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By-Prombain, Dorothy R.; And Others
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This science sourcebook was written for intermediate grade teachers to provide guidance in teaching a specially developed unit on chemical indicators. Directions and suggestions for guiding student science activities are given. Some of the activities concern soil testing, crystals, and household powders such as sugar and salt. A list of necessary equipment, visual aids, and a bibliography of science information sources are provided. (BC)

Chemical

Experimental Guide Prepared For Testing in the Intermediate Grades

CHEMICAL INDICATORS

Developed by: Dorothy R. Prombain, *team leader*
Marjorie Nealon
Amy Solinger

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Chemical Indicators
starch
baking soda
cream of tartar
plaster
starch and baking soda

TABLE OF CONTENTS

I. INTRODUCTION

The purpose of this sequence is to provide intermediate grade children with opportunities for experiences in scientific thinking. Pupils are encouraged to work along an involvement flow that includes:

1. Observing
2. Questioning
3. Predicting
4. Trying
5. Discovering
6. Concluding

At this age most children have had little or no experience with science in life-like situations. Opportunities to set up problems, make predictions, and then find the result of their predictions have been limited. For the most part, children rely solely on their five senses to evaluate the properties of things.

Chemical Indicators enables the curious child to use materials and equipment from a Pupil Kit. It affords him opportunities to:

1. Set up experiments.
2. Use Chemical Indicators such as iodine, vinegar , blue and red litmus. Use water and heat.
3. Observe and record his observations on charts.
4. Analyze known and unknown materials.
5. Test soils for acidity or alkalinity using a soil testing kit.

6. Use a microscope in observing the types, shapes, and growth of crystals.

7. Develop questions, explorations, and predictions.

Each teacher approaches children and materials differently. In this guide are suggestions for teaching the sequences. These are merely suggestions. Each teacher is free to adjust the sequences to her pupils' interests and needs. The unit is intended to be open-ended. It is desired that teachers note suggestions as they evaluate the lessons. Please keep a record of your childrens' reactions and suggestions for further trials.

Many people have contributed to the development of Chemical Indicators. We especially appreciated the back-up services provided to us by the Center for Collaborative Learning Media Packages staff. These included: George Moore, Project Director; Leo LaMontagne, Project Supervisor; Terese O'Connell, Intermediate Grade Resource Teacher; L.Dennis McLaughlin, Office Manager; Ruth Fay, Curriculum Center Secretary; Ronda Pimentel, Title III Secretary; and David Webster, Curriculum Specialist whose guidance was most appreciated.

We especially want to express our gratitude to Elementary Science Study of 55 Chapel Street, Newton for providing ideas from Mystery Powders that led to the explorations in this sequence.

Dorothy R. Prombain, Teacher Leader
Fiske School

Marjorie Nealon
Warren School

Amy Solinger
Kingsbury School

II. MATERIALS

Available on order from the Curriculum Center

A. For the Mystery Powders Sequence

1. Pupil Kits
2. Paint buckets for powder mixtures
3. Sandwich bags
4. Souffle cups
5. Plastic spoons
6. Starch, cream of tartar, baking soda, plaster, sugar, salt (Diamond Crystal and kosher), dried milk, (all white powders)
7. Vinegar, iodine, red and blue litmus paper
8. Microscope slides
9. Poster size chart for basic powders
10. Individual chart shells for pupil use.
11. Balance Scales
12. Poster board

B. For the Soil Testing Sequence

1. La Motte Soil Testing Kit
2. Porcelain trays (one per pupil)
3. Color charts
4. Mimeo pamphlet C. How Much Acid (for teacher use)
5. Bromthymol blue
6. Phenolphthalein
7. Two-inch aluminum foil cups

C. For the Crystals Sequence

1. Bausch & Lomb 100x microscopes
2. Diagrams of microscope for pupil use
3. Overhead projector transparency of microscope diagram
4. Microscope slides (approximately 5 per pupil)
5. Hand magnifying glasses (1 per pupil)
6. Lens tissue
7. Kleenex
8. Poster size diagram of microscope
9. Solutions of alum, copper sulfate, bluing, potassium permanganate, "instant crystals"
10. Aluminum foil
11. Six-inch aluminum foil pie tins
12. Ammonia
13. Paper cups
14. Graduated beakers
15. Tweezers
16. Coal, galena, mica

III. TEACHING APPROACH TO MYSTERY POWDERS

The Mystery Powder Sequence deals with the use of indicators in detecting the presence of various substances. Mixtures of unknown white powders (all harmless) are tested using iodine, vinegar, water, heat and litmus paper. The important result we hope to achieve is to have children think as they use evidence from their experiments. Generally, there is no absolutely right or wrong answer. The children should be made to feel free in making critical observations and evaluations. They need freedom to manipulate materials and equipment. Some children will conclude that the five (5) senses are inadequate and unreliable in making judgments, hence the need to find chemical indicators through testing. Others will not attain this sophistication.

By testing, pupils become familiar with the reactions. Some powders become hard when mixed with water, however, plaster of Paris gets hardest. When starch is heated it becomes light brown; sugar bubbles, smokes, blackens and hardens. In using iodine, vinegar and litmus with the powders many unusual things will happen. The child will begin to see the need for these and other chemical indicators.

The following approach to teaching Mystery Powders is a suggested guide. Always feel free to extend or modify it to suit your class and your own style of teaching.

First Week

1. Have equipment and supplies exposed so that children may become familiar with them. This will also stimulate curiosity.
2. Send home permission slip to be signed by parent. (See parent letter in appendix.)
3. Discuss familiar uses of our five senses in everyday living. Can the weatherman predict weather by looking at the sky or going outdoors? "No, he needs tools to help him make decisions.
   "If the sugar and salt aren't labeled can you tell them apart by looking at them"?
4. Distribute sandwich bags to each child. Place about two (2) teaspoons of each powder in a bag. These are starch, baking soda, cream of tartar, plaster, and starch and baking soda mixture. Number each bag to correspond with powder number. Distribute Chart 1.
5. Develop possible home testing techniques from pupil suggestions. Emphasize safety by having parents permission and to be aware of what children are about to do.
6. Discuss rules for filling in charts, stressing neatness and legibility -- do not insist on language or spelling accuracy as this will discourage your slow learners.
7. Itemize home testing results on chart drawn on the board. Tabulate results and identify powders.

Name Richard Zahn

CHEMICAL INDICATORS

Powder Number	Powder Name	How You Found Out
1	Starch	Tasted it Mixed it with a small amount of water, shiny, sticky, smells, grainy feeling
2	Baking Soda	Mixed it with water and then mixed baking soda with water. Cooked it. Compared it Tasted it
3	Cream of Tartar	Cooked it, tasted it, mixed it with water, tasted sour, water made it cloudy, color was greyish green
4	Plaster	mixed it with a small amount of water, then stirred and it hardened Mixed it with water felt sandy-
5	Starch and Baking Soda	Compared it-felt like others
6		

2. Tasted salty - Fizzed in water, turned clear

Remember, there are no absolutely correct answers. Children discover for themselves that their senses are not adequate to correctly identify names of the powders. The next step is to examine the kit for other indicators.

Second Week

(note: time schedule is flexible to suit your particular situations)

1. Acquaint pupils with the kit. They will handle dropper bottles, iodine, souffle cups, and other kit materials.
2. Pair pupils for next experiments. The mutual aid will enforce an interaction of pupils with pupils and pupils with materials.
3. Pupils use iodine with the basic powders, observe the effects and record on charts. At the conclusion there is a general discussion of results and children realize that they agree more often than disagree on their conclusions. (Use Chart 2)
4. Pupils use a few drops of iodine with unknown powder mixtures. Some children conclude that if a mixture turns black with iodine it is an indication that starch is present. Others say that a powder similar to starch is in the mixture. Ask the children what can be said when a mixture does not turn purplish-black with iodine. Most nine-year-olds find it requires too much perception to conclude that there may not be starch in this mixture. Possibly it is their first formal exposure to "negative" thinking.

Name David Goodhart

CHEMICAL INDICATORS

Name	What Happens With Iodine
starch	It looks like black licorice
baking soda	It just stuck together
cream of tartar	I turned into bumps that were yellow inside
plaster	It got bumps in it
Starch and baking soda	It made bumps that were black inside
6 starch and cream of tartar	Starch turns black and cream of tartar turns yellow
7 It has starch in it I think	I think it has starch in it because it turned black
8 Baking Soda and boric acid	it turn orange and was sort of fluffy

Follow-up Activities:

a. Since children agree that iodine is a good chemical indicator for starch, encourage them to bring foods from home for testing; use various types of paper for iodine test.

b. Discuss the practical application of iodine as a chemical indicator for determining the amount of starch in someone's diet (the children will suggest other practical applications.)

Third Week

1. Now that the children feel at home with eye droppers and small bottles, they may use the vinegar on the basic powders. Follow the same procedure as with iodine.

2. Have children record results (Chart 3 in appendix). Discuss results. Vinegar is a good indicator for baking soda. At this point it might be wise to elicit from the children just how good an indicator is iodine or vinegar. They detect the presence of certain substances but do they measure how much or how little of that substance? Perhaps there are more definitive indicators which can paint a more detailed and accurate picture. Use unknown mixtures with vinegar.

3. Use Chart #4 at home for testing powders with water and heat. Discuss variables i.e., how much water or with heat - what temperature range, heating time, heating pan, etc. Include sugar from their kitchen as an additional powder. Talk of safety factors and

Name George Marsh

CHEMICAL INDICATORS

Powder Name	What Happens with Vinegar
Starch	I put in two drops of vinegar and it got sticky and turned pink slowly
Baking Soda	Fizzed quickly, turned into white flakes. It felt sandy.
Cream of Tartar	Formed bumps, didn't turn colors.
Plaster	Same as cream of Tartar
Plaster and Baking Soda	Erupted like a volcano, bubbled, made gurgling sounds
Cream of Tartar and Baking Soda	Same as plaster and baking soda

Name Howard Gould

CHEMICAL INDICATORS

Name	Mix with Water	Name	Heat
1		Starch	It sizzled and smelled burnt
2		Baking Soda	It turned light brown and yellow. It bubbled
3		Cream of Tartar	It sizzled and it did not turn colors
4		Plaster	It made a puff, it turned off white
5		Powder Sugar	It turned Flaky and turned to little ball like sand
6			
7			

3. (con't)

of parent's permission to use the stove. Allow a couple of days, then discuss results. Sugar will give an unusual reaction. (This possibly could be done in the classroom.)

4. Before using red and blue litmus paper it is helpful to have pupil reports on these materials. This will give the pupils an understanding of the properties of litmus and also serve to introduce new vocabulary, such as acidity and alkalinity.

5. Children use blue litmus with water on the basic powders, record their results and discuss them. Taped litmus to charts helps later recall. Use litmus paper with unknown mixtures (Chart #5)

6. Children may use blue litmus dipped in vinegar, orange juice and/or boric acid. Blue litmus turns pink quickly because the articles tested are acids.

7. Use red litmus on basic powders, record results on Chart 6 and discuss the results. Introduce borax, Spic and Span and ammonia. Red litmus turns blue with these materials. These are alkaline and "balance" acids.

8. Follow-up Activities:

   a. Children may bring in materials as Alka-Seltzer tablets, Tums, coffee and other household items and experiment with them.

   b. Pupils may build a volcano using baking soda and vinegar.

Name Richard Zahn

CHEMICAL INDICATORS

Materials Tested	What Happens with Blue Litmus
Baking Soda + Plaster	It erupted, turned pink, smelled like beer, and turned blue again
Plaster + Starch	It bubbled a little, turned pink, stayed pink
Starch + Baking Soda	It fizzed, turned pink, then it turned blue again
Cream of Tartar + Baking Soda	It fizzed, turned pink, was stick, stayed pink.

Name David Goodhart

CHEMICAL INDICATORS

Material Tested	What Happens with Red Litmus: Water	Vinegar
Starch	dark pink, blue dots didn't turn back	Same as with water
baking Soda	turned very dark blue quickly	fizzed, turned orange then turned blue
Cream of Tartar	Same as starch less spots	same as starch
plaster	same as starch except paler less spots	same as starch

8. (con't)
   c. Some may want to dilute vinegar to see if it will react.

   Using red-blue litmus papers as indicators has far more practical application to everyday living then we anticipated and is most useful in light of the projected experiments with soils.

   For those pupils who show interest you may want them to work with suggestions included in C. How Much Acid. A copy is in the appendix.

Fourth Week

1. This is optional with several teachers finding this useful before going on to soil testing. Using Charts #7 and #8 children can use four indicators with unknown mixtures.
2. Experiment called "Mystery Powders". (Chart #8)
   a. Use look-alike powders such as Accent, instant mashed potatoes, unscented talc, vanilla pudding, etc.
   b. Follow regular procedure using water, iodine, vinegar and litmus and record results.
   c. Mix powders, number and code them, have children use indicators in testing.
   d. At this point a few children will probably conclude that the absence of reactions proves something positive.
3. Organizing the Master Chart
   a. Children will organize prior data onto Chart #9 in the appendix. This chart serves as a

3. a. cont.

composite for easy reference. Wherever possible encourage using diagrams, or pasting samples showing color changes.

4. Make a personal dictionary of new words and terms. This can be an on-going activity, adding to it as more sequences are completed.

IV. SOIL TESTING

In most classrooms, teachers keep plants of various kinds whose care is in the hands of pupils. From time to time questions arise as to why a particular plant seems to be drooping, why doesn't this one flower, or what is this white powdery substance on top of the soil, is it good or harmful, why is this plant tall and spidery while this one is green and bushy?

Someone may suggest using chemical indicators to find out what may be in the soil. If not, direct them to the use of red and blue litmus. (Chart #10)

Before we can really test soils we should learn about the composition, kinds of and changes in soil. Laidlaw, Science 4, has an excellent chapter relating to soil. The LaMotte Soil Handbook, found in each soil testing kit is also helpful. (Suggestion: Use 4 x 6 cards and outline pertinent information.)

Brainstorming groups will offer suggestions as to why people test soils. In groups list all reasons for testing soils. Develop a poster on display with the reason they offer. These might include.

1. What is lacking in the soil
2. Soil content - such as minerals, nitrogen, humus, etc.
3. Degrees of acidity
4. Rotation of crops
5. What to feed the soil

The teacher can now refer back to the experiments using blue and red litmus paper. In reviewing these indicators we discover that blue litmus will show acid if there is a great amount present. It will not show how much acidity. Clearly, a more sensitive indicator is needed.

It becomes obvious that litmus and vinegar are not adequate or precise indicators. Here bromthymol blue is introduced in a demonstration, followed by phenolphthalein. Since the LaMotte Soil Testing booklet has very specific directions for testing, it is unnecessary to repeat them here.

Color charts for these indicators may be displayed for future reference. Charts may be used and a record kept of what develops. (Chart #11) Pupils may want to try these new indicators on the basic powders.

Children should be encouraged to bring soil samples from home such as found under asparagus, lilac, mountain laurel, rhododendron, geraniums, hydrangea, or perhaps samples of soil from far away places for testing. A chart (see #11 in appendix) will help the pupil organize his findings.

Name David Goodhart

CRYSTALS

Starch	I put some starch and looked at it through my scope black crystals were squiggly and the light ones were
baking Soda	I saw different colors and many circles black, gray, silver, white
cream of Tartar	I saw triangles all in masses and separate white and black was the color
Plaster	crystals were clear all had straight edges
galena	all rectangles color was shiny brown, silvery, blue, green, gray
marble	mixture of shapes, looked black, light edges
granite	Pyramid shapes, jagged edges and sparkling lights
coal	separated crystals gold, white, silver, blue, black, different shapes

Name Rich Zahn

SATURATED SOLUTIONS

Materials Tested	What I Discovered
Iodine	Different shapes, straigh edges, squiggley lines, Straight lines. Clear, white, black, brown
Alum	Separated crystals, black lines, purple background white
Copper Sulfate	It looked like fish scales, solar system, veins, ice.
Potassium Permanganate	It looked like a human eye. It moved around
Instant crystal	Looked like grass, lines, eyes
Salt and Water	Square Crystals

Name Rich Zahn

SATURATED SOLUTIONS

Materials Tested	What I Discovered
Iodine	Different shapes, straigh edges, squiggley lines, Straight lines. Clear, white, black, brown
Alum	Separated crystals, black lines, purple background white
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Potassium Permanganate	It looked like a human eye. It moved around
Instant crystal	Looked like grass, lines, eyes
Salt and Water	Square Crystals

V. CRYSTALS

From the outset the children were very anxious not only to taste, but to touch the basic powders. They comment frequently on how smooth this powder is, how sticky and gritty that one feels.

The use of films and filmstrips in providing background is beneficial. The filmstrip, "How Crystals Are Formed" engendered questions plus an urge to explore. Leveled study guides are an aid. The children soon discovered that very little could be seen with the naked eye and they needed microscopes.

At this point a resource teacher from the Curriculum Center can help the class in understanding how to use a microscope.

The scopes may be distributed to the paired children. Each child is given his own diagram of the scope and a microscopic print sheet to use. (14 and 15 in the appendix.)

The next day review the rules for using the scopes and then examine things in the room; a human hair, a drop of water, the four basic powders.

Solids such as galena, marble, granite, mica, and coal may be used. Encourage the children to draw pictures of the crystals. (Chart 12) Galena has a definite cubed pattern, the marble showed a mixture of shapes and looked black; the granite was pyramid shaped, with jagged edges and many lights; the coal had different shapes, the crystals were separated and shone gold, blue white, silver and black.

Since the next involvement was to examine saturated solutions, the film, "Chemical Changes Around Us" was shown. From this film you can initiate a discussion of variables which might be encountered in examining solutions under a microscope. Pupils might make notes as the following observations progress.

(Chart #13)

Step 1. Examine a drop of tap water under the scope. Draw a small sketch of what you see.

Step 2. Examine a drop of pond water under the scope. Draw a sketch of any crystals you see. Compare with picture in Step 1. Are the crystal shapes alike or different?

Step 3. Examine a drop of salt water under the scope. Draw a sketch of what you see. Are the crystal shapes different? If so, why?

Step 4. Examine a drop of iodine under the scope. Draw a picture of what you see.

Step 5. Examine a drop of alum under the scope. Draw a picture of what you see.

Step 6. Examine a drop of bluing (commercial). Draw a sketch of what you see.

When the children examine the above liquids, have them look continuously for at least five minutes. As the water evaporates, the solution becomes more concentrated and crystals begin to form.

The rate of evaporation varies for different children. Now go back to a discussion of the variables which might have been a factor. Someone will offer that the varied temperatures in the room (near a radiator, close to a sunny window, directly under the room light) were a factor; the size of the room and the amount of air circulating; the amount of solution used, some used two or three drops rather than one; all of these did not change the basic shapes of the crystals. At this stage you could show and discuss the filmstrip "Atoms and Molecules." More able students may want to do a written report on crystals, others may offer to show and report on their rock collections.

Up to this point the children have been examining known substances and solutions to find crystal shapes and patterns. A more sophisticated step is to have them examine unmarked solutions and solids to see whether or not these can be identified from their shape, color or pattern. Try to provide two solutions which look alike for each experiment.

Step 1. Examine two blue solutions under the scope. "From the shape and pattern of the crystals can you tell what the solution contains?" (Bluing and copper sulfate)

Step 2. Repeat using alum and iodine

Step 3. Repeat using salt and sugar solutions. This can be carried as far as the teacher feels it is productive.

Possible additional activities

1. Have each child make his own Magic Garden. Materials needed:

    low 6" aluminum foil pie pan

    aluminum foil (@ 2 feet for each child)

    old tablespoon

    paper cup (for mixing ingredients)

    5 tablespoons salt (all measurements level)

    5 tablespoons bluing

    5 tablespoons water

    1 tablespoon ammonia

Procedure:

Combine ingredients in paper cup: mix well until

1. cont.

crystals have dissolved.

Line pie plate with foil - crush to make hills and valleys

Pour mixture over foil

DO NOT MOVE

You may add food coloring immediately or use twigs and leaves to simulate a real garden.

2. Encourage pupil reports

3. Make posters illustrating crystal or groups of crystals.

4. Make folders, organize charts, insert drawings, have children write a short evaluation (What I liked, didn't like, would like to see added, etc.?)

VI. EVALUATION

An evaluation of pupil learning evolves through the entire sequence even as they are organizing their master charts. The purpose of this whole unit was to encourage children to Observe, Discover and Draw Conclusions. This then, should be the basis for evaluation.

Does the child observe with more perception?

Do his observations lead to questioning, trying, and predicting?

Does he discover the joy of handling new materials and new equipment?

Is his interest in experimentation rather than in the right and wrong answers?

Does he draw conclusions on the basis of what he saw and discovered rather than on answers given in books?

Does he relate scientific thinking to other areas in the curriculum?

The answers to these questions and others are a help in evaluating pupils' progress and growth.

For an evaluation of the teacher's participation consider the following question:

Is this a program of pupil involvement rather than constant teacher orientation?

VII. CORRELATION OF CHEMICAL INDICATORS WITH OTHER SUBJECT AREAS

A. Arithmetic

1. Keeping charts and drawing graphs
2. Using a number line to show degree of acidity
3. Becoming familiar with measurements, i.e., using calibrated beakers, eye droppers, measuring cups (reinforces fractions)
4. Furthering readiness for more involved geometry (crystal shape observation)

B. Art

1. Sketching for quick recall
2. Cutting letters and shapes and poster layout
3. Making relief maps showing rock formation, soil erosion, etc.
4. Creating models of crystal shapes
5. Using toothpicks and cotton batten to make models of atoms and molecules
6. Developing a bulletin board showing pin map of areas of mineral deposits

C. Language Arts

1. Reading for specific information
2. Writing and giving reports
3. Skimming
4. Writing short, concise descriptions in capsule form
5. Keeping a glossary of new words and new terms
6. Creative writing with microscopic living and non-living objects for use in a fictional story.

C. 6. cont.

a. Composition Planning from Curriculum Center is a help in creative writing

VIII. BIBLIOGRAPHY

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7. Science 4, Laidlaw 1966. Units 2, 3, 4.
8. Vaczek, Louis, The Enjoyment of Chemistry, Viking Press, New York, 1964.

IX. VISUAL AIDS

A. Filmstrips (Audio Visual Department)

1. How Crystals Are Formed

2. Atoms and Molecules

B. Films (Audio Visual Department)

Chemical Changes Around Us

C. Pictures

S. V. E. Inc. 1345 Diversey Parkway, Chicago, Illinois.
#S.P. 113 - Important Minerals
#S.P. 114 - Common Rocks

D. Diagrams & Charts (Curriculum Center)

1. Basic Powders Charts

2. Microscope Diagrams

3. Atoms and Molecules Charts

APPENDIX

Dear Parents:

Your child is going to be involved in a science unit called Chemical Indicators. He will be bringing home some bags of powders and materials to use in identifying these powders.

These powders are completely harmless, non-toxic, and non-explosive. They can be experimented with freely with no worry.

Using some of these materials at home rather than in school is important for the youngsters as it allows them the opportunity to explore a situation where completion time is not a factor.

The children need a suitable place for chemical storage and the location of experimentation should be designated by the parent. The most common tests are tasting, smelling, feeling, matching and heating the powders. Since heating requires the use of the stove, permission for its use is needed. The work, however, should be done by the student with no - or as little as possible - guidance by the parent.

Although the children learn factual information, the practice in scientific thinking or discovery for itself is probably the most significant experience to be gained from the unit.

Would you kindly sign and return the permission slip below so that we know you are aware of the extent and materials of this unit.

Principal

****

____________________________ has my permission to experiment

with the Chemical Indicators.

____

Signature of Parent

Name ______________________

CHEMICAL INDICATORS

Powder Number	Powder Name	How You Found Out
1		
2		
3		
4		
5		
6		

Name________________

CHEMICAL INDICATORS

Name	What Happens With Iodine

Name ____________________

CHEMICAL INDICATORS

Powder Name	What Happens with Vinegar

Name________________________

CHEMICAL INDICATORS

Name	Mix with Water	Name	Heat
1			
2			
3			
4			
5			
6			
7			

Name ____________________

CHEMICAL INDICATORS

Materials Tested	What Happens with Blue Litmus

Name ______________________

CHEMICAL INDICATORS

Material Tested	What Happens with Red Litmus

Name ____________________

CHEMICAL INDICATORS

Chemical Indicator	Mixture Number	What Happened	Powder it probably does NOT have	Powder it probably DOES have
IODINE				
VINEGAR				
BLUE LITMUS				
RED LITMUS				
IODINE				
VINEGAR				
BLUE LITMUS				
RED LITMUS				

Name ____________________

CHEMICAL INDICATORS

What You Used	What Happened	Powders it probably does NOT have	Powders it probably DOES contain

Name ____________________

CHEMICAL INDICATORS

Powder	Mix with Water	Heat	Iodine	Vinegar	Blue Litmus	Red Litmus

Name ____________________

SOIL TESTING

Materials Tested	What Happens with Litmus	
	Blue	Red

Name ______________________

SOIL TESTING

Materials Tested	Bromthymol Blue	Phenolphthalein

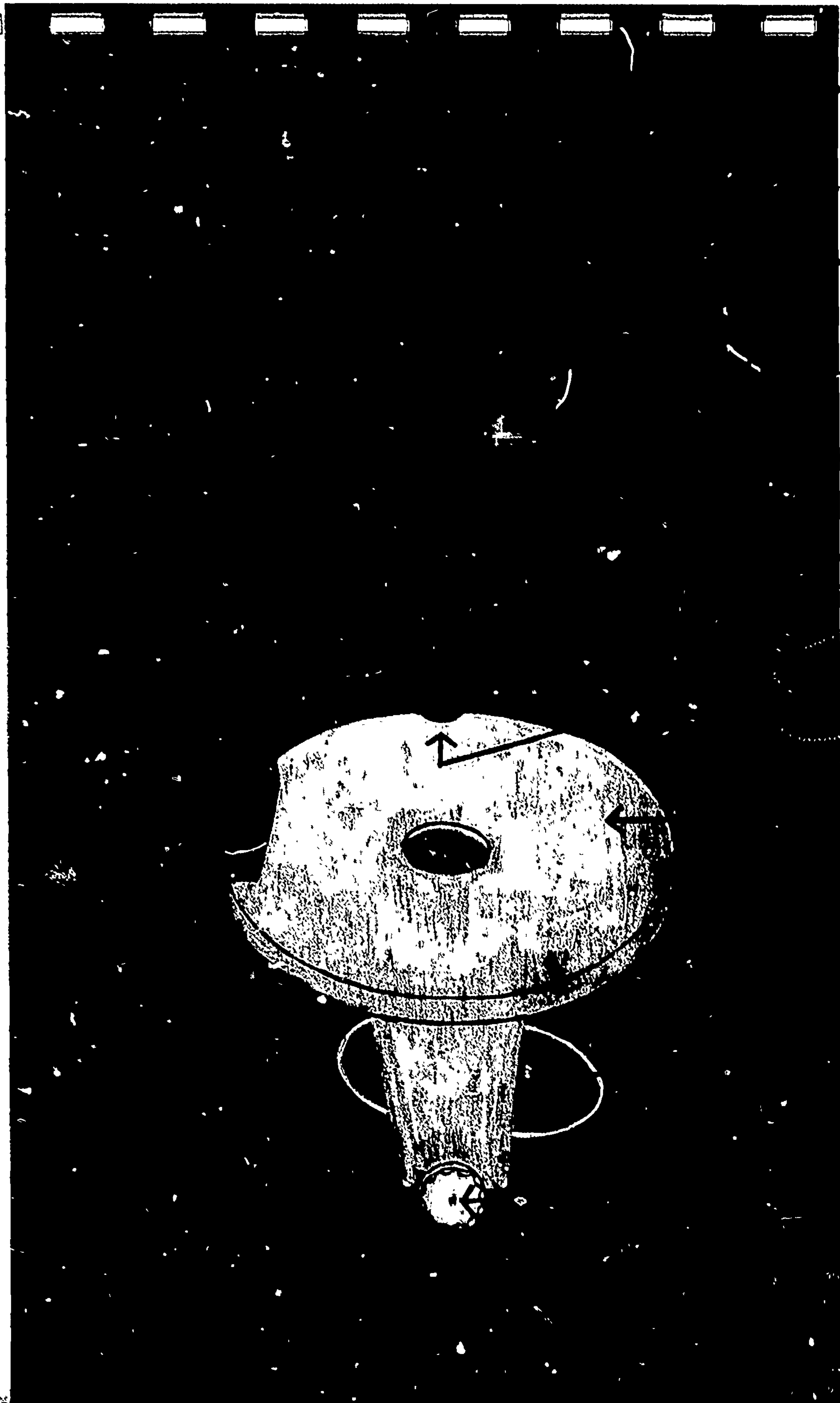
Name ______________________________

CRYSTALS

Name ____________________

SATURATED SOLUTIONS

Materials Tested	What I Discovered



Ocular Lens

Focus Tube

Arm

Objective Lens

Stage

Mirror

Mirror Adjusting Knob

Base

In all which I observed that if they were of any regular figures, they were always branched out with six principal branches, all of equal length, shape, and make from the center, being each of them inclined to the branches on either side of it by an angle of sixty degrees. In a very little time I have observed above an hundred several sizes and shapes of these starry flakes.

Snowflakes

With an apology for the crudeness of his drawing, Hooke still shows his delight at these "starry flakes." A hand glass will show you much detail on snowflakes. A microscope will show you even more. But you must leave your instrument out of doors for an hour or so to get cold and then work very quickly in order to see the little crystals, for to snowflakes you are like a fireplace. Not many people have ever seen a real snowflake so magnified, and it is well worth the effort.

Of the shape of feathers

As for the make of the down itself, it is indeed very rare and admirable, and such as I can hardly believe that the like is to be discovered in any other body in the world, for there is hardly a large feather on the wing of a bird, but contains near a million of distinct parts, and every one of them shaped in a most regular and admirable form, adapted to a particular design.

C.L.M.P. ACTIVITY

Grade ______________________ Date ______________________

Content Area

Activity (Describe briefly)

Pupil Evaluation

Materials Used

Procedure (List questions and procedure)

Evaluation (Including any suggestion for modification)

Teacher's Signature ______________

C. HOW MUCH ACID?

A. Litmus Tests at Home

Students are given vials of blue litmus paper and they are told how to use it to test substances at home. Salt might be used as an example of a solid which must be made into a solution by adding a little water before testing. The Litmus Test Chart is distributed and the manner of filling in columns one and two is explained. The paper used to test each substance is taped to the sheet in the appropriate space in column two.

Litmus Test

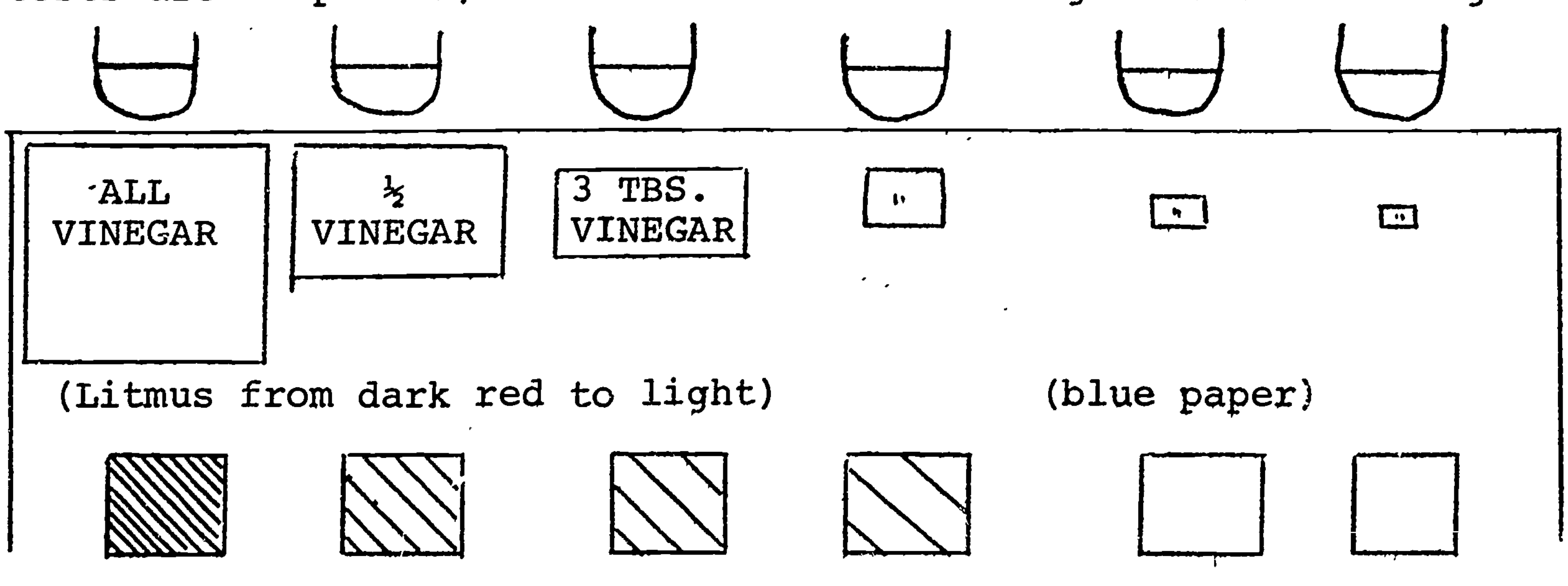
(1) What Tested?	(2) Color of Litmus Paper (tape it on)	(3)	(4)

The following day in class, students are told that substances which change blue litmus to red are called acids. Now the students can write at the top of column three, 'acid' or 'non-acid' and then answer the question for each substance which they tested. Things were found to be acids and those which were not, could now be discussed.

B. Sorting Stronger Acid Concentrations with Litmus

The question could be asked if it is thought that all substances have the same amount of acid in them. Some might feel that things which made the paper dark red had more acid that did others which changed it to light red. The following demonstration is conducted to establish this point.

Vinegar is diluted with water to make various concentrations. Six small jars are placed in a row on the demonstration box. The first jar is filled about halfway with cider vinegar. (The dark color permits visual evidence for dilution as the color becomes less intense.) Into each succeeding bottle is placed less and less vinegar, such as one-fourth of a bottleful, three teaspoons, one teaspoon, one dropperful and one drop. Now water is added to the last five until all six are the same level. A sign indicating how much acid is in each jar can be made and affixed beneath the appropriate jar. The size of the labels might vary in size according to th amount of acid. Each jar is tested with a three by three inch piece of blue litmus, which is then stuck below the jar on front of the box. When the tests are completed, the demonstration box might look something like th



The range in color from vivid red to blue is immediately apparent. It should now be evident that the darkness of the red is an indication of how much acid is present. In the fourth column of the Litmus Test Chart the amount of acid can be shown by the words, 'a lot of acid' or 'a little acid'. Spaces following substances which caused no color changes are left blank temporarily.

Why are these spaces left blank? Does blue litmus paper always indicate that no acid is present? Call attention to the bottle with one drop of vinegar. It has a little acid in it, but still the paper is the same color as that put into water with no acid. What can be said about things which do not change litmus paper? (They may have very little acid or they may have none). 'A very little acid or no acid' can now be written in column four for substances which caused no change in the test paper. For a final check, students might be asked if litmus is useful in finding out if things have a very little bit of acid in them.

The children can now practice what they should have learned by ranking six or seven unknown solutions from most acid to least or no acid. This exercise is best conducted in class as a lab-type activity. Six or seven dilutions are previously prepared such that three or four will change litmus varying shades or red and a few will not change it at all. At least a quart of each solution is required. Baby food jars or similar small containers can be used by the students to take samples from the main containers to the individual desks. Results can be recorded on a suitable chart.

How Much Acid	Bottle Letter	Color of Litmus Paper (attach)

Students should be encouraged to indicate as 'unknown' those solutions which do not change the color of blue litmus.

C. Sorting Weaker Acid Concentrations with Brom Thymol Blue (BTB)

BTB can be introduced to answer the need for some way of determining trace amounts of acids. A demonstration can be performed similar to that on litmus paper except that the concentrations are less and are tested with BTB.

Six jars are lined up, and, as before, one if half-filled with vinegar. Into the next three are added a spoonful, a dropperful, and five drops, respectively. The jars are filled with water to the halfway points, and then filled almost to the top with BTB. (The BTB used in all tests should be diluted with about four parts of water and made blue with a few drops of some basic substance like ammonia or limewater.) It might be seen at this point if any difference in color is observable. The least concentrated may be slightly less yellow. Next one drop of vinegar can be placed in a jar and water and BTB added. The color may still be yellow.

How can I get less vinegar, say one-half of a drop, in the jar? At first the students will say to make a smaller drop, but they can be shown that all drops are about the same size. Someone who has an idea can come forward to try. There are, of course, several solutions. One is to fill the bottle all the way, add one drop, and pour half out. Another is to add a drop to one-half jarful, throw half away and replenish with water. The one-half drop mixture is tested with water and may begin to show a greenish tint. Another student can prepare a solution with one-fourth a drop of vinegar, which might show a definite green color with BTB. The dilutions might continue even further until the BTB remains blue. It might be seen how many drops of vinegar must be added to a bucket of water before BTB will show a color change.

The jars from the different tests can be displayed as before, in order, with a sign to denote the amount of acid in each. Litmus could be used to show that it does not indicate the presence of a small amount of acid.

Before this demonstration is conducted in class, it should be tried out by the teacher to determine what concentrations will bring the desired reactions of the indicator.

The students can use BTB in a lab exercise to measure the acidity of various foods. Some of the substances which have already been tested at home should be used and also some which will cause a color change in BTB but not litmus, such as carrots, cabbage, aquarium water, potatoes, and milk. Solids are shaken with a little water before adding BTB. In addition to baby food jars, a supply of test tubes and test tube racks should be made available for the BTB tests. To obtain some uniformity of results, the BTB used should always be an amount equal to the liquid to which it is added. The danger of incorrect results because of contamination can be shown by pouring all the vinegar from a jar, but not washing it. When BTB is added to the 'empty' jar, it changes yellow. This can be suggested as a good test for unclean glassware.

The results should be tabulated on a chart.

What Tested	Color with Litmus	Color with half part BTB	Lot of acid A little acid Very little acid

Students might be asked the meaning of a blue color. Remembering this same color appeared when 1 drop of vinegar was put into a bucket of water, it is hoped that some might conclude that this color does not necessarily mean no acid at all. There might be a very, very little acid present.

D. <u>Ranking Unknown Dilutions with Litmus and BTB</u>

As a summary and evaluation, six solutions can be ranked according to strength. The dilutions should be made to give a gradient with litmus in the higher concentrations and with BTB in the lower concentrations. It mig be possible for the pupils to proceed on their own with no instructions and to write their finidngs in a form which they devise.

This unit might include the introduction of some unfamiliar pH indicators to have the students find their range. The classical exercise of using BTB to analyze the amount of carbon dioxide in the breath might even be handled by upper elementary children as a conclusion to their work with acids. Other equally challenging problems might be found which could demonstrate some practical use of indicators.