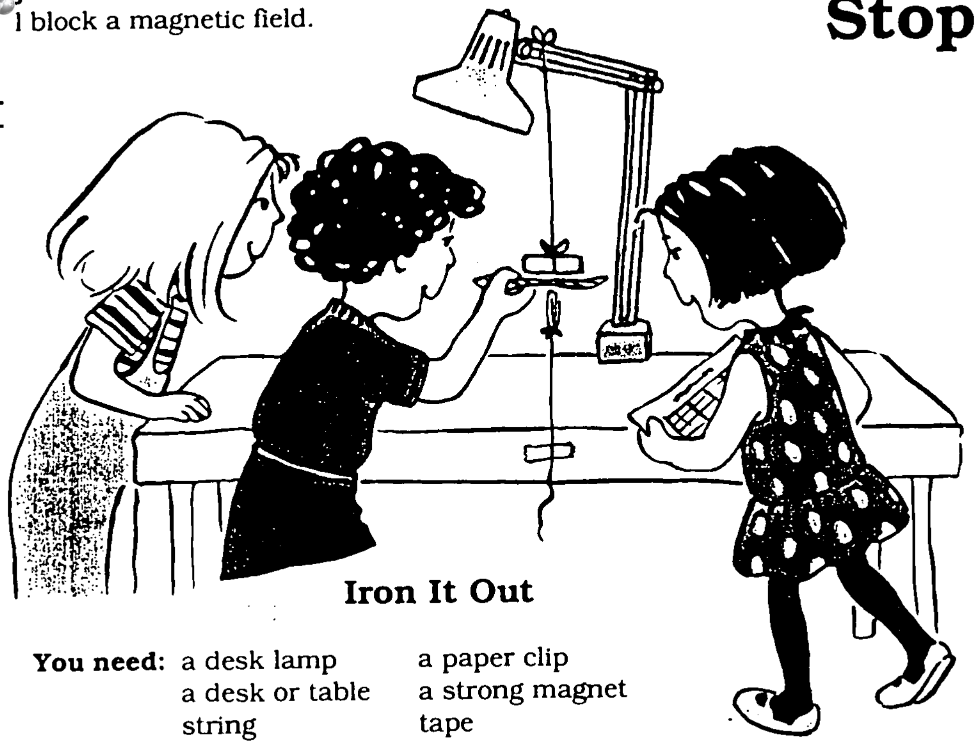
ART EXPERIMENT:
1. Place Plexiglas across two large blocks with enough room under the plexiglass to move hands.
2. Tape the paper on top of the Plexiglas.
3. Tie varying lengths of embroidery floss to washers and nuts.
4. Dip the washers or other metal objects in paint and lay them on the paper.
5. Hold a magnet against the underside of the Plexiglas and begin moving the magnet.
6. The magnet will "paint" with the metal objects and embroidery floss as they move over the paper.
7. Remove the objects, dip again in more paint, and continue painting until design is complete.

VARIATIONS:
- Spoon blobs of paint on the paper and drag the objects through the paint with the magnet.
- Experiment with food coloring or watercolors instead of tempera paint.
- Insert a marker through a nut. Place the nut and marker on top of the washer so that marker tip is exposed. Tape the marker, nut, and washer together. Move the magnet underneath the Plexiglas to begin drawing with the marker in the nut (see illustration).

85 86

Stop It!

jective: To discover what material
l block a magnetic field.



Iron It Out

You need: a desk lamp
a desk or table
string
a paper clip
a strong magnet
tape
samples of various materials: a sheet of paper, a piece of cloth, a paper clip, a wooden ruler, a small stainless-steel spoon
copies of the "Yes or No?" chart (page 32)

Steps

1. Tell the children that they are going to test different materials to find out if there is anything that will block the field of a magnet. Then place a desk lamp (or chair, or any other convenient object from which you can hang a magnet) on top of a table or desk. Suspend a bar magnet or another strong magnet from a string tied to the desk lamp so that the magnet hangs several inches above the table top.

2. Tie a string onto a paper clip, and tape the end of the string to the surface of the table. Adjust the length of the string so that the paper clip will stand up without touching the magnet. (The stronger your magnet, the more space you will have in between.)

3. Let children take turns carefully passing the objects you have assembled between the paper clip and the magnet. The paper clip will remain standing until someone passes an iron or steel object between it and the magnet. Then it will fall. (You may need to hold the magnet in place so that it doesn't grab onto the object.) Let the children repeat the experiment several times. To help them see that their results are consistent, make a chalkboard chart like the one below. Have students keep track, on their own "Yes or No?" charts, of the objects they tried.

DID THE PAPER CLIP FALL?

MATERIAL	1st try	2nd try	3rd try
paper	no	no	no
cloth	no	no	no
paper clip	yes	yes	yes
ruler	no	no	no
spoon	yes	yes	yes

4. Reminding the class that iron is the only material that can become a magnet, help the children figure out that iron is also the only material that can block a magnetic field. (Note: If a student tries an object such as a very thick piece of wood or a book, the paper clip may fall. Explain that a much stronger magnet would be able to attract through any such object, but even the strongest magnet cannot attract through a sheet of iron.)

Follow-up Activity

Place a paper clip on a sheet of paper and let children move the paper clip with a magnet held under the paper. Then put the paper clip in a stainless-steel pan, and let the children try moving it with a magnet held underneath the pan.

5 Senses Activities

Grade 1

The Senses Working Together

Activity 1: The Sense Chart

Grades K-2

This is a good project to start young children toward learning about their senses. Draw or make a chart with a picture of an eye, ear, nose, tongue and hand. Write down words or hold up pictures that "go" with each of the senses that are represented by the eye (vision), ear (audition), nose (olfaction), tongue (gustation) and hand (tactile sense). For example under the:

1. Eye: light bulb, sun, flashlight
2. Ear: piano, music
3. Nose: garbage, skunk
4. Tongue: ice cream, apple, hamburger
5. Hand: glove, pencil, book

Of course, most of these items could go under a few of the categories, but that is part of the project. Our senses work together to tell us about the outside world.

Materials:

- Blackboard and chalk OR a poster chart
- A list of words or pictures to be placed under the appropriate catagories.

Activity 2: Food Party

For grades K-6

It is not often that you get to EAT your experiment, but here is your chance. If possible, bake a cake or a batch of cookies within smelling distance of the class. Popping popcorn is also a good idea. Have all the students describe the sounds, taste, smell, feel, sight of the food. Make a list of everything that was experienced by each of the senses. Of course eat the treats too and describe the texture of the food.

Materials:

- Food (cake mix, cookie mix, popcorn)
- Cooking appliance
- Bowls or plates to serve food

Activity 3: Sensory Stations

Grades K-3

Explore the 5 senses in different "stations" around the classroom. Set up tables with hands-on materials for kids to touch, smell, taste, hear and see. Some possible station items:

- Hearing: bells, drums, whistles, rice-filled containers, spoons to tap.
- Touch: sandpaper, playdough, clay, ice, finger paint
- Vision: microscope, magnifying glass, colored water, prism
- Olfaction: vanilla, perfume, chocolate, spices
- Taste: jellybeans, cookies, crackers, fruit slices

[Back to Top]

GO TO: Hearing | Smell | Taste | Touch | Vision | Working Together

BACK TO: The Senses | Experiments and Activities | Table of Contents

Please send comments and suggestions about this page to me at chudler@u.washington.edu

Survey Please take a few minutes and fill out this survey - it will help me improve this resource.

Classifying The Five Senses

Submitted by: Bambi Exum

Endorsed by: Don Descy

Mankato State University

May 6th, 1997

Grade Level: Grades 1-3

Description:

In this lesson students are given index cards labeled with the five senses and picture cards with pictures that represent the five senses. The students will sort the picture cards to gain an understanding of the five senses and classifying.

Goal:

Students will understand the five senses.

Objectives:

The student will list the five senses. The student will correctly match pictures with the sense it belongs to.

Background Information:

This activity is done after previos lessons of learning what the five senses are. It can be used as a review of the senses and to introduce classifying.

Concepts:

Students will be able to:

1. Explain what classifying is

2. Identify the five senses

Materials:

20 index cards labeled with the senses: *See, Hear, Smell, Taste and Touch*

4 sets of sense picture cards that are laminated

Carton of milk	Cookies
A book	Crayon box
Brown lunch sack	Backpack

Pencil	Orange
Sandwich	Notebook

Procedure:

1. Have students tell you what each bag is for

2. Tell the class you want them to classify the items A. State: Classifying is putting things together that go together

3. Call on students to tell you which item goes in which bag

4. When done, take the items out of the each bag and ask if the item and the bag go together

5. Review the senses by having students describe how each item looks and how it might sound, smell, taste and feel

6. Divide the class into groups

7. Tell the students to sort picture cards by putting them by the index card with the sense they represent

Assessment:

1. Check to see if picture cards are under correct sense.

2. Ask students to draw their own pictures that would belong to the senses

Objective: To explore our sense of sight.

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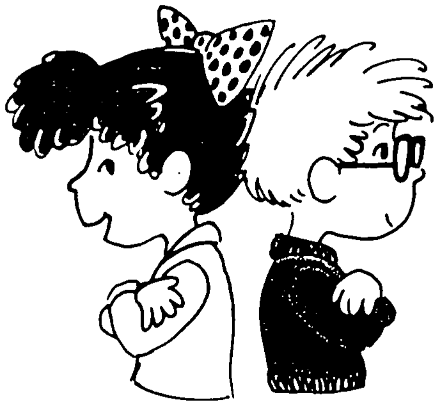
Use Your Eyes

I'll Be Seeing You

Steps

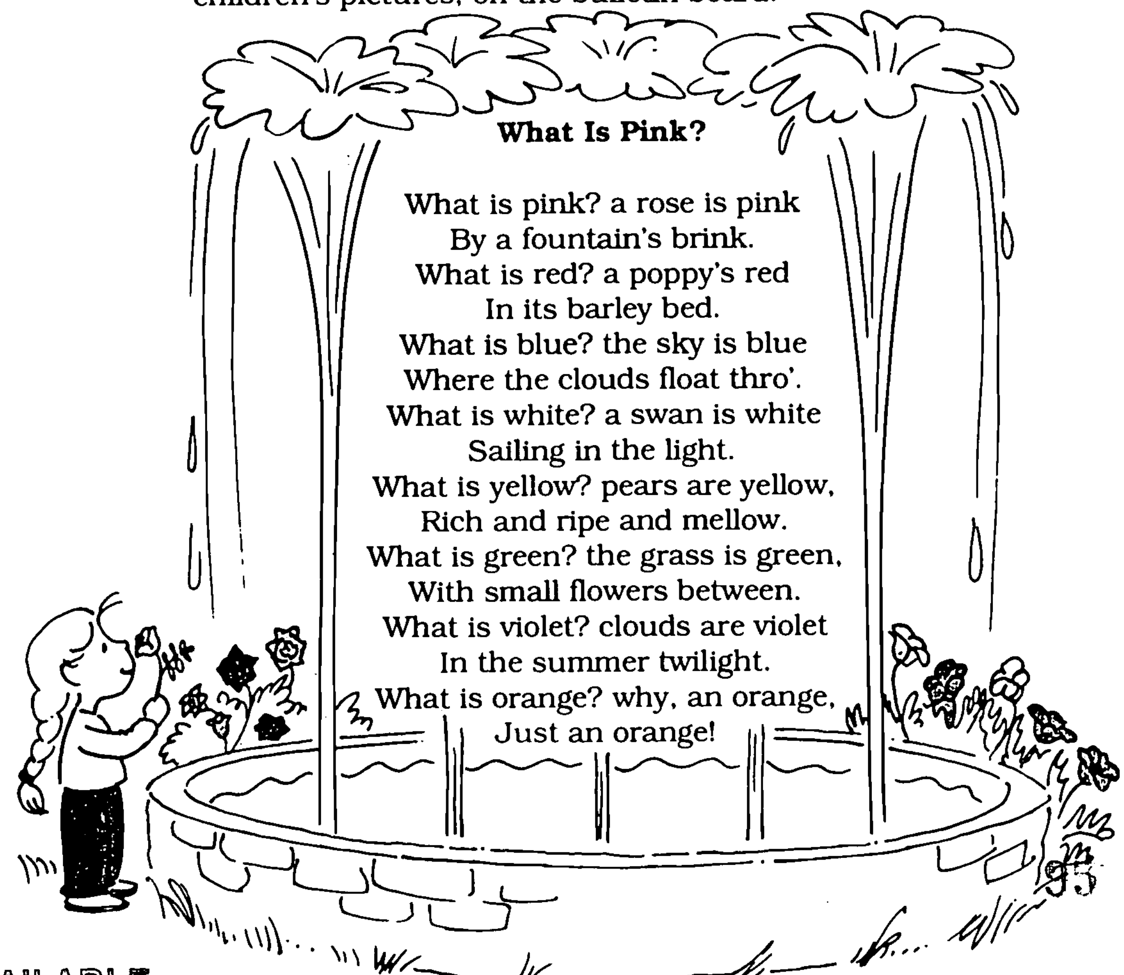
1. Tell the class they are going to play some games to see if they are sight experts.
2. Have all the children stand up and close their eyes. Tell them that the person who is tapped will leave the room. Then, very quietly, tap one student on the shoulder and have that student tiptoe out of the room. Then see who can be first to guess who is missing. Have students scramble their seating positions and play the game again. You may also wish to try removing an object from view and seeing who can guess what is missing.
3. Have the class pair off. (If there is an odd number of children, you can be someone's partner.) Give the children ten seconds to look at each other, trying to notice every detail. Then have partners stand back to back and answer questions they ask each other, such as, "What color are my shoelaces?" "How many buttons are there on my shirt?" or "Am I wearing glasses?" The first student to stump his or her partner is the winner. Have students switch partners and play again.



4. Play "Does It Look...?" Choose one student to be "It," and have It think of an object. The other students must guess the object by asking for clues. Their questions must begin with, "Does it look... (big, small, round, square, etc)?" The student loses his or her turn after a "no" answer.

A Colorful Poem

Ask students to say the word that first comes into their minds when you ask, "What is ____ ?" and name a color. Write their answers on the chalkboard, and let the children draw pictures of the objects they name. Then read them the following poem by Christina Rossetti. Some of the poet's answers may be the same as the students'! You may wish to post the poem, along with the children's pictures, on the bulletin board.



What Is Pink?

What is pink? a rose is pink
By a fountain's brink.
What is red? a poppy's red
In its barley bed.
What is blue? the sky is blue
Where the clouds float thro'.
What is white? a swan is white
Sailing in the light.
What is yellow? pears are yellow,
Rich and ripe and mellow.
What is green? the grass is green,
With small flowers between.
What is violet? clouds are violet
In the summer twilight.
What is orange? why, an orange,
Just an orange!

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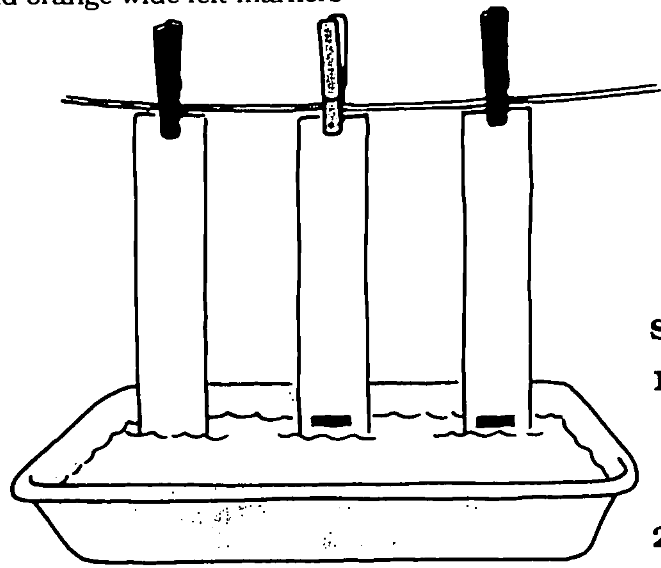
"What Is Pink?" from SING-SONG by Christina G. Rossetti (New York: Macmillan, 1924)

Objective: To demonstrate that all colors we see come from the three primary colors.

Show Your True Colors

See Them Separate

You need: white blotting paper or coffee-filter paper, cut into six-inch strips
green, purple, and orange wide felt markers or food coloring
a pan of water
string
clothespins



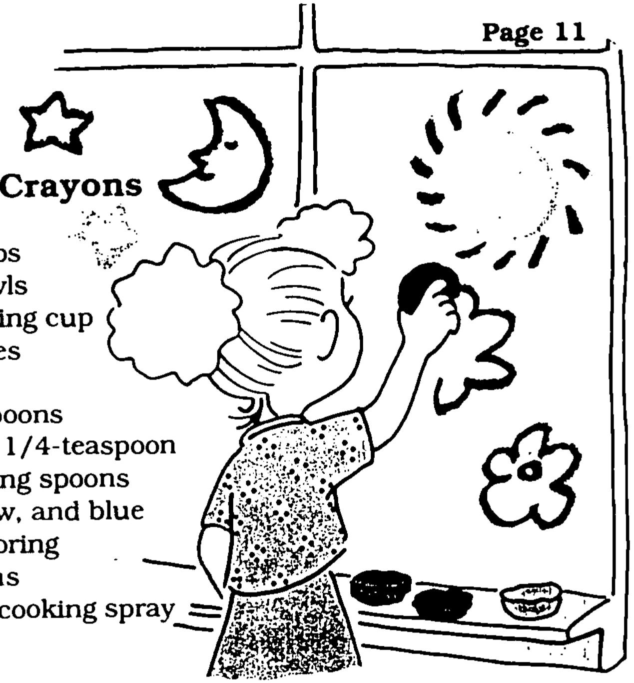
Steps

1. Tell students they are going to do an experiment to learn about colors. Have each student mark a stripe of color or put a drop of food coloring on a strip of paper, about one inch from the bottom.
2. Hang the paper strips on a string tied above a pan of water (colored end down). The bottom of each strip should touch the water.
3. After a few minutes, different-colored bands will spread up the paper. Green will separate into blue and yellow; purple into blue and red; and orange into red and yellow. Make sure children understand that each color they put on the strips is a mixture of the two primary colors they now see.
4. After the strips have dried, children can use them as colorful book marks.

Follow-up Activity

Repeat the experiment with the primary colors, and compare the results. (The colors will not separate.)

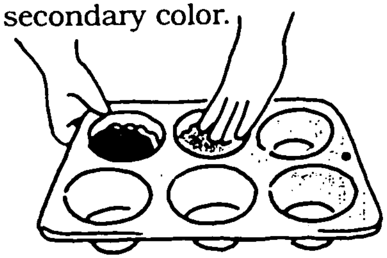
Cooking Up Crayons



You need: paper cups
small bowls
a measuring cup
soap flakes
water
mixing spoons
1/2- and 1/4-teaspoon measuring spoons
red, yellow, and blue food coloring
muffin tins
nonstick cooking spray

Steps

1. Divide the class into small groups. Give each group two paper cups and a bowl with enough ingredients inside to make two crayons: 7/8 cup of soap flakes and 1/8 cup of water
2. Have the children mix the soap flakes and water in the bowls and take turns stirring them until there are no lumps.
3. Tell students that they are going to see if they can put colors together to make other colors. Help the groups add food coloring to their mixtures: 1/4 teaspoon each of two primary colors to make a secondary color.
4. Spray the nonstick cooking spray on the muffin tins, and let each group help press their mixture into two of the muffin cups.



5. Leave the crayons in the tins to harden for a day or two. Children can then use the crayons to draw on the classroom windows. The color will wash off easily!

Plant Activities

Grade 3

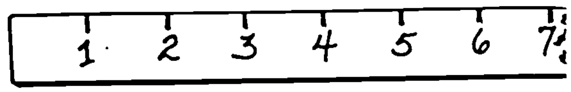
Inside a Seed

Scientist: ____________________

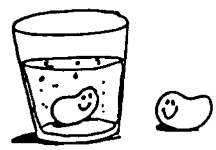
1. What does the dry seed look like? ____________________

____

2. How big is the dry seed? Trace the seed on the ruler.



3. Soak the dry seed in water overnight.



How is the wet seed different from a dry seed?

____

____

4. Split the seed in half. What does it look like on the inside? Look for the tiny plant called the embryo.

____

____

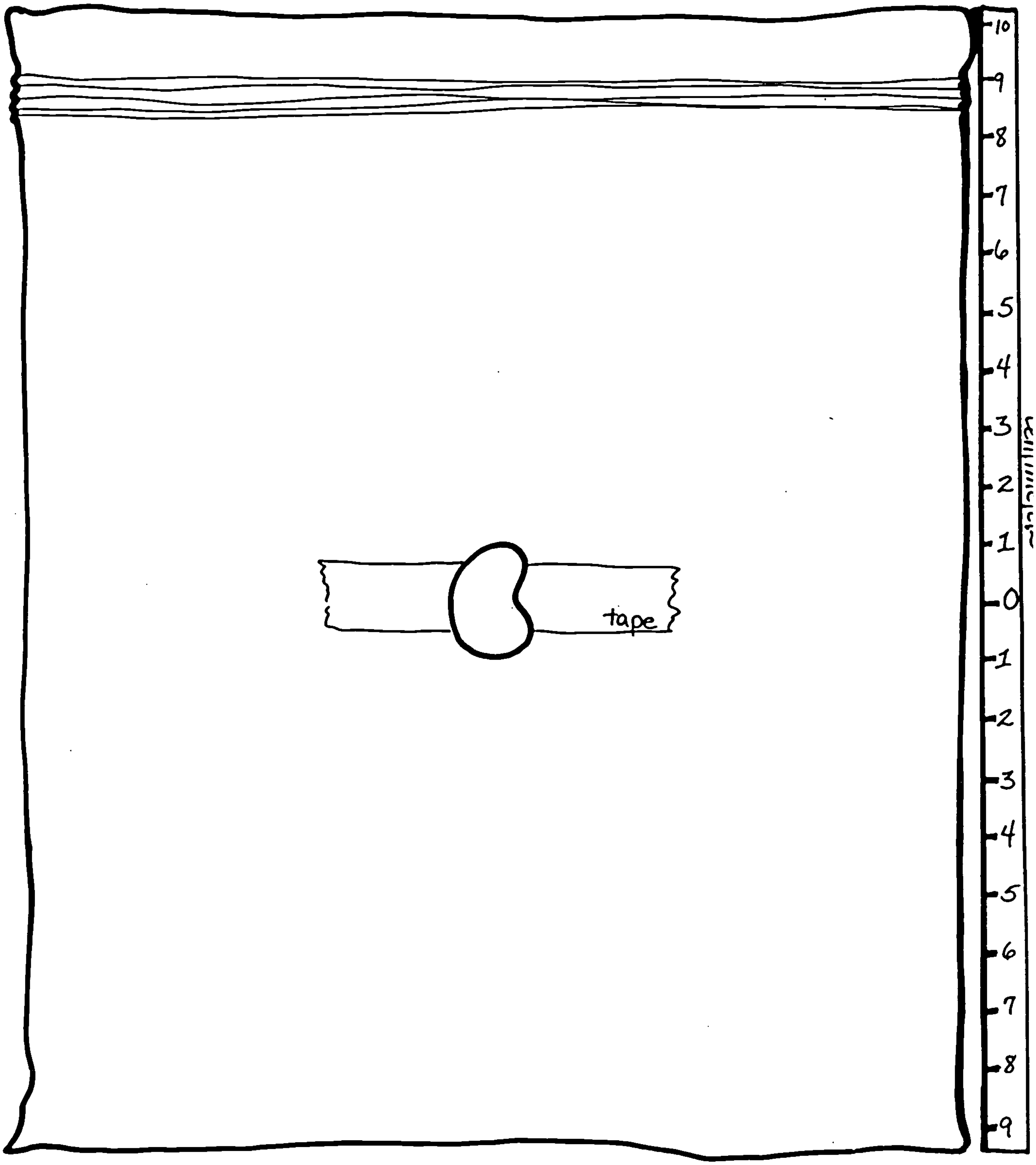
5. Why do you think there is so much food stored for the tiny plant (embryo)?

____

Scientist

A Seed Grows

Place a lima bean in a bag. Use the next page to make your predictions about its growth. Measure the growth each day. Draw the plant as it grows.



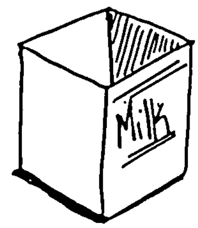
What do Plants Need to Grow?

You will need:

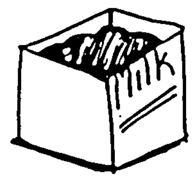
4 milk cartons
soil
radish, bean, or corn seeds
scissors

Do This:

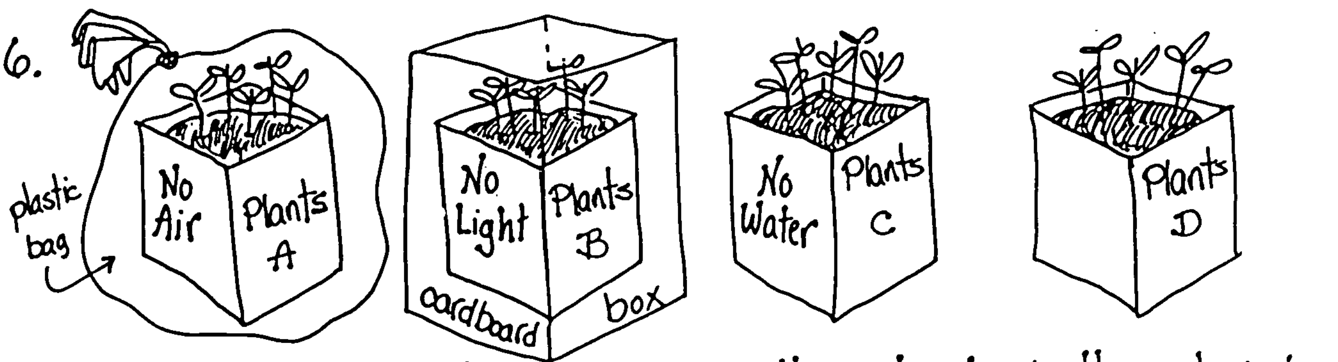
1. Cut off the top of the milk cartons to make planters.



2. Decorate with roving or paper.



3. Fill the cartons with soil.
4. Plant the seeds in the soil. Dampen the soil.
5. Wait. After the seeds sprout, divide the cartons into 4 groups to test growing conditions.
6.



Has: soil, water, light	Has: soil, water, air	Has: soil, air, light	Has soil, air, ligh[t]
No Air	No Light	No Water	and water

7. Watch to see which plants grow best. What do plants need to grow?

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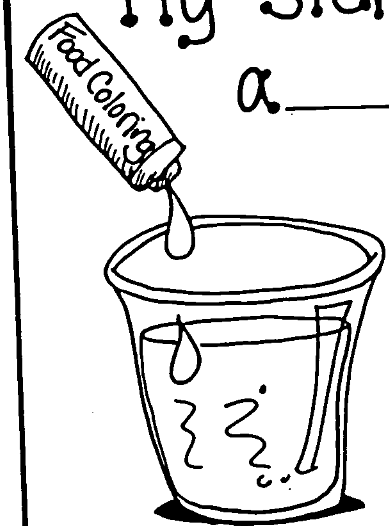
My Name

Stem Study

Here is a drawing of my stem.

My stem is from a



1. Put some water in a glass.
2. Add 4 drops of food coloring
3. Cut off the end of the stem
4. Place the stem in the glass.
5. Leave overnight.

What happened?

Why?

What are stems for?

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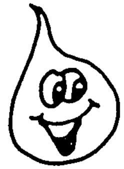
Water Activities

Grade 3



Where is Water Found?

Name: ______________________

Think of all the places you have seen water. List and draw.

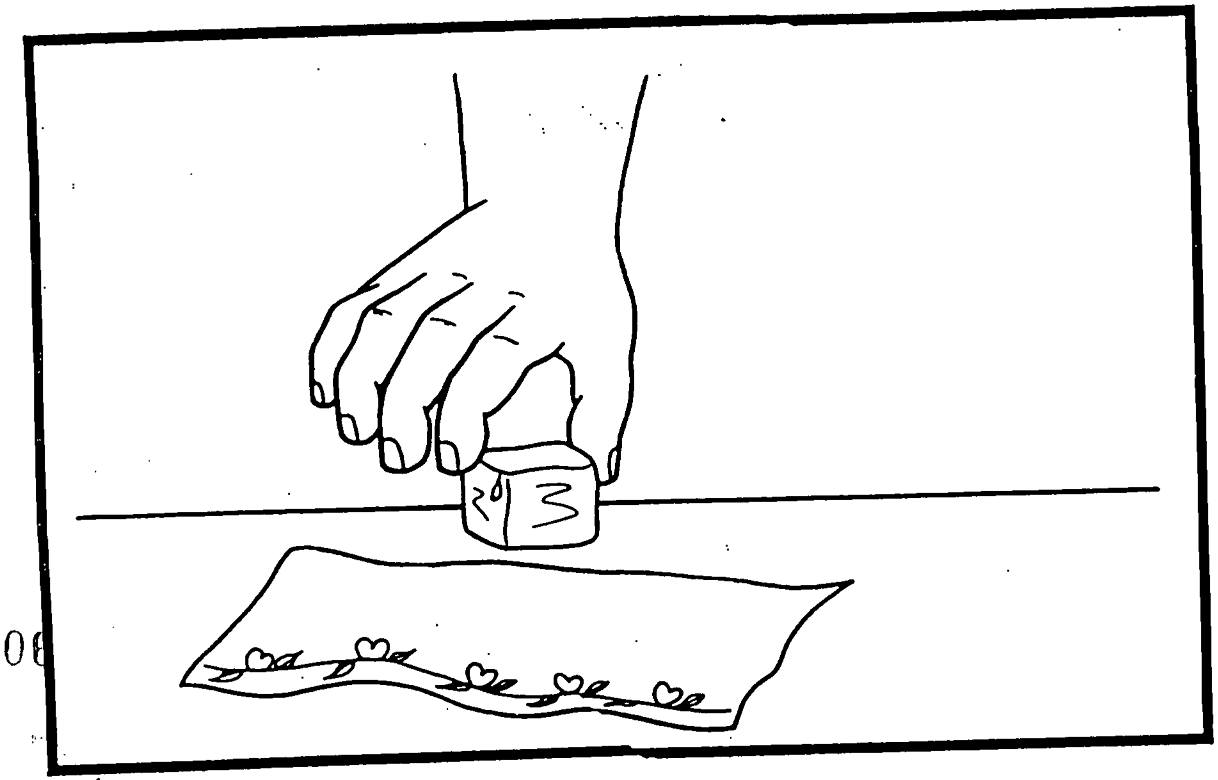
MELTING

Experiment

Materials: paper towel, ice cube

Experimental Procedure:
Place the ice cube on the paper towel.
Let the ice cube sit on the paper towel in the room for thirty minutes.

Results:
The ice cube got smaller. The paper towel got wet. As the ice became warmer, it MELTED.



Talk About the Experiment

1) What did you make your ice cube out of? [water]
2) How does the ice cube feel? [very cold]
3) What happened to the ice cube as it set out in the classroom? [The ice cube got smaller.]
4) What is it called when an ice cube turns into water? [MELTING]

Try Singing About MELTING

(to the tune "Little Red Caboose")

Little cube of ice, MELT, MELT, MELT
Little cube of ice, MELT, MELT, MELT
Little cube of ice no longer big.

When you are not cold, COLD, COLD, COLD
Your shape you can not hold, HOLD, HOLD, HOLD
Little cube of ice MELTED to water.

Name ____________________ Date ____________

Discover

How can you tell if there is water in the air?

Materials

- ☐ paper cup
- ☐ metal can
- ☐ water
- ☐ ice

Procedure

Pour water into a metal can until it is half full. The water should be at room temperature. Make sure the outside of the can is dry.

Add a few ice cubes to the water in the can. After a few minutes, look at the outside of the can. What is different about it?

____

____

____

____

How can you explain what you see?

____

____

____

____

CHAPTER 10
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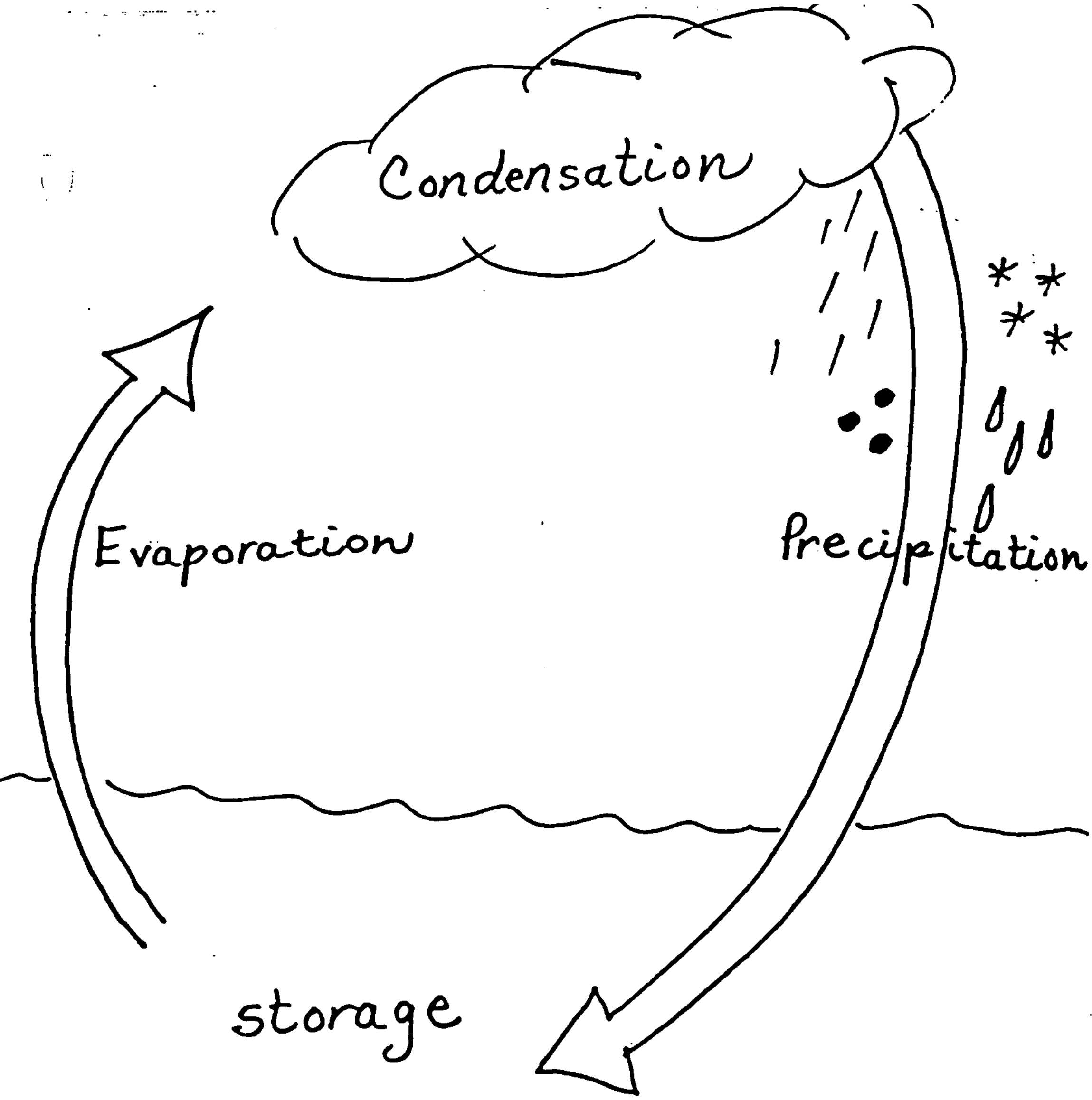

made in a ziplock bag with water and gravel at bottom

Simple Machines Activities

Grade 3

Name ____________________ Date ____________

Explore Together

How does a fulcrum's position affect the force needed to lift an object?

STEP 1 Place the fulcrum on 50. Place the clay on "load". Now place washers, one by one, on "force" until the clay is lifted.

How many washers were needed to lift the clay? ____________

STEP 2 Place the fulcrum on 40. How many washers does it take to lift the load now?

____

STEP 3 Place the fulcrum on 60. How many washers does it take to lift the load now?

____

Observations and conclusions.

1. When were the fewest washers needed to lift the load?

____

____

2. When were the most washers needed to lift the load?

____

____

3. To lift a load easily, should the fulcrum be closer to the load or farther from it?

____

____

School Days

Homework:

Your homework assignment is to bring a lever to school tomorrow. It needs to be a lever used for "real life", not one that you make. You may find a lever in the kitchen, or maybe in the shop. You need to know how it works and be able to explain it to the class. You also need to show us which part is the fulcrum, the load, and where the force is applied.

Thank you!

Mrs. Fisher

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NAME ______________________

1. QUESTION: How does a pulley make it easier to lift a load from a lower place to a higher place?

2. HYPOTHESIS: ______________________

____

____

____

3. COLLECT DATA:

Load	Lifting Force	Force used with a pulley
1.		
2.		
3.		
4.		

4. DRAW CONCLUSIONS:

____

____

____

____

____

Body Activities

Grade 4

PUT SOME STARCH IN YOUR DIET

What You'll Need: Tincture of iodine (have an adult get some from the medicine cabinet or a drug store) and different kinds of food: a slice of bread, a piece of apple, a lettuce leaf, a small bit of meat . . . you get the idea.

Now, below, list all the foods you've gathered. If you think the food has starch in it, put a check next to its name. Poll other members of your family to see which foods they think contain starch. To test your theory about which foods contain starch, put a small drop of iodine on the food. If starch is present, the food will turn blue-black. Are there certain groups of food that always contain starch? Which are they?

____

____

____

____

Which never do?

____

____

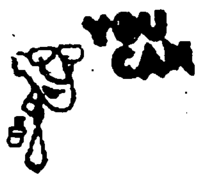
____

____

INTESTINAL PROBLEM

What You'll Need: Your own two feet and a large walking area

You may be between 3 and 5 feet tall, but your small intestine is 16 feet long! How is that possible? Can anything 16 feet long really fit inside your belly? Measure 16 feet by walking heel-to-toe 16 steps. This is how long your small intestine is. Can you think of anything else that measures 16 feet long? Can you imagine it fitting inside your belly?



Mucus

by jok church

Question: If you have acid in your stomach, why don't you melt?

A GOOD QUESTION IS A VERY POWERFUL THING!

Answer:
Your stomach does have acid inside of it - hydrochloric acid - strong enough to eat through a piece of the metal zinc.

The reason your stomach isn't destroyed by the acid is our old friend snot, which is also called mucus.

Mucus is thick, sticky, slimy and gooey. And it's a good thing.

The inside of your stomach is covered with it. That layer of snot protects the stomach from its own acid. In fact, the miracle of mucus protects many parts of our bodies Ð some parts that even I will not mention in the funnies.

You Can make fake snot and get a reputation for being the really strange kid everyone knows. Your fake snot will have many of the same ingredients as the real thing.

Whip Up Some Fake Snot !

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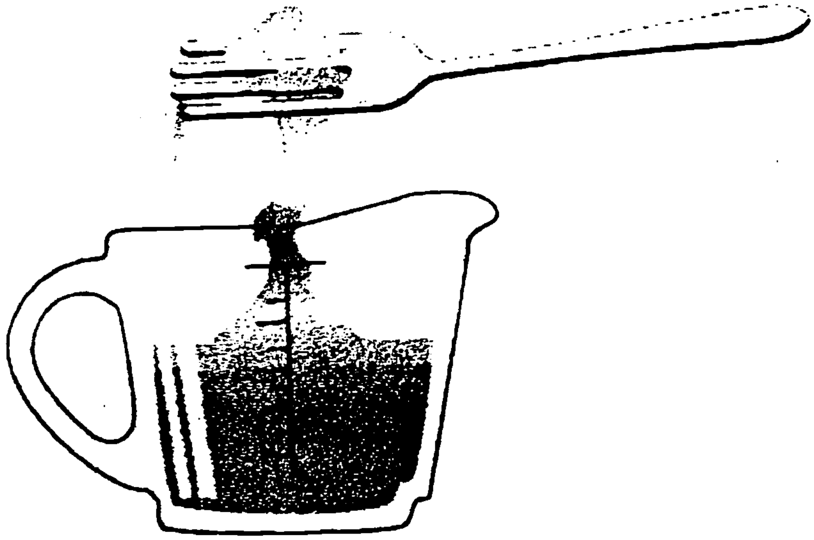


WHAT YOU NEED:
Light corn syrup -
unflavored gelatin -
measuring cup - water -
microwave oven or stove -
permission from your
family to cook in the
kitchen, or family help

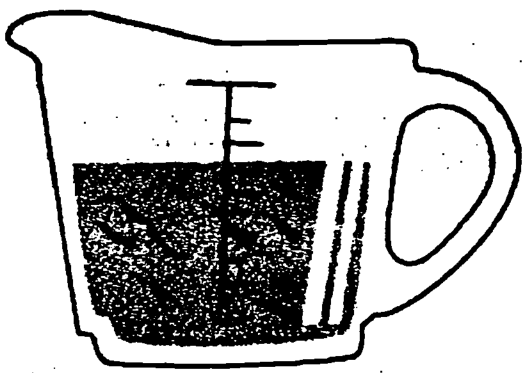
WHAT TO DO:
Heat 1/2 cup water just until it boils. Remove the heat. Sprinkle in 3 envelopes of unflavored gelatin. Let it soften a few minutes and stir with a fork. Add enough corn syrup to make 1 cup of thick glop. Stir with the fork and lift out the long strands of gunk. As it cools, you'll need to add more water, spoonful by spoonful.

SO WHAT:
Mucus is made mostly out of sugars and protein. That's what you used to make your fake snot, only you used different proteins and different sugars. Did you see those long, fine strings inside your fake snot when you lifted out the fork?

Those strands are proteins. They're why real snot can be stretched out real long. The protein helps make it sticky, too. (The protein in your fake snot is gelatin.)

Real mucus sticks to the inside of your stomach. Without it, *you'd digest yourself.* Real mucus has lots of other jobs, which *You Can* learn in Experiment #2.

Build Some Boogers !



WHAT YOU NEED:
The fake snot you just happen to have made.

WHAT TO DO:
Ask someone who knows to show you the right way to change the vacuum cleaner bag. (You Can sell everyone on the idea of doing this experiment because you'll now be able to help out around the house.)

Go outside with the dirt bag and your fake snot. Blow a bit of the dust from the vacuum cleaner. It's very fine and is a bad thing to breathe into our bodies.

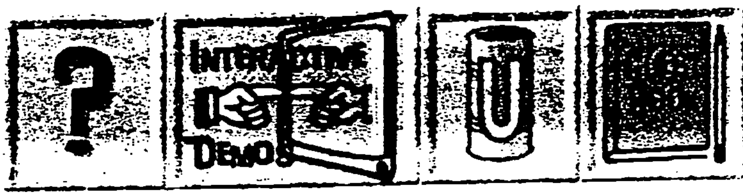
Dump a pinch of the finest dust onto your fake snot. Now stir it up. Look closely into the goo from the side. You just made fake boogers'

SO WHAT:
The fine dust got trapped and suspended in the thick fake snot. That's the idea of having mucus in your nose.

We use it to trap all the dust, pollen and junk that's floating in the air. Sometimes when you blow your nose, out comes gross black stuff. It's usually mucus with trapped dust.

It's healthier to keep that kind of dirt outside of our bodies. And with the miracle of snot on guard, most of the schmutz is trapped and then blown out in boogers!

P.S. from Jax: It's probably a good idea to save this recipe. You Can never have too much thick, gooey, sticky, slimy stuff on hand, or at least the directions for making it. This is an especially wonderful treat for Halloween! (Or is it a trick for Halloween?)



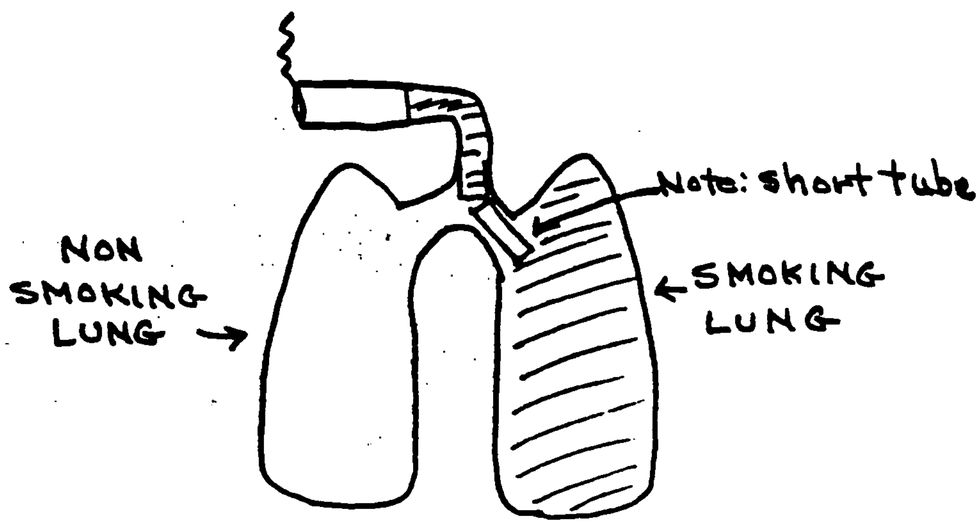
Jok Church - jok@nbn.com
Web Site services: North Bay Network - support@nbn.com

AMERICAN CANCER SOCIETY, ILLINOIS DIVISION, INC.

FOR MORE INFORMATION, [redacted]

SMOKING LUNGS

DEMONSTRATES THE ACCUMULATION OF TARS AND NICOTINE IN THE LUNGS



These smoking "lungs" have been designed to demonstrate the accumulation of tars and nicotine from smoking in the human lungs. Even one inhalation of smoke by the model will cause visible color change or tar deposit. Each additional cigarette 'smoked' by the lungs makes the demonstration more effective. We recommend the 'lungs' be stored in a plastic bag with a usage record card.

The lung connected by a short tube to the throatpiece is the lung that should be squeezed and used. The small air spaces in the foam lung resemble the small air sacs in the human lung. The whole lung should be squeezed so there is complete exhalation and when released, complete inhalation.

To start the demonstration, place the lungs on a table. Have a cigarette and a match ready. Place forearm on lung connected with tube and force arm down so that the lung will exhale. Place cigarette in mouthpiece. Light match and, releasing pressure so that the lung will inhale, light the cigarette. The model will smoke cigarette by removing the cigarette when exhaling (squeezed) and placing cigarette in mouthpiece when inhaling (released). Just squeezing the lung at the top will not create a full exhaling and inhaling effect and will only darken the upper part of the lung.

(OVER)

Squeezing the lungs after use and smelling the smoke makes one aware of the strength of cigarette smoke. Smelling the smoke and seeing and wiping the throatpiece with a pipe cleaner shows how tar coats the mouth, tongue, larynx and the entire respiratory and digestive system with these poisons and irritants.

Smoking accounts for about 30% of all cancer deaths. It is related to about 320,000 deaths each year. It is important to remember that besides tar and nicotine, cigarette smoke contains a host of other poisonous gases, such as hydrogen cyanide, volatile aromatic hydrocarbons, and especially carbon monoxide -- possibly a critical factor in coronary heart disease.

We hope the visibility created in your demonstrations will be educational and helpful.

IT IS REQUESTED YOU REPORT HOW MANY PEOPLE WERE SHOWN THIS DEMONSTRATION.

Additional educational materials are available, free of charge, from your local American Cancer Society Area Office.

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Name ______________________ Date ____________

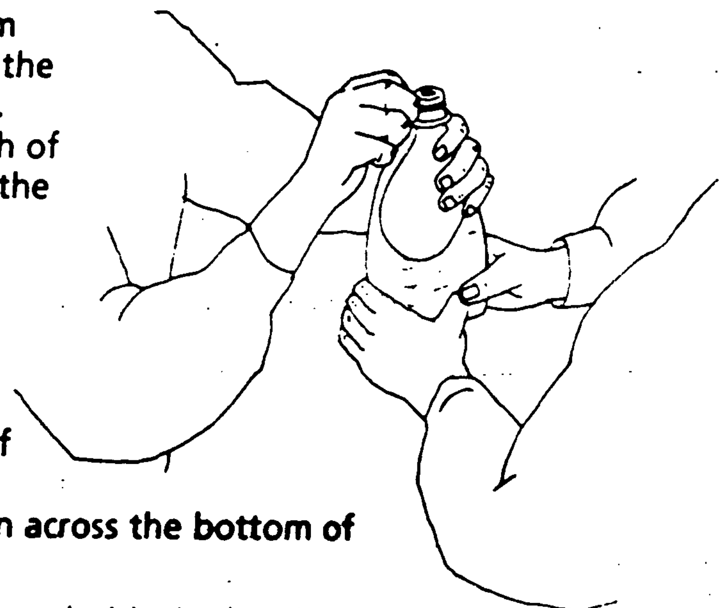
Explore Together

How does the diaphragm help fill the lungs with air?

Materials

Organizer
- ☐ top half of a 1-L plastic bottle
- ☐ medium balloon ☐ small rubber band
- ☐ scissors ☐ large balloon ☐ large rubber band

Procedure



Investigator **A.** Place the medium balloon through the top of the bottle. Stretch the mouth of the balloon over the bottle opening. Hold the balloon in place with the small rubber band.

Investigator **B.** Cut off the neck of the large balloon. Stretch this balloon across the bottom of the bottle.

Manager **C.** While the Investigator holds the bottle, place the large rubber band around the bottom of the bottle to hold the balloon in place.

Group, Recorder **1.** Compare this model with the diaphragm and lungs.

____

____

____

2. Predict what will happen when you pull down on the large balloon.

____

____

CHAPTER 13 PAGE 425

(CONTINUED)

Investigator D. Pull down on the large balloon.

Group, Recorder 3. Observe what happens to the balloon inside the bottle.

____

____

____

Writing and Sharing Results and Conclusions

Group, Recorder 1. Explain how the action of this model compares to how the lungs and diaphragm work.

____

____

____

____

____

Reporter 2. How do your results and conclusions compare with those of your classmates?

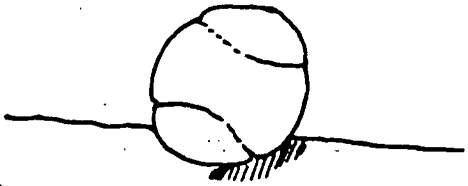
____

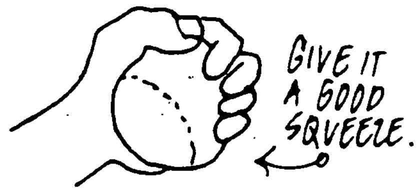
____

____

CHAPTER 13 PAGE 425

Tennis Ball Squeeze Try to do a heart's work with your hand. Test the ease with which you can squeeze, and get a grasp on the power of this mighty muscle.





① THE FORCE NEEDED TO SQUEEZE A TENNIS BALL IS SIMILAR TO THE FORCE NEEDED TO SQUEEZE BLOOD OUT OF THE HEART.

② IF YOU SQUEEZE 70 X A MINUTE (THE NORMAL PULSE), YOU WILL GET A FIRST HAND IDEA OF HOW HARD YOUR HEART WORKS.

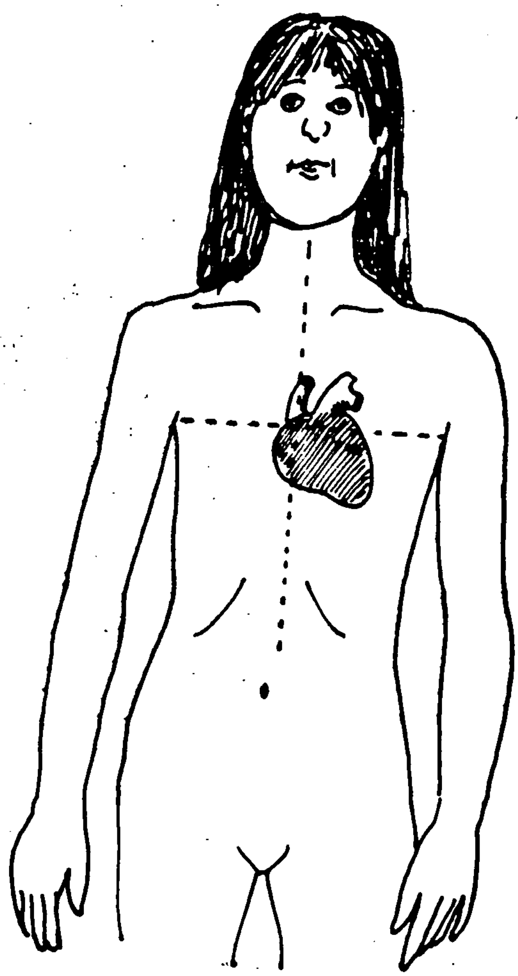
Listen In

As your heart pumps, it makes a variety of clicks and thumps. Each sound has a special meaning if you know how to listen in.

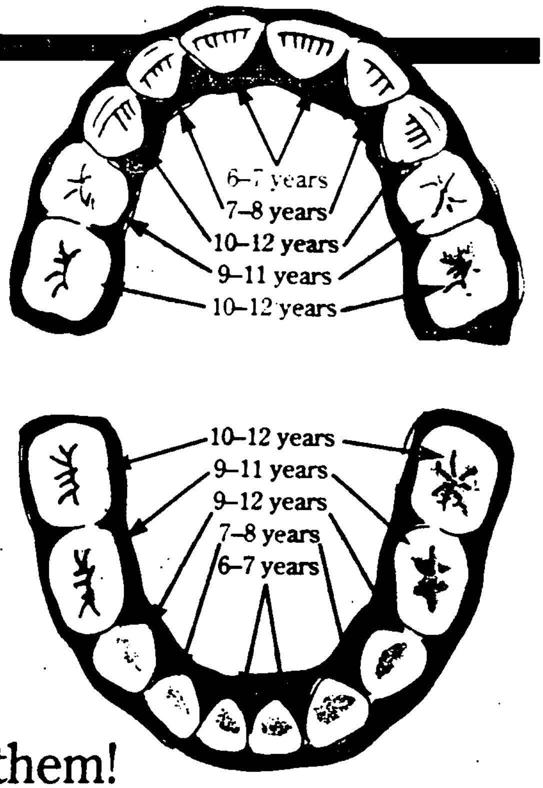
First you need to find the place where the pulse is strongest. Many people think their hearts are on the left side. That's not exactly true. The heart is hung in the center of the chest between your lungs, just under your breastbone.

It is tipped a little to one side. This is where the confusion arises. The tip sticks out and taps against the left side of the chest. This is the spot where it is most easily felt and heard.

(Note: You may have a hard time hearing heart sounds. Be patient. Move your stethoscope. Get rid of as much background noise as you can. If you still have problems, skip rope or tap dance first for a minute.)



The Whole Tooth



Of the 20 teeth in your first set (your "baby teeth"), those at the front are usually the first to go; the last are farther back. These "dropouts" make room for your permanent teeth—all 32 of them!

A good way to take care of your teeth is to cut down on sugary foods. **Sugar is food for plaque, which in turn gives off acid that causes cavities.** To see how this happens, do the following experiment.

You will need:

- 2 halves of an eggshell
- A jar of water
- A jar of vinegar
- Soda pop

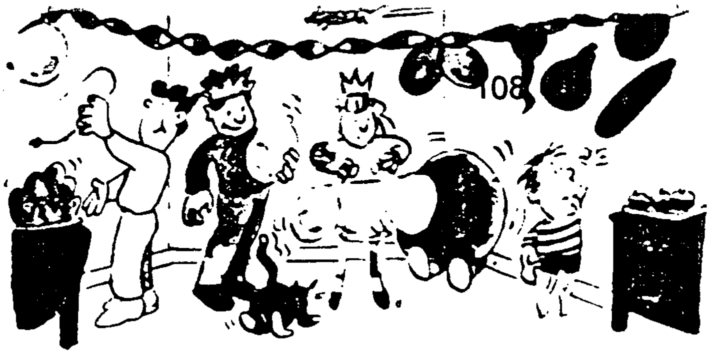
Eggshell makes a good substitute for a tooth because it's made mostly of calcium and so are teeth. (If you've kept a tooth left behind by the tooth fairy, use it in the experiment!) Put one-half of the eggshell in the jar of water and the other half in the vinegar. Leave them overnight. What happens when the acid in the vinegar gets at the shell?

Try the experiment a second time, using soda pop. Does the soda contain enough acid to eat away the eggshell? What does that tell you about drinking a lot of pop?

Magnets & Electricity Activities

Grade 4

Static electricity



Electricity is always trying to move from one thing to another. If it cannot move for some reason, it is called static electricity. There are several ways that you can create static electricity, and see its effects. These experiments are most successful if you do them on a dry day.

Sticky balloon

You can use the forces of static electricity to make a balloon stick to your clothing or hair. It's best to wear something made of wool if you want the balloon to stick to your clothes.

You will need

- Balloon
- Sweater made from wool

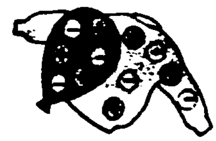
1. Blow up the balloon. Rub it vigorously against your sweater or your hair, about ten times.

2. Hold it to your hair or sweater for a moment and then let go. Does the balloon move?

What happens?

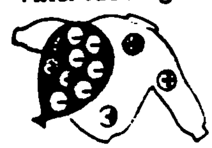
When you rub the sweater with the balloon, each one takes a different electrical charge (see page 45). The balloon becomes negatively charged, and the sweater becomes positively charged. These opposites attract each other.

Before rubbing



The positive and negative charges are balanced in both things.

After rubbing

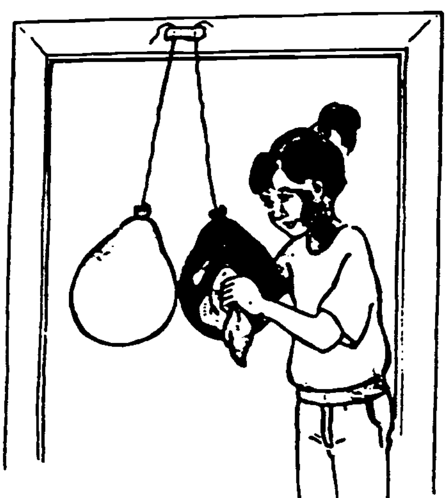


The balloon borrows some of the sweater's negative charge.

Pushing apart

You will need

- Two balloons
- Two pieces of nylon thread, the same length
- Adhesive tape
- A piece of cloth made from wool (a wool scarf is ideal)



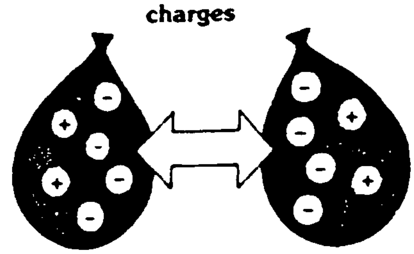
1. Take the lengths of nylon thread and tape them to the top of a door frame, spacing them about 2.5cm (1in) apart. Tie a balloon to the end of each thread, so they are hanging at the same height. They should be touching.

2. Rub the balloons with the cloth to give them an electrical charge, one at a time. Let go of the balloons. How do they hang now?

What happens?

Things that are made of the same material always take the same charge. Balloons become negatively charged when you rub them. Matching charges of static electricity always push each other away, like matching poles of a magnet, so the balloons hang a little distance apart.

Matching electrical charges



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Name ____________________

STATIC STROKES

Part 1

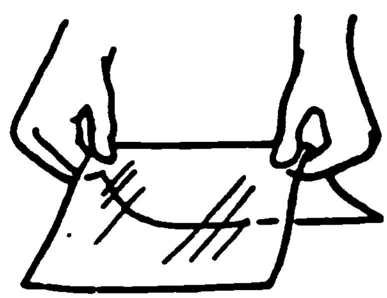
Place a piece of plastic wrap flat on your desk and rub it with a paper towel. Pick the plastic wrap up by one corner.

What happens? ____________________

____

____

Place the plastic wrap on your desk and rub it with a paper towel again. Pick the plastic wrap up by the midpoints of two opposite sides.



What happens? ____________________

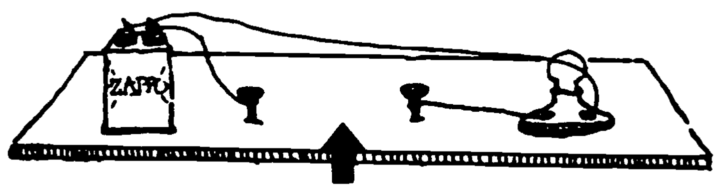
____

____

Name ____________________

CONDUCTORS AND NONCONDUCTORS

Test different materials to see which ones will conduct electricity. Test each material by placing it across the nails or switch. If the material conducts electricity, the light bulb will light.



Place test materials here.

Try testing the following:

different metals	salt water	chalk
wood	rubber	fabric
plastic	glass	cardboard
cotton	leather	

CONDUCTORS	NONCONDUCTORS

QUESTION:

What similarities do you notice about the things that will conduct electricity?

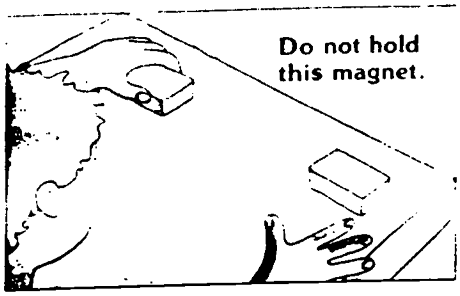
____

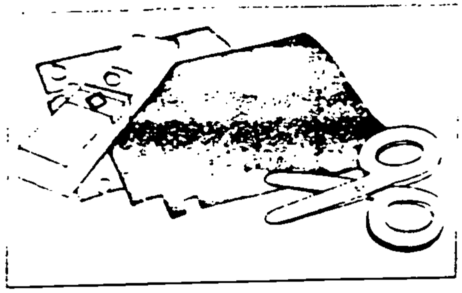
____

Floating magnets

[illegible]

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- Penc[illegible]

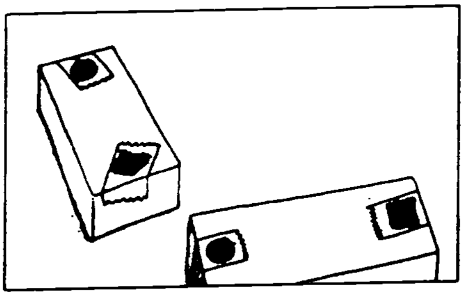


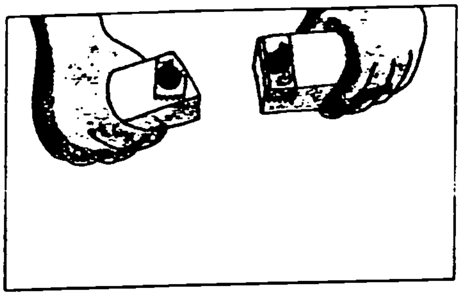


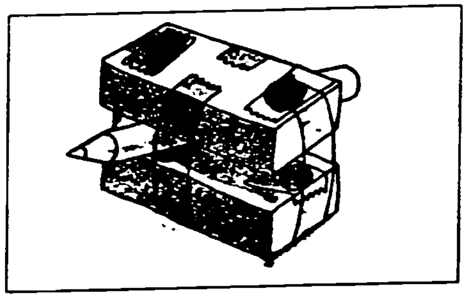
Magnets will behave in one of two ways if you point one at another. You can use this to make a magnet float in the air, following the instructions here.

1. Push the end of one magnet to the end of the other. They will either pull together or push apart. If they push, turn one around so they pull together.

2. Cut out and tape shaded paper on the ends (called the poles) that pull together. Use one shade for one magnet, and a different shade for the other.



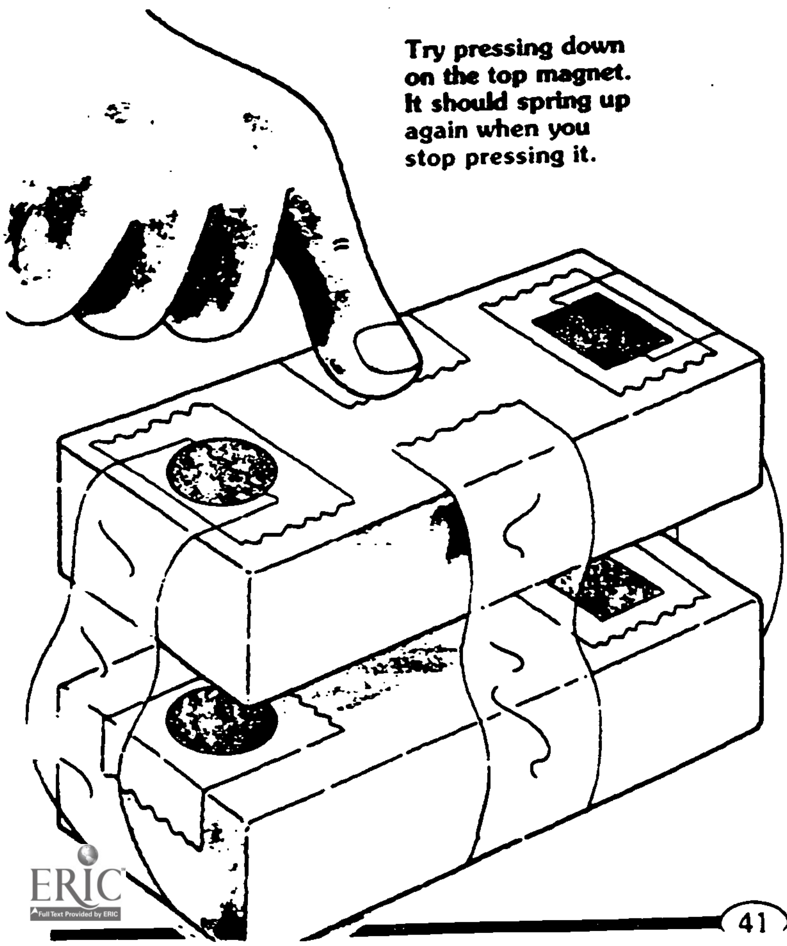




3. Turn both magnets around and repeat step 2. Mark them with pieces of the same paper that you used in step 2, so that all ends have paper on them.

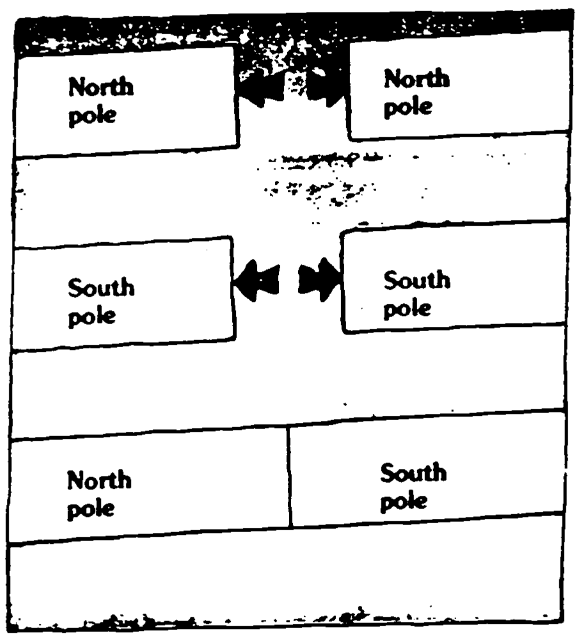
4. Try to push two of the same-shaded poles together. You should be able to feel them pushing against one another, refusing to stick together.

5. Copying the picture above, tape the two magnets together with a pencil between them. What happens when you remove the pencil?



What happens?

The magnet on top will float over the one beneath it. Each magnet has two kinds of pole. One is called north, the other is south. Poles of the same kind push each other away but different poles pull each other together.



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ATTRACTING BALLOONS

Submitted by: Dawn Grosklags

Endorsed by: Dr. Don E.Descy, Mankato State University

Grade Level: Grades 4-6

DESCRIPTION: Static electricity can be a difficult concept for elementary students to understand and relate to. Allowing students to learn about static electricity through a hands on lesson will create an exciting learning environment. While theyUre learning about the new concept of static electricity.

GOAL:

The students will learn about static electricity.

The students will understand that everything has an electric charge.

OBJECTIVES:

The students will be able to demonstrate static electricity using balloons.

The students will be able to identify static electricity that occurs in their daily lives.

BACKGROUND INFORMATION: This lesson can be used with students who have little or no understanding of static electricity. The lesson is a basic activity that elementary students will be able to perform and enjoy.

CONCEPTS:

The students will be able to identify that protons have a positive charge and electrons have a negative charge.

The students will be able to identify that protons and electrons attract causing static electricity.

MATERIALS:

Balloons

PROCEDURE:

1. Give each student a balloon or put students into small groups and have them share the balloons. Whatever method fits your class better.
2. Have the students blow up the balloon and tie the end together.

3. Tell the students to rub the balloon on their hair.

4. Explain to the students that some of the electrons from their hair move to the atoms on the balloon. The balloon now has more electrons. This is causing it to have a negative charge. Their hair has more protons than electrons. This is giving their hair a positive charge. When the protons and electrons are unequal, static electricity is produced. Static electricity is the charge on an object that has an unequal number of protons and electrons. Static electricity is causing their hair to stick up.

5. Allow the students a chance to experiment with balloon. Have them try to stick the balloon to their clothes or the wall.

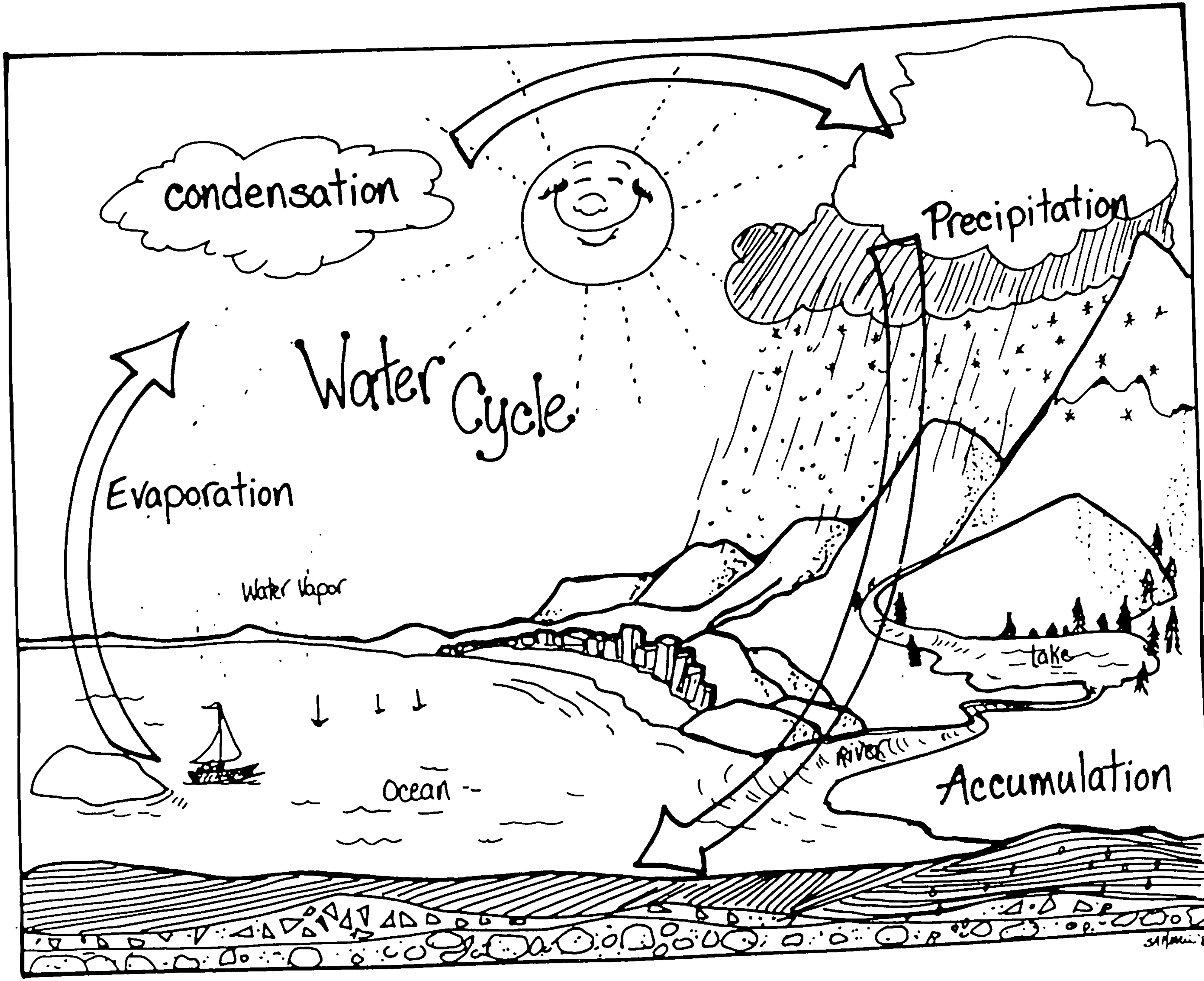
ASSESSMENT:

1. Have the students write down to examples of static electricity.

2. Ask the students to explain why their hair was sticking to the balloon.

Ocean Activities

Grade 4


condensation
Precipitation
Water Cycle
Evaporation
Water Vapor
Ocean
Lake
River
Accumulation

133

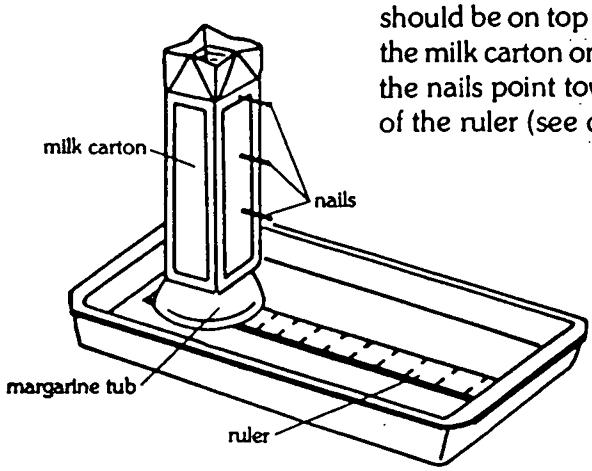
134

#1—Under Pressure

What You Need: empty 1-quart milk carton; 3 identical nails; ruler; empty margarine or small cottage cheese tub; cup or other container; 9 × 13″ baking pan; water

What To Do:

1. Open the entire top of the milk carton. Then push each of the 3 nails through the cardboard on one side of the carton so they are in a column (see diagram). Make sure that the bottom nail is at least 3 inches above the bottom and all the nails are at least 1 inch apart.
2. Lay the ruler down the middle of the pan so that the 12-inch end of the ruler is touching one end of the pan.
3. Place the empty margarine tub upside down in the baking pan at the 1-inch end of the ruler. (The margarine tub should be on top of the ruler.) Then set the milk carton on top of the tub so that the nails point toward the 12-inch end of the ruler (see diagram).



4. Fill the milk carton with water all the way to the top.
5. Pull all 3 nails out of the milk carton at the same time and then slowly pour water into the milk carton so that it's *always* filled.
6. As the water squirts out the nail holes, watch to see how far each jet goes.

Make a Prediction: Will the water coming from each hole travel the same distance or will some jets travel farther than others?

Brain Busters: What did you observe and why did it happen? What might this tell you about how pressure changes the deeper you go in the ocean?

#2—Hot and Cold

What You Need: 4 containers; clear plastic cup; measuring cup; measuring spoon; saltwater solution; aquarium, kosher, or canning salt; hot tap water; food coloring; medicine dropper; refrigerator

What To Do:

1. Pour 1 cup of saltwater solution into one of the containers and label it *solution A*. Then put it in a refrigerator for at least 2 hours.
2. Pour 1 cup of hot tap water into another container and add 1½ teaspoons of salt. Stir until all salt is dissolved. Label this container *solution B*.
3. Pour a small amount of *solution B* into a different container, add 4 or 5 drops of food coloring, and stir well. Label this container *solution 1*.
4. Fill the clear plastic cup with about 2 inches of *solution A*. Then drop about 20 drops of *solution 1* into the cup, using a medicine dropper. Watch to see what happens as the colored, warm salt water drips into the cold salt water. Then clean out the plastic cup.
5. Pour a small amount of *solution A* into a different container, add 4 or 5 drops of food coloring, and stir well. Label this container *solution 2*.
6. Fill the clear plastic cup with about 2 inches of *solution B*. Then drop about 20 drops of *solution 2* into the cup, using the dropper. Watch to see what happens as the colored, cold salt water drips into the warm salt water.

Make a Prediction: When you add warm salt water to chilled salt water, will it float at the surface, sink to the bottom, or mix right in? When you add chilled salt water to warm salt water, will it float, sink, or mix right in?

Brain Busters: What did you observe and why did it happen? Based on this experiment, where would you find the warmest water in the ocean—at the surface or close to the bottom?

#3—The Salty Sea

What You Need: 4 containers; clear plastic cup; measuring cup; saltwater solution; aquarium, kosher, or canning salt;

Betty Olivolo

measuring spoon; food coloring; medicine dropper

What To Do:

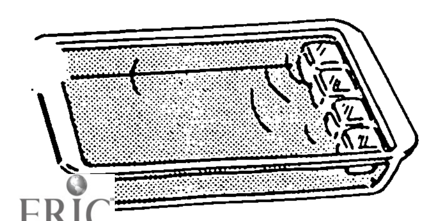
1. Pour 1 cup of saltwater solution into each of 2 containers and label them *solution A* and *solution B*.
2. Make *solution A* extra salty by adding ¾ teaspoon of salt to it and stirring until the salt is dissolved.
3. Pour a small amount of *solution A* into another container, add 4 or 5 drops of food coloring, and stir well. Label this container *solution 1*.
4. Fill the clear plastic cup with about 2 inches of *solution B*. Then drop about 20 drops of *solution 1* into the container, using a medicine dropper. Watch to see what happens as the colored, extra-salty water drips into the less-salty water. Then clean out the plastic cup.
5. Pour a small amount of *solution B* into another container, add 4 or 5 drops of food coloring, and stir well. Label this container *solution 2*.
6. Fill the clear plastic cup with about 2 inches of *solution A*. Then drop about 20 drops of *solution 2* into the container, using a medicine dropper. Watch to see what happens as the colored salt water drips into the extra-salty water.

Make a Prediction: When you add extra-salty water to salty water will it float at the surface, sink to the bottom, or mix right in? When you add salty water to extra-salty water will it float at the surface, sink to the bottom, or mix right in?

Brain Busters: What did you observe and why did it happen? Based on this experiment, what do you think happens to river water, which is fresh water, as it flows into the sea? (Does it tend to float or does it sink to the bottom?)

#4—The Current Connection

What You Need: 9 × 13" glass baking pan or other large, clear container; saltwater solution; container; plastic ice cube tray; food coloring; lukewarm tap water; freezer



What To Do:

1. Add 4 or 5 drops of food coloring to a container of saltwater solution and stir well.
2. Fill 4 ice cube compartments in a plastic ice cube tray halfway with the colored salt water and freeze.
3. Fill a clear baking pan with lukewarm tap water. Then line up the 4 colored ice cubes along one end of the baking pan. (Use your finger to keep them from floating away.) Look into the pan from the side and watch what happens as the ice cubes melt.

Make a Prediction: As water from the ice cubes melts, will it sink straight to the bottom, float at the surface, or mix in?

Brain Busters: What did you observe and why did it happen? Based on this experiment, what do you think happens to ocean water as it's chilled at the polar regions?

#5—Changing Temperatures

What You Need: 2 large glass jars with lids; 2 thermometers that fit inside the jars; water; graph paper; refrigerator

What To Do:

1. Set a thermometer inside a glass jar and screw the lid on. A few minutes later, record the temperature on the thermometer. (This is the temperature of the air inside the jar.)
2. Fill the other glass jar with water that's the same temperature as the air inside the first jar. Put a thermometer in the jar and screw the lid on.
3. Put both jars in the refrigerator and record their temperatures every 3 minutes for 21 minutes. Graph the results.

Make a Prediction: After you set the jars in the refrigerator, will they change temperature at the same rate or will one change faster than the other?

Brain Busters: What did you observe and why did it happen? Based on this experiment, do you think the ocean changes temperature at the same rate as the air around it? How do you think temperatures along the coast might compare with an area 100 miles inland during the summer? During the winter?

by humpback whales when they feed. You might want to have students discuss hunting and feeding practices of other animals. Discuss whether or not the use of bubble clouds and bubble nets indicates a relatively high level of intelligence.

Materials: Shallow pan, water, finely-ground black pepper, fine-toothed comb, drinking straws (optional)

This activity simulates the function of baleen.

The drinking straws can be used to simulate how a bubble net works. The straw is used to blow a ring of bubbles around the edges of the pan. The pepper will be pushed together toward the center of the pan.

Enrichment Activities

WATER DENSITY (Demonstration)

Materials: 2 bottles or jars with narrow necks, hot water, cold water, food coloring, small piece of cardboard

1. Fill one bottle or jar to the rim with cold water.
2. Fill the other bottle or jar with hot water and add food coloring.
3. Place the cardboard over the mouth of the bottle of cold water. Carefully invert it and rest it over the mouth of the bottle with warm water and food coloring.
4. Carefully slide the cardboard from between the two bottles.
5. Ask students to observe what happens.

The colored water from the bottom bottle will move up into the bottle on top, demonstrating that cold water is denser, and therefore sinks below warmer water. In this experiment, the colder, clear water is actually displacing the colored water in the lower bottle, causing it to be pushed up into the upper bottle as the colder water sinks.

POLLUTION DEBATE

The scientists aboard the *Mimi* considered the pros and cons of using expendable sensors (XBTs) to measure water temperature, thus, in a sense, littering in the ocean. Have students consider other forms of ocean pollution: chemical waste, oil from leaking tankers or drilling mishaps, garbage dumping, carelessness. Make a list of sources of pollution. Have students investigate alternatives, justifications, known and possible consequences. Form teams to debate the issues.

Extending Concepts

To relate the content of this episode to your core science curriculum or other curriculum areas, use these topics as guides:

Temperature
Ocean temperature
Water density
Whales (feeding)
Pollution
Graphing formats

DO ↑

Excellent!

cold water

cardboard

hot water & food color

Cold water is denser. So it sinks below warm water. This causes warm water to be moved up water? Where could they get fresh water, if they need it?

Have students watch Episode 10 ("Making Dew") of the video series.

FOLLOW-UP QUESTIONS

Asterisks (*) denote questions that are particularly challenging and that may require additional discussion time.

1. How did C.T. figure out what island they were on? *He used the navigation charts and visible landmarks, such as the two islands, to determine their location.*
2. Why was it not likely that a ship would come by and rescue them? *The island was off the main shipping and traffic lanes.*
3. How did Rachel know how to fix the *Mimi*'s hull? *Her father taught her.*
4. Why did they take the *Mimi* to deeper water? *So that the boat wouldn't be resting on its bottom each time the tide went out.*
5. What happened to the fresh water supply aboard the *Mimi*? *It was contaminated by sea water during the storm.*
6. Why couldn't the crew drink sea water? *The salt in sea water will dehydrate the body.*
7. What was the purpose of the dark garbage bag that Anne placed in the hole with the sea water? *The dark color of the bag absorbed the sun's heat and made the evaporation process happen faster.*

Navigation Chart

C.T. pinpointed the castaways' location as Seal Island. Discuss how he came to this conclusion. Have students locate Seal Island on the Navigation Chart (68°45' W long., 43°50' N lat.). Discuss the other information gained by pinpointing their location (e.g., that they were off the main shipping lanes).

"The Voyage of the Mimi: The Book"

ACTIVITY

"Water, Water, Everywhere . . . And Not a Drop to Drink," p. 117

Materials: paper cup, pencil, string cut into two 40-cm lengths and one 25-cm length, a clear plastic bag, water, salt

Students can build miniature solar stills which operate on the same basic principles of evaporation and condensation as the ones built by the *Mimi*'s crew. It is necessary for students to place their stills in a spot that gets full sun (preferably southern exposure). After several sunny days they should be able to make the following observations:

The water evaporates because the sun heats the water in the cup until it turns to vapor.

The vapor inside the bag condenses because it cools when it hits the cooler bag.

The source of the condensation is the water in the cup, which has less water in it as the days pass.

The water that collects in the bottom of the bag is clear. It tastes like fresh water since it is distilled and has no salt.

Software Connection:
Maps and Navigation: navigation charts, use of landmarks, latitude and longitude

Enrichment Activity

IMPROVING A SOLAR STILL

Materials: Materials used for solar still in the Student Guide activity; black plastic bag, aluminum foil, other miscellaneous materials

Can students find ways to make their solar stills produce more water in less time? Encourage them to experiment with adding a black plastic bag, pieces of aluminum foil and other materials that they bring in from home in an attempt to increase their still's efficiency. Constructing several stills which employ different materials and testing them simultaneously will help them to make a more accurate comparison of the test materials. Have them compare their results with each other.

Extending Concepts

To relate the content of this episode to your core science curriculum or to other curriculum areas, use these topics as guides:

Solar energy	Water
Condensation	Survival
Evaporation	Physiology

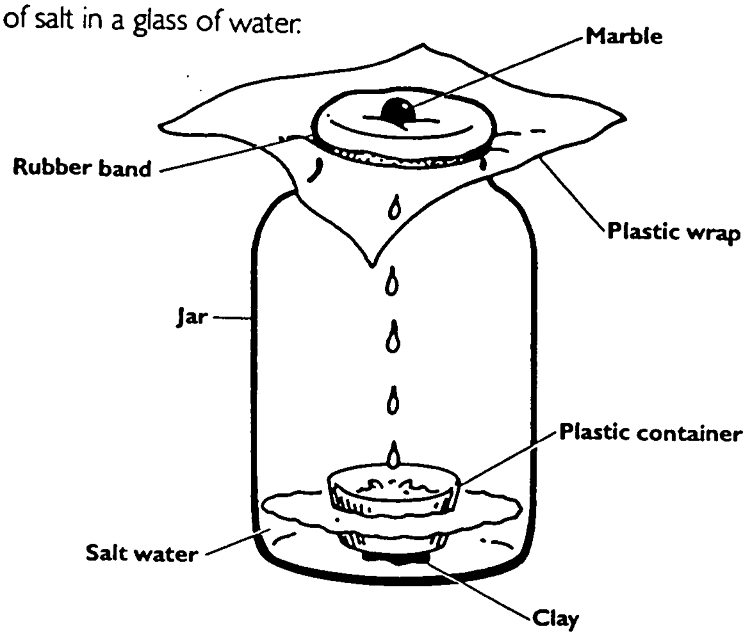
Salt-Free Water

Many countries have built desalinization plants to convert the ocean's salt water into fresh water. Have students create a distillation system by doing the following experiment. As they perform the experiment, have students record their observations.

Give groups of students these materials: a glass jar, a plastic container small enough to fit in the bottom of the jar, clay, salt, water, a small rock or marble, plastic wrap, and a rubber band.

- Use clay to affix the plastic container to the bottom of the glass jar.
- Create a saltwater solution by mixing two tablespoons of salt in a glass of water.
- Pour the saltwater into the bottom of the jar until it is halfway up the side of the plastic container.
- Put plastic wrap over the jar opening and secure it with a rubber band.
- Place the small rock or marble on the plastic wrap so that it is directly over the plastic container.
- Put the jar in the sun. After a while, taste the water that has collected in the plastic container.

What did you notice? How is the distillation process like the water cycle?



WORD BANK

desalinization

distillation

DID YOU KNOW?

Scientists have discovered a chemical in coral polyps that absorbs ultraviolet radiation. They hope to replicate this chemical in order to perfect sunscreen.

Scientists are exploring methods of using shark's cartilage to prevent the growth of cancer.

ON THE BOOKSHELF

The Ocean World of Jacques Cousteau: Riches of the Sea
by Jacques-Yves Cousteau
This book covers many of the resources humans get from the sea.

The Seavegetable Book
by Judith Cooper Madlener

Island of the Blue Dolphins
by Scott O' Dell
This popular Newbery Medal winner is a story about a Native American girl and how she survives living alone on San Nicolas Island for 18 years.

RESEARCH IDEA

- What other resources do we get from the sea? Students can research what some of these items are.

ACTIVITY

Problem Solving

A Quicker Picker-Upper

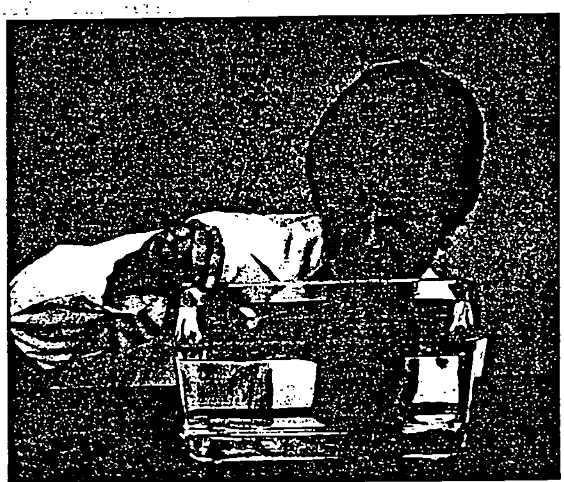
Do 121

Scientists are always trying to find better ways to clean up an oil spill. In the picture a scientist is using chicken feathers to soak up oil.

How do scientists try to solve the problem of removing oil from an ocean? First, they test new methods in a laboratory. Think about ways that you might try to solve this problem.

How can oil be removed from the surface of salt water?

Pour 60 mL cooking oil into a pan of salt water. Experiment to find ways to remove the oil from the salt water. Try to leave as much water in the pan as possible. Which method worked fastest? Do you think your methods would work on a large body of water like an ocean? Do you think your methods might harm ocean life? Explain your answers.



Where are oil and natural gas found?

Resources are also found under the oceans. Huge pools of oil and natural gas lie in rock sediments below the ocean floor. Most of this oil and gas is near the shore. It is reached by drilling wells through the rocks.

Appendix C

Science Journals

NAME ________________
DATE ________________
ACTIVITY ______________
____

SCIENTIFIC METHOD

1. Ask a question: ____
____
____

2. Form a hypothesis: ______________________________________
____
____

3. Perform an experiment / collect data: ______________________
____
____
____
____
____

4. Draw a conclusion: ______________________________________
____
____
____

NAME
DATE 3- -98
ACTIVITY Stem

SCIENTIFIC METHOD

1. **Ask a question:** What will happen when we put celarly in suger water and plain [illegible]

2. **Form a hypothesis:** The celarley in the plain jar will stay the [illegible]. The celary in the sweet jar will be [illegible]

3. **Perform an experiment / collect data:** We put 8 spoons of [illegible] in water and stirred it. Then we put celarley in it and another [illegible] after one day the celary in the sweet jar was sticky

4. **Draw a conclusion:** The celarty in the plain water tasted plain because the stem carried the water to the ceary. The one in sweet water was sweet because the stem carried the sweet water to the ceary.

Appendix D

Teacher Observation Checklist

Group or Individual________________

TEACHER OBSERVATION CHECKLIST

___1. Everyone participates.

Comments:____

___2. The scientific method was used in the correct order.

Comments:____

___3. The following steps of the scientific method were explained:

___Step 1: Question
___Step 2: Hypothesis
___Step 3: Data/Experiment
___Step 4: Conclusion(s)

Comments:____

___4. Each person did his/her job.

Comments:____

___5. Proper Procedures were followed in the experiment or data collection.

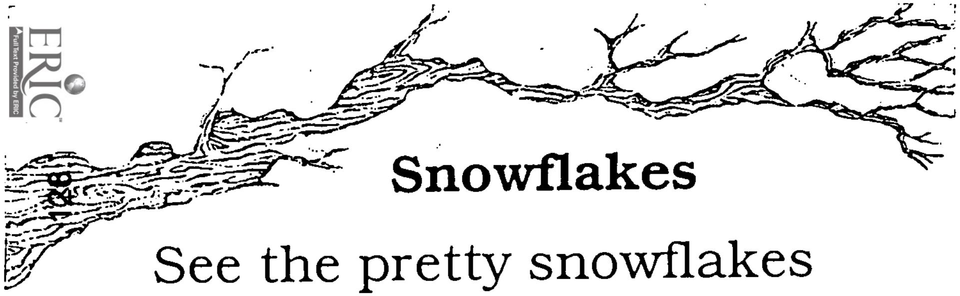
Comments:____

___6. All materials were collected.

Comments:____

Appendix E

Multiple Intelligence Review Lessons



Snowflakes

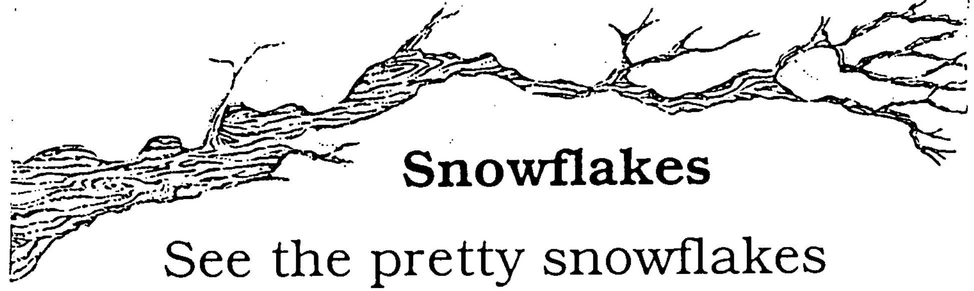
See the pretty snowflakes
Falling from the sky;
On the walk and housetop
Soft and thick they lie.

On the window-ledges
On the branches bare,
Now how fast they gather,
Filling all the air.

Look into the garden,
Where the grass was green;
Covered by the snowflakes,
Not a blade is seen.

Now the bare black bushes
All look soft and white,
Every twig is laden--
What a pretty sight!

Unknown



Snowflakes

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Falling from the sky;
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Soft and thick they lie.

On the window-ledges
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Look into the garden,
Where the grass was green;
Covered by the snowflakes,
Not a blade is seen.

Now the bare black bushes
All look soft and white,
Every twig is laden--
What a pretty sight!

Unknown

Little Brown Seeds

Little brown seeds so small and round
Are sleeping quietly underground.
Down came the raindrops
Sprinkle, sprinkle, sprinkle.
Out comes the rainbow
Twinkle, twinkle, twinkle.
Little Brown seeds way down below
Up through the earth they grow, grow, grow.
Little green leaves come one by one.
They hold up their heads
And look at the sun.

Teams Games Tournament

1. Use your "study group" to review the material for the test. Everyone is accountable for each person in the group.
2. Go to your "game group" (Mrs. G. will assign these.")
3. Sit in a circle.
4. 1 person draws a number
5. Next person reads the question that corresponds to the number.
6. If you answer correctly, you get a point for your "study group."
7. If answered incorrectly, next person may challenge.
8. Rotate roles and continue until all questions have been answered.
9. Return to your "study group" and tally points.

People Search

question. You may only sign someone's sheet once. If you sign, be prepared to share in class. Sign to the right of the question

1. REWRITE THESE SCIENCE TERMS IN ORDER FROM SIMPLEST TO MOST COMPLEX: ORGAN TISSUE SYSTEM CELL

2. NAME AN ORGAN IN EACH OF THE FOLLOWING SYSTEMS:

DIGESTIVE
RESPIRATORY
SKELETAL
CIRCULATORY

3. EXPLAIN THE JOB OF EACH SYSTEM:

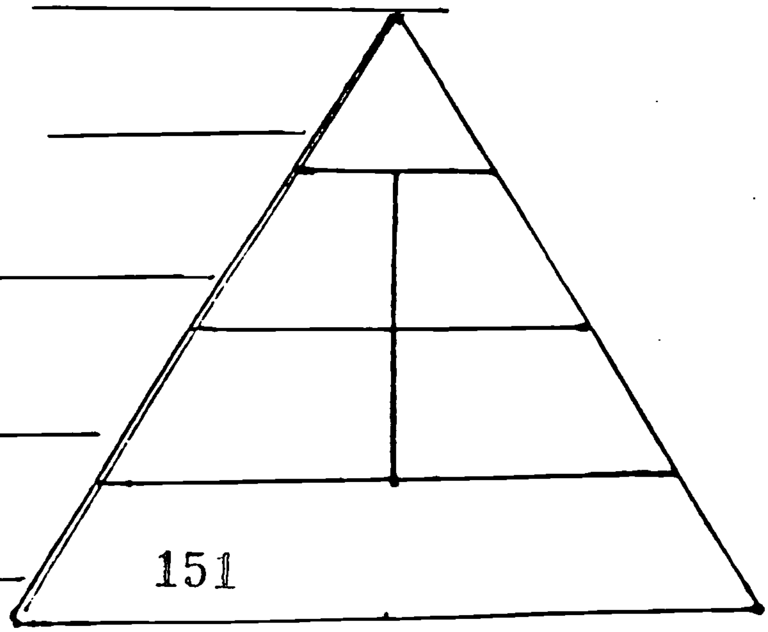
DIGESTIVE

RESPIRATORY

SKELETAL

CIRCULATORY

3. FILL IN THE PYRAMID CORRECTLY.



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4. NAME A FOOD IN EACH FOOD GROUP.

______

______

______

______

______

______

MATCH THE FOLLOWING.

5.------ORGAN ______

6. -----CIRCULATORY SYSTEM ______

7.-----DIGESTIVE SYSTEM ______

8.-----CELL ______

9.-----TISSUE ______

10.-----SKELETAL SYSTEM ______

11.-----RESPIRATORY SYSTEM ______

12.-----ORGAN SYSTEM ______

A. BUILDING BLOCKS OF LIVING MATTER

B. A GROUP OF CELLS WORKING TOGETHER

C. GIVES THE BODY SHAPE AND SUPPORT

D. A GROUP OF TISSUES WORKING TOGETHER

E. A GROUP OF ORGANS WORKING TOGETHER

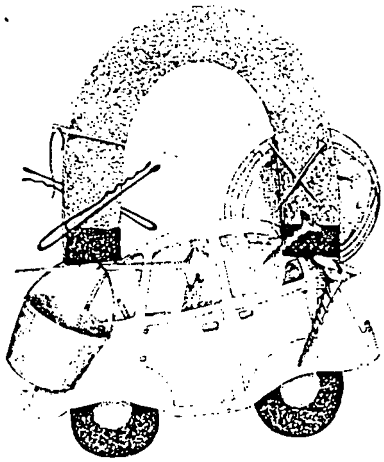
F. CIRCULATES THE BLOOD

G. BRINGS OXYGEN INTO THE BODY

H. DIGESTS FOOD

Magnets

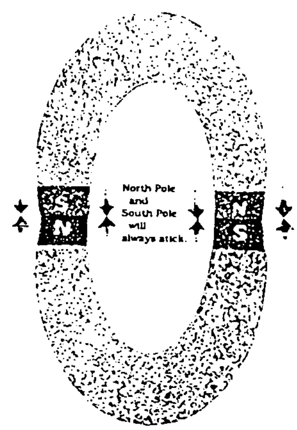
Magnets attract.
That's a fact.



Things like nails
And metallic pails.

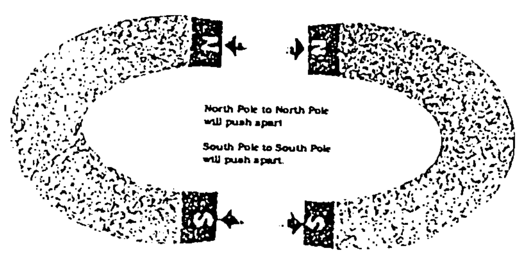
Magnets attract.
That's a fact.

Things like cars
And lids on jars.



Magnets attract.
That's a fact

Things like pins
And cookie tins.



Magnets attract.
That's a fact.

Leslie Tryon
Jo Ellen Moore

BACKWARDS SCIENCE TEST

NAME

DIRECTIONS: Write the question for each answer.

OCEAN

1. Three-fourths of the Earth

2. Natural gas, oil, fish, and minerals

3. The continental shelf

4. Atlantic, Pacific, Indian, and Arctic

MAGNETS AND ELECTRICITY

5. They would attract.

6. They would repel.

7. metal

8. rubber

9. Never use electricity near water.

BODY

10. cells

11. cells, tissue, organ, organ system

12. The heart belongs to this system.____________________

____

13. Changes food to be used by the body.____________________

____

14. To breathe in oxygen and out carbon dioxide.____________________

____

15. cereals____________________

____

16. fats____________________

____

17. cereals, vegetables&fruits, meats, dairy products, and fats______

____

18. Question, Hypothesis, Experiment, Conclusion____________________

____

19. Conduct experiments____________________

____

20. Write the conclusion____________________

____

Appendix F

Performance-Based Assessments

Rubrics

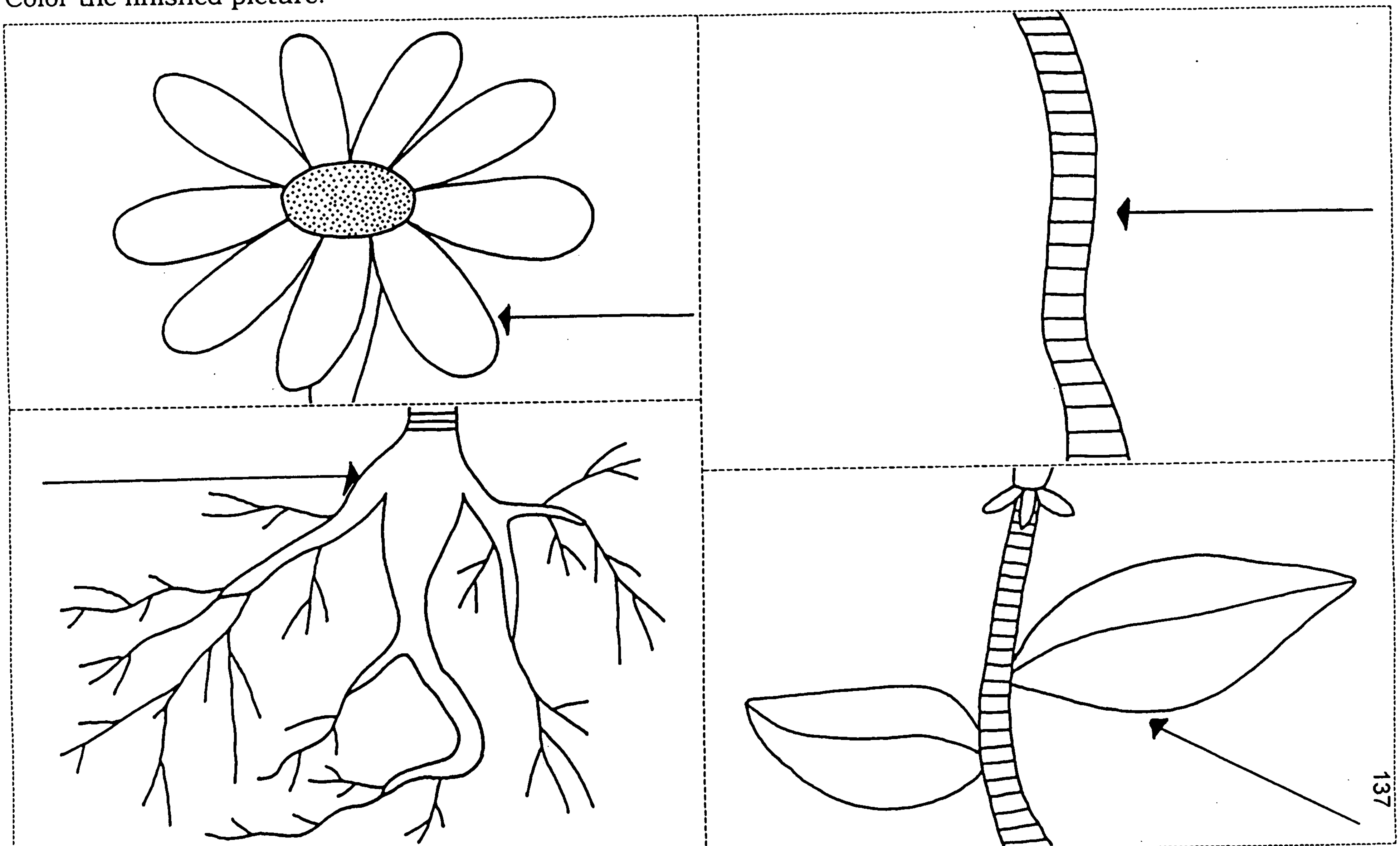
Student Conferencing

Student Tests

Plant Parts Puzzle

Name ______________________

You can build a flower plant. Cut along the dotted lines. Then put the puzzle pieces together and paste them on a long piece of paper. Color the finished picture.



Science Test: Plants Name ______________________________

1. Match the plant part with its job.

Roots	Make food
Stem	Make new seeds
Flowers	Absorb water and hold the plant in the ground
Leaves	Holds the plant up and carries water

2. Draw a plant and label its 4 parts.

3. Seeds can be scattered by _______________, _______________, and by

_______________________.

4. What happens when a seed germinates? Use a sentence.

____

____

____

5. Write SIMPLE or COMPOUND as you look at each leaf.

a. ______________________________________

b. ______________________________________

c. ______________________________________

6. Seeds can be made by ____________________ and by ______________________.

7. Three of the things that a plant needs to keep growing include ____________________,

______________________________, and ______________________________.

8. Draw and label a plant life cycle.

9. In order for a seed to germinate it must have ______________________________

and ____.

10. Write 3 things that you learned in our study of plants. Use sentences.

SCIENCE TEST: Water Unit

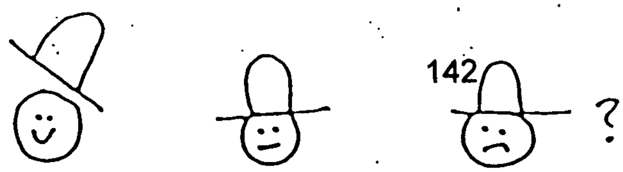
Name ______________________________

Draw the water cycle. Label each part.

On the back of this paper explain the water cycle.

Name______________________________

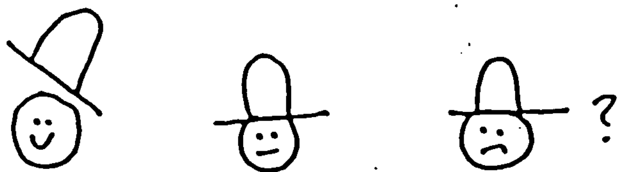
Water Unit Assessment Rubric



	Hats off to you!	OK Job!	Keep hat on and rethink.
1. Drew water cycle in correct order			
2. Labeled all parts correctly			
3. Clearly and correctly explained steps of the water cycle			

Name______________________________

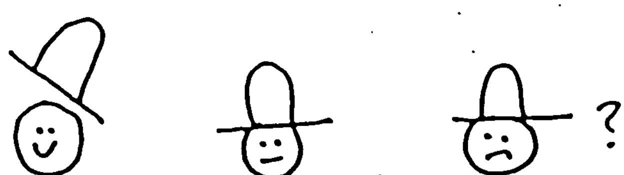
Water Unit Assessment Rubric



	Hats off to you!	OK Job!	Keep hat on and rethink.
1. Drew water cycle in correct order			
2. Labeled all parts correctly			
3. Clearly and correctly explained steps of the water cycle			

Name______________________________

Water Unit Assessment Rubric



	Hats off to you!	OK Job!	Keep hat on and rethink.
1. Drew water cycle in correct order			
2. Labeled all parts correctly			
3. Clearly and correctly explained steps of the water cycle			

DETAILS REGARDING 3RD GRADE CHILD-CREATED HOMEMADE MACHINE!

Below are several guidlelines for the machines that are to be made by the 3rd graders with the assistance of their parents:

1. Machine may be made of any materials.

2. It must be able to perform some type of a task. It should work!

3. Machine must include at least 2 simple machines.

4. 3rd grader needs to write a paragraph essay describing the machine, the job it does, and how it works. (Can either be handwritten or typed on the computer.)

5. Child will be expected to demonstrate the machine for classmates, explaining its job and how it works.

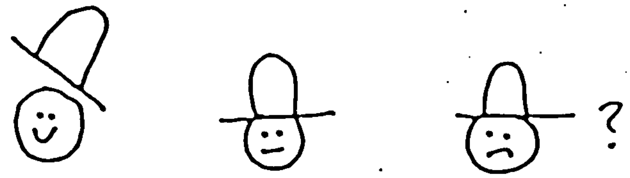
6. Machine and essay need to be brought to school on or before Friday, January 23, 1998.

Each machine project will be assessed by these criteria:

1. Creativity
2. Inclusion of at least 2 simple machines
3. Paragraph clearly explains machine and its function
4. Demonstration and explanation easily understood

QUESTIONS???? Do not hesitate to call Mrs. Fisher!

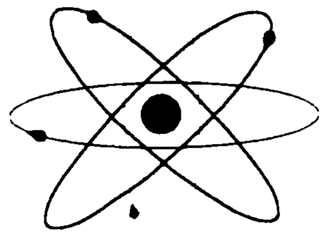
Science Machine Name ______



Creative	3	2	1
Includes 2 simple machines	3	2	1
Clearly understood paragraph	3	2	1
Understand-able explanation	3	2	1

Comments:

MAGNETS & ELECTRICITY



"HANDS-ON" TEST

1. Demonstrate "repel" & "attract."______________________________
2. Show which poles "repel."__________________________________
3. Show which poles "attract."_________________________________
4. Magnitize a paper clip.____________________________________
5. Explain why the paper clip in activity #4 could be magnitized.__________
6. Make a closed circuit.____________________________________
7. Make an open circuit._____________________________________
8. List two safety rules for electricity.____________________________
9. Pick a good conductor from the selection of materials.________________
10. Pick a good insulator from the selection of materials._________________

EXTRA CREDIT:____

____

Name ______________________

Science Test: Magnets and Electricity

A. Please match the definitions on the left with the terms on the right.

_____ 1.	An object that attracts some materials	a.	static electricity
_____ 2.	A device used to open or close a circuit	b.	current electricity
_____ 3.	A material through which electricity does not easily flow	c.	switch
_____ 4.	A kind of electricity produced with static charges	d.	unequal charges
_____ 5.	A material through which electricity easily flows	e.	conductor
_____ 6.	The scientific term for negative charges flowing in one direction through matter	f.	magnet
		g.	insulator

B. Questions 7-10 refer to the pictures below. Please follow directions!

●.


●●.


7. Put a circle around a north pole and a triangle around a south pole.

8. In picture ●, the poles are going to **(attract, repel)** each other. [circle your answer]

9. In picture ●●, the poles are going to **(attract, repel)** each other. [circle your answer]

10. Unlike poles ______________ each other. [complete the sentence]

11. Like poles ______________ each other. [complete the sentence]

12. How is static electricity made? Write in complete sentences.

____

____

____

____

13. List five properties of static electricity.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

14. List two differences between static electricity and current electricity.

Static Electricity	Current Electricity
1. ______________	1. ______________
2. ______________	2. ______________

15. What is the function of a switch in an elecrical circuit? Explain in one or two complete sentences.

____

____

____

16. List two materials that are good conductors: ______________ and ______________ .

17. List two materials that are good insulators: ______________ and ______________ .

18. List four ways that you can safely conduct yourself around electricity.

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

19. What does electricity travel over in order to get from power plants to people's homes?

a. air
b. wires
c. the ground
d. telephone cords

20. Alternative Assessment: Draw a picture that describes the conditions needed for an open circuit and a closed circuit.

Name ______________________

Science Test: The Human Body

A. Please match the definitions on the left with the terms on the right.

____ 1. A group of tissues working together	a.	cells
____ 2. The building blocks of the human body	b.	tissue
____ 3. Cells working together in a large group	c.	Kleenex
____ 4. A group of different organs working together	e.	system
	f.	organ

B. Please match the definitions and functions on the left with the systems on the right.

____ 5. It helps the nervous system control body activities. It is made up of glands that produce chemicals.	a.	skeletal system
____ 6. It removes wastes from the body. It contains the kidneys and the bladder.	b.	digestive system
____ 7. A control system made up of the brain, spinal cord, and nerves.	c.	respiratory system
____ 8. Your nose, mouth, trachea, and lungs help you to breathe in oxygen and breathe out carbon dioxide.	d.	excretory system
____ 9. This system changes food so it can be used by the body. It is made up of your tongue, teeth, stomach, and intestines.	e.	immune system
____ 10. This system allows the body and its parts to move. Movement occurs because muscles contract and relax.	f.	nervous system
____ 11. This system carries food and oxygen to all parts of the body. It is made up of the heart, blood vessels, and blood.	g.	endocrine system
____ 12. This system gives your body shape and support. It is made up of bone and other tissues.	h.	circulatory system
	i.	muscular system

C. True or false. Please circle the correct answer.

13. Parts of our body are continuously making new cells.
    a. true
    false

14. All cells in our body replace themselves at the same rate.
    a. true
    b. false

15. Your pancreas is a system.
    a. true
    b. false

16. Your skin is an organ .
    a. true
    b. false

17. Muscle cells working together form muscle tissue.
    a. true
    b. false

18. Hair is a tissue.
    a. true
    b. false

19. Personal cleanliness, proper rest, a good diet, and exercise are not important for a healthy body.
    a. true
    b. false

20. It is important to wash your body because it removes dead skin cells, dirt, and sweat.
    a. true
    b. false

D. Please answer the following question in one complete sentence. How are the systems of your body affected by...

21. proper exercise? ______________________________

____

22. a balanced diet? ______________________________

____

23. proper rest? ______________________________

____

24. personal hygiene? ______________________________

____

RUBRIC

NUTRITION EVALUATION

1. The menu includes a variety of foods from the food pyramid.

ALL SOME NONE

2. The student can classify the ingredients according to the food groups.

ALL SOME NONE

NAME OF
STUDENT________________________________

BODY TEST
HANDS ON VERBAL TEST
USING THE

HUMAN TORSO

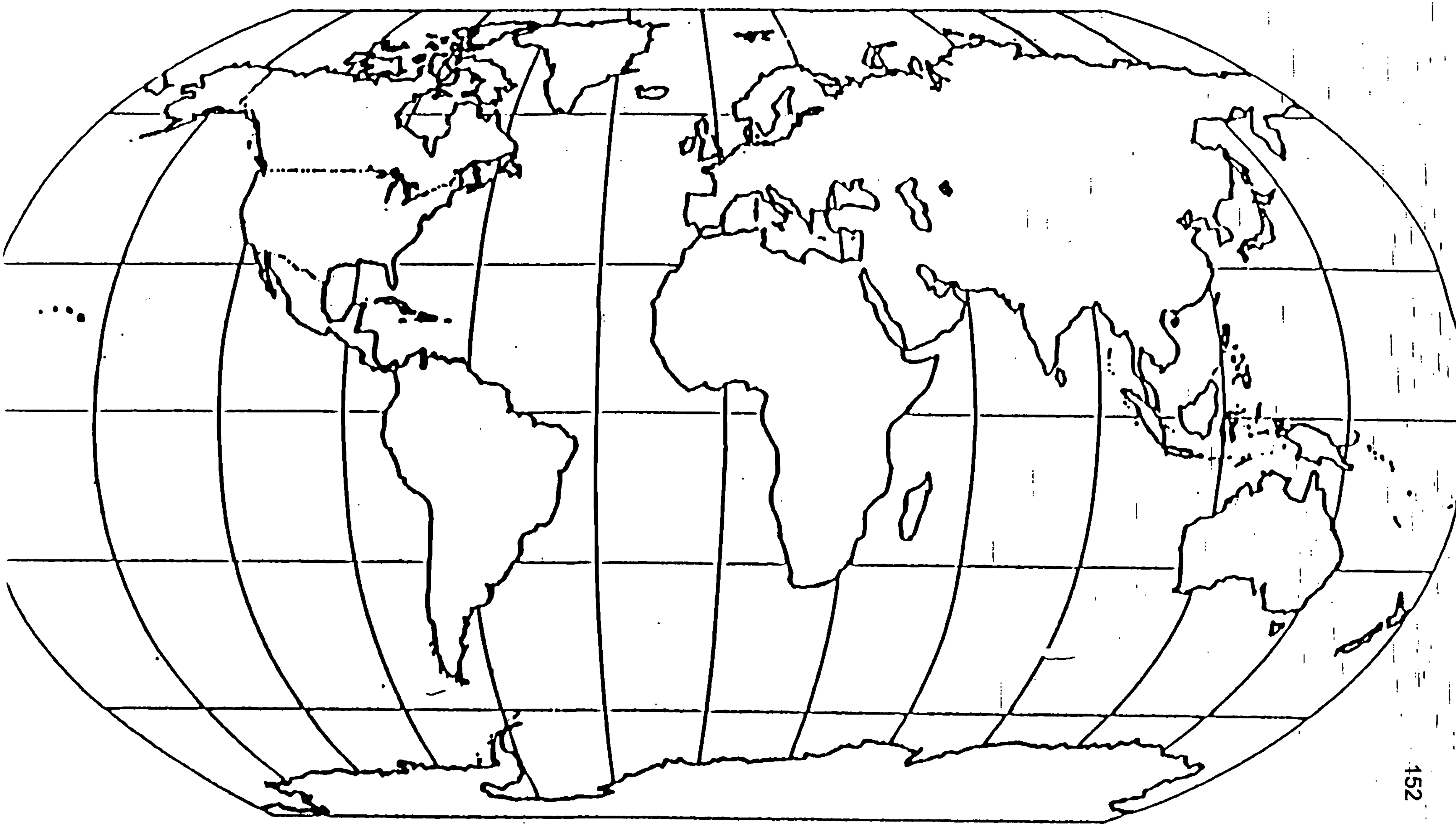
LOCATE EACH OF THE FOLLOWING ON THE HUMAN TORSO

lungs
liver
stomach
small intestine
large intestine
heart
brain
bladder
kidneys
pancreas
spleen
gall bladder
esophagus
skin
appendix--extra credit

Name ______________

Science Test - Oceans

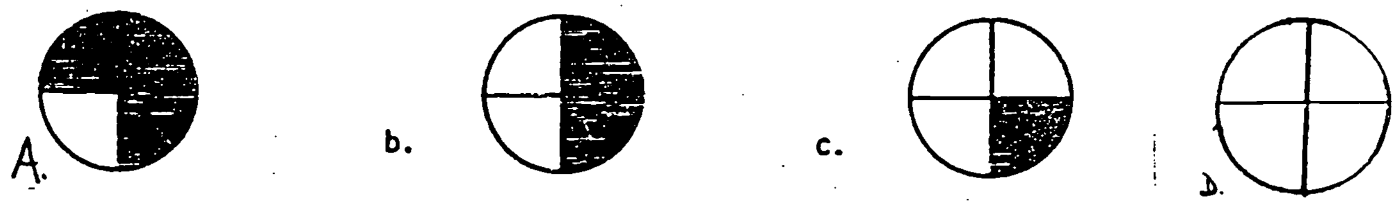
1. Label only the oceans.



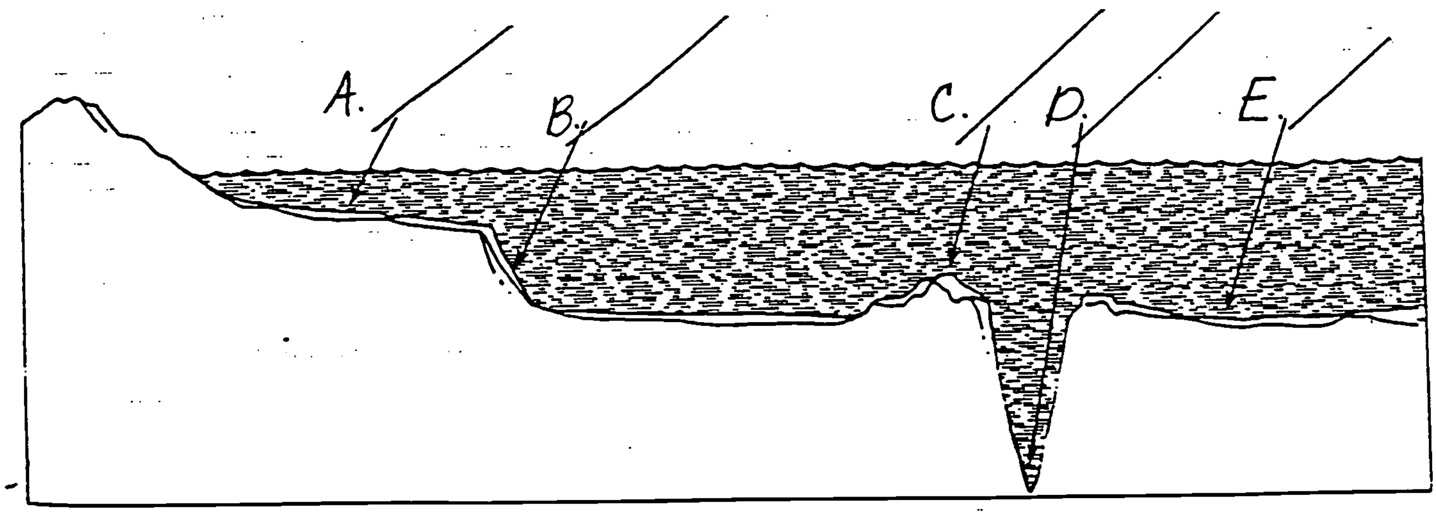
Name ______________________

Science Test - Oceans

2. The circles stand for the Earth. The dark parts stand for water cover. Circle the letter of the picture which shows how much covers the Earth.



3. Label the features of the ocean bottom.



4. Compare the life and water temperature of

Continental Shelf	Continental Slope	Ocean Plain
______	______	______
______	______	______
______	______	______

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5. List 2 different uses for kelp or seaweed.

______________ ______________

6. Name the industry that needs the ocean to provide cod, tuna, halibut and haddock. ______________

7. List two minerals found in the ocean.

______________ ______________

8. List one problem our ocean faces. Give one way to solve the problem.

Problem:

Solution:

9. Explain how ocean water warms or cools nearby land areas. Please answer in complete sentences.

RUBRIC - SCIENTIFIC PROCEDURE

1. Ask a question	GOT IT	NOT YET
2. Form a hypothesis	GOT IT	NOT YET
3. Do an experiment/collect data	GOT IT	NOT YET
4. Draw a conclusion	GOT IT	NOT YET
5. Performed steps of scientific method in order	GOT IT	NOT YET

Appendix G

Parent Volunteer Sheet

PARENT VOLUNTEERS NEEDED

_____ I will volunteeer to help with science experiments.

_____ I am willing to send supplies needed for science experiments.

_____ I would be interested in sharing information about the following science units:

Name ________________________________ Phone ________________

Thank you! I will contact you as needed.

PARENT VOLUNTEERS NEEDED

_____ I will volunteeer to help with science experiments.

_____ I am willing to send supplies needed for science experiments.

_____ I would be interested in sharing information about the following science units:

Name ________________________________ Phone ________________

Thank you! I will contact you as needed.

date

Dear Parents,

Our class will be doing several science experiments this month.

Can you help by sending any of the following items?

We will need them by ____________________ .

____

____

____

____

____

Thank you for participating in the excitement of discovery with your child.

Sincerely,

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Sign here→ please

Signature: Nancy Fisher	Printed Name/Position/Title: Nancy Fisher Student/FBMP	
Organization/Address: Saint Xavier University 3700 W. 103rd Street Chicago, IL 60655 Attn: Lynn Bush	Telephone: 773-298-3159 E-Mail Address:	FAX: 773-779-3851 Date: 4-15-98

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