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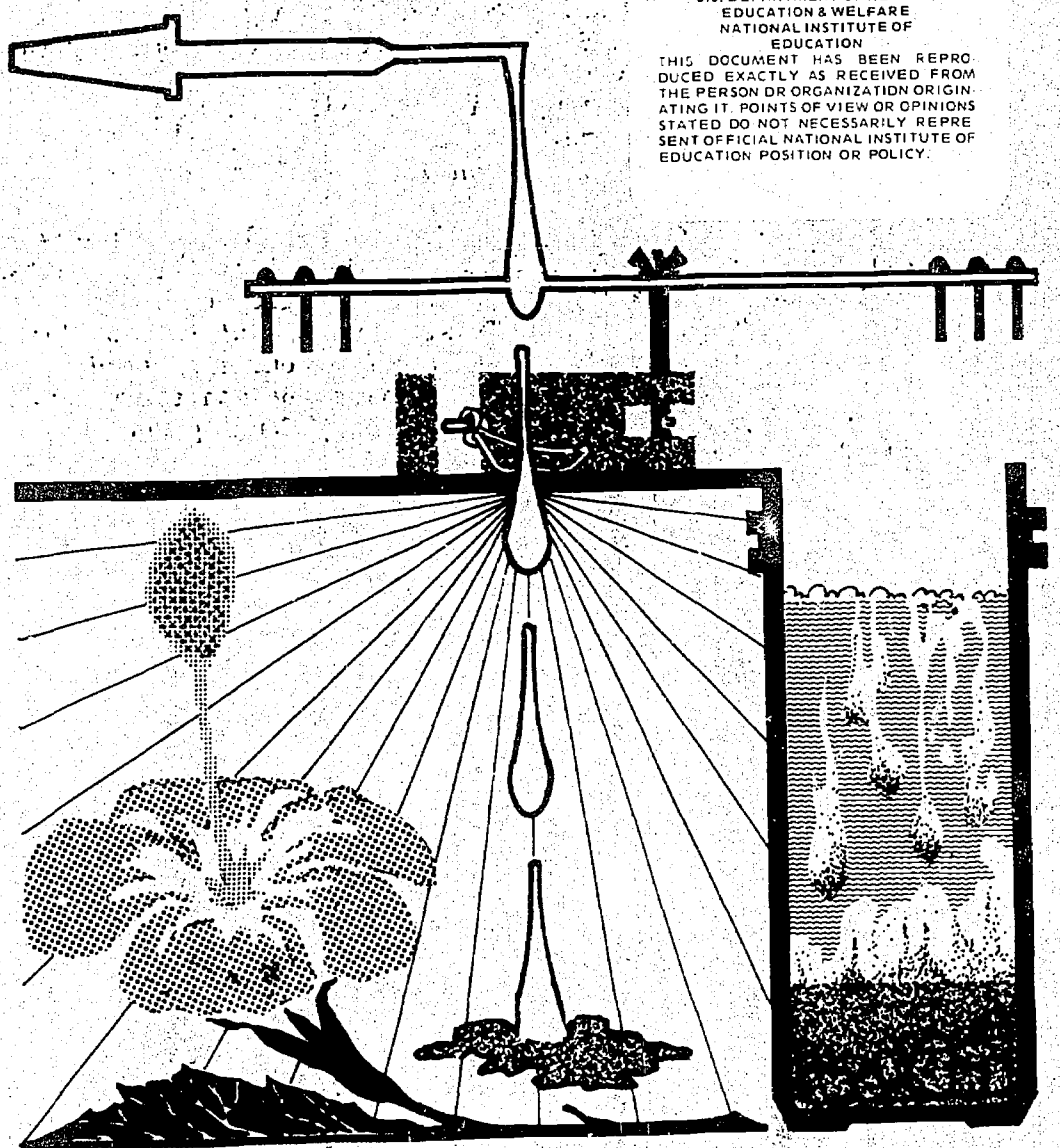
ABSTRACT

This teacher's guide is for an elementary school science unit designed for use with third grade (or older) children in the schools of the Trust Territory of Micronesia. Although there is a degree of similarity to curriculum materials developed for the Science Curriculum Improvement Study, this Micronesian unit does not purport to be an adaptation or edition of the SCIS materials. Designed to be taught in the vernacular language, this unit was prepared to be a companion unit to one concerning populations, with the two units covering the school year. Activities are designed for active student involvement with the teacher acting as a guide. The unit involves the concepts of systems, variables, evaporation, temperature, and histogram and the science process skills of observing, communicating, predicting, inferring, and recording. The guide contains information concerning objectives, teacher and student activities, rationale for these activities, needed materials, teaching suggestions (provided on a day by day basis), and questions to be posed in class discussions. (PEB)

SYSTEMS AND VARIABLES

• BASIC EDITION



SCIENCE for MICRONESIA

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CONTENTS

"SCIENCE FOR MICRONESIA"

Systems And Variables - Basic Edition

The teaching concepts utilized in this unit have been adapted from similar programs currently in use in the United States, Africa and other areas of the world. This unit has been adapted for use here by teachers and science educators in the Trust Territory who have considered the local environment, language, educational structure, local materials and culture.

It has gone through the following process:

1. Adaptation for experimental use done by Education Specialist/ Science - Trust Territory. Printed in November 1971.

2. Experimental teaching done in third grade classes in Marianas District during the school year 1971-72. Micronesian teachers and Peace Corps Science Co-teachers did the experimental teaching. The unit was also used in some of the other districts in its experimental form.

3. Trial Edition printed in October 1972 as a result of the feedback obtained from the experimental teaching.

4. Unit used in pilot classes in all districts from November 1972 through January 1973. Feedback on the unit was gathered at the February 1973 Trust Territory wide science conference.

5. Basic Edition printed in March 1973. Rewritten and printed under the coordination of the Curriculum Task Force as part of the E. S. E. A., Title III "Elementary Science Improvement Project".

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WORDS FOR THE TEACHER ABOUT SYSTEMS AND VARIABLES

What grade is it to be used at? It is designed to be used in the third grade, but it could be used in any of the upper grades.

What language should be used to teach it? Most of the lesson should be taught in the vernacular. You will have to use some English words like "variables" and others not found in the vernacular.

How long will this unit SYSTEMS AND VARIABLES take? If you use this unit with the unit POPULATIONS it will be enough material for more than a school year. You should use the two units ("Systems And Variables" and "Populations") so that you do one unit for a while and then switch back to the other unit. For example: start the terrarium experiment in "Populations" and then do some activities from "Systems And Variable" while you are waiting for the terrarium to change.

You may do the unit "Systems And Variables" before you start on any other unit if that is the way you want to do it. The choice is up to you. This unit should take over half a year to complete.

What kind of science is this? In this science program the children do science activities. We call this "sciencing". Instead of "reading about" science the children "do" science. They "do" science with things found around them and with some new materials supplied in the science kit.

What does the teacher do in class? The teacher should act as a guide. You should guide the students to find answers themselves instead of telling them the answers. To be a good guide the teacher must: ask inquiry type questions, listen to the students, let the students find their own answers.

How fast should the activities be done in class? The unit gives some suggestions for time. Many activities will take more time than suggested if the students are interested in doing other things having to do with the activity. Don't rush the students. It is better to do the activity well than to rush through it.

Does this unit, SYSTEMS AND VARIABLES, have special things it teaches? Yes, the activities in the unit are designed to let the children do activities that develop or continue to develop the big ideas (concepts) of:

systems	temperature
variable	histogram
evaporation	

This unit gives the children opportunities to develop skills that are used in sciencing. For example the skills of: observing, communicating, predicting, inferring and recording.

This unit should be taught in a way that encourages children to think for themselves, become more responsible for their own learning and gain confidence in themselves.

Is there any connection between "Populations" and "Systems And Variables"? Yes, they both develop the same skills and are concerned with CHANGE. This CHANGE can be seen as an increase in population or as result of a variable.

How do I evaluate the students in the class? The education department will give you "narrative evaluation" forms to use. On these forms you can evaluate how your students are doing in many different areas.

Is this kind of science harder to teach? You must be prepared. It will be harder if you do not know what you are doing. To prepare the teacher, workshops are given and these units are written to make the teaching directions easy to understand.

Instead of using your time grading paper, and making tests and filling out lesson plans you will now use it in preparing materials. It should not take any more time than with the old science program, if you were properly prepared when you taught the old science program.

It should be easier to plan for because the units are lesson plans that tell you what to do and what materials you need to do it.

It should be easier to teach because you will be supplied with most of the materials needed for the lessons.

It should be easier to teach because it is interesting to you and the children.

The hardest part of teaching this kind of science is for you to learn to be a guide instead of always telling and showing.

What about the materials? Some materials (a kit) will be given to you at the beginning of the school year. Some materials will be collected by the students or by the teacher.

The teacher gets the materials kit by asking the Science Program Area at District Education. When you have the materials you are responsible for them and will be expected to pay for any that are lost.

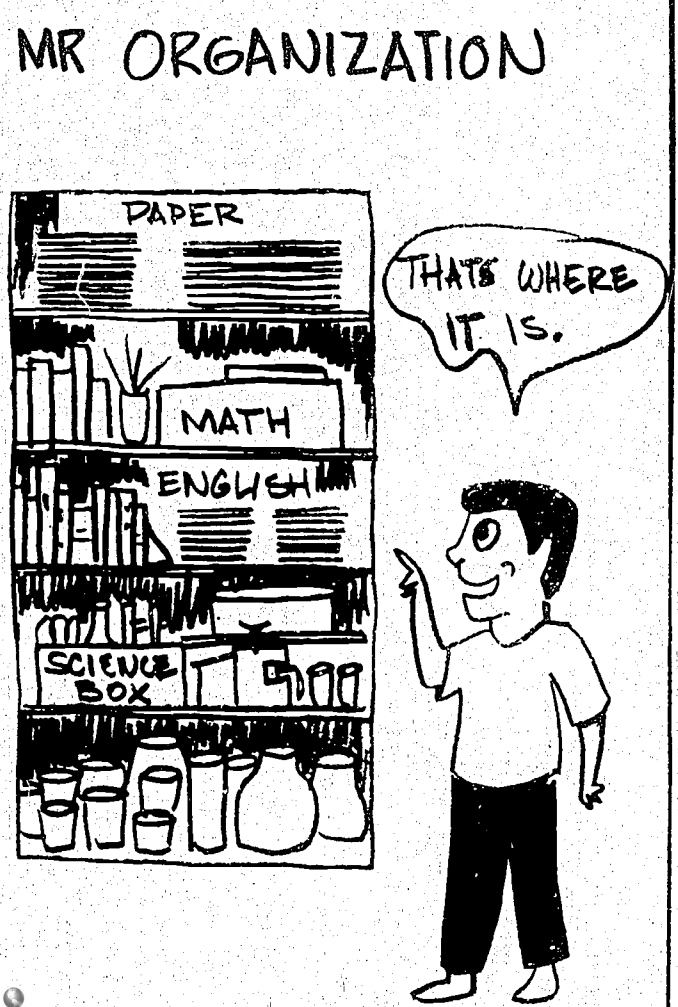
Is this kind of science used anywhere else? Yes, the teaching concepts used in this unit were adapted from similar programs now used in the United States, Africa, Papua and other areas of the world. This unit has been adapted for use here by teachers and science educators in the Trust Territory. They have considered the local environment, language, educational structure, local materials, and culture. The program is now being used in all of the districts in some way. All teachers who now graduate from the Community College of Micronesia are prepared to teach "Science For Micronesia".

How does this unit, "Systems and Variables", fit with the other units?

Below is a diagram showing all the units in grades one through six.

SCIENCE FOR MICRONESIA

PHYSICAL SCIENCE UNITS	LIFE SCIENCE UNITS
Material Objects	Organisms
Interaction and Systems	Life Cycles
Systems And Variables	Populations
Relative Position And Motion	Environments
Energy Sources	Communities
Models: Electrical And Magnetic Interaction	Ecosystems



PART 1

WORKING WITH SYSTEMS

OBJECTIVES (WHERE IS PART ONE GOING?)

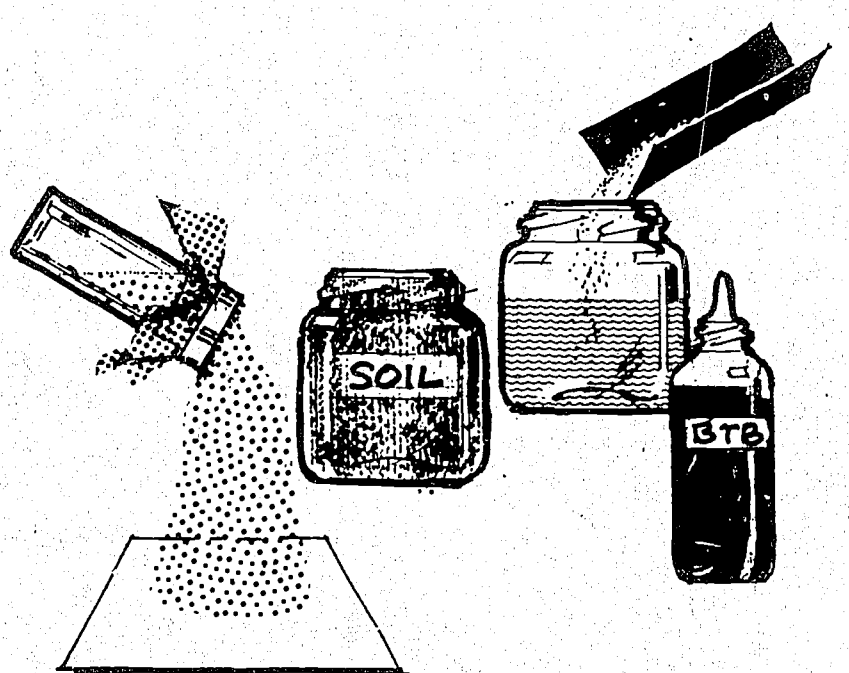
At the end of Part One the children should be able to:

-- Describe changes that occure during an experiment.

-- Interpret the changes as evidence of interaction.

-- Use the word system to refer to a group of related objects.

-- Investigate systems around the school.



ACTIVITY 1 INVESTIGATING SYSTEMS AND INTERACTIONS

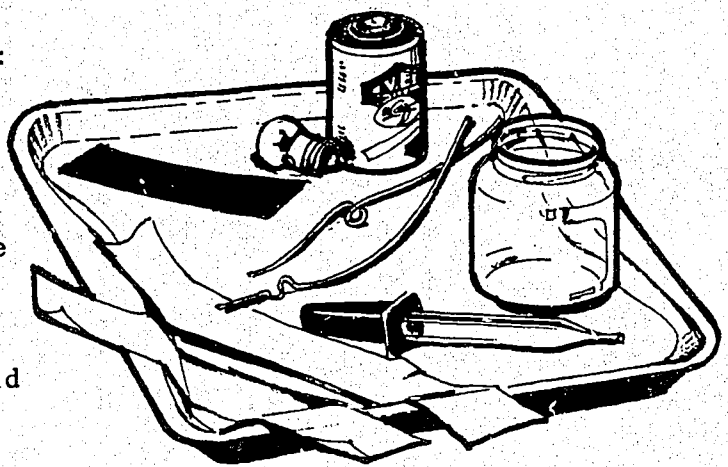
SYNOPSIS (WHAT WILL YOU BE DOING?)

The children investigate very simple electric circuits (batteries, wires and bulbs) and temperature-sensitive color cards. They make records of some of their experiments.

OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

This activity allows review of the systems and interaction concepts. It gives the children a chance to record experiments. By observing the children, you can decide if they need more review of the "systems" or "interaction" concepts.

MATERIALS



For each group of two children:
- color card
- flashlight bulb
- two pieces of copper wire (six inches long)
- battery (size D)
- two pieces of masking tape (four inches long)
- medicine dropper
- small jar
- tray, or can or bag to hold the materials
- Record sheet

For the class:
- paper towels
- large jar of cold water or ice cubes
- large jar of hot water
- collection of objects: pieces of metal, paper clips, aluminum foil, pieces of plastic and other small objects

ADVANCE PREPARATION

Put the color card, medicine dropper and jar onto trays. Each group should have its own tray of materials. Put the collection of object's on a tray.

Know where you can get one jar of hot water and one jar of cool or cold water.

TEACHING SUGGESTIONS

First Day-Exploring

1. Divide the class into groups of two children each.

   Show the class a tray of materials:

   Say: "Each group can experiment with the materials on their tray."

   "You can work with the materials, but do not destroy them."

2. Give each group a tray of materials.

   Pour cool water into half the classes' jars and hot water into half the classes' jars.

3. Later in the period give each group a bulb, battery, two wires and masking tape.

   Show the class the collection of objects. Tell them they can use these objects and other objects they can find for their experiments.

4. Let the groups hand back their tray of materials at the end of the period. Everything should be dry.

Second Day-Recording Experiments

1. Give each group their tray of materials.

   Pour hot and cool water into the small jars.

   Let the groups experiment for a while.

2. While the children are experimenting talk with the groups using questions such as:

   "How does the color cards show evidence of interaction?"

   "What objects did the color card interact with?"

   "What are some attributes of the color cards?"

   "Did you make a closed circuit with your electrical materials?"

   "What are the objects in your system?"

3. Give each child a record sheet.

   Let each child draw experiments they did. One record is for an experiment with the color cards. One record is for an experiment with the electrical materials.

4. Collect the materials and the record sheets at the end of the lesson.

Third Day-Looking At The Records

1. Give each child his Experiment Record.

2. Let volunteers explain their experiments to the class. Discuss the following about each experiment:

   "What objects were in the system?"

   "What was the evidence of interaction?"

   "What objects interacted?"

3. End the lesson when the children begin to lose interest in the discussion.

OPTIONAL ACTIVITIES

The concepts of INTERACTION and SYSTEMS may need more review. If you think your students need more work on these concepts, look at the unit INTERACTION AND SYSTEMS. The two activities you could use are Activity 2 "Inventing the Interaction Concept" and Activity 5 "Inventing The Systems Concept".

Draw a picture story of an experiment you did with the color cards.

Draw a picture story of an experiment you did with the electrical materials.

ACTIVITY 2 PARTS OF A MIXTURE

SYNOPSIS (WHAT WILL YOU BE DOING?)

The children use cloth screens to separate a powdered mixture. The mixture separates into sand, salt and baking soda. The attributes of the separated parts are discussed. The children then try and find out which parts interact with yellow BTB.

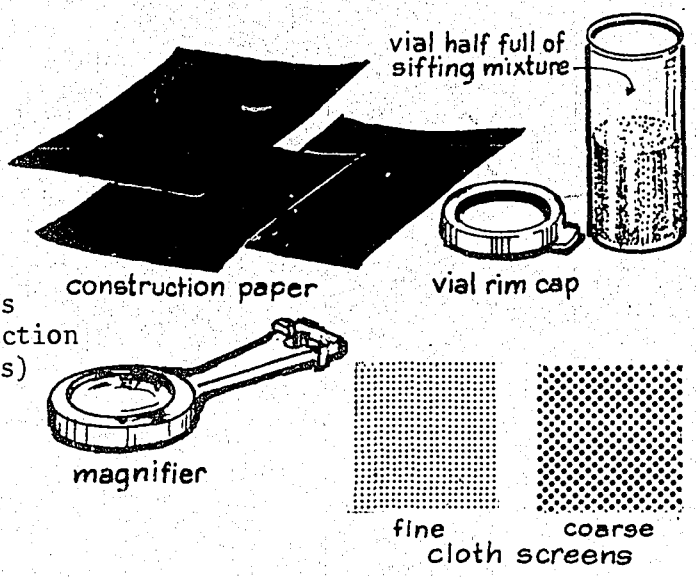
OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

The children see that they can separate a system into parts. Then they work with the separate parts of this system.

This activity lets the children practice the skills needed to investigate systems around them. Later they will investigate "the soil system". This activity should give them some ideas on how to separate the soil system.

MATERIALS

For each child:
- vial of sifting mixture or small jar
- vial cap rim or rubber band
- fine-mesh cloth screen
- course-mesh cloth screen
- tray or can to hold materials
- three pieces of dark construction paper (4 inches x 4 inches)
- magnifier
- record sheet



For the class:
- jar of sifting mixture
- plastic spoon
- masking tape
- paper towels
- sixteen jars-small
- BTB
- vinegar
- jar-large
- chart paper

ADVANCE PREPARATION

Fill each child's vial half full of sifting mixture. Mix up the mixture before filling the vials.

Sometimes the sifting mixture absorbs moisture and gets hard or sticky. You can heat it to remove the moisture. Then it will go through the screens easily.

Prepare each child's tray with the materials needed. Look at the above picture. Keep the fine screen off the tray.

TEACHING SUGGESTIONS

First Day-Separating The Mixture

1. Show the class the jar of sifting mixture. Say:

   "You will each get some of this material."

   "Using the tools you get, you can separate this material into three parts. Each part will have different attributes."

2. Give each child a tray of materials with the course screen.

   Later in the period give each child a fine screen.

   Let the children work on separating the mixture all period. They will separate it many times and in many different ways.

3. At the end of the period have each child pour the separated parts back into the vial. The parts should be poured in one at a time so they do not get mixed up.

   Let the children put their name on their vial with masking tape.

   Put all the vials of mixture in one place in the room. These will be used tomorrow.

   Collect the trays and other materials.

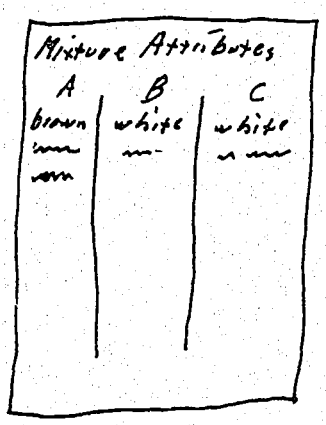
Second Day-Looking At The Parts Of The Mixture

1. Give each child his vial and a magnifier.

2. Ask: "How many parts did you separate the material into?"

   "What are the attributes of these parts?"

   List the attributes of each part on a chart as the children discuss the parts. You should have three parts, but some children may have separated the mixture into four or more parts. Make a list of attributes for each part.

3. Give the children their trays and sifting material. Let them observe the mixture again for more attributes.

4. Near the end of the period ask:

"Did you find any new attributes to add to the lists on the board?"

Tell the class that the mixture is made of three materials: salt, baking soda and sand.

"Which list of attributes is the sand part of the mixture?"

"Which list of attributes is the salt part of the mixture?"

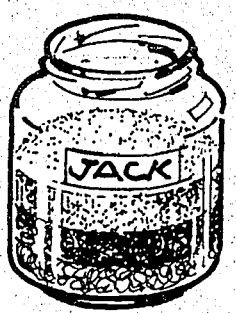
"Which list of attributes is the baking soda part of the mixture?"

Put the name of the material over the attribute lists.

You may have several lists of the same material. For example: One attribute list might be of the large sand and one of the small sand. They are both sand, but are of different sizes.

5. At the end of the period say:

"Put the parts back in the vial so they are separated. We will use them tomorrow."



Collect the vials, trays and other materials.

Third Day-The Mixture Interacts With B. T. B.

1. Show the class the jar of sifting mixture. Pour some of the mixture into a vial. Say:

"Let's call this material SYSTEM MIX."

"What are the parts of SYSTEM MIX?"

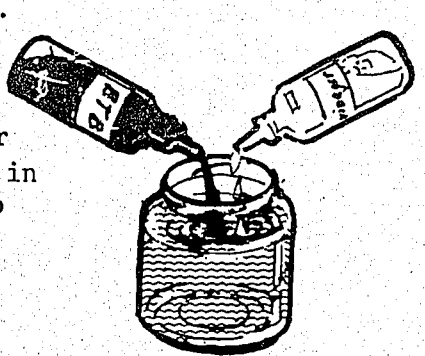
The children should talk about the parts they separated out yesterday.

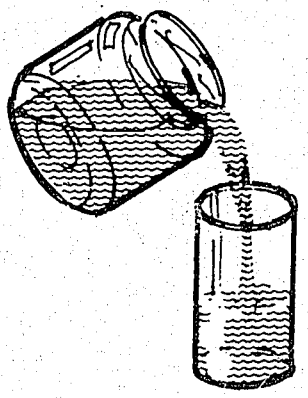
2. Let the class watch you prepare some yellow BTB solution.

Put three squirts of BTB into the large jar of water.

Stir the solution.

Put several drops of vinegar into the solution. Only put in enough to turn it yellow. Do not add any extra vinegar?





Stir the solution.

The solution should be yellow. If it is not yellow, add more vinegar.

3. Hold up the vial of SYSTEM MIX.

   Pour a little of the yellow BTB into the vial.

   "Was there any interaction?"

   "What is your evidence?"

   "What do you think? Did all of SYSTEM MIX interact with the BTB? Did part of the mixture interact with the BTB?"

   "How can we experiment to see the parts interact with the BTB?"

4. Tell the class that today they can experiment with the part of the mixture that goes through the course screen.

   Give each student a SYSTEM MIX Record Sheet.

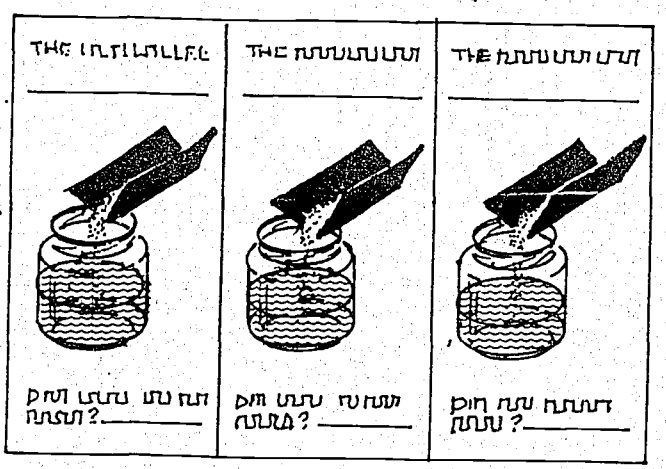
   Let them put the name of the part they are going to work with on the first picture.

5. Divide the class into groups of two children each.

   Give each group a tray of sifting materials, their vials of mixture and the course screen.

   Give each group a jar of yellow BTB.

6. Each group should separate out the part of SYSTEM MIX using the course screen. Check the groups to be sure they are using the correct part.



7. Let the children answer the question on their record sheet. "Did the BTB stay yellow?" This should be answered only for the first picture.

8. Let the children keep their record sheets for discussion. Collect the sifting materials and the vials of mixture.

9. Discuss the experiment.

   "Did the BTB stay yellow?"

   "Did this part of SYSTEM MIX interact with the yellow BTB?"

   "What does this tell you about this part of SYSTEM MIX?"

10. Collect the record sheets for use in the next lesson.

Fourth Day-Do The Other Parts of SYSTEM MIX Interact With Yellow BTB?

1. Give the children their record sheets.

   "Today we will experiment with the other parts of SYSTEM MIX."

   "Which part of SYSTEM MIX do you want to experiment with next?"

2. Let the class decide which part to work with next. Be sure they all understand the part they will work with.

3. Give each group a tray of sifting materials and their vials of mixture. Give each group a jar of yellow BTB.

   Let them experiment with the next part of SYSTEM MIX.

   Let them record their results on the record sheet.

4. Ask the class:

   "What part of SYSTEM MIX is left?"

   "How can you find out if the last part of SYSTEM MIX interacts with yellow BTB?"

5. Give each group new yellow BTB. Let them experiment with the last part.

   Let them record their results on the record sheet.

6. Let the class keep the record sheets for discussion.

   Collect the trays of materials.

7. Have a discussion:

   "What happened to the second part of SYSTEM MIX? Did the BTB stay yellow?"

   "Did the second part interact with yellow BTB?"

   "What happened to the third part of SYSTEM MIX? Did the BTB stay yellow?"

   "Did the second part interact with yellow BTB?"

   "Do you know now which parts of SYSTEM MIX interact with yellow BTB?"

8. Let the children clean up their vials and jars. Everything should be dry and clean.

OPTIONAL ACTIVITY - Which Part Of SYSTEM MIX Interacts With Vinegar?

Interested students may want to try this.

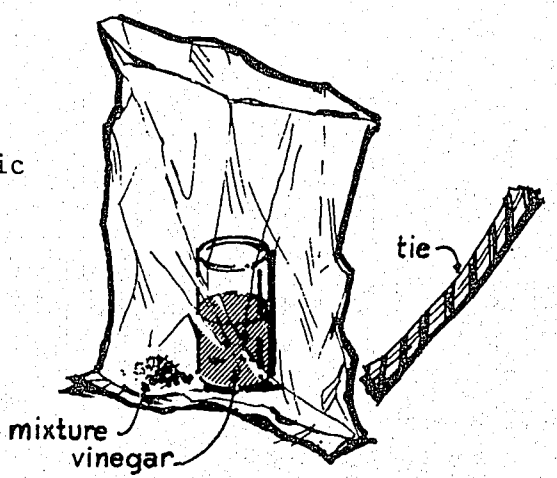
Do a demonstration:

A. Pour some of the mixture into a plastic bag.

B. Put a vial of vinegar into the bag. Do not spill the vial.

C. Carefully squeeze the air out of the bag.

D. Tie the bag closed.

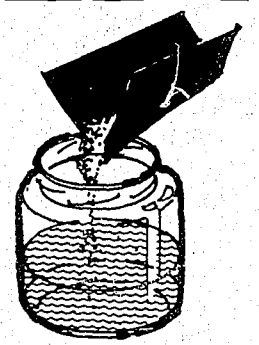
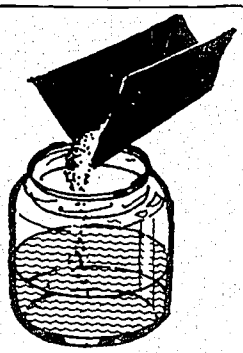
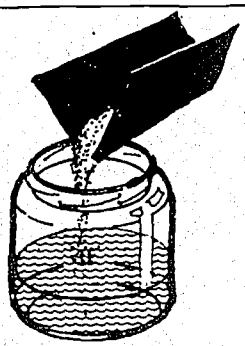


E. Upset the vial so the vinegar pours onto the mixture.

Ask the children what part of the mixture they think interacted with the vinegar. Let them separate the mixture and experiment with each part. Let them find out which parts of SYSTEM MIX interact with vinegar.

NAME _____

Which parts of SYSTEM MIX interact with the yellow BTB?

This part is mostly _____	This part is mostly _____	This part is mostly _____
		
Did the BTB stay yellow? _____	Did the BTB stay yellow? _____	Did the BTB stay yellow? _____

Which parts of SYSTEM MIX interacted with the yellow BTB?

ACTIVITY 2 STUDENT RECORD SHEET

ACTIVITY·3 SYSTEM SOIL

SYNOPSIS (WHAT WILL YOU BE DOING?)

The children collect soil samples to investigate. They observe and separate the SOIL SYSTEM. Other experimenting is done to answer the children's questions about the soil. You decide what to do by listening to the children and observing their interests. Several ideas for "sciencing" with the soil are suggested.

OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

This activity allows the children to investigate one of the most basic systems around them, the soil. The activity starts by using the separation skills the children learned in Activity 2. Then the activity gives suggestions on other "sciencing" that could be done with soil. It is hoped that the children and teacher will have many experiments of their own that they want to try with soil.

This activity should be one of "sciencing" with soil. It should not be an activity where the teacher tells the class about soil.

MATERIALS

For each group of two students:

- vial or small jar
- vial cap rim or rubber band
- fine-mesh cloth screen
- course-mesh cloth screen
- tray or can to hold materials
- three pieces of dark construction paper
- magnifier
- two Record Sheets
- plastic spoon
- jar-small
- medicine dropper
- two pieces of white paper

For the class:

- paper towels
- vinegar
- masking tape
- paper
- paper or other materials to cover desks (optional)
- three large jars or cans for water and waste.
- extra Record Sheets

ADVANCE PREPARATION

During this activity you may want to cover the desks with old paper or other materials. The soil can be messy. You may need protection for the desks and a cleanup time at the end of each lesson. Remember some of the best sciencing can be messy. Don't let it bother you. Just be prepared.

TEACHING SUGGESTIONS

First Day-Getting Samples Of Soil

1. Have a short class discussion:

   "I am thinking about a system you see everyday - SYSTEM SOIL."

   "Does system soil have parts? Did you ever look at the soil on the sides of a hole? Like when someone digs a new benjo."

   "Is the soil at everyone's house or farm the same?"

   "How could we get some soil to look at?"

2. Take the class outside to get some soil samples.

   Divide the class into groups of two children each. Give each group a jar or can to put the soil in.

   Let each group get a sample of soil.

3. Let each group put its name on their soil sample. Put the soil samples away until tomorrow.

4. Say to the class: "Is the soil you found like the soil at your house?"

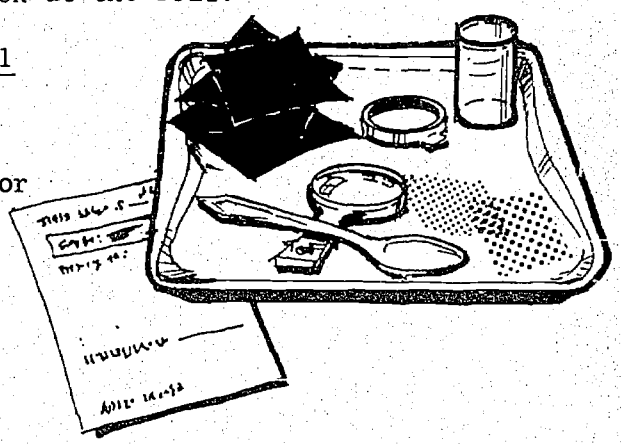
   "You can bring soil from your house or farm if you want to."

   "Tomorrow we will look at the soil."

Second Day-Observing And Separating The Soil

1. Let each group get its soil sample.

   Give each group a tray, the materials for sifting, magnifier, plastic spoon and a sheet of paper.

2. Let the class investigate the soil.

Walk around the room and listen to the children. What they say can give you ideas for experiments and questions.

3. Have a short class discussion at the end of the lesson:

   "What did you find out about soil?"

   "Is each group's soil the same?"

   "Tomorrow we can look at the soil again."

4. Let each group put its soil away. Collect the materials. Be sure the class is careful in cleaning up their materials and desks.

Third Day-Recording

1. Give each child a Record Sheet.

   "You can write or draw what you find in your soil."

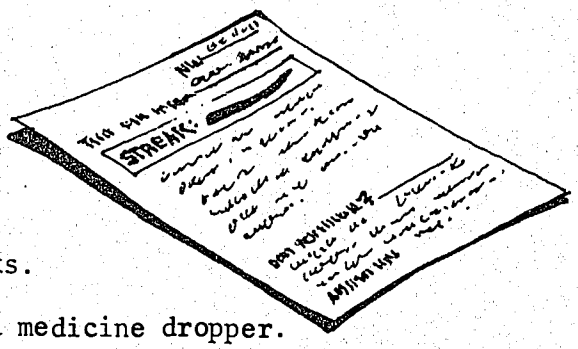
   Show the class how to use the record sheet. They should use the part - "This is in our soil".

2. Give each group their soil and the same materials from the last lesson. Let them put their answers on the Record Sheet.

3. Put some water out. Show the class how they can make a streak of their soil on their record sheet.

   The streak can be made by using your finger to rub some wet soil on paper.

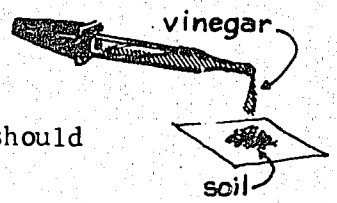
   Let the groups compare their soil streaks.



4. Put out some vinegar. Give each group a medicine dropper. Ask:

   "Does your soil interact with vinegar?"

   Let the children try the vinegar experiment. They should record the results on their record sheet.



5. At the end of the period, have a class discussion:

   "What is in your soil system?"

   "Is it living or nonliving?"

   "Were the streaks all the same?"

"What happened when you put vinegar on your soil?"

"What would you like to do with your soil tomorrow?"

6. Put the soil away and cleanup the materials.

Fourth Day And Later Days-"Sciencing" With Soil

What you do now is up to you and the class. It is hoped that the class has many questions and experiments they want to work on.

Below are some suggested experiments and questions. Use the children's ideas first. Use any of the ideas below that you choose.

Suggestion #1 Watching Soil In Water

Put some soil in a jar of water. Shake it up. Observe what happens after setting it down.

"What part of the soil falls to the bottom first?"

"Why are some things floating? Moving?"
"How many layers are in the jar now?"

"Did all the soil fall to the bottom?"

"If it sets overnight, what will it look like tomorrow?"

"Look at other group's jars."

"Could you record it in a drawing?"

Suggestion #2 Making Soil

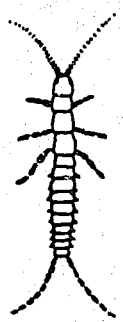
Let the class try and make some soil from rocks and other materials of their choice.

Suggestion #3 Which Soil Is Best For Growing Plants?

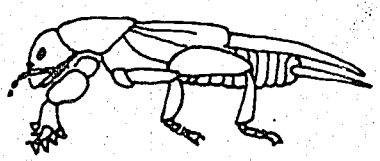
Let the class plant one kind of seed in several different soil samples. Give them the same water and sunlight. Does the soil make a difference?

Suggestion #4 - Most soil has living organisms in it.

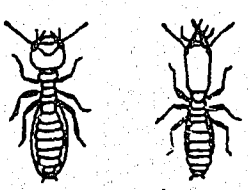
- Compare organisms from different soils.
- Count the organisms. What is the population in one jar of soil? How many different populations are in a jar of soil.
- Discuss - "Living things are part of the soil system."
- Look at the organisms with magnifiers or a microscope.
- Discuss - "Are these organisms helpful? Harmful?"



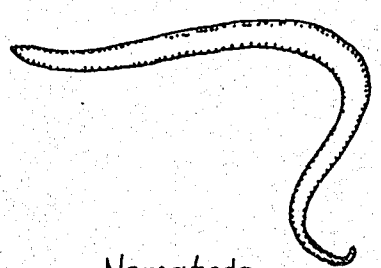
Forktail



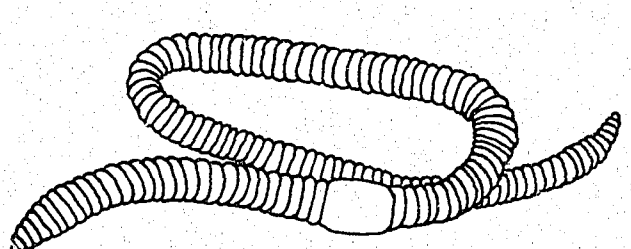
Cricket



Termites



Nematode



Earthworm

NAME _____

This soil is from _____

Streak:

This is in our soil:

Did your soil interact with vinegar? _____

ACTIVITY 3 RECORD SHEET

PART 2

LIQUIDS AND POWDERS

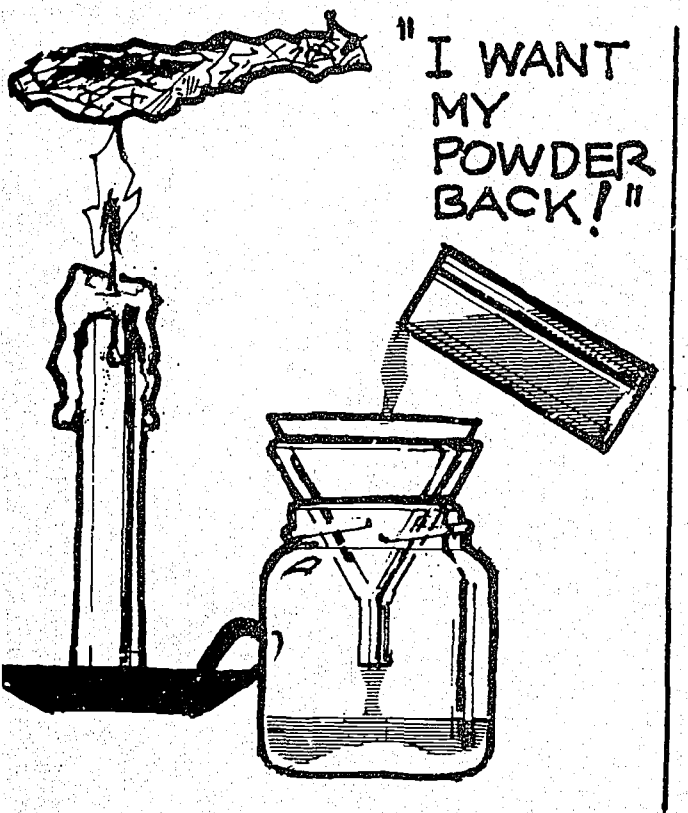
OBJECTIVES (WHERE IS PART TWO GOING?)

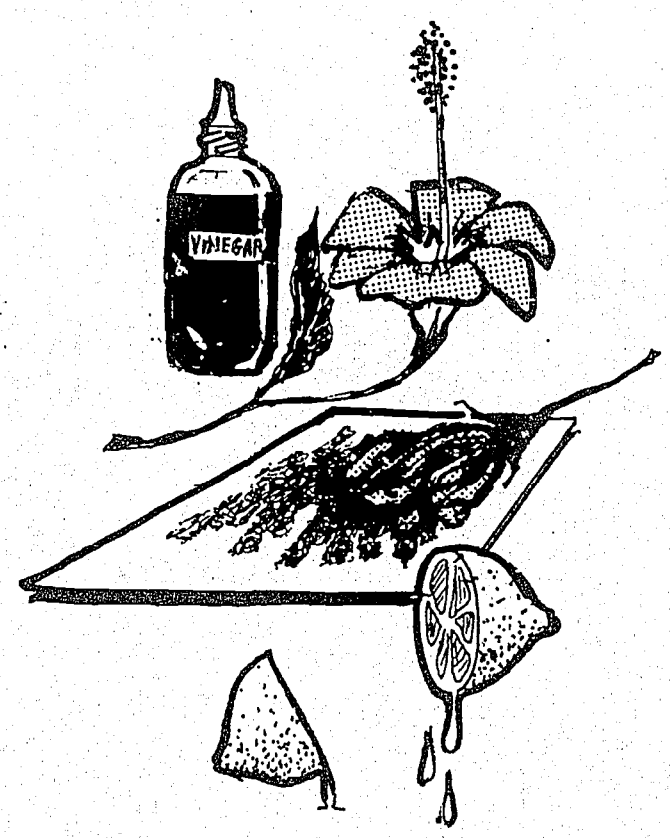
At the end of Part Two the children should be able to:

-- Identify parts that can be separated from a liquid mixture by filtering or evaporation.

-- Talk about how common powders and liquids interacted in their experiments.

-- Set up an experiment to find out about a powder or a liquid.





ACTIVITY 4 COLORED LIQUIDS

SYNOPSIS (WHAT WILL YOU BE DOING?)

The children make and mix different colored powders with water. They explore the attributes of the liquids they are working with. They look through their liquids at crayon dots of different colors. Each child saves his favorite liquid to observe later.

OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

During the activity the children do "sciencing" by mixing liquids with powders (solid material). The children have many systems like this around them. For example: the ocean water, Kool Aid, liquids found around the home or used for cooking and medicine.

MATERIALS

For each group of four children:

four medicine droppers
four magnifiers
small jar, lid and spoonful of red mixture
small jar, lid and spoonful of yellow mixture
small jar, lid and spoonful of blue mixture
small jar, lid and spoonful of white mixture
two small jars or vials
tray or can to hold the materials
four or more crayons of different colors
four worksheets - "Make a Colored Liquid"
four worksheets - "Mixing Liquids"

For the class:

two large cans or jars of water
two large cans or jars for waste
two sets of colored plastic sheets (red, yellow, blue, green)
plastic spoon
paper towels
paper to cover the desks (optional)

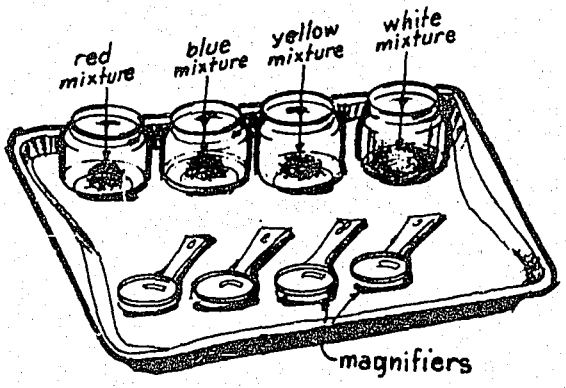
ADVANCE PREPARATION

For the First And Second Day- For each group of four children prepare a tray containing the following:
spoonful of red mixture in a jar
spoonful of blue mixture in a jar
spoonful of yellow mixture

For the Third Day Prepare: The same tray as prepared for the First day. Then add four medicine droppers and four jar lids.

TEACHING SUGGESTIONS

First Day-Exploring Colored Liquids



1. Divide the class into groups of four students each.

2. Show the class the tray each group will get.

3. Tell the class:

   "Today you can experiment with these materials."

   "Be careful not to spill them."

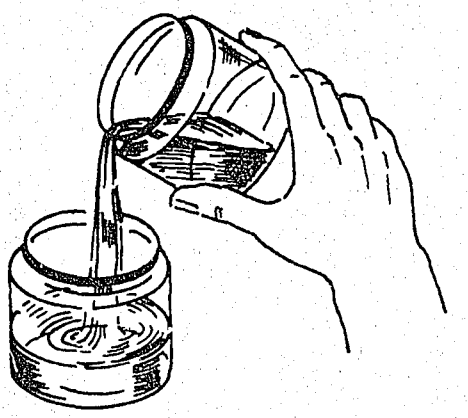
4. Give each group its tray of materials.

   Walk around the class and pour one inch of water into each of the jars of mixture.

   Give each group two extra jars to use.

5. Let the class experiments.

6. Let the children cleanup at the end of the lesson. Collect the materials.



Second Day-Experimenting With Colored Liquids

1. Divide the class into groups of four students each.

   Give each child the worksheet "Make A Colored Liquid" and crayons.

   Let each child make four crayon marks in the circle on the worksheet. The marks should be different colors.

   Explain the worksheet to the class. Be sure the children know what to do when they get their colored liquids.

2. Show the class the tray each group will get.

   Hold up the jar containing the spoonful of red mixture.

   "This powder is salt and red food coloring."

   Hold up the jar containing the spoonful of blue mixture.

   "This powder is salt and blue food coloring."

   Hold up the jar containing the spoonful of yellow mixture.

   "This powder is salt and yellow food coloring."

   Hold up the jar containing the spoonful of white mixture.

   "This powder is salt and starch."

3. Give each group its tray of materials.

   Walk around the class and pour one inch of water into each of the jars of mixture.

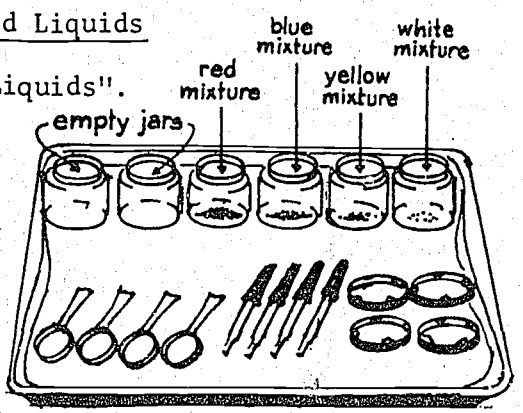
4. Let the children complete the worksheet while they experiment.

5. Show the class the four colored plastic sheets. Let them experiment with these sheets. They can cover the jar of colored liquid with the sheet and see what the color is.

6. Let the children cleanup. Collect the materials.

7. Discuss the answers on the worksheets.

Third Day - More Experimenting With Colored Liquids



1. Give each child the worksheet "Mixing Liquids".

   Explain the worksheet to the class.

2. Give each group its tray of materials.

   Walk around the class and pour one inch of water into each of the jars of mixture.

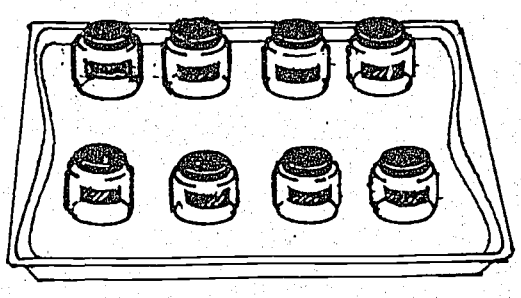
3. Let the children complete the worksheet while they experiment. Give them plenty of time for experimenting.

4. Let the children put their name on their favorite mixture. Put a lid on it. These will be saved for later.

5. Let the class cleanup. Collect the materials.

6. Discuss the answers on the worksheets.

   Put the "favorite mixtures" in a safe place.

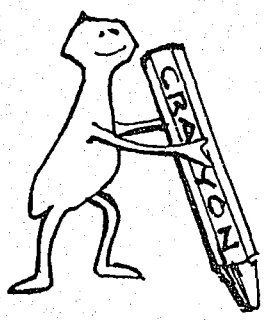


NOTE: This activity could go on for several more days if the children are very interested. Let the children's interest be your guide.

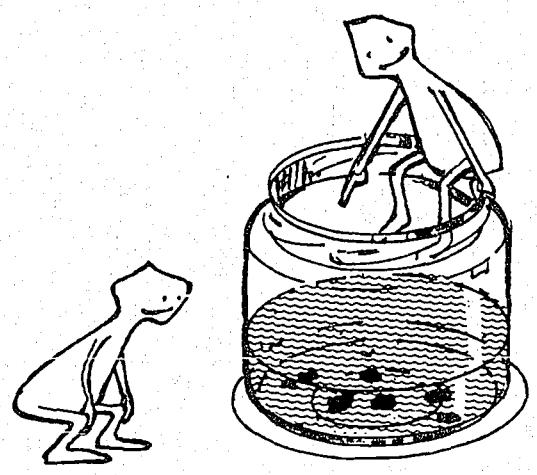
Name _____

Make a colored liquid.

A. Draw colored dots in the circle.



B. Look at the dots through the liquid.



C. What color is your liquid?

_____

Is your liquid clear?

_____

Is your liquid cloudy?

_____

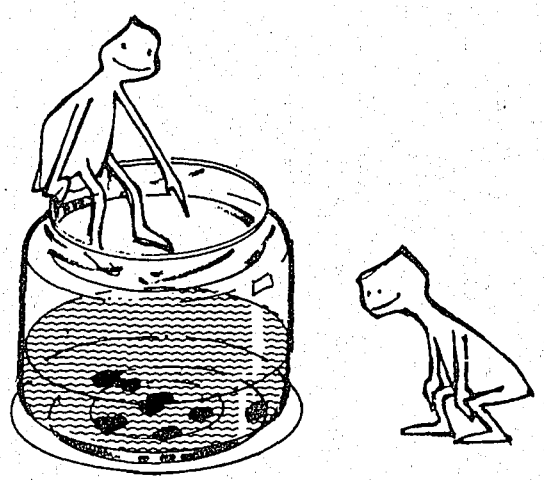
Which dots can't you see?

_____

Which dots can you see?

_____

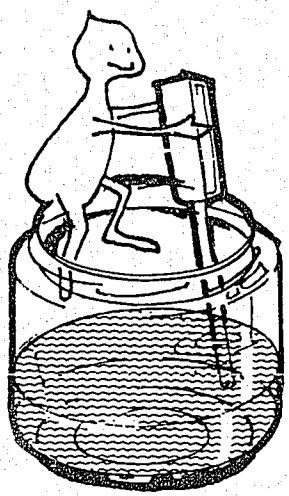
D. Look at the dots through another liquid.

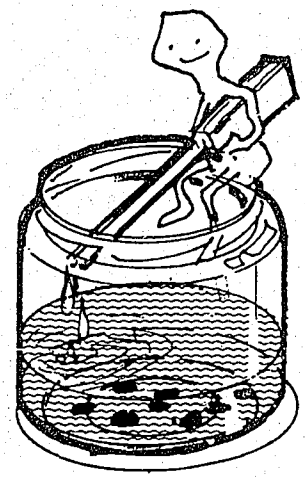


NAME _____

MIXING LIQUIDS

A. Mix the liquids and look at the dots.





C. What is the color of the mixture you saved? _____

Is it dark? _____

Is it light? _____

Is it clear? _____

Is it cloudy? _____

ACTIVITY 5 "I WANT MY POWDER BACK"

SYNOPSIS (WHAT WILL YOU BE DOING?)

The children take their "favorite mixtures" from Activity 4 and try to get the powder back out of the liquid. They use filtering and evaporation to separate their mixtures.

OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

This activity lets the children see how they can separate a system into its parts.

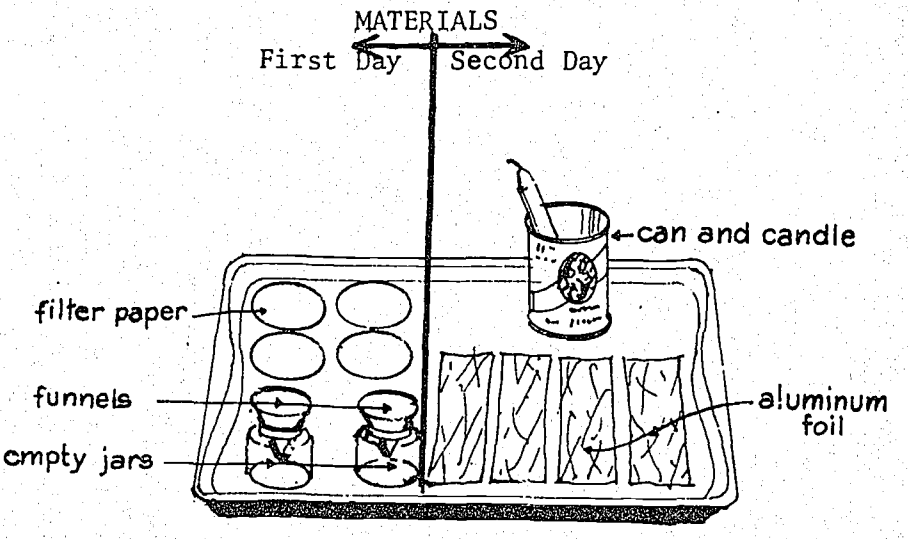
MATERIALS

For each group of four children:

each child's "favorite mixture" from Activity 4
two small jars
small can for holding a candle (optional)
candle
four pieces of aluminum foil (six inches long) or small bottle caps
two funnels
four pieces of filter paper or paper towels
tray or can to put the materials in

For the class:

matches
paper towels



ADVANCE PREPARATION

Put the materials for each group on a tray. For the First Day they will need the jars, funnels and filter paper. For the Second Day they will need the candle and aluminum foil.

TEACHING SUGGESTIONS

First Day-Filtering To Get The Powder Back

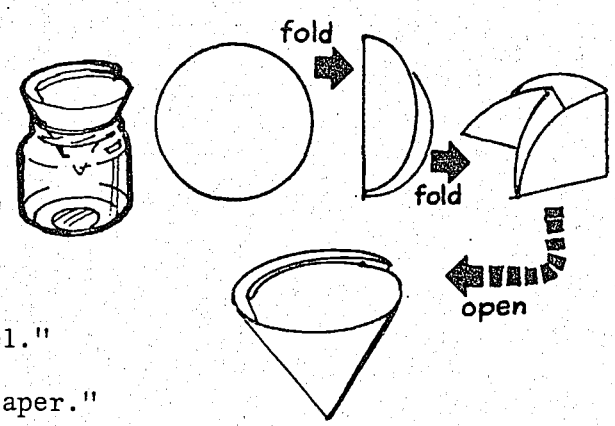
1. Have a short discussion:

"What is in your favorite mixture (the mixture you saved)?"

"Did you ever see someone get small fish in a net? They used a filter (a net) to get something out of the water."

"How can you get the powder back out of the mixture?"

2. Show the class how to filter a mixture using the funnel and filter paper. Demonstrate how to fold the filter paper.



"Put the funnel in the empty jar."

"Fold the filter paper like this."

"Put the filter paper in the funnel."

"Pour the liquid into the filter paper."

3. Let each group get their favorite mixtures.

"Do the mixtures look the same as yesterday?"

Tell the class to only use half of the mixture. They will need the other half for tomorrow's lesson.

4. Give each group their tray of filtering materials.

5. Let the groups experiment. Let them try to get the powders back out of their mixtures.

Walk around the room and help them fold the filter paper.

Be sure they are leaving some mixture for tomorrow's lesson.

Let the groups talk about their experiment:

"Can you filter the powder out?"

"How can you dry it?"

"What color is the powder?"

6. Collect the materials and let the class cleanup at the end of the period. Be sure everything is clean and dry.

Put the jars of "favorite mixture" away for tomorrow's lesson.

Place the filter papers in a safe place to dry.

Second Day-Using Heat To Get The Powder Back

1. Let the class look at their filter paper.

   "What color is your powder?"

   "Is there another way of getting powder back out of a mixture?"

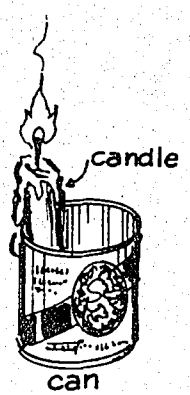
   "Did you ever see someone get salt out of ocean water using a fire?"

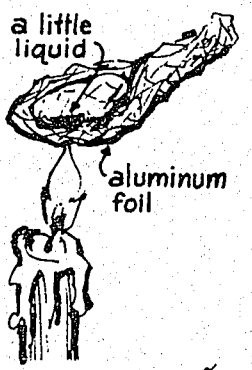
2. Show the class how to heat the liquid with the candle.

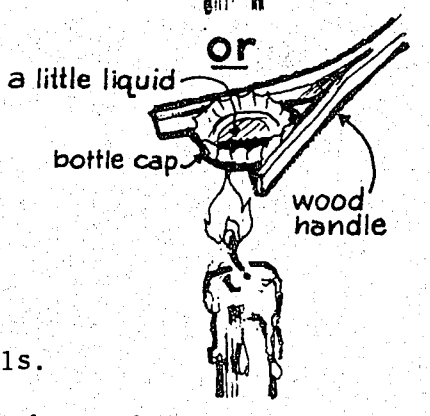
   "Put the candle on the desk or in a can."

   "Fold the aluminum foil to make a place for the liquid and a handle. Put a little of the liquid in the foil."

   "Hold the foil over the candle flame."







3. Let each group get their favorite mixtures.

   "Do the mixtures look the same as yesterday?"

4. Give each group their tray of heating materials.

   Let each group light their candle. Make sure the candle in in a safe place on the desk.

5. Let the groups experiment. Let them try to get the powders back out of their mixtures.

   See that the candles are used correctly and there is no danger of fire.

   Let the groups talk about their experiment:

   "What happens when you heat the mixture?"

   "What color is the powder?"

6. Collect the materials and let the class cleanup at the end of the period. Be sure everything is clean and dry.

OPTIONAL ACTIVITY - GETTING SALT FROM THE OCEAN

Let the children bring in ocean water and heat it over the candles.

"What powder do you get?"

"Does your powder look like your neighbor's?"

"Did you ever see someone in your village heating ocean water?"

ACTIVITY 6 "SCIENCING" WITH POWDERS AND LIQUIDS

SYNOPSIS (WHAT WILL YOU BE DOING?)

The children make some new mixtures. They watch closely as the powders dissolve to make the mixtures. The class separates some of their mixtures using skills they have learned in Activities 4 and 5. At the end of this are many OPTIONAL ACTIVITIES with more "sciencing" for the children and the teacher to chose from.

OVERVIEW OF THIS ACTIVITY (WHY AM I DOING THIS?)

The children are able to "science" with powders and liquids found around them. They can see how powders and liquids make mixtures. They can experience separating some of the mixtures. In doing this they gain experience with systems and parts of systems.

The most important thing in this activity is that the children have fun finding out about things in their environment.

MATERIALS

For each group of two students:

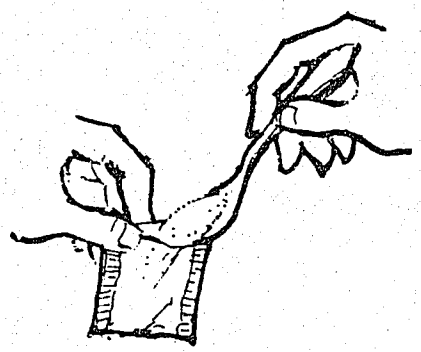
- one spoonful of salt in a tea bag
- one spoonful of salt and food coloring in a tea bag
  (red, blue or yellow salt and food coloring from Activity 4)
- one spoonful of "Mystery Powder" in a tea bag - the teacher makes this - see the ADVANCED PREPARATION
- small jar and lid
- two magnifiers
- funnel
- filter paper
- piece of aluminum foil - 6 inches long
- small jar
- small can to hold the candle (optional)
- candle
- two worksheets

For the class:

- paper towels
- plastic spoon
- salt
- chalk dust
- salt and starch mixture
  (same as that used in Activity4)
- sugar
- sand, salt and baking soda
  (same as the sifting mixture used in Activity 2)

ADVANCE PREPARATION

For the First Day: For each group of two children put one spoonful of salt in a tea bag. Put all bags on a tray so they can be passed out easily.



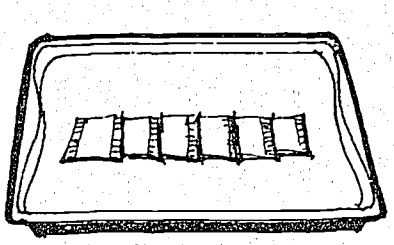
For each group of two children put one spoonful of salt and food coloring mixture in a tea bag. This is one of the blue, red, or yellow mixtures used in Activity 4. Put all the bags on a tray so they can be passed out easily.

For each group of two children put one spoonful of "mystery powder" in a tea bag. Make a few tea bags of each "mystery powder".

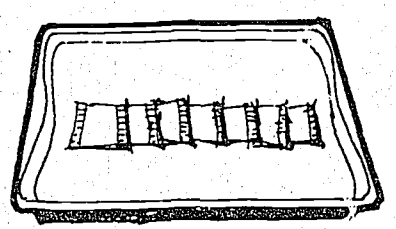
The teacher makes these

"Mystery powder" #1 - chalk dust and salt
"Mystery powder" #2 - salt and starch
"Mystery powder" #3 - sugar
"Mystery powder" #4 - sand, salt and baking soda (sifting mixture)
"Mystery powder" #5 - sand, salt, baking soda and copper chloride.

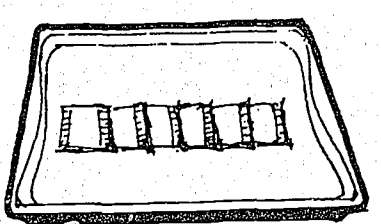
Each group gets one tea bag, but different groups will get different "Mystery powders". Put all the bags on a tray so they can be passed out easily.



salt tea bags



salt and food coloring tea bags



"Mystery Powder" tea bags

For the Second Day: Make a tray of these materials for each group - funnel, filter paper, piece of aluminum foil, small can for the candle, candle, small jar, two magnifiers.

TEACHING SUGGESTIONS

First Day - Mixing Powders and Liquids

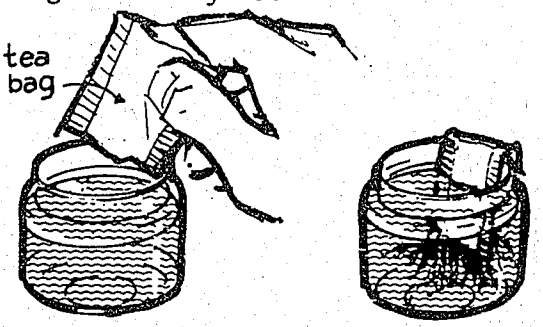
1. Divide the class into groups of two children each.

2. Show the class how to use the tea bags in the jars.

   "Put the powder in the tea bag."

   "Put the tea bag carefully into the jar of water. Hook it over the side of the jar."

   "Watch carefully while you are doing this."



3. Give each group a tea bag containing salt and two magnifiers.

   "What is this powdery material?"

4. Give each group a jar of water.

   Let them put the tea bag of salt into the water.

   "What is happening?"

   "Where is the salt?"

   "What is your evidence?"

   "What interacted in the system?"

5. Let the class throw away the wet tea bags and the water.

   Give each group new water and a tea bag containing salt and dye.

   Let them put the tea bag into the water.

   "What is happening?"

   "Where is the salt?"

   "Where is the dye?"

   "What is your evidence?"

6. Show the class the "mystery powder tea bags".

   "Each group will get one mystery powder in a tea bag."

"Observe it carefully when you put it in the water."

Give each child a "mystery powder" record sheet.

"You can draw or write down what your mystery powder looks like before you put it in the water. Then you can draw or write down what it looks like after you put it in the water."

7. Let the class throw away the wet tea bags and the water.

   Give each group a tea bag of "mystery powder".

   Let them fill in the Before part of the worksheet.

8. Put new water in each group's jar.

   Let them put the tea bags of "mystery powder" into the water.

   Let them fill in the After part of the worksheet.

9. Each group should label and save their "mystery mixture" for the next lesson.

Second Day-Separating The "Mystery Mixture"

1. Let each group get its "mystery mixture".

   "Each group will get materials to work with."

   "Can you separate your mystery mixture?"

   "What do you think it is?"

   "Maybe you can find out what it is."

2. Give each group a funnel, piece of filter paper, piece of aluminum foil, small jar, candle, and two magnifiers.

3. Let the class work with their materials and "mystery mixture" for the rest of the period.

   Listen to the children. Discuss their experiments with them.

4. Let the class cleanup at the end of the period.

OPTIONAL ACTIVITY - POWDERS AND LIQUIDS FROM HOME

Let the children bring powders and liquids from home. They can mix these and try to separate them. Some of the common powders and liquids would be those used for cooking.

OPTIONAL ACTIVITY - PAINTING, USING FLOWERS AND LIQUIDS

Different flowers can be rubbed on paper to color the paper. Red Hibiscus flowers and red Poinsetta leaves work very well.

a. Rub the flowers on paper. Color all the sheet of paper.
b. Dip your finger into a liquid. Use your finger to mark on the colored paper.
c. Try different liquids. For example: water, salt water, starch in water, chalk dust in water, white wood ash in water, lemon juice, vinegar, baking soda in water, beer, ammonia.

While the children are painting, these questions could be used.

"How did the painting help you learn more about liquids?"

"Which liquids made the best colors?"

"Which flowers make the best colors?"

"Which liquids make the paper change color?"

"Do you have other liquids you would like to try?"

"Does the same liquid always make the same color?"

"Can you make a blue color?"

"Could you make a tree with green leaves?"

"Can you predict the color you will get when you put a liquid on your paper?"

The class may want to try many different flowers and liquids. They may know of some plants used at home to make colors.

OPTIONAL ACTIVITY - SEPARATING COLORS ON PAPER

Water and paper can be used to separate color. The children may be interested in trying different colors on different papers. For color you can use food coloring or ink.

a. Put a drop of color on a strip of paper. The best paper is like filter paper.

b. Hang the paper over a jar or can.

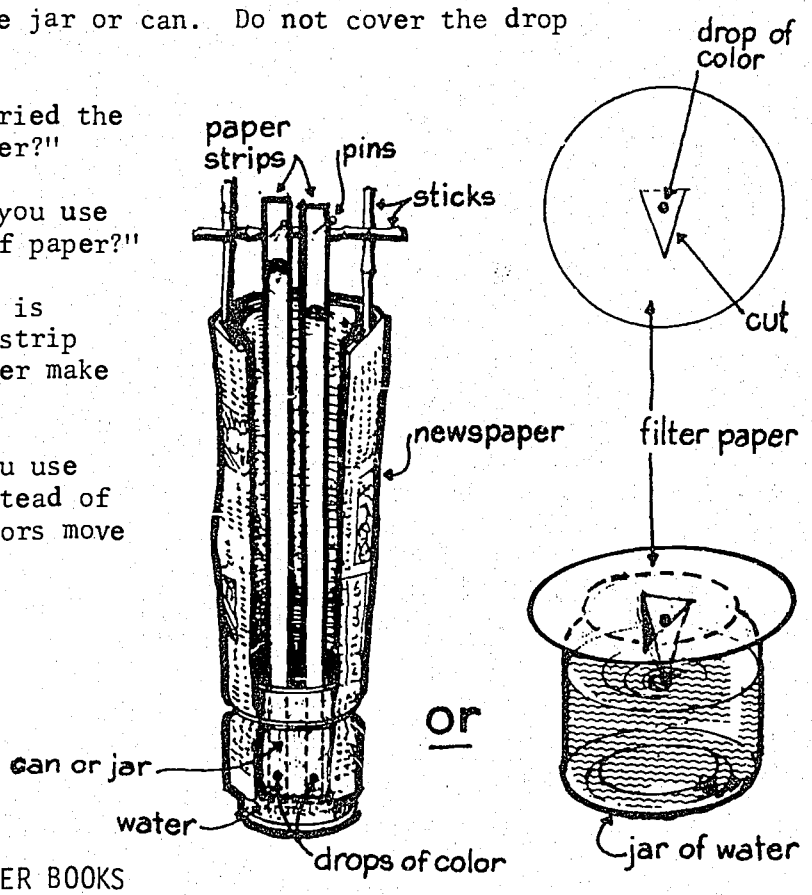
c. Put water in the jar or can. Do not cover the drop of color.

"Which color is carried the highest by the water?"

"What happens when you use a different kind of paper?"

"If a drop of color is put higher on the strip of paper, does water make it rise higher?"

"What happens if you use another liquid instead of water? Do the colors move in the same way?"



OPTIONAL ACTIVITY - OTHER BOOKS

For ideas on "sciencing" with powders and liquids you could look in these books:

"Colours, Water and Paper" - African Primary Science Program

"Common Substances Around The Home" African Primary Science Program

"Inks and Papers" - African Primary Science Program

"Powders" - African Primary Science Program

"Mystery Powders" - E.S.S. Teachers Guide

My "mystery powder" before I put it in the water.

My "mystery powder" after I put it in the water.

PART 3

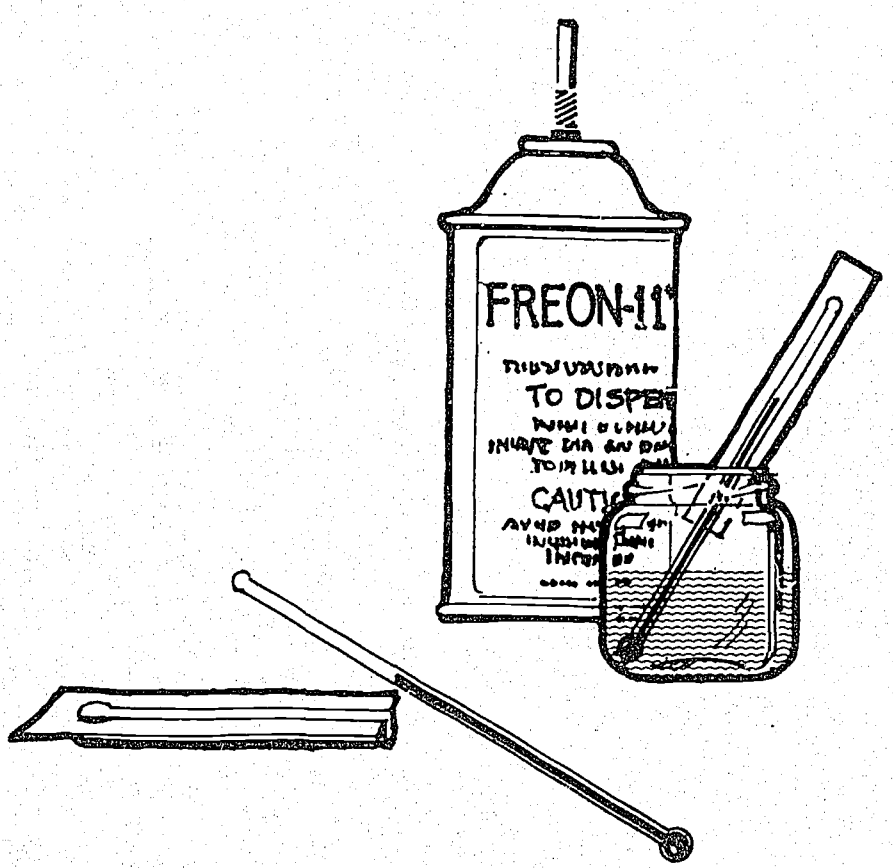
WATER AND FREON

OBJECTIVES (WHERE IS PART THREE GOING?)

At the end of Part Three the children should be able to:

-- Identify samples of Freon and water by their attributes.

-- Observe and describe the boiling and evaporation of liquids, (if ice is available) the melting of solids, and condensing of gases.



Note: If you do not have Freon, do Activity 9 next.

ACTIVITY 7 ATTRIBUTES OF FREON AND WATER

SYNOPSIS (WHAT WILL YOU BE DOING?)

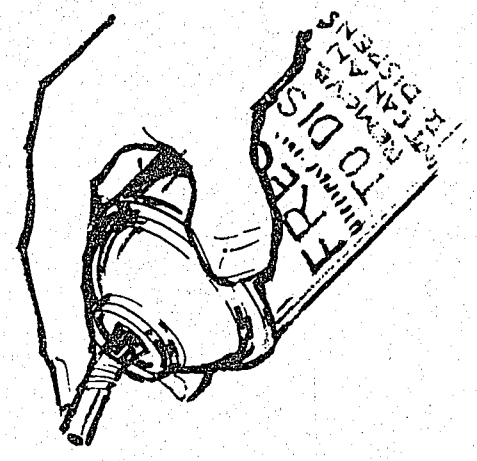
The class explores the attributes of Freon. They compare the Freon to water.

OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

Freon is very much like water. The children can investigate how it compares to water. Later they will investigate how Freon changes states (changing from a liquid to a gas and back to liquid).

Freon is found in refrigerators, air conditioners and spray cans. However, most children are not familiar with Freon. They will find it interesting. Freon is a good system to use to investigate change.

MATERIALS



For each group of two students:
- small jar
- small plastic bag
- two medicine droppers
- paper towel

For the class:
- can of Freon-11
- food coloring
- paper towels
- masking tape
- plastic tumbler or piece of plastic (This plastic must interact with the Freon)
- four large jars for water

ADVANCE PREPARATION

Learn how to get the Freon out of the can:

a. Turn the can upside down.
b. Press the nozzle with your finger.

Know about Freon:

a. It will not hurt you if you get it on you. You can put some in your hand.

b. Do not breath in Freon. It can be smelled very carefully.

c. Do not taste or drink Freon.

d. If a child breaths in a lot of Freon and gets sick, let him sit on a chair and put his head between his legs.

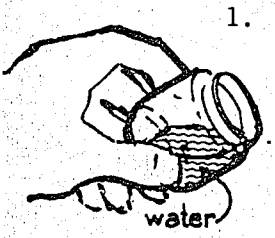
e. Freon is safe to work with if you know these things about it.

Put masking tape over the words on the Freon can. You will take the tape off at the end of the Activity.

Make four large jars of colored water. Use food coloring to color the water.

TEACHING SUGGESTIONS

1. Let a child get a jar of water. Show the water to the class.



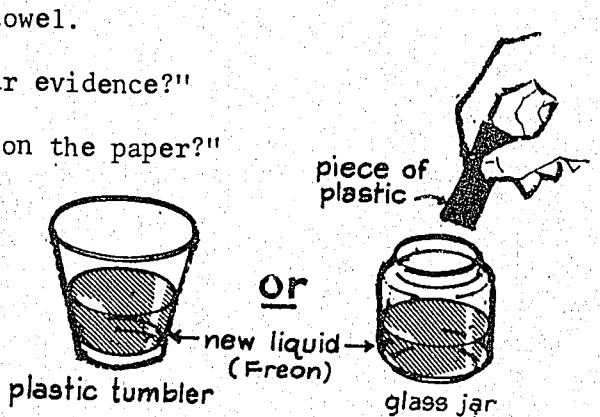
"What are the attributes of the water?"

Pour some of the water on a paper towel.

"Is the paper wet? What is your evidence?"

"What will happen to the water on the paper?"

2. Squirt some of the new liquid into a plastic tumbler. Be sure the words on the Freon can are covered with tape.



"What do you think this liquid is?"

"How can you find out about it?"

Let the plastic tumbler set. You will need it at the end of the activity.

3. Divide the class into groups of two children each.

Give each group a jar, two medicine droppers and a plastic bag.

Show the class the four jars of colored water. Tell them they can get droppers full of this water when they experiment. The jars of water should be placed in different parts of the room.

4. Show the class the can of new liquid (Freon):

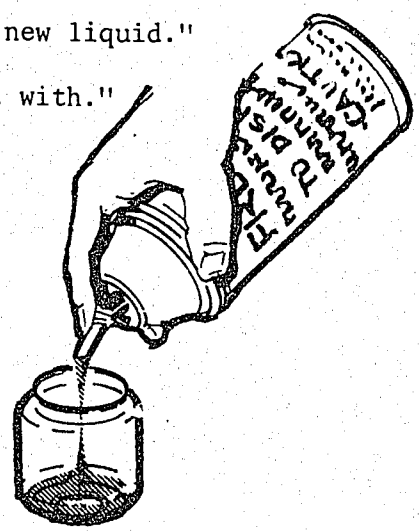
   "I will give each group a little of this new liquid."

   "You can use your materials to experiment with."

   "Do not breath in the new liquid."

   "Do not taste or drink the new liquid."

   "You can touch the new liquid."



   Walk around the class and give each group a little of the new liquid. Only put ¼ inch of Freon in each group's jar. Do not use it all now. You will need some later.

5. Let the children experiment. Walk around the class. Be sure they are using the Freon safely.

   Let the children experiment until all their Freon has evaporated.

6. Have a class discussion:

   "What are the attributes of the new liquid?"

   List the attributes on the board.

   "How does it compare with water?"

   Show the class your plastic tumbler or the piece of plastic in the jar. The Freon should have interacted with the plastic.

   "What happened here?"

   "Did this happen to your jars?"

   "Where did the new liquid go to?"

   Squirt some Freon on a paper towel. Let it set until later.

7. Take the tape off the Freon can. Tell the class:

"This new liquid is called Freon."

"Freon is used in air conditioners, refrigerators and spray cans."

8. Show the class the paper towel:

"What happened to the Freon?"

"Where is the Freon that was on the paper?"

"Can we get the Freon back?"

9. Let the class cleanup the materials.

OPTIONAL ACTIVITY - WHAT WILL FREON INTERACT WITH?

After the class sees how the Freon interacted with the plastic tumbler, they may want to see what will interact with Freon.

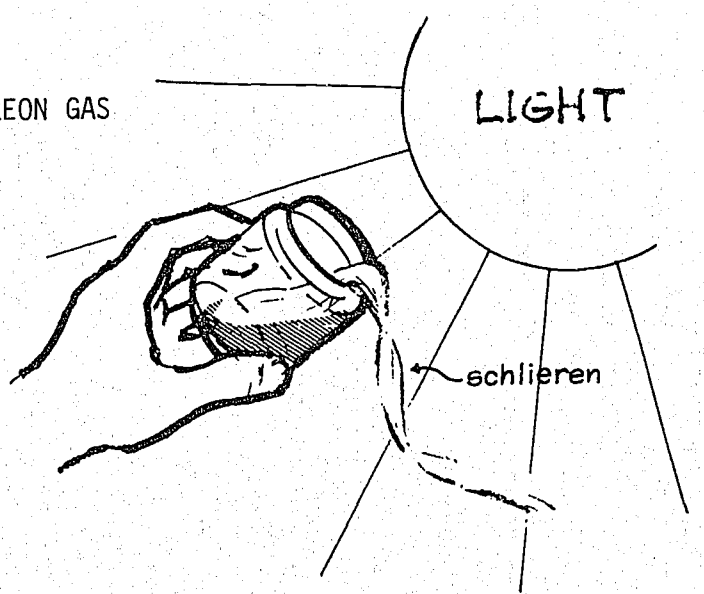
Before you do this, are you sure you have enough Freon to do this and the next activity?

Let the class bring in objects to test. Give each group a little Freon in their jar. Let them put objects in the Freon and observe the interaction.

OPTIONAL ACTIVITY - POURING FREON GAS

Hold the jar of Freon up to the light. Tip the jar, but do not pour the liquid out. Look at the edge of the jar.

You can see the Freon moving out into the air. This movement looks like a stream (schlieren).



ACTIVITY 8 FREON - LIQUID AND GAS

Note-Do you have ice? If you do not have ice at your school you can still do the first part of the activity.

SYNOPSIS (WHAT WILL YOU BE DOING?)

The class explores more of the attributes of Freon. They put some freon in a large plastic bag and watch it change into a gas. If you have ice, ice cubes can be put on the bag. This changes the Freon gas into a liquid again. The children's observations are discussed.

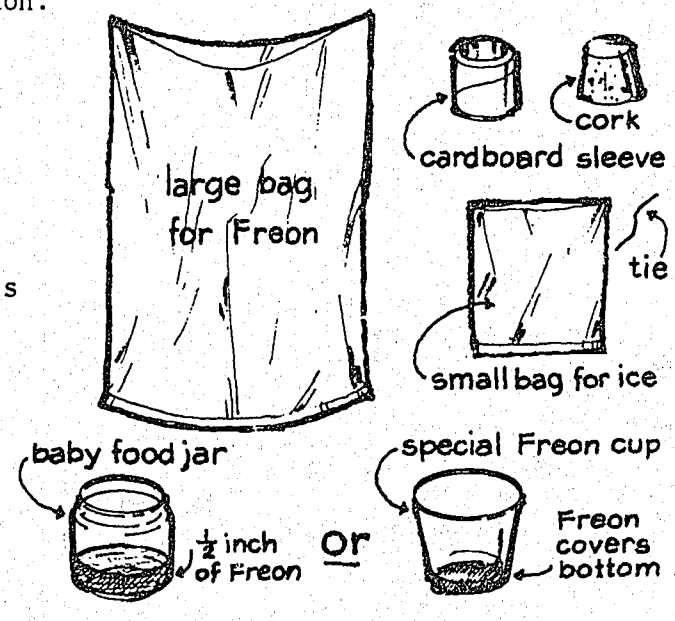
OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

The children are able to observe the material (Freon) change states. During their experience they see how the Freon interacts to different temperatures. This experience gives a background for the concepts of condensation, expansion and evaporation.

MATERIALS

For each group of four children each:
- large plastic bag
- cork stopper
- cardboard sleeve
- small plastic bag and tie
- tray or can to hold the materials

For the class:
- can of Freon-11
- paper towels
- ice in a container
- baby food jar or special cup for Freon

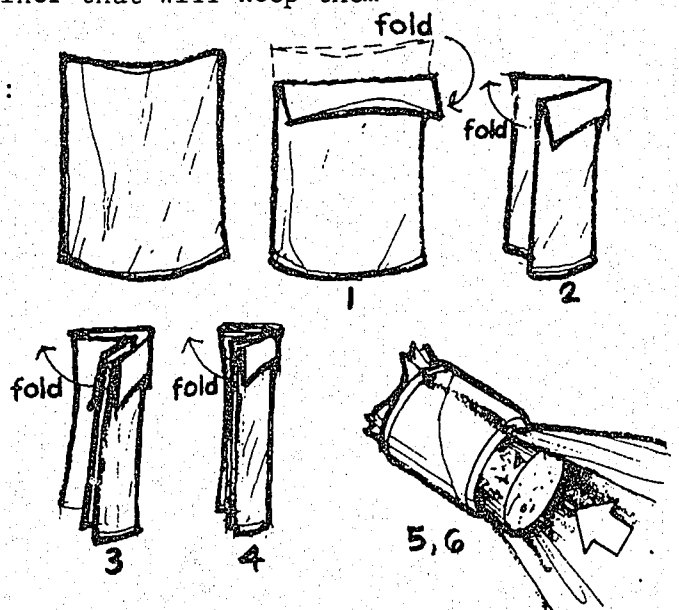


ADVANCE PREPARATION

If your school has ice cubes, be sure you will have them for the lesson. You should put them in a container that will keep them cool.

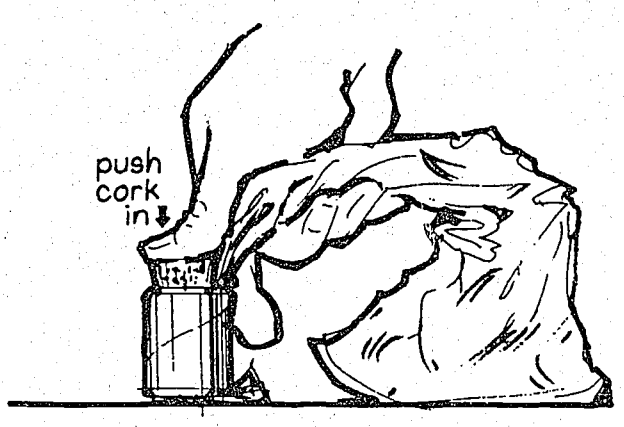
Practice closing the large plastic bags:

1. Fold over the top of the bag two inches.
2. Fold the top of the bag in half.
3. Fold the top of the bag in half again.
4. Fold the top of the bag in half again.



5. Push the folded end through the cardboard sleeve.

6. Push the cork into the cardboard sleeve tightly. Push it against the desk.



TEACHING SUGGESTIONS

1. Show the class the large plastic bag.

   Demonstrate how to put Freon in the bag. The class should watch carefully. They will do this later.

   Put some Freon in the baby food jar. Put in ½ inch of Freon. It is important to get the right amount of Freon.

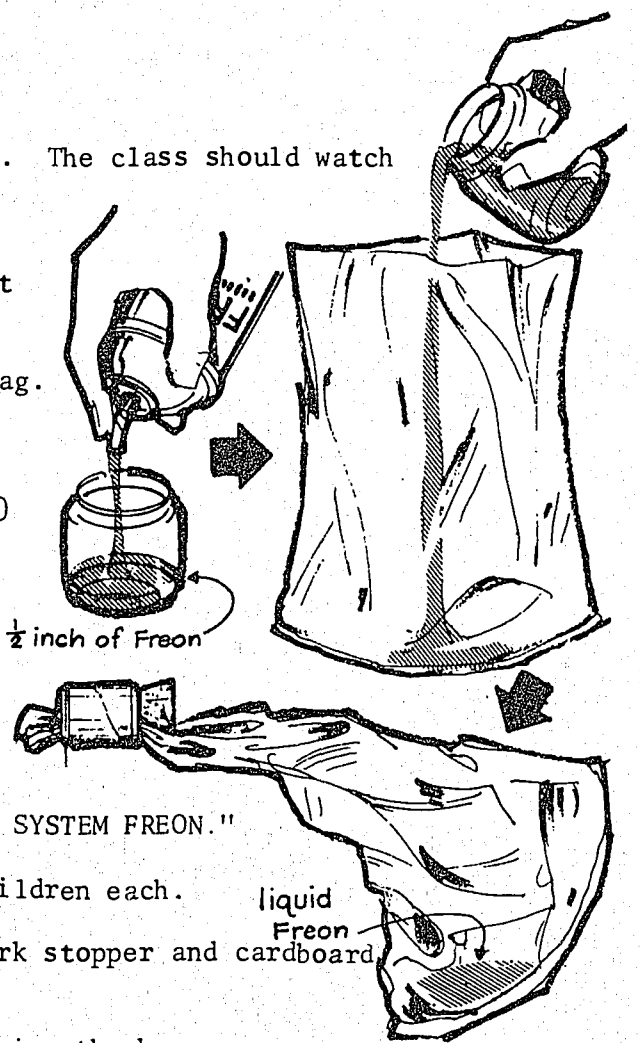
   Pour the Freon into the large plastic bag.

   Smooth out the bag to remove the air.

   Fold the top of the bag. (as practiced)

   Put the cork and cardboard sleeve on the bag to close it.

   Hold the bag up so the class can see the Freon.



2. Pass the bag around the class:

   "The bag and what is inside it is SYSTEM FREON."

3. Divide the class into groups of four children each.

   Give each group a large plastic bag, cork stopper and cardboard sleeve.

   Let each group practice folding and closing the bag.

4. Check to see if the groups can close the bag correctly.

   Give each group some Freon. Measure it in your baby food jar. Pour it into each group's large plastic bag.

   Each group should close their bag and observe the Freon.

   The bags should not be squeezed. They might break.

5. Have a class discussion after all the Freon evaporates.

   "What changes did you observe in the bag?"

   "Is this still SYSTEM FREON?"

   "Where is the Freon now?"

   "How can we get the liquid Freon back?"

6. Let the class try any method they think of to get the liquid Freon back.

7. Give each group a small plastic bag and tie. Let them put ice cubes in the bag.

   Let each group experiment with the bag of ice on their large bag of Freon.

8. Have a class discussion:

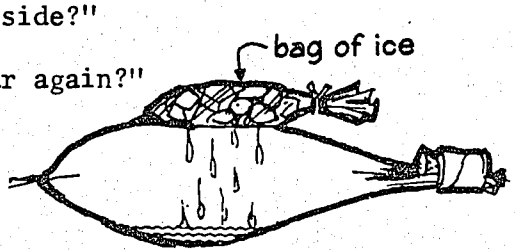
   "What happened when you put ice on the bag of Freon?"

   "What do you think the liquid is inside?"

   "Could you make the liquid disappear again?"

   "Where did the liquid come from?"

   "Is this still SYSTEM FREON?"



9. Let the class cleanup and return the materials. Be sure everything is dry.

NOTE: Do you have ice? If your school doesn't have ice you can still do most of the activity. Just leave out the ice.

ACTIVITY 9 TEMPERATURES OF DIFFERENT SYSTEMS

SYNOPSIS (WHAT WILL YOU BE DOING?)

The children investigate thermometer stems. These stems have no numbers or marks. The children observe how the stems interact with different systems. For example: warm water, drinking water, ice, ocean water, their hand. The children use a scale to measure the length of the red liquid in the thermometer stem. This measurement gives them a way to compare temperatures.

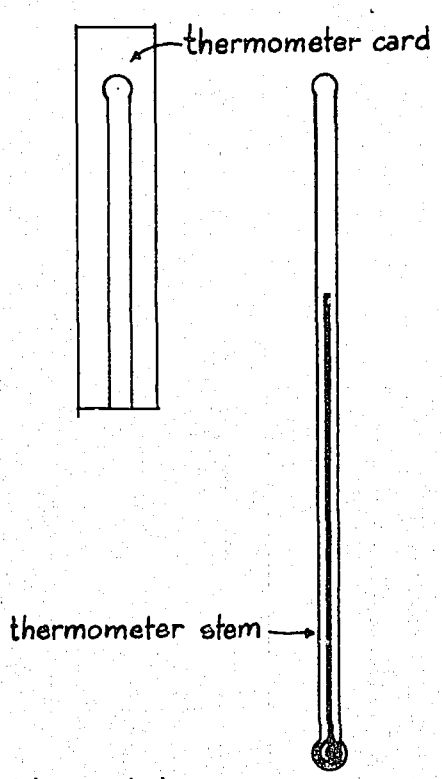
OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

In this activity the children gain experience with another method of investigating systems. This may be their first contact with thermometers. They may know that it is something the nurse or doctor uses. Now they can see how a thermometer interacts with different systems. They use the scale on the worksheet to compare the temperatures of different systems.

MATERIALS

For each group of two children:
- two thermometer stems
- two thermometer cards
- small jar of warm water
- small jar of cool water or ice
- two paper towels
- two Temperature Worksheets
- two Comparing Temperatures Worksheets

For the class:
- thermometer stem
- large can or jar of warm water
- four large cans or jars for waste
- large can or jar of cold water or ice
- paper towels
- two calibrated thermometers
- Freon-11



ADVANCE PREPARATION

If you have ice on your island, get some for this activity. It is best to break the cubes into pieces before using them. You will need ice or cool water each day.

Get the warm water and cool water (or ice) ready before each day's class.

TEACHING SUGGESTIONS

First Day - Investigating Thermometer Stems

1. Divide the class into groups of two children each.

2. Give each group two thermometer stems and two paper towels. Let each group get a jar of warm water.

   Let the groups experiment with their materials.

   "What happens to the red liquid in the thermometer stems?"

   "Can you make the red liquid longer? Shorter?"

   Let each group get a jar of cool water or ice.

   Let them experiment using cool water or ice.

   "What happens to the red liquid in the thermometer stem?"

   "Can you make the red liquid longer? Shorter?"

   "Does the red liquid stop moving?"

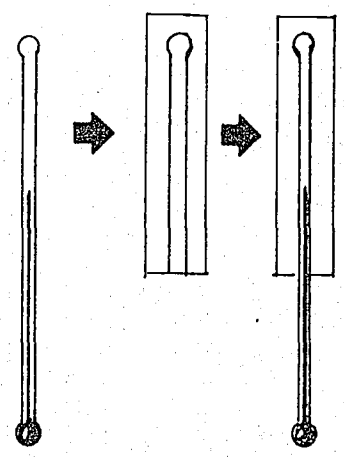
3. Give each group two thermometer cards.

   Show the class how to put the stem on the card:

   "Hold the stem so you can see the red liquid."

   "Put the stem into the card. The red part should be at the bottom."

   Let the class put their stems on the cards.



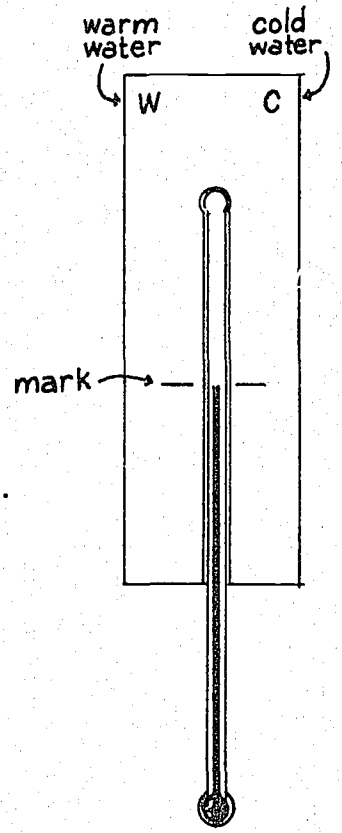
4. Let the children write their names on the back of the cards with a pencil.

5. The class should get to see the liquid inside the thermometer. Usually someone will break a thermometer stem. When this happens, let the class look at the red liquid and the pieces of tube.

   The red liquid is a liquid often used in cleaning cloths. It is called Stoddard's Solvent. The children can smell it and feel it. Sometimes thermometers have a silver colored liquid in them called Mercury. The silver colored liquid should never be touched or smelled.

If none of the thermometer stems are broken, you should break one so the class can see the red liquid. Only do this if none are broken by the class. Wrap the thermometer stem in cloth and break it. Then let the class observe the red liquid. Tell the class they are not to break their stems. One broken stem is all the science dept. can afford to replace.

6. Collect the materials for use tomorrow. Let the class cleanup the jars.



Second Day - Measuring Temperatures

1. Give each group their thermometer stems and cards.

"Put a C on the right side of the card. This is for cool water."

"Put a W on the left side of the card. This is for warm water."

Put a large drawing on the chalkboard to show this.

Let the children mark their cards C and W.

"We will see where the red liquid is in warm water. We will mark this place on the side of the card."

Draw the card and stem on the chalkboard.

2. Give each group a jar of warm water.

"Mark your thermometer after it is in the warm water."

"Try another group's warm water. Mark your card."

"Try different jars of warm water until you have four marks."

3. Let the class pour out the warm water.

Give each group a jar of cool water or ice.

"Make your marks on the side marked C."

"Mark your thermometer after it is in the cool water."

"Try another group's water. Mark your card."

"Try different jars of cool water until you have four marks."

4. Let the class keep their cards. Collect the thermometer stems and jars of water.

5. Give each child a Temperature Worksheet.

   Show the class how to use the Temperature Worksheet.

   "Place your card to the right of the scale on the worksheet."

   "The buttom of the card should be at the bottom of the scale."

   "Look at the top mark on your card on the warm water side."

   "Use the scale to find how many units up this mark is."

   "Put the number of units in the first line under WARM WATER SYSTEM."

   "This is the temperature of that warm water system."

   Let the children fill in the Temperature Worksheet. They should do the warm water systems first and then the cool water systems.

6. Collect the cards for later use.

7. Have a short discussion:

   "What was the highest temperature of any of the systems?"

   "What was the lowest temperature of any of the systems?"

Third Day - Comparing Temperature

1. Give each group two thermometer stems, two cards, two small jars and two Comparing Temperature Worksheets.

   Put out two regular (calibrated) thermometers for interested children.

2. Explain the Comparing Temperatures Worksheet to the class.

   "Find the temperature of each of the systems marked on the worksheet."

   "Use the scale on the worksheet to measure temperature. Mark the units on the worksheet."

3. Let each group get the materials it needs to measure the temperature of each system. Let them work with only one system at a time.

   Help the groups get the materials they need. Help them fill in the worksheet if they have trouble.

4. Collect the materials. Have a class discussion:

   "What was the temperature of each system?"

   "Which system had the coolest temparature?"

   "Which system had the warmest temperature?"

   "Did you all get the same temperature for the same system? Why not?"

   "What other systems did you find the temperature of?"

OPTIONAL ACTIVITY - COLOR CARDS AND TEMPERATURE

Let the class experiment with the color cards used in Activity 1. Let the class predict temperatures by looking at the color of their cards. They can put the color cards in warm and cool water. They can compare their predictions to the readings they make using their own thermometers.

"What temperature will change the color of each card?"

"How many different colors are there on one card?"

OPTIONAL ACTIVITY - WHAT IS THE TEMPERATURE?

Interested children may try and find out the temperature in many different places around the school or island. Here are some suggestions: What is the temperature of air by the floor; of air by the roof; in the ocean; under a tree; of the soil; in your mouth; in a refrigerator.

Be careful some thermometers will not measure high temperatures. The thermometer stems in the kit will break if heated over 120° F. Use calibrated thermometers that measure higher temperatures for this activity.

NAME _____

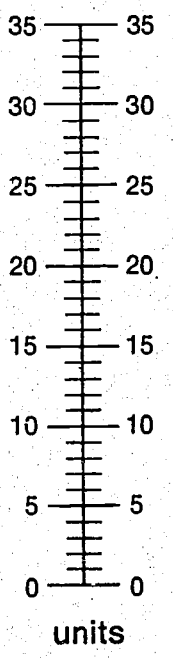
FIND THE TEMPERATURES OF THE DIFFERENT SYSTEMS

Put your card beside the scale.

The bottom of the card should be at the bottom of the scale.

Use the scale to count the number of units the mark is on the card.

Mark the number of units in the space below.



Freon	_____ units
Drinking Water	_____ units
Water Setting In The Sun	_____ units
The Coolest Water You Can Find	_____ units
Your Hand	_____ units
The Air In The Room	_____ units
_____	_____ units
_____	_____ units

ACTIVITY 9 - COMPARING TEMPERATURES WORKSHEET

NAME _____

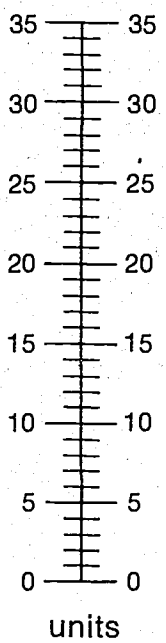
FIND THE TEMPERATURES OF THE WARM WATER SYSTEMS AND THE COOL WATER SYSTEMS

Put your card beside the scale.

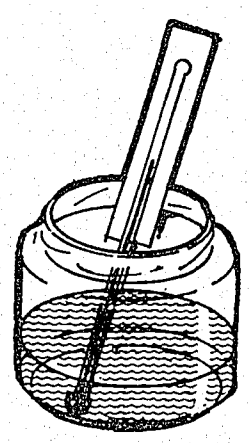
The bottom of the card should be at the bottom of the scale.

Use the scale to count the number of units the mark is on the card.

Mark the number of units in the space below.



WARM WATER SYSTEMS



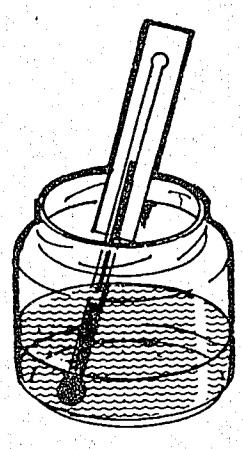
____ units

____ units

____ units

____ units

COOL WATER SYSTEMS



____ units

____ units

____ units

____ units

ACTIVITY 9 - TEMPERATURE WORKSHEET

PART 4

VARIABLES

OBJECTIVES (WHERE IS PART FOUR GOING?)

At the end of Part Four the children should be able to:

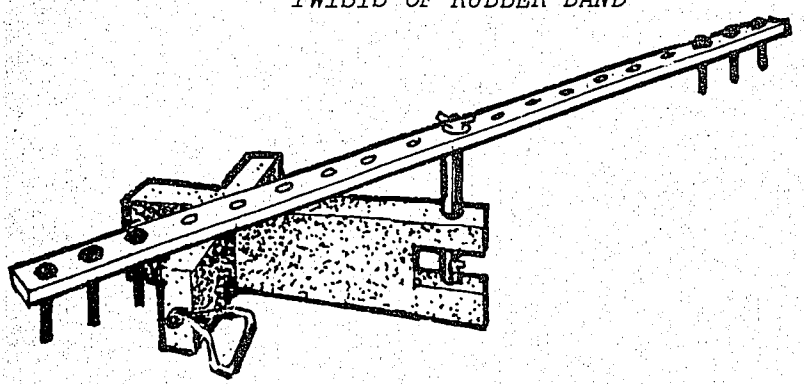
-- Analyze and compare data from a histogram.

-- Identify variables that affect an experiment with a simple mechanical system.

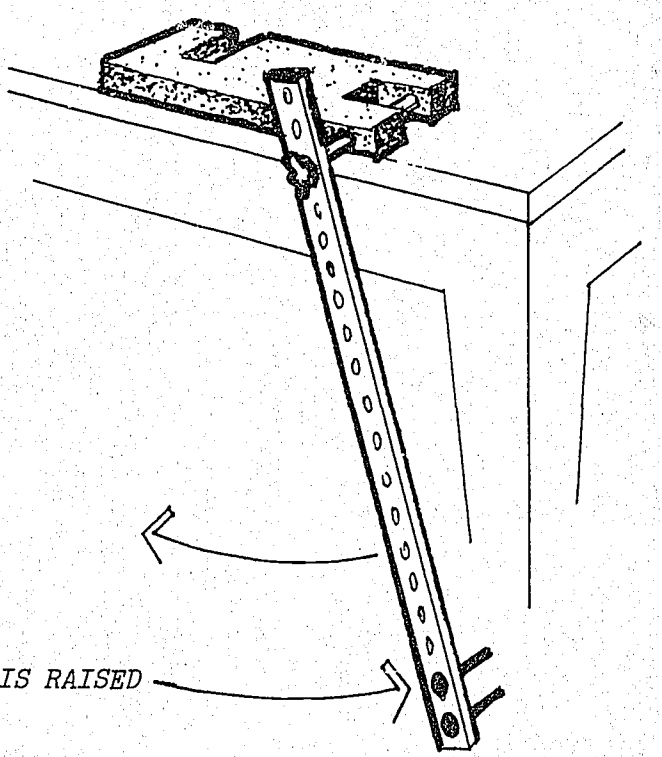
-- Predict the result of changing one variable in a simple mechanical system.

POSITION OF RIVETS

TWISTS OF RUBBER BAND



WHICH HOLE THE POST IS IN



NUMBER OF RIVETS

HOW HIGH THE ARM IS RAISED

ACTIVITY 10 EXPLORING THE WHIRLY BIRD

SYNOPSIS (WHAT WILL YOU BE DOING?)

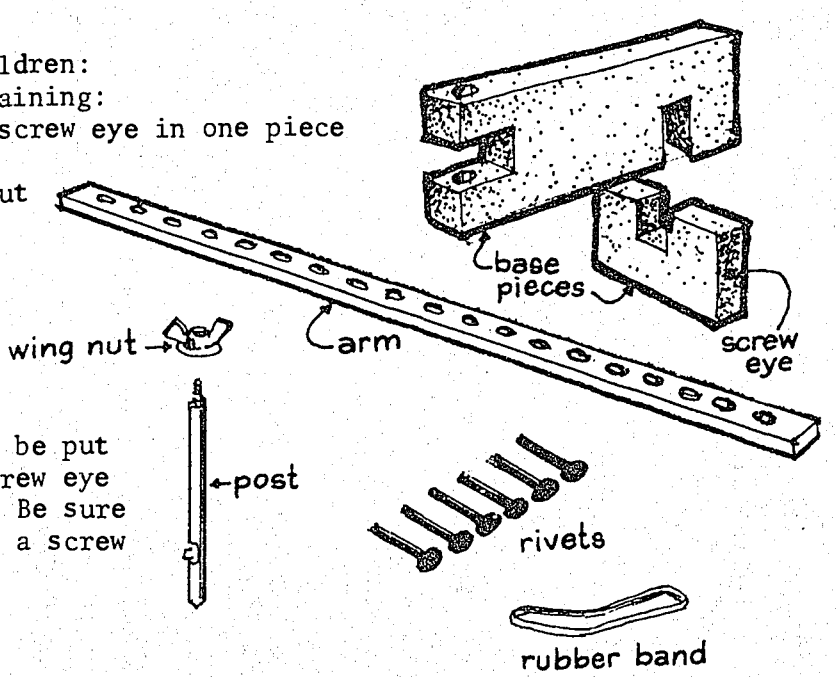
The children are given the whirly bird materials. They explore ways of putting it together. Later, the class uses the worksheet to put the whirly bird together. The class uses the worksheet to practice recording where they placed the rivets.

OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

This activity lets the children become familiar with the whirly bird. Later, after they are familiar with it they can start to do activities with it.

MATERIALS

For each group of two children:
- whirly bird set containing:
  - two base pieces/screw eye in one piece
  - arm
  - post with wing nut
  - six rivets
  - rubber band
- two worksheets



ADVANCE PREPARATION

The only part that should be put together should be the screw eye on the small base piece. Be sure each small base piece has a screw eye.

TEACHING SUGGESTIONS

First Day-Exploring the Whirly Bird Set

1. Divide the class into groups of two students each.

2. Give each group the pieces of a whirly bird set. Do not give out the rubber bands. The rubber bands will be given out tomorrow.

   Let the groups explore the whirly bird set. They can put it together any way they can think of.

3. Collect the materials at the end of the period.

Second Day-Using The Whirly Bird Set With A Rubber Band And Worksheet

1. Give each group a whirly bird set and one rubber band.

   Give each child a worksheet.

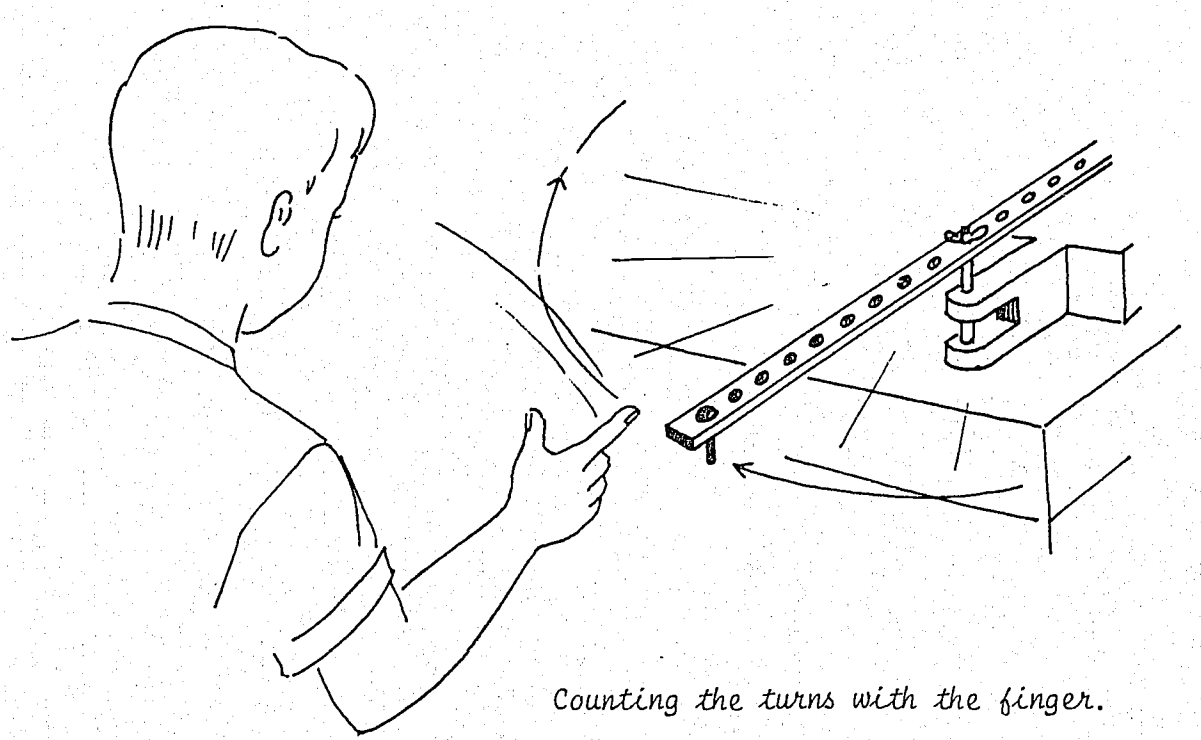
2. Let the groups set up their whirly bird like the picture on the worksheet.

   Let them explore using the whirly bird set.

3. Explain the second part of the worksheet to the class.

   Let each child record the rivet placement for two experiments.

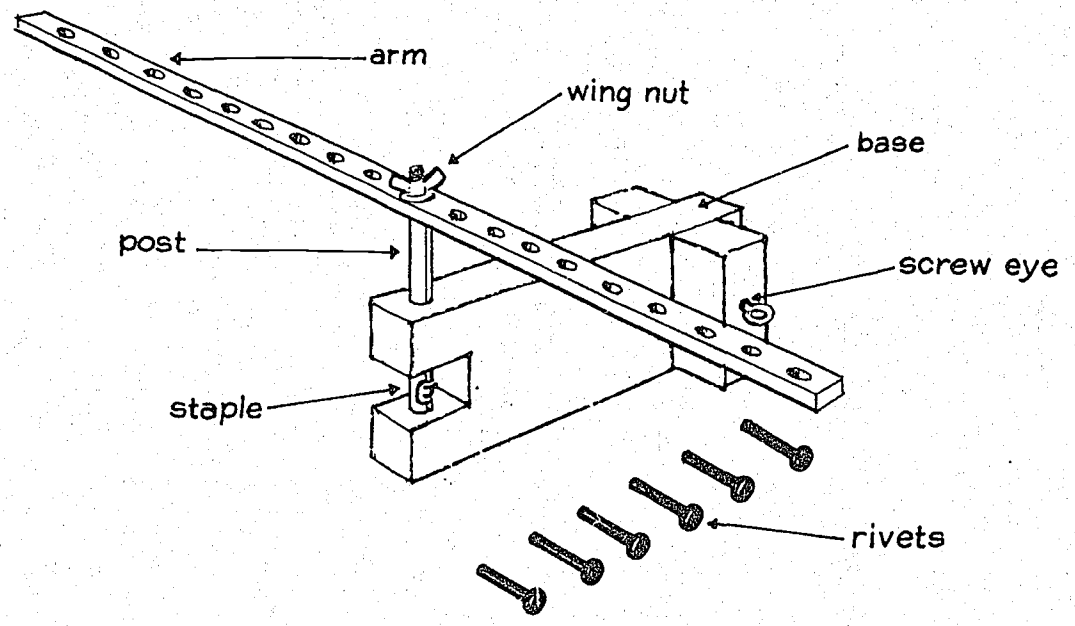
4. Collect the materials.



Counting the turns with the finger.

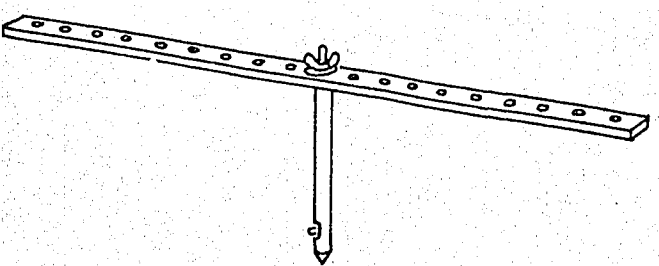
NAME _____

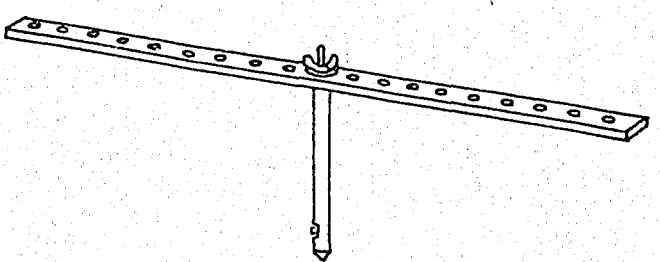
Put your whirly bird together like this.



Draw a picture of where you put your rivets.

Do this for two experiments.





ACTIVITY 11 "INVENTING VARIABLES"

SYNOPSIS (WHAT WILL YOU BE DOING?)

The children experiment with the whirly birds and rubber bands. They count and record the number of turns the whirly bird arm makes in the experiments. The results of the experiments are placed on the chalkboard in a histogram. The histogram will show how different each experiment was. The class discusses the reasons for the differences. During this discussion the concept of variables is introduced.

OVERVIEW OF THIS ACTIVITY (WHY AM I DOING THIS?)

This acitivity uses the children's experience to introduce the "variables" concept. Through such experiences the children are able to start identifying variables in classroom experiments and in experiences they have outside the classroom.

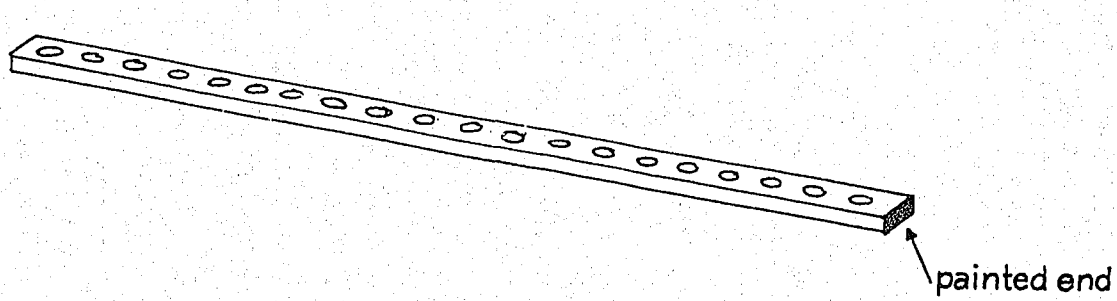
MATERIALS

For each group of two children:
- whirly bird set
- worksheet

For the class:
- number line strip-0 to 99 or put these numbers on chart paper or the chalkboard
- chart paper for listing the variables

ADVANCE PREPARATION

It will take the children time to learn how to count the number of turns the whirly bird arm makes. It is best to put a mark on one end of the arm. One way of doing this is to paint one end of the arm. Maybe the whirly birds in your kit already are painted. Check them.



TEACHING SUGGESTIONS

First Day-How Many Times Does The Arm Turn?

1. Divide the class into groups of two children each.

   Give each group a whirly bird set.

2. Let the group practice counting the number of turns the whirly bird arm makes. They should wind it up using the rubber band let the arm go. They should count the turns the arm makes from the time they let it go until it stops moving.

   Counting the turns takes practice. Help groups that are having trouble counting.

   One good way to count is to point your finger each time the painted end of the arm passes you. The number of times you move your finger will be the number of turns the arm made.

   After some time the children will learn how to count the number of turns the arm makes.

3. Give each group a worksheet.

   Explain the worksheet to the class:

   > "The worksheet has a place to record four experiments."
   >
   > "On each experiment show where you put the rivets. Draw them on the picture of the whirly bird arm."
   >
   > "On each experiment count the number of turns the arm makes. Record the number of turns on the worksheet."

4. Let each group do the four experiments and record them on the worksheet.

5. Collect the materials and the worksheets. The class will talk about the worksheets tomorrow.

Second Day-Inventing the "Variables" Concept

1. Put the number line strip on the chalkboard.

   Give each group their worksheet from yesterday.

2. Tell the class:

   "We will use the number line to record the results of your experiments."

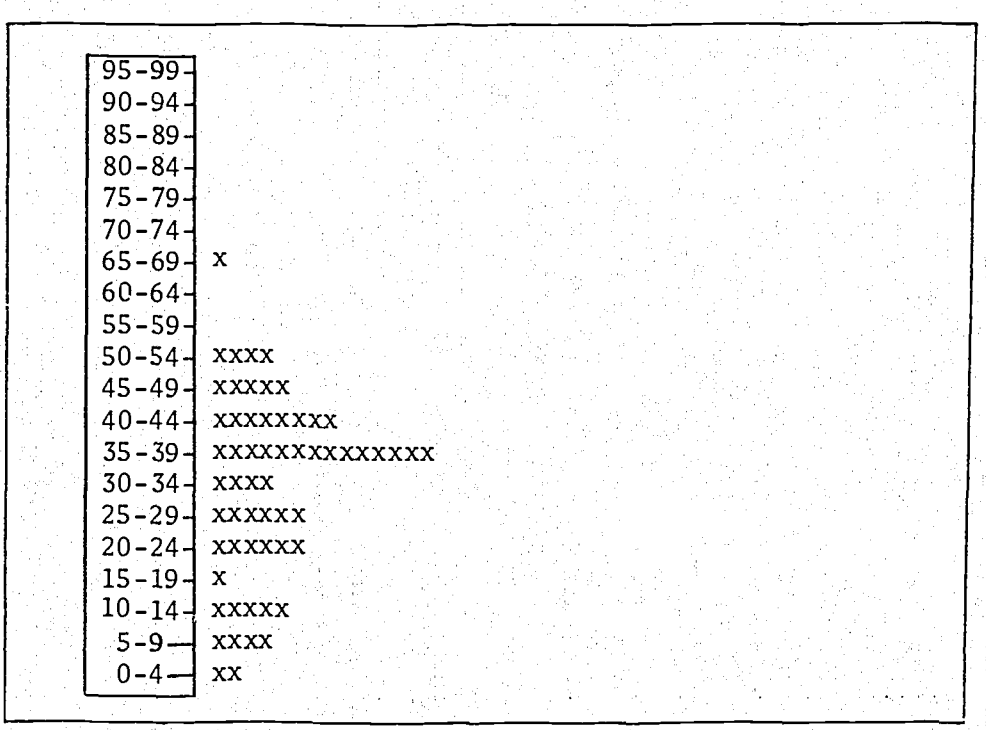
   "In what place would the number ten be on the number line?"

   "Where would these numbers go on the number line 40, 45, 41, 21, 18, 60, 84?"

3. Ask each group to read the number of turns their whirly bird arm made in each experiment. Each group will give you four numbers.

   Put an X on the chalkboard for each number a group reads to you. Put the X beside the correct line on the number line strip.

   You are making a "histogram". It is like a graph. It will show the results of all the experiments done by the class. They will all be in one place. It will show how the results are the same and how they are different.



Example: Histogram for a class of 15 groups. Each group did 4 experiments. The results of all 60 experiments are recorded.

4. Put the chart paper on the wall.

   Point to the histogram:

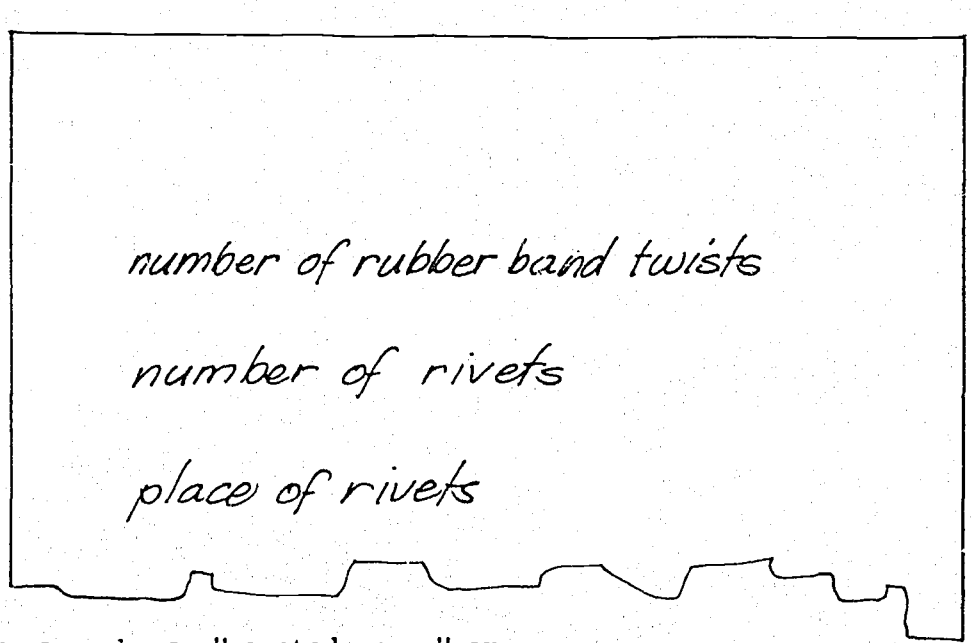
   "You got many different results in your experiments."

   "Why are the results different?"

   "Where the whirly birds all operated the same?"

   "How did the whirly bird in one experiment differ from another experiment?"

5. Write down the children's answers on the chart.

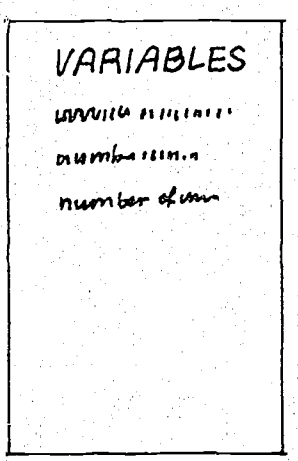


Answers such as, "counted wrong" or "stopped the arm with my finger" should be written on the chalkboard. These are mistakes made while doing the experiment. They do make the results different. They are not variables of the whirly bird set up.

6. Tell the class:

   "These are variables."

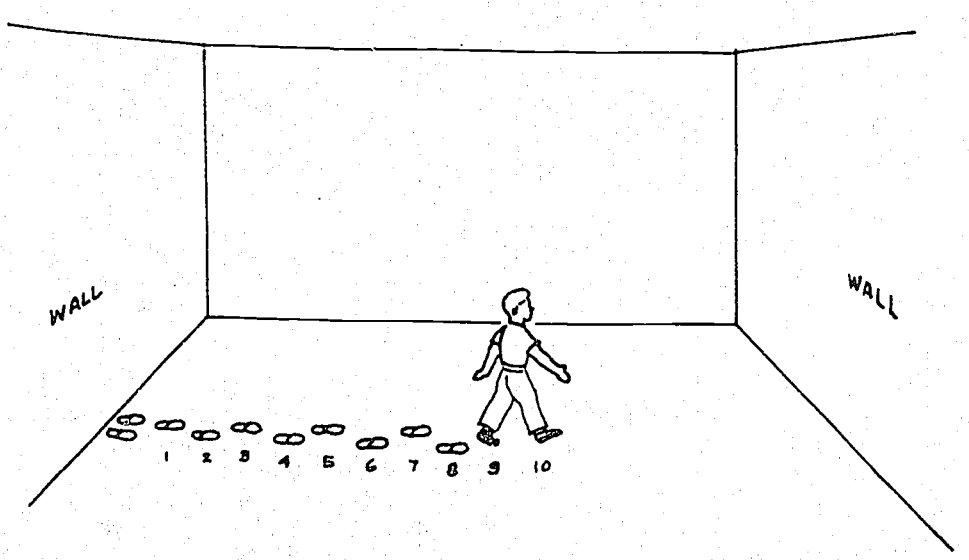
   Write the word VARIABLES at the top of the chart.



OPTIONAL ACTIVITIES - OTHER VARIABLES

The children might discover variables in everyday life. They could do experiments, record results, make histograms and discuss their findings.

1. You can choose a distance, for example from one side of the classroom to the other. Then each child walks, placing one foot right in front of the other,and counts the number of "feet lenghts".

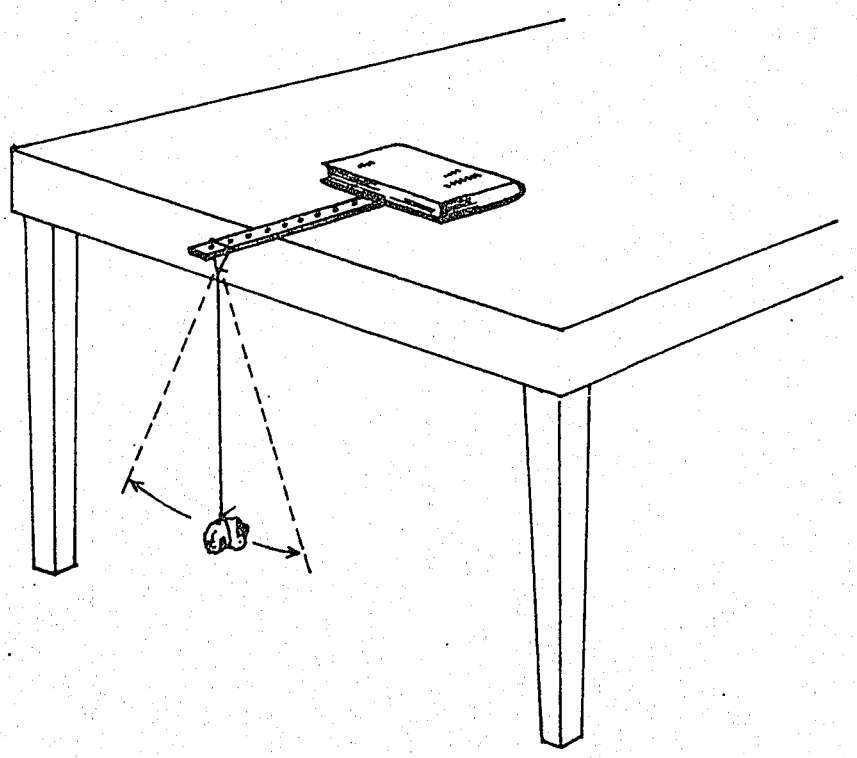


"Why isn't the number of steps the same for each person?"

Discuss with the children that the variables might be the lengths of their feet or how close they placed their heel to their toe.

2. Let each child tie a rock to one end of a string. Attach the other end of the string to a ruler and let the rock swing from the side of the desk. (Put a rock, book or heavy object on top of the other side of the ruler). Let the children count the number of swings and record the results. Then the class can make a histogram on the blackboard. Discuss the differences in their results.

   Discuss that the weight of the rock and the length of the string might be some of the variables.



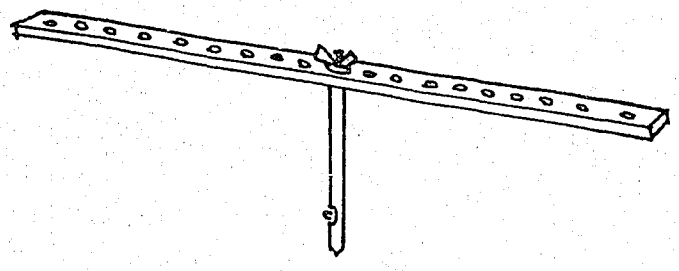
3. You or the children may be able to think of other experiments or games you can play with variables in everyday life.

NAME _____

NAME _____

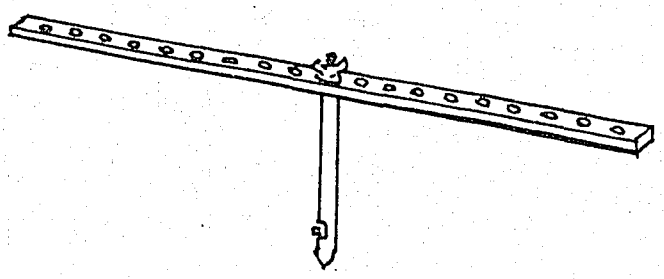
How many turns does the arm make?

Show where you placed the rivets.



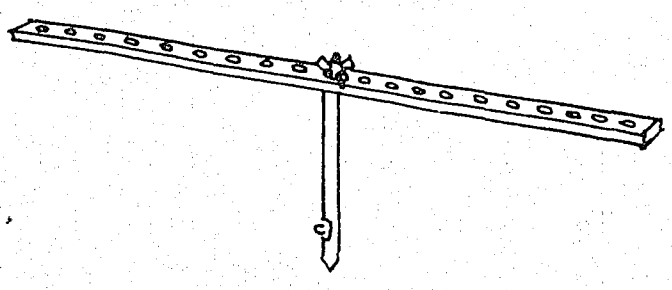
How many turns? _____

Show where you placed the rivets.



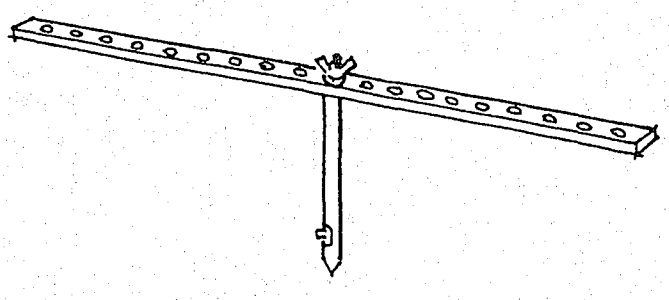
How many turns? _____

Show where you placed the rivets.



How many turns? _____

Show where you placed the rivets.



How many turns? _____

ACTIVITY 11 WORKSHEET

ACTIVITY 12 WHIRLY BIRD VARIABLES

SYNOPSIS (WHAT WILL YOU BE DOING?)

The children review their variables chart. Then they are given worksheets of experiments. They make a prediction for each experiment. Then they do the experiment to see if their prediction is correct. The experiments use the different whirly bird variables: rivet placement, number of rivets and rubber band twists.

OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

In this activity the children start to talk about and work with variables. They are given an opportunity to experience the effect variables have in their experiment. They are dealing with the question, "What makes it do what it does?", in an objective manner.

MATERIALS

For each group of two children:
- whirly bird set
- set of three worksheets

For the class:
- chart of variables from Activity 11

TEACHING SUGGESTIONS

<u>First Day-Working Together On An Experiment</u>

1. Show the class a whirly bird set.

   "What were the variables you found the last time we used this?"

   Go over the VARIABLES CHART with the chart.

   Discuss those variables that were not put on the chart.

2. Give each group of two children worksheet number one.

   "We will set up an experiment like the one on this worksheet."

"How many times does it say to twist the rubber band?"

"Do both whirly bird arms have the same number of rubber band twists?"

"Do they have the same number of rivets?"

"Are the rivets placed the same in both whirly birds?"

3. Have the children write on the worksheet the variable that is different.

4. Let the children predict which whirly bird arm will make the most turns. They can circle their prediction.

5. Let two volunteers set up the whirly bird like picture A.

   Ask the class: "Is the whirly bird like picture A?"

   "Count the turns when they let the arm go."

   Let the class count the number of turns the arm makes. Record it under picture A.

   Sometimes it is difficult to tell how muny twist of rubber band there are. A good way to count the number of twists is to:

   attach the rubber band to the post
   turn the arm the correct number of turns
   the rubber band is now twisted the number of turns of the arm.

6. Let two volunteers set up the whirly bird like picture B.

   Ask the class: "Is the whirly bird like picture B?"

   "Count the number of turns when they let the arm go?"

   Let the class count the number of turns the arm makes. Record it under picture B.

   "Which arm made more turns, A or B?"

   "Was your prediction correct?"

   "Which variables did not change? They were the same in both A and B."

"Which variable was different? Was not the same in A and B?"

Second Day-Predicting And Experimenting

1. Divide the class into groups of two student each.

   Give each group worksheet number two.

   "Each group will set up an experiment like this."

   "How many times does it say to twist the rubber band?"

   "Do both whirly bird arms have the same number of rubber band twists?"

   "Do they have the same number of rivets?"

   "Are the rivets placed the same in both whirly birds?"

2. Have the children write down on their worksheet the variable that is different.

3. Let the children predict which whirly bird arm will make the most turns. They can circle their prediction.

4. Give each group a whirly bird set and let them do the experiment.

5. Discuss the results of the experiment.

6. Give each group worksheet number three.

   "Which variable is different? Write it on the worksheet."

   "Which arm will make the most turns? Circle your prediction."

   "Do the experiment."

7. Discuss the results of the experiment.

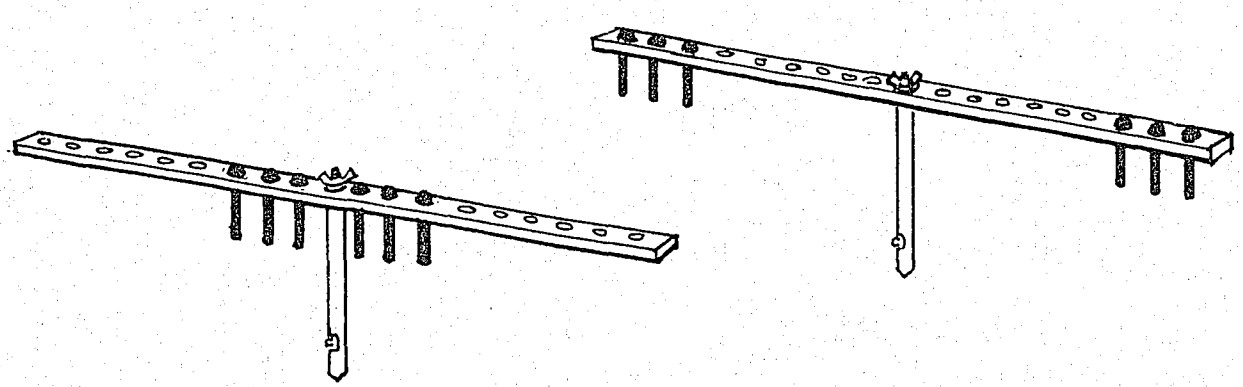
NAME_____

NAME_____

EXPERIMENT 1

Predict which arm will make more turns.

A. Two twists of the rubber band. B. Two twists of the rubber band



How many turns?_____ How many turns?_____

Which variable is different?_____

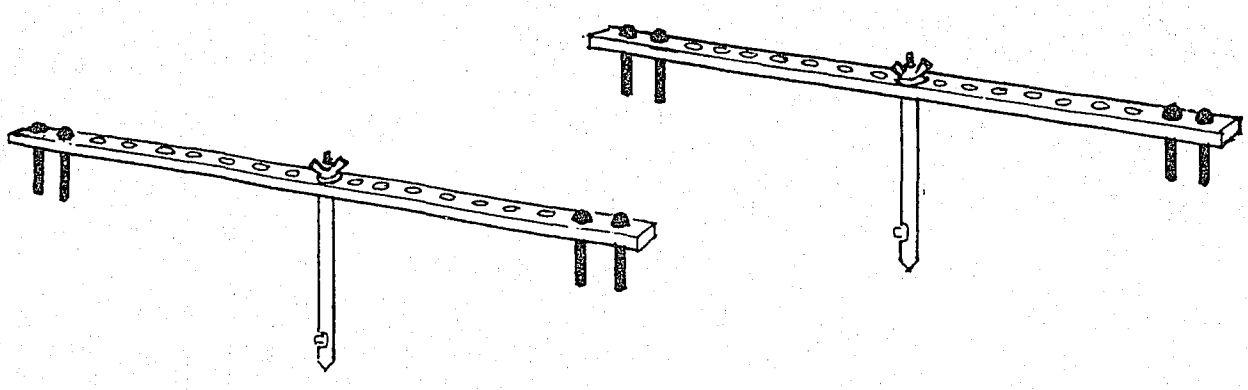
NAME_____

NAME_____

EXPERIMENT 2

Predict which arm will make more turns.

A. One twist of the rubber band. B. Three twists of the rubber band.



How many turns?_____ How many turns?_____

Which variable is different?_____

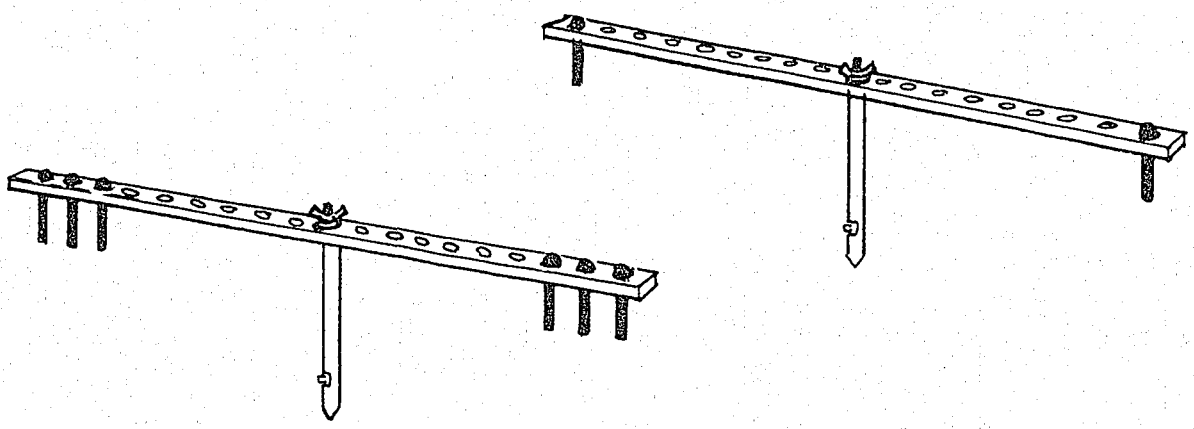
NAME _____

NAME _____

EXPERIMENT 3

Predict which arm will make more turns.

A. Two twists of the rubber band. B. Two twists of the rubber band.



How many turns? _____ How many turns? _____

Which variable is different? _____

ACTIVITY 13 MORE WORK WITH VARIABLES (OPTIONAL)

SYNOPSIS (WHAT WILL YOU BE DOING?)

This optional activity lets the children experiment with variables that affect pendulums and balances.

OVERVIEW OF THIS ACTIVITY (WHY ARE YOU DOING THIS?)

The suggestions made in this activity allow the children and the teacher to use their own interests, ideas and imagination. The suggestions are the starting points, but what is done is up to the teacher and the children.

This activity is for those teachers and children who have finished the other activities and still would like to do more.

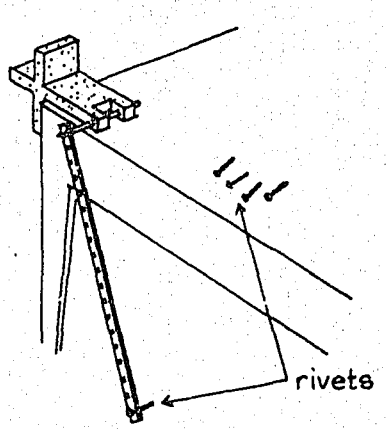
MATERIALS

For the class:
- whirlybird set
- paper clips
- paper cups
- string
- washers

TEACHING SUGGESTIONS

First Suggestions-Experimenting With Pendulums

Set the whirlybird up like in the picture. Make sure the wing nut is loose so the arm can swing easily. The children can use this set up to: do experiments, record data, make histograms. The class can discuss the variables in their experiments.



"How many swings will the arm make when I let it go?"

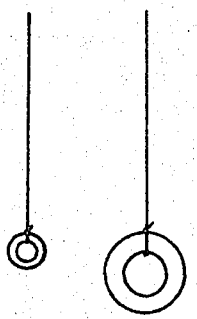
"Does it make a different number of swings if you put rivets in the holes?"

"What makes it swing faster? a longer time?"

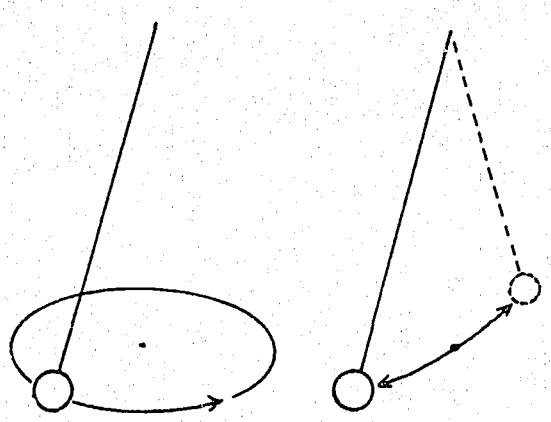
"What happens if the arm swings from a different hole?"

You could also take the arm off and tie a piece of string onto the post by the wing nut. Different objects (bobs) can be tied to the end of the string. The string can be made different lengths.

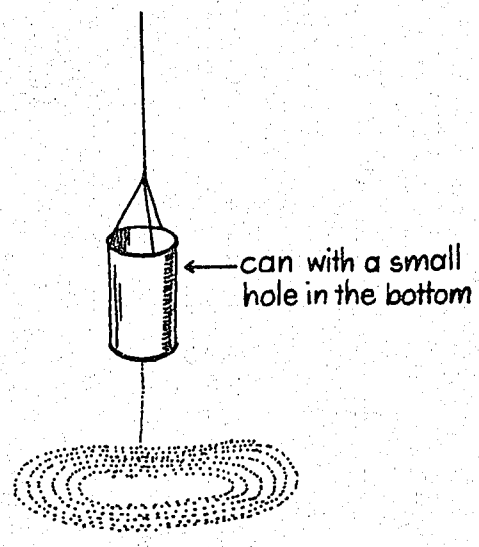
Here are some pictures of ways to use this kind of pendulum. You and the children will discover your own questions.



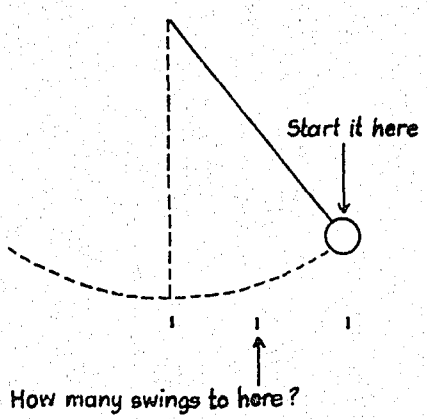
Bobs of different weights like washers



Tracing the path of the bob.

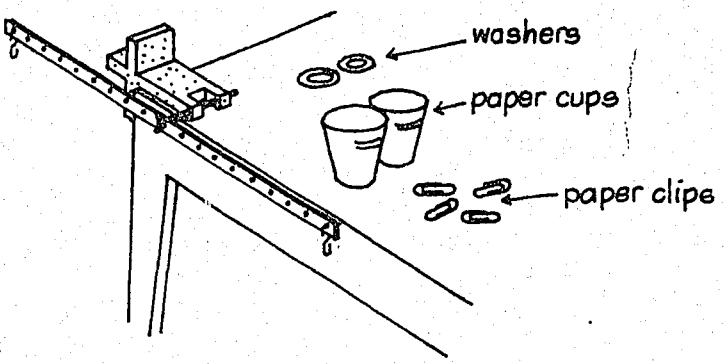


Showing the path of the bob with sand.



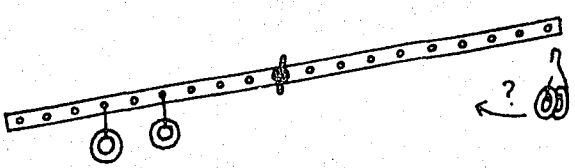
Second Suggestions-Experimenting With Balances

Set the whirlybird up like in the picture. Make sure the wing nut is loose so the arm can swing easily.

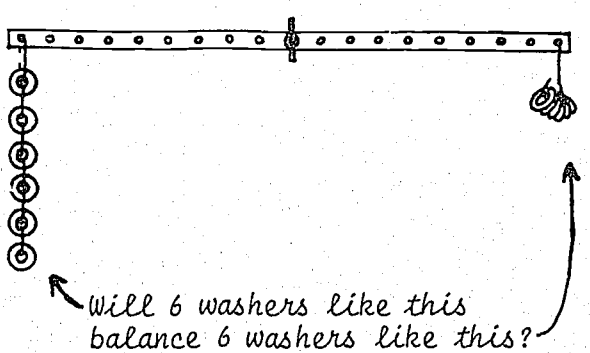


The children can use this set up to: do experiments, record data and make histograms. The class can discuss the variables in their experiments.

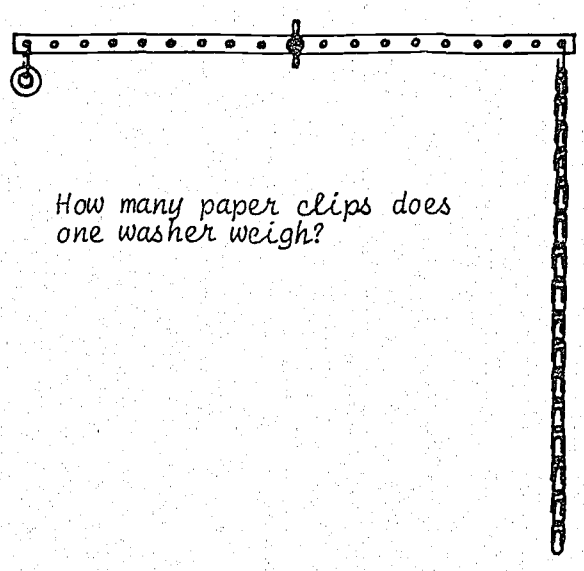
Here are some pictures of ways to use the balance. You and the children will discover your own questions.



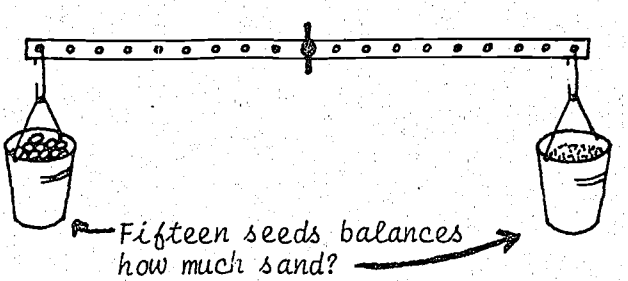
Where can you put them so it balances?



Will 6 washers like this balance 6 washers like this?



How many paper clips does one washer weigh?

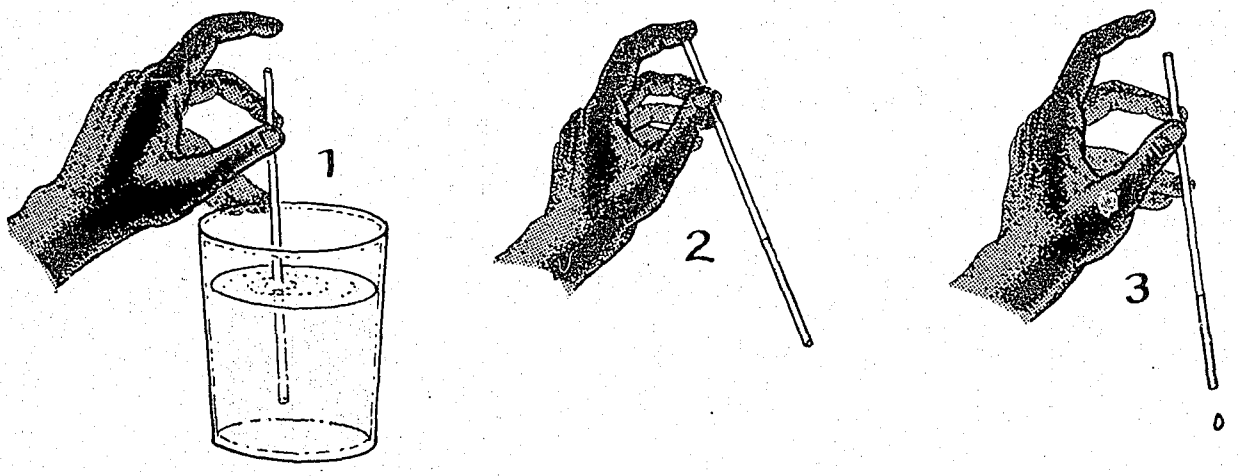


Fifteen seeds balances how much sand?

SUGGESTIONS ABOUT MATERIALS

Is there a substitute for the medicine droppers?

Try drinking straws. Use them like this.



Can I make my own "sifting mixture" for Activity 2?

With a little experimenting you can. You will need:

- clean, dry sand that will not shake through the course screen;
- salt;
- baking soda.

Experiment with the mixture until you have the right amount of each part. You must have enough baking soda to interact with the yellow B. T. B.

Keep your "sifting mixture" dry in a sealed jar. It must be dry to shake through screens.

Can I make my own "colored powders" for Activity 4?

Yes, but it may not be as clear as the commercial powders. It will work.

Mix salt and red food coloring to get the red powder (mixture). Put in enough food coloring to make it the color you want. Dry the mixture in the sun or under a light before you put it in a jar.

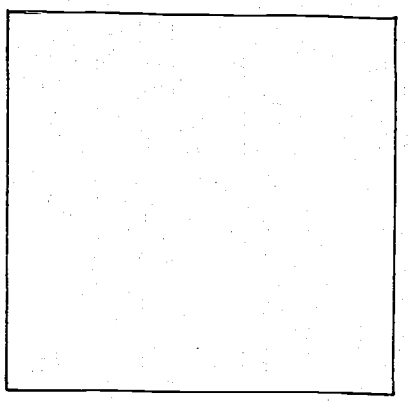
Mix the yellow and blue powders the same way using yellow and blue food coloring.

The white mixture is made of salt and starch. You can find the starch in the store. It is corn starch and is a white powder. Mix the corn starch and salt together.

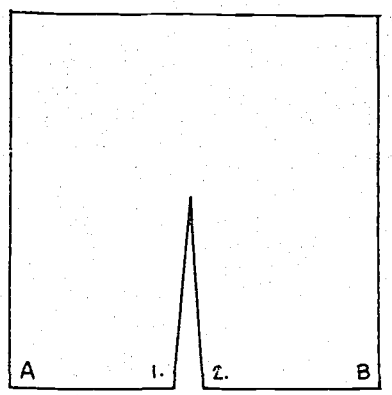
Some people have used sugar in the mixtures in place of salt. This will also work. It does not get as hard as salt, but ants eat it.

Can I make my own funnels for Activity 5?

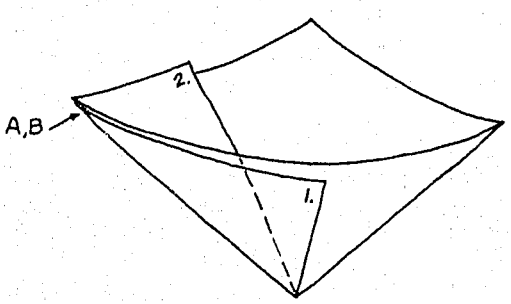
Here are directions that you could use to make funnels if you need them.



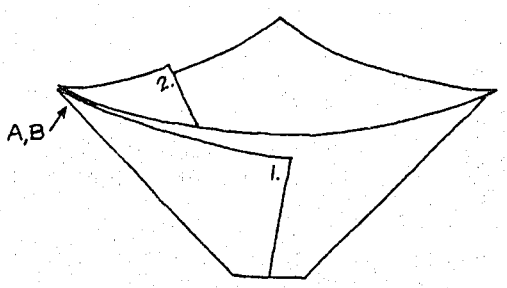
1. Start with a 6 inch square of plastic or waterproof paper.



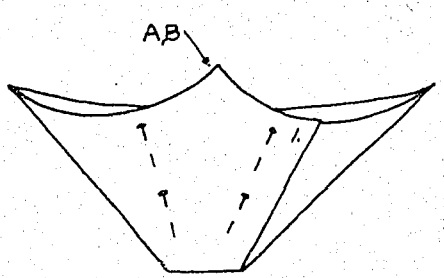
2. Make cut from center of one edge to center of square.



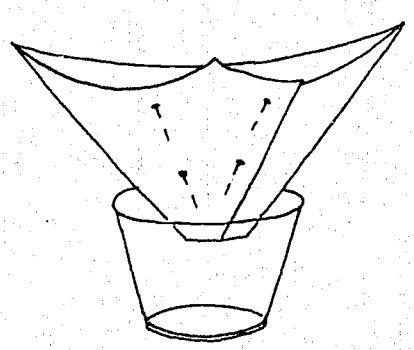
3. Slide corner B. on top of corner A.



4. Make hole at bottom by cutting off tip.



5. Pin the sides together with 4 pins.



6. The funnel is now ready to use.

Is there a substitute for the empty tea bags needed in Activity 6?

You could try making small bags out of any white tissue such as Kleenex or toilet paper.

How can I make the whirlybird post turn easier?

Sometimes the post is too tight in the hole of the base.
You could: sandpaper the post if it is wood, or rub graphite (the lead) from a pencil on the parts that touch.

SYSTEMS AND VARIABLES MATERIALS NEEDED FOR ONE CLASSROOM FOR ONE YEAR
(based on 32 students per class)

		1	2	3	4	5	6	7	8	9	10	11	12	Total Needed
KIT-RETURNABLE	color card (low temp)	16												16
	color card (high temp)	16												16
	flashlight bulb	16												16
	copper wire-6 inch	32												32
	battery (size D)	16												16
	medicine dropper	16		16	4			32						32
	tray	16	32	16	8	8			8					32
	vial (7 dram)		32	16										32
	vial rim cap		32	16										32
	cloth screen, fine		32	16										32
	cloth screen, course		32	16										32
	magnifier		32	16	4		32							32
	plastic spoon		1	16	1		1							16
	funnel					16	16							16
	plastic bag, small							16	8					16
	tie for plastic bags								8					8
	plastic bag, large								8					8
	cork stopper								8					8
	cardboard sleeve								8					8
	thermometer stems									20				20
	thermometer cards									16				16
	calibrated thermometer									2				2
	whirly bird assembly										16	16	16	16
	number line 0-99 strip											1		1
KIT-CONSUMABLE	dark construction paper		128	39										128 (4" x 4")
	jar of sifting mixture		X											1 jar
	B. T. B.		X											1 bottle
	vinegar		X	X										1 bottle
	red mixture				X		X							1 jar
	yellow mixture				X		X							1 jar
	blue mixture				X		X							1 jar
	white mixture				X									1 jar
	set/colored plastic sheets				2									2 sets
	candle					8	16							16 (4 long candles)
	aluminum foil					X	X							½ roll
	filter paper					32	16							60 pieces
	salt						X							1 jar
	starch (powdered)						X							1 jar
	tea bags						48							48
	copper chloride						X							1 small vial
	Freon-11							X	X					2 cans
	food coloring							X						1 bottle
	plastic tumbler							1						1
SCHOOL/TEACHER	masking tape	X	X	X				X						
	paper towels	X	X	X	X	X	X	20	X	32				
	sheets of paper			64										
	chalk dust						X							
	crayons				X									
	matches					X								
	jar, small	16	16	16	16	16	32	16	1	32				
	lids for small jars						16							
	jar, large	2	1	3	4			4		6				
	sugar							X						
	chart paper		1									1		
	worksheets	32	32	50	64		32			64	32	16	48	