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A handbook for middle school science teachers

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A HANDBOOK FOR

MIDDLE SCHOOL SCIENCE TEACHERS

MASTER'S PROJECT

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by

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CHAPTER I

INTRODUCTION

All children learn differently and their needs must be met in different ways. The middle school science curriculum should accommodate the needs and learning styles of the early adolescent. Students should be provided with opportunities to be actively involved in a process of learning science.

Many teachers shy away from using various experiments or hands-on activities because of the time involved in organizing, making necessary activities, locating materials, and wondering whether the activities would work.

The researchers felt that classroom experiments or hands-on activities would provide students to be actively involved in learning science.

Statement of the Problem

The problem the researchers discovered was the infrequent use of science experiments or hands-on activities used by teachers in the middle school grades. Thus, the purpose of this study is to develop a handbook of science experiments and activities that can be used to supplement and enrich the seventh and eighth grade curriculum. These activities should stimulate and motivate the students to see the relevance of science in his or her life.

Procedures

Subjects

This handbook was designed for use by teachers instructing science to seventh and eighth graders.

Setting

The study is intended for use in the researchers' seventh and eighth grade science classes at Hilltonia Middle School. The school is located in the Columbus Public School District, Franklin County, Columbus, Ohio. This school has approximately seven hundred students. Most students are black Afro-Americans and low income families.

Data Collection

Information, activities, and research data were collected from:

1. Published educational documents
2. Articles from educational journals
3. Instructional activities guides
4. Teacher's guides of texts
5. Subject related texts.

Definitions of Terms

Critical thinking — the process of reviewing any problem with a reasonable, open-minded approach while applying scientific problem solving skills.

Data — facts, including measurements.

Hands-on activities — Learning by direct experiences rather than by textbook study.

Independent thinking — being able to think critically about everyday problems without any intervention.

Inquiry — asking questions to aid in solution of problems.

Investigative skills — being able to observe, infer, measure, identify, classify, hypothesize, experiment, manipulate variables, interpret data, and draw conclusions.

Middle School — a scholastic division, including the upper elementary grades and leading to the final secondary grades.

Process of science — investigative skills.

Design

The writers intended to create a handbook of science activities to be used by the classroom teachers. These activities were intended to be easy to set up and come from readable and available materials for students and teachers. The emphasis was aiding the teachers in selecting activities to start, or enrich and enhance a seventh or eighth grade science program.

Summary

Science, for the most part, has been directed by the contents of the particular science textbook adopted by the individual schools. Children have been given little opportunity to be actively involved in the learning process. The use of

experiments and hands-on activities will provide an opportunity to be actively involved in the learning process of science. Thus, this handbook has been written to provide teachers of science with a resource that provides numerous activities to supplement the textbook. The handbook should make the job of the teacher desiring to use science activities easier. The ideas should assist the teacher in motivating students' learning and enriching experiences.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

The Development of Science

Science had its beginnings with the earliest humans. Ancient people discovered fire and learned to plant crops. As early as 3000 B.C., the Egyptians, the Babylonians, and the Chinese had made discoveries in medicine, astronomy, and mathematics.

It was in ancient Greece that the study of science really began. Greek scientists studied the human body, the stars, and the planets. The Romans then applied these discoveries in science to constructing improved buildings and roads.

During the 1600's and the 1700's, the pace of scientific discoveries increased. The seventeenth century is often called the Age of Genius. Sir Isaac Newton was one of the great scientists from this period.

The 1800's are often called the Age of Electricity. During this time many discoveries were made about electricity and magnetism. During this period Charles Darwin made his discoveries regarding evolution.

Never before in human history has scientific knowledge increased as quickly as during the last seventy-five years. New discoveries have led to sleek automobiles, modern airplanes or jets, and modern electronics. New discoveries

have even caused scientists to change their ideas about space and time (Harcourt, Brace, Jovanovich, 1989, p. 5).

The Space Age began in 1957 when the Russian satellite Sputnik was placed into orbit. Twelve years later, two United States astronauts walked on the moon. Space probes have since landed on Mars and the space shuttle has begun carrying teams of astronauts into space.

The world has now entered the Computer Age. In supermarkets, factories, offices, and homes, computers have become a part of everyday life.

Technology has advanced so rapidly that it is hard to keep up. No one ever dreamed of seeing a war happen live on television as we are seeing today in the Persian Gulf.

How do these advances affect the classroom? Before curricular reforms of the 1960's, school science had two goals: understanding basic laws and principles and testing facts through laboratory exercises. Since Sputnik, a third goal has been added: understanding how those basic laws and principles came to be established. Since the 1960's, the intensified connection of science to human welfare has imposed a fourth goal: understanding the relationship between science and society (Brinckerhoff, 1990, p. 4).

Science Education Today

Science today is being viewed as a process — a way of doing something — rather than a body of knowledge (McBruney, 1978, p. 420).

Science courses generally lack clear socially significant goals and a sense of mission (Brinckerhoff, 1990, p. 45). Most science courses prepare students for the next course more than they produce scientifically literate citizens. Science teaching generally consists of learning the textbook rather than hands-on activities. Content is information-bound, isolated from other parts of the school program and unrelated to student needs.

There appears to be a lack of consensus on what should be taught at each grade level and inconsistent development of content from grade to grade. For example, chemistry is usually taught only on the high school level instead of being presented in the lower grades.

Juliana Texley (1983, p. 28) claims, "High schoolers have little or no experience in the art of doing science." To gain such experience, middle school students need opportunities to actually do science experiments.

Many elementary and middle school teachers have poor grounding in science, especially the physical sciences, and avoid teaching science in the younger grades. Many who teach science may be very uncomfortable with hands-on activities. These teachers may present misleading view of concepts in science as well as convey their own fear of the subject to the pupils. This may dampen their curiosity and wonder, rather than foster the pursuit of more scientific knowledge.

It should be noted that over seventy-five percent of the facts learned in a particular subject is not remembered a year later (Ornstein, 1989, p. 22). Retention from a single lecture lasting over an hour is as low as sixty percent

(Ornstein, 1989, p. 22). Yet many classroom teachers use the lecture and fact-learning technique as their primary teaching style.

One goal of science teaching should be for students to be able to emulate the process used by scientists. In fact, this goal is likely to be found in most schools' science curriculum philosophies but how many teachers know how to achieve this goal? Smith (1981) felt that if a primary goal in science teaching is to teach critical thinking, inquiry, and investigative skills, then students should be encouraged to carry out investigative projects involving scientific process.

A science curriculum should allow for students to do experimental or investigative activities to promote independent, critical thinking and give the students a chance to use the investigative process. Many of the classroom activities should be built on something important and of interest in the child's life (Fort, 1985, p. 21).

Gail Foster (1983) feels students need to be introduced to the idea of asking questions. She suggested taking the class outside, watching an aquarium, or looking at a resource center of interesting items brought in by students. Questions would naturally arise, then teachers should discuss which questions could be answered by investigating and which could not. Teachers could explain the difference and then select a question and have groups of students design simple investigations to find the answer. In this way students learn to question as well as investigate.

Fort (1985) cited the experience of another teacher who required her students each month to read parts of any science magazine.

Many people are reluctant to try inquiry as strategy because of the shroud of mystery that surrounds the process. "Many teachers feel that the inquiry methods are only for those who can wade through the glut of scientific research with its formidable jargon" (Hillman, 1989, p. 1).

Science students often think that scientific knowledge is the result of some magical process which only belongs to the intellectual. The key to doing inquiry is to do inquiry and lots of it. Inquiry can be done at any level of sophistication. One can begin with simple games and progress to highly sophisticated models. Some teachers experiment with loosely-structured problems — solving activities in which students discover their own cognitive strategies. All of these sytesms "work" because inquiry is a natural process that proceeds naturally from a student's curiosity (Hillman, 1989, p. 1).

The teacher's role should be as facilitator: one who asks questions, provides connections between ideas, assists students in finding information, identifies correct and incorrect reasoning, as well as the traditional role of presenting facts and/or concepts. The teacher should help each student to identify his or her particular problem — solving strategies and to develop new strategies. Problem-solving skills retain their meaning and relevance when presented during the course of solving interesting problems (Hillman, 1989, p. 2). Teachers must teach each student how to deal with it in a personal, significant manner.

Science education should be planned for and include all students, without stereotyping by sex and race. Teachers must meet the needs of students who are not destined for careers in science as well as the ones who desire advanced study.

Most teachers think of science as an area in which students conduct experiments and discover scientific data, but it is also the dissemination and acquisition of data through the reading of printed materials. Students must have competence in the various raeding-study skills: skimming and scanning, intensive reading, library usage, finding the main idea, summarizing, using appropriate study procedures, and using visual aids such as graphs, pictures, tables, and charts effectively.

Students also need to know how to take notes. Science writing can be described as intense, precise, specific, and jammed with facts. "The body of knowledge that exists about the world and the method used to obtain that knowledge are called science" (Harcourt, Brace, Jovanovich, 1989, p. 3). Students must learn how to access that knowledge.

Science needs to be taught as an activity through which problems and questions dealing with the natural world can be identified and defined and solutions proposed and tested. Science education must be an important priority for students. Students must develop skills necessary to proactively meet the challenge of the future.

Science Education in the Future

The American Association for the Advancement of Science has presented Project 2061. This Project is intended to help reform science, mathematics, and technology education in the United States.

Students should leave school with an awareness of what the scentific process is and how it relates to their culture as well as their lives.

One way to accomplish this concept is changing the curriculum. There must be a reduction in the amount of material covered. There needs to be a relationship between science, mathematics, and technology.

The effective teaching of these subjects must be based on learning principles that come from systematic research as well as from well testing craft experience.

One needs to start with the question about a situation rather than with answers to be learned. The use of the hypothesis, the collection, and use of evidence, as well as design of investigations and processes, all need to be taught and practiced. Students need to be provided with hands-on experience. Emphasis should be placed on the curiosity and creativity of the student, as well as using a cooperative learning approach.

Middle school classrooms need to be designed to provide laboratory work stations. There needs to be an adequate budget for supplies, equipment, and maintenance.

Teachers need to be trained in creating and implementing hands-on activities instead of using only textbooks.

Partnerships need to be developed between business and industry and the school. Perhaps developing tax incentives to encourage business and industry to hire science teachers during the summer and to release company scientists to work in the classroom could be tried.

Students need to manipulate objects and personally observe phenomena in order to become truly interested in science (Chenoweth, 1990, p. 48). The difference between performing an experiment and watching one being performed is profound!

CHAPTER III

A HANDBOOK FOR MIDDLE SCHOOL SCIENCE TEACHERS

by

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and

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April 15, 1991

HANDBOOK

TABLE OF CONTENTS

INTRODUCTION

The activities in this handbook will emphasize hands-on, cooperative learning activity based at grades six through eight. All areas of the curriculum will be integrated into these activities. These activities will help prepare students to be scientifically literate ready to respond to technological and social problems. Students will develop process skills in order to think scientifically. Students will manipulate scientific equipment and materials in order to make observations and gather data.

When science ideas are presented to adolescent children, the experiences need to be real, concrete tangible experiences with real materials. The ideas and experiences need to be presented in a way that will allow students to feel a connection to them. The information, ideas, or activities need to be presented so that it ties them to a child's life so that the child will feel a desire to know. Teachers often become overly concerned with content and facts. It is more important for adolescents to be actively involved in science experiences for them to learn all the facts (Levenson, 1985).

The handbook provides teaching strategies, activities, games, and lessons that can be used to supplement a regular middle school science program. Students will think critically, creatively, and rationally in order to solve problems scientifically.

TITLE: SCIENCE ISSUES — BUMPER STICKERS

Objectives: Critical thinking, creative writing, awareness, and appreciation of current science issues and art.

Materials: Tagboard Strips

Colored markers

Pencils

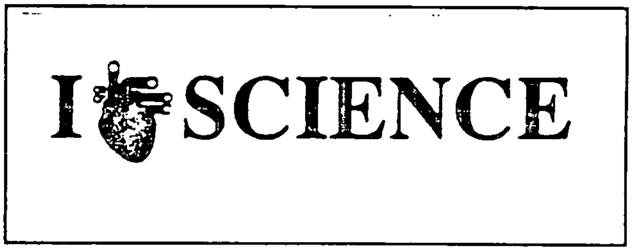
Crayons

Old magazines

Scissors

Glue, or tape

Example:



Background: The purpose of this activity is to stimulate class discussion relative to science issues. One class period should be used for brainstorming, one class period to do the activity.

Procedures:

1. Have each student pick a topic. Some ideas could include: Inventions, Recycling, Safety, Energy, Conservation, Pollution, Weather, Wildlife, and Space.
2. Each student is to come up with a catchy slogan or creative eye-catching phrase.
3. Draw or find a magazine picture that symbolizes your topic.
4. Display the finished products so others can learn more about important science issues.

TITLE: SCAVENGER HUNT

Objectives: Students will:

- find natural wonders within a community
- rediscover and appreciate the environment
- create a display to share with the class.

Materials: Poster board

Old magazines

Markers

Glue

Items from scavenger hunt

Procedure:

1. Give a list of items to be found to each student or pairs of students.
2. Divide a poster board into twenty-four equal sections and have students display items from a secavenger hunt or pictures from old magazines.
3. Have students share their displays with the class and explain why they classified items into certain categories.

<u>THINGS TO FIND</u>:

1. Something changing due to weather
2. Something decomposing
3. A hiding place
4. A seed plant
5. Something to eat

6. Something which can be recycled
7. Something camouflaged
8. Something that will be gone tomorrow
9. An immovable object
10. A sign of boundary
11. An object which sends or receives
12. A source of water
13. Something that flies
14. Something bright and cheerful
15. A place of rest
16. A source of heat
17. A person working
18. A thing of beauty
19. A resting or relaxing object

20-24. Your choice

TITLE: PHOTOSYNTHESIS

Objectives: To see how plants obtain their food through photosynthesis.

Materials: Paper clips

Aluminum foil

One flourishing plant

Procedure:

1. Put little pieces of aluminum foil on the leaves of the plant and attach them with the paper clips.
2. Leave the plant in a window that receives direct sunlight for many days.
3. Take off the paper clips and pieces of aluminum foil. Notice the results.
4. Sun produces the green coloring, chlorophyll, in plants. When it is blocked, the leaves lose or lighten their color.

TITLE: AN IMAGINARY REPTILE

Objective: To form a model of an imaginary animal that has the features of a reptile.

Materials: Unlined white paper

Lined white paper

Pencil

Colored pencils, crayons, or markers

Procedure:

1. You will be drawing an imaginary reptile. List all the reptile characteristics your imaginary animal should have.
2. Then list the function of each characteristic.

Data Table
Characteristics / Function

3. On a piece of unlined white paper, draw an imaginary reptile. Your creature may have any special features that you would like to add but remember, the animal must have the characteristics of a reptile.
4. In addition to the reptile, draw some of the other things that would be found in the reptile's environment, such as plants and rocks.
5. Check to make sure that your drawing of the imaginary animal has all the characteristics that you listed in the data table.

6. To illustrate some reptile characteristics, you may need to add things to the animal's environment in your drawing. For example, you may want to show the eggs your animal lays or an organism that it eats.

(Bierer, 1991)

TITLE: LOOKING AT A PLANT CELL

Objective: To investigate a plant cell.

Materials: Onion

Microscope

Slides

Coverslip

Tweezers

Iodine

Procedure:

1. Put a drop of water on the center of a slide.
2. Remove a think slice of an onion skin, so that is paper thin.
3. Float the onion skin on the drop of water. Make sure there are no folds in the onion skin.
4. Put a coverslip on the slide.
5. Put a drop of diluted iodine on one side of the coverslip.
6. Tear off a small piece of the paper towel and hold it with the tweezers.
7. Touch the towel to the liquid at the edge of the coverslip on the opposite side of the stain. (The stain should spread beneath the coverslip.)
8. Observe the plant cells. Find the cell wall, cytoplasm, and the nucleus.

(J. Richardson, 1979)

TITLE: OBSERVING A MEALWORM

Objective: To observe a mealworm.

Materials: Mealworm

Hand lens

Strings

Metric ruler

Oats

Index cards

Procedure:

1. Place a mealworm on an index card. Use the hand lens to oberve the different parts of the mealworm. Record your observations.
2. Make a sketch of your mealworm.
3. Put the mealworm on a corner of an index card. Put some oats on the opposite corner of the index card.
4. Trace the track of the mealworm to the oats with a pencil. (Do not touch the mealworm with the pencil.) Make a dot (.) at every point at which the mealworm changes direction.
5. Measure the distances between all of the dots which is the total distance the mealworm has traveled.

TITLE: WORM REGENERATION

Objective: To demonstrate regenerative powers. To show that specific animal parts must be present for regeneration to occur.

Materials: Earthworms, jar, soil, leaves, grass, decaying organic material, water, scalpel

Procedure: Mix soil, leaves, grass, and decaying material together. Dampen the soil mixture. Fill the jar half full of the damp soil mixture. Using the scalpel, cut each worm into three pieces, making sure the head is intact. Place all worm pieces in the jar and observe for two to three weeks.

TITLE: PRESERVING SPIDER WEBS

Objective: To preserve webs.

Materials: White aerosol paint, black matt card/black construction paper, glue (spray glue is best), sharp scissors, spray varnish

Procedure: After finding a "good" spider web, carefully spray the web with white paint. Paint or spray a think layer of glue onto the black paper. While the glue is still damp, carefully press the black paper into the web. Avoid any sideways movement that may damage the web. Cut the supporting threads of the web. Spray a think layer of varnish over the web for protection.

TITLE: HELPFUL WORMS

Objectives: To demonstrate how earthworms break up, fertilize, and aerate the soil.

Materials: Large glass jar, sand, soil, worms, grass, dead leaves, paper

Procedure: Dampen the sand and soil. Using alternating layers, place sand and soil in a jar. Place worms in a jar. Add a layer of grass and dead leaves for food. Cover the jar with thick paper and leave it for several days. Remove the paper and observe tunnels made by the worms.

TITLE: INHERITING TRAITS

Objective: To determine the chance of inheriting one gene instead of another gene.

Materials: A coin

Paper

Pencil

Procedures: Some guinea pigs have long hair and others have short hair. Suppose a guinea pig has a gene for short hair and a gene for long hair. What is the chance that the young will receive a long-hair gene from this parent?

You can toss a coin to find out. Let heads stand for short hair and tails stand for long hair. Toss the coin 20 tries. Place a check mark in the proper column. Find the total number of times for heads and for tails. Divide each total by 20. (Example: five heads in 20 tries is 5/20, or 1/4.) What happens if you go for 50 tries or 100 tries?

(Barufaldi, 1985)

INHERITING TRAITS

TOSS	HEADS	TAILS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

TITLE: MAKING AN INSECT CAGE

Objective: To develop more of an understanding of invertebrate animals.

Materials: Two jar lids of the same size

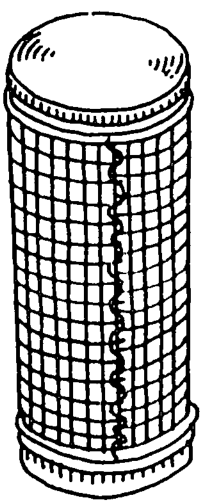
Piece of window screen

Thin wire

Scissors

Procedure: Cut the piece of screen so that it is about three times the width of the jar lid. The height of the screen should be about 20 cm. Roll the screen so that it fits tightly inside the jar lids. Use thin wire to secure the screen where it overlaps. Tape the lids to the screen if they do not fit tightly.

Note: When you capture an insect for your cage, notice what its natural habitat is like. Then place same soil, twigs, and leaves inside the cage. The insect should also have the same light and temperature that it had in the wild. Use a field guide to show how to care for the insect. Release the insect when you finish observing it.



TITLE: CELL MODEL

Objective: To show the different parts of the cell. To demonstrate that cells have shape and thickness.

Materials: Jello (yellow for cytoplasm)

Hot and cold water

Bowl

Spoon

Zip lock bag — quart size*

Assorted materials to represent different cell parts (noodles, grapes, macaroni, thread, buttons, marbles, Cheerios, Wheat Chex, etc.)**

Fine tipped magic marker

Diagram of a cell

Procedures:

1. Follow directions on box to prepare the jello.
2. Decide which items will represent each part of the cell.
3. Place all items representing cell parts into the zip lock bag.
4. One student should hold the bag open as a second student pours 2-2½ cups warm jello into it. (A 2-liter bottle cut in half makes a nice base to stabilize the bag as students pour. Place bag and bottle on a tray or thick pad of newspaper.)
5. Close top of bag making sure it locks.
6. Carefully lay bag on its side and arrange the "cell parts."
7. Place bags in refrigerator to allow jello to gel.

8. When gelled, use marker to label outside of the bag with names of cell parts.

*A clear plastic glass may be substituted for the zip lock bag. Fill three-fourths full of warm jello; allow to partially gel before adding cell parts.

**Cells can be made edible if only food items are used as cell parts and appropriate sanitary measures are taken.

TITLE: FINDING SMALL ANIMALS IN SOIL

Objectives: Observing small invertebrates.

Materials: Plastic funnel

Jar

Absorbent paper

Light source

Cotton cloth

Rubber band/Masking tape

Procedures: For a "Berlese Funnel"

1. Pack leaf litter and soil into a plastic funnel; place a think cotton cloth over it and secure with a rubber band or masking tape.
2. Put absorbent paper in the bottom of the jar.
3. Wedge the funnel into the jar.
4. Place a light above the funnel. The light will drive the "critters" onto the paper in the jar.
5. Use a hand lens and insect guide to identify small invertebrates.

<u>Note to the teacher</u>: A Berlese Funnel is a useful device for collecting small. inverterbrate, animal specimens in the classroom. You may want to ask the students as part of this lab to bring a soil sample in a zip lock bag. After the students have set up the funnel and light source, place a cloth over the funnel and

secure it around the jar with masking tape. Students will see results the next day. Use a hand lens for close examination.

TITLE: POTATO TRAP

Objectives: To collect small animals for students to study.

Materials: Large potato

Knife

Apple corer

Rubber bands or string

Procedure:

1. Slice potato in half lengthwise.
2. Hollow out the inside of each potato half.
3. Using corer, drill entrance tunnels into each end of potato.
4. Fit potato halves back together and secure.
5. Bury potato in soil so entrance tunnels are level with soil.
6. Check daily for millipedes, centipedes, slugs, snails, pill bugs, etc.

Students may use hand lens to count the legs on each segment of isopods, do experiments to determine what type of environment pill bugs prefer, or observe snail's method of movement and eating.

TITLE: WATER HOLDING CAPACITY OF SOIL

Objectives: Students will observe the drainage capacities of different types of soil. They will calculate and compare the amount of water absorbed in each type of soil.

Materials: (per group of students)

3 styrofoam cups (8 oz.)

3 transparent cups (10 oz.)

Pencil (for punching holes)

300 ml water

Metric ruler

Graduated cylinder

180 g of sand

180 g of clay

180 g of potting soil

Procedures:

1. Punch five holes in the bottom of each styrofoam cup (drainage).
2. Make a mark 5 cm from the bottom of the cup.
3. Add a different type of soil to each cup, packing the soil tightly.
4. Label each cup with the type of soil it contains.
5. Place each styrofoam cup inside the plastic cup.
6. Predict what will happen when you pour 100 ml of water into each cup.

7. Record the time it takes for all of the water to drain from each cup.

8. Measure the amount of water in the plastic cup. Be sure to record the data.

9. Subtract the measure of the amount of water in the plastic cup from the measure of the amount poured into each cup. Record the data.

RESULTS AND CONCLUSIONS:

1. What is the texture of each kind of soil?
2. Which type of soil drained the fastest? Why?
3. Which soil held the most water? Why?
4. Why were holes punched in the bottom of each cup?

EXTENSIONS:

- Try testing absorption of different brands of paper towels or toilet tissue.
- Test to evaluate which type of soil is best for bean seeds to grow (may substitute other types of seeds for comparison).

(Science Scope, Vol. II No. 5)

TITLE: SOIL SAMPLE IN A JAR

Objectives: Observation, making a soil profile, sedimentation study, experimentation.

Materials: Gravel

Sand

Clay

Water

Plastic jar with lid

Background: This activity will give students a firsthand look at sedimentation. Sedimentation occurs in lakes, rivers, and oceans. As the layers separate, students will see what happens in a lake or sea. It is an important part of the non-living environment that affects an ecosystem.

Procedure:

1. Place a mixture of gravel, sand, clay, and top soil into a plastic container.
2. Add water until it completely covers the mixture, plus an extra 2-3 inches.
3. Close jar tightly!
4. Shake the jar and let it settle.

TITLE: FRESH WATER

Objective: Students will be able to make fresh water from salt water.

Materials:

Large spoon

Salt

Water

2 small cups

Large bowl

Plastic wrap

Tape

Marble

Procedure:

1. Mix one large spoonful of salt in a small cup of water.
2. Pour a think layer of salt water into the bowl.
3. Place a clean cup right-side-up in the middle of the bowl.
4. Cover the bowl with the plastic wrap. Tape the plastic wrap securely to the bowl.
5. Place a marble over the center of the cup, on top of the plastic. Do not let the plastic wrap touch the cup.
6. Leave the bowl in sunlight until water collects in the cup. Lightly tap the marble on the plastic wrap to collect more water.
7. Remove the plastic wrap and let the water in the cup and bowl evaporate.

8. Rub the bottom of the bowl with one finger and the bottom of the cup with another finger. Record what you feel in each container.

TITLE: CHEMICAL CHANGES — ACID AND BASES

Objective: To test common solutions, such as vinegar and household ammonia, to determine whether they are acids or base.

Materials: Household ammonia (or sodium hydroxide)

Vinegar

Red and blue litmus paper

Medicine dropper

Procedure:

1. Litmus paper is treated chemically to indicate whether a solution is an acid or a base. An acid solution causes blue litmus to turn red and red litmus to remain red. A basic solution causes red litmus to turn blue and blue litmus to remain blue.
2. Use a medicine dropper to place several drops of vinegar on blue litmus paper. Look for a color change. Record your observations.
3. Place several drops of vinegar on red litmus paper. Look for a color change. Record your observations.
4. Use a clean dropper to place a drop of household ammonia on red litmus paper and to place another drop of ammonia on blue litmus paper. Look for color changes and record your results.

Note to teachers: Vinegar is an acid and ammonia is a base.

(Tilsner, 1970)

TITLE: HEAT-CONDUCTION

Objective: To see whether a brass rod or a glass rod conducts heat more rapidly.

Materials: Candle wax

Candle in holder

Brass rod

Glass rod

2 marbles

Match

Procedure:

1. Use melted candle wax to fasten a marble four inches from the end of a brass rod.
2. Fasten another marble four inches from the end of a glass rod.
3. Use equal amounts of wax to attach the marbles to each rod.
4. Hold the ends of both rods in a candle flame.
5. Record on a piece of paper which marble fell off which rod first. The rod which the marble fell from first is a better conductor of heat.

TITLE: INVISIBLE MESSAGE

Objective: Students will be able to write invisible messages using cornstarch.

Materials: Petri dish

Toothpicks or small paintbrushes

1 small beaker (container for cornstarch mixture)

Filter paper

25 ml of iodine solution*

25 ml of cornstarch solution**

Procedure:

1. Use the toothpick, or small paintbrush and dip it in the cornstarch solution.
2. Write a message or draw a picture on the filter paper. (Make sure each letter or drawing is saturated on the paper.)
3. Let the message or drawing dry completely.
4. Pour the iodine solution into the petri dish.
5. Place the dried filter paper into the petri dish.

*Iodine solution = mix 25 grams of iodine crystals with 1000 ml of isopropyl alcohol (rubbing) or ditto fluid (methanol).

**Cornstarch solution = saturated solution of cornstarch and water.

RESULTS AND CONCLUSIONS:

1. What type of food is cornstarch?
2. What is iodine?
3. What is iodine used for?

4. What happened when the dried filter paper was placed in the iodine solution? Why?
5. Iodine is a test for which food?

TITLE: UNDERWATER – YET NOT WET

Objectives: Demonstrate that air takes up space.

Materials: A large beaker or jar 3/4 full of water

A drinking glass

A small handerkerchief or small cloth

Procedure: Pack a handkerchief or cloth firmly into bottom glass, turn glass upside down and lower it into the beaker of water. (You must hold the glass straight.)

TITLE: SURFACE TENSION

Objectives: Demonstrate water molecules cling to each other (surface tension).

Materials: Penny

Medicine dropper

Cup (small container of water)

Paper

Pencil

Procedure: Each pair of students will use a medicine dropper and try to put as many drops of water on the penny without spilling over. Students do this three times and take the average.

TITLE: POPPING OFF

Objectives: Demonstrate air pressure is very strong.

Materials: Pop can

15 ml of water

Heat source; hot plate or candle with tripod stand

Container of cold water (large enough to invert can)

Heating tongs

Procedure: Pour 15 ml of water in a pop can. Place over heat source (water must boil inside can for one minute; steam must flow out of the can driving out all air). Quickly invert can (top of can only) into cold water.

<u>Please note</u>: Always take precautions when students are using heat sources.

TITLE: ELECTROMAGNET

Objective: To see how electricity can be used to make a magnet.

Materials:

1½ volt electric cell

10 feet of insulated wire

Large nail

Paperclips or tacks

Procedure:

1. Remove the insulation from the ends of the wire.
2. Carefully wrap at least fifty turns of the insulated part of the wire around the nail. Be sure to do all the wrapping in the same direction.
3. Connect the wire to the cell to form a circuit.
4. Test your magnet with paperclips, tacks, or other materials made of iron or steel. Disconnect one end of the wire. Record what happens on a piece of paper.

TITLE: DETERGENTS CLEANING

Objective: To discover how detergents help clean fabrics.

Materials:
2 clear plastic glasses

2 droppers

Liquid detergent

Salad oil

Spoon

Thin needle

Paperclips

Water

Procedure:

1. Fill one plastic glass almost to the top with water.
2. Bend the paperclip to form a support for the needle.
3. Balance the needle on the paperclip and carefully lower the needle to the surface of the water. With practice, you should be able to float the needle.
4. Carefully add a drop or two of detergent to the water's surface. Record your observation.
5. Fill the second plastic glass half full of water. Add a few drops of salad oil to the water. Stir with the spoon. Record your observations.
6. Add several drops of liquid detergent to the salad oil/water. Stir with the spoon. Record your observations.

(Perkins, 1981)

TITLE: LIGHT WAVES

Objective: To see how light waves travel.

Materials:
Book
Coffee can
Flashlight
Masking tape
Meter stick
Pencil
3 pieces of cardboard, each 30 cm x 15 cm
Screen or piece of white paper
Table

Procedure:

1. Place the screen at one end of the room. If you do not have a screen, tape a large piece of white paper to a wall.
2. Stand a book on a table in front of the screen.
3. Turn off the room lights and turn on the flashlight.
4. Aim the flashlight at the book. Describe what appears on the screen.
5. Repeat steps 2-4 using the coffee can in place of the book.
6. Fold each piece of cardboard into an "L" so that 15 cm is standing upright, and 15 cm is extending horizontally.
7. In the center of each upright side of cardboard, punch a hole with your pencil.

8. Arrange the three pieces of cardboard, 30 cm apart, in a straight line on the table.
9. Place the flashlight at one end of the table and turn it on.
10. Turn off the room lights and look through the pencil holes at the light.
11. Move the pieces of cardboard until you can see the light through all three holes at one time.
12. Move the middle piece of cardboard a little to one side.
13. Look through the holes at the light. Record your observations.

TITLE: HOW TO MAKE A FLOWER PRESS

Objective: A student will become more aware of how to classify plants.

Materials: Flowers, weeds, or fern

Newspapers

Paper towels

Glue

Cardboard, oaktag, or poster board

Plastic wrap

Procedure:

1. Select a wild flower, weed, or fern. Cut the flower, leaving a long piece of stem on it. Place the flower in water unless you use it right away.
2. Put six sheets of newspaper together. (Do not use the colored comic pages or any shiny pages.) Place a layer of paper towels on one-half of the newspaper. Put a flower on top of the paper towel, carefully spreading out the leaves. A flower that has a thin center can be pressed by laying it on the paper towel and flattening it with your fingers.
3. Next, carefully place a second layer of paper towels on top of the flower. Fold the newspaper over the flower. Put heavy books or bricks on top. This will complete the flower press. If the flower has a thick center, remove the petals, putting the petals in one flower press and the flower center in another.

4. Check the flower in two weeks. It is dry if the petals are stiff and flat. They will feel like paper. The dried flower can be glued to white or ivory-colored cardboard, oaktag, poster board, or paper. Write the name of the flower beside it.
5. Cover it with plastic wrap, and mount it on a bulletin board or a page in a notebook.

TITLE: SHELL CASTING

Objective: To further the study of ecology and make a cast of a shell.

Materials: Sea shells

Small cake pan

Clay

Vaseline

Plaster of Paris

Procedure:

1. Put the clay evenly along the bottom of the pan.
2. Grease the pan and clay with vaseline as you would for a cake.
3. Set the shell or shells in the pattern you desire into the dough.
4. Lift the shell out carefully with the tip of a knife.
5. Mix the Plaster of Paris and pour it in before it sets. Allow it to harden completely before you take it out of the pan.
6. Decorate or paint the raised cast.

TITLE: NATURAL PHENOMENA

Objective: To study natural phenomena, their causes and effects.

Materials: Reference books

Paper

Pencil

Procedure:

1. Go to the library or gather reference books on natural phenomena.
2. Study natural phenomena, their causes, and their good and bad effects. Find out how, why, and where these natural phenomena occur. Which have you seen where you live? Which ones are predicted for your area?
3. Make a world map showing the areas most likely to exhibit these phenomena.

<u>Examples</u>:

Volcanoes	Whirlwinds
Hot springs	Monsoons
Earthquakes	Eclipses
Tidal waves	Ellipses
Tornadoes	Meteors
Cyclones	Meteorites
Quicksand	Shooting stars

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Restatement of Problem

The purpose of this study was to develop a handbook listing games, activities, and lessons that middle school teachers could use to supplement the science curriculum.

Conclusions

The authors maintain in order to achieve maximum success in science the teacher must provide lessons with hands-on activities for their students. By being actively involved, students will develop skills in order to think scientifically. Students will think creatively and rationally in order to solve problems.

The science experiments and activities in this handbook provide the teacher with a variety of strategies to enhance the science curriculum. These activities allow flexibility in teaching as well as stimulation to maximize the scientific approach. These activities may be instructed with individual students, in small groups or entire class instruction.

Recommendations

This handbook should be useful for any middle school science teacher as a resource to accompany the science program in their school system. The hands-on activities and experiments are divided into five areas: science issues, life science activities, earth science experiments, physical science activities, and nature lessons. These activities and experiments are clearly explained and easily accessible for use by the classroom teacher.

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