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 Mathematics for Elementary Schools

ABSTRACT

In this set of four booklets on collecting data, primary grade students learn how to record data, do an experiment, make an opinion survey, and choose a sample. The major emphasis in all Unified Sciences and Mathematics for Elementary Schools (USMES) units is on open-ended, long-range investigations of real problems. In most instances students learn through observing results of their own and their classmates' experiments. However, students may recognize the need for certain facts and/or skills during their investigations. Although some children prefer to work things out for themselves, others may ask for help. USMES "How To Sets" are designed to provide such assistance. Each booklet in a set contains several examples of children using a skill being taught, each example emphasizing a different aspect of the skill or a potential pitfall. Cover pages summarize what is being taught by illustrating the general problem and solution. There is no sequence to the sets (or booklets within sets) and they should not be used out of the context of childrens' open investigation of a practical problem.

(Author/JN)

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HOW TO SET

COLLECTING DATA

IN THIS SET
STUDENTS
WILL FIND
OUT
HOW TO ...

RECORD
DATA

DO
AN
EXPERIMENT

MAKE
AN
OPINION
SURVEY

CHOOSE
A
SAMPLE



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WHAT IS USMES?

USMES challenges students to solve real problems within their school and community. Children tackle problems like a busy or unsafe intersection near their school, classroom furniture that doesn't fit them, or playgrounds that are crowded or uninteresting. These problems have immediate and practical impact on students. They have no established, correct solutions--students take or recommend action based upon whatever data they collect and analyze. Furthermore, the children themselves, not the teacher, direct the problem-solving process.

Solving real problems is interdisciplinary: skills, processes, and concepts from science, mathematics, social science, and language arts all play a part. For example, students conduct opinion surveys, build measuring devices, write letters, and make and use graphs. They also make decisions, work productively in small groups, and develop and clarify values.

The USMES curriculum is organized into twenty-six problems, or units, that have been developed in the classroom by teachers and students in a wide variety of schools. Most units can be used in grades K-8, although the level at which students approach a problem and develop a solution will vary according to age, ability, and interest.

RESOURCES FOR AN USMES PROGRAM

In addition to the USMES "How To" Series, there are--

The USMES Guide: This book describes the USMES project, real problem solving, classroom strategies, the Design Lab, the units, and the support materials as well as ways that USMES helps students learn basic skills.

Teacher Resource Books (one per unit): Each of these guides to using USMES units describes a broad problem, explains how students might narrow that problem to meet their particular needs, recommends classroom strategies, and presents logs from teachers whose classes have worked on the unit.

Design Lab Manual: This guide helps teachers and administrators set up, run, and use a Design Lab--a place with tools and materials where students can build things they need for their work on USMES units. A Design Lab may be a corner of a classroom, a portable cart, or a separate room.

Background Papers: These papers, correlated with the "How To" Series, provide teachers with information and hints that do not appear in the student materials.

Curriculum Correlation Guide: By correlating the twenty-six USMES units with other curriculum materials, this book helps teachers integrate USMES with other school activities and lessons.

The "How To" Series is a resource developed by the USMES project. Earle L. Lomon, Project Director, Betty M. Beck, Associate Director for Development, Thomas L. Brown, Associate Director for Utilization Studies, Quinton E. Baker, Associate Director for Administration.

This material is based upon research supported by the National Science Foundation under Grant No. SED69-01071. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the National Science Foundation.

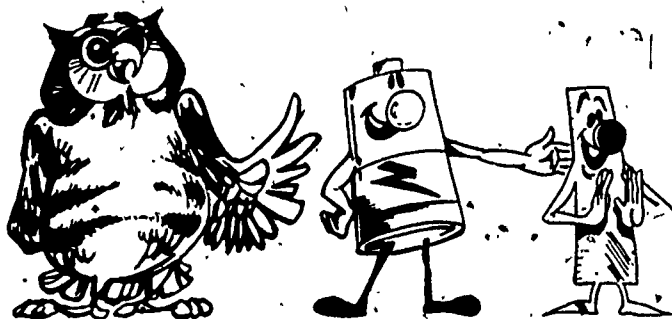
THE USMES BEGINNING "HOW TO" SERIES

USMES and Skills

USMES students often see a need to learn new skills to help them get a problem-solving job done. Children seeking to improve a street crossing may want to learn how to use a stopwatch or how to make a trundle wheel. Children comparing different brands of paper towels may want to learn how to design an experiment and how to make a bar graph. The list can go on and on, but the pattern is clear; solving a real problem requires skills.

Purpose of 'How To' Series

Written resources that help children learn skills like designing an opinion survey and choosing the appropriate measuring tool are not readily available for elementary school students. However, the USMES "How To" Series fills this gap. Its cartoon-style format helps younger children and those with reading difficulties acquire the skills and knowledge they need to do things like redesign their classroom, find the best buy in potato chips, or run a school store.



How to Use the 'How To' Series

Wait for a need. When a student asks for help, refer him or her to the appropriate booklet. Having a child read a booklet before there is a need to do so will not only result in less effective learning but will defeat the USMES purpose of allowing children to decide what needs to be done.

When necessary, use the "How To" Series as a teaching aid. Most of the time children will be able to go through a booklet by themselves and learn the skills they need to learn. However, some material in some sets is difficult and somewhat abstract. Such sections are usually towards the ends of booklets and often labeled "extra." When the booklet by itself is not doing the job, feel free to step in and help the student go through it.

Knowing how the content of the booklets are organized may help in using the series effectively.

- Each cover page summarizes what is in the booklet by illustrating the general problem and solution.
- Each booklet contains several examples of children using the skill being taught. Each example emphasizes a different aspect of the skill or a potential pitfall.
- Where a skill covered in one booklet is used in another, there is a reference in the form: See "How To...."

OTHER USMES 'HOW TO' SERIES

Intermediate "How To" Series: This magazine-style series covers in more detail essentially the same material as the cartoon-style series with a few booklets on additional skills. This series gives students a chance to read something they have a need to read.

Design Lab "How To" Series: These illustrated cards help children learn how to use tools safely and effectively.

"How To" Cards: These cards are printed on colored card stock rather than paper as the other series are. They contain fewer words than the Intermediate "How To" Series and utilize the American system of units (ft.-lb.-sec.) rather than the metric system.

BEGINNING "HOW TO" SERIES

BIOLOGY

- How To
Make a Home for Your Animal
Make a Home for Your Rodent

COLLECTING DATA

- How To
Record Data
Do an Experiment
Make an Opinion Survey
Choose a Sample

ELECTRICITY

- How To
Make Simple Circuits
Make a Circuit Stay Together
Add Things to a Circuit
Make and Use Switches
Fix a Circuit

GRAPHING

- How To
Choose Which Graph to Make
Make a Bar Graph
Make a Bar Graph Histogram
Make a Conversion Graph
Make a Line Chart
Make a Line Graph
Make a Scatter Graph
Make a Slope Diagram

MEASURING

- How To
Use a Stopwatch
Choose the Right Tool to Measure Distance
Use a Trundle Wheel
Make a Scale Drawing
Find the Speed of Things

SIMPLIFYING DATA

- How To
Round Off Data
Find the Median
Find the Average

Conceived and Written by:

Sally Agro, Betty M. Beck, & Ray Brady, Jr., Edward Manfre

Illustrator Art Director

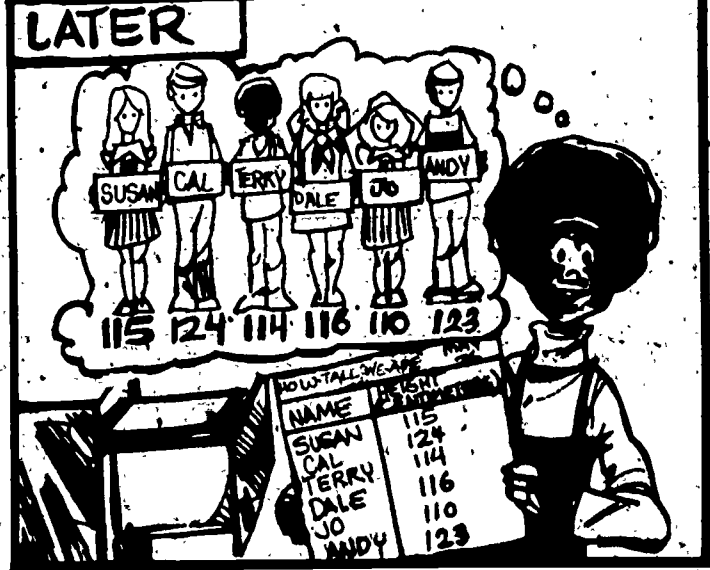
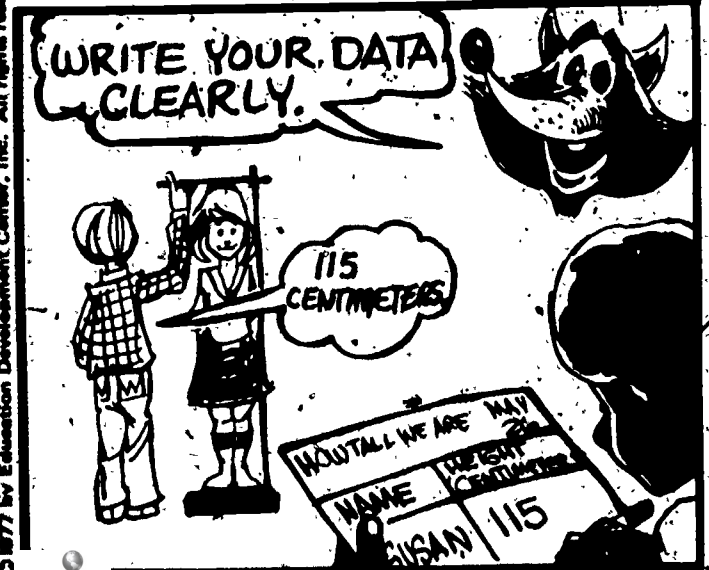
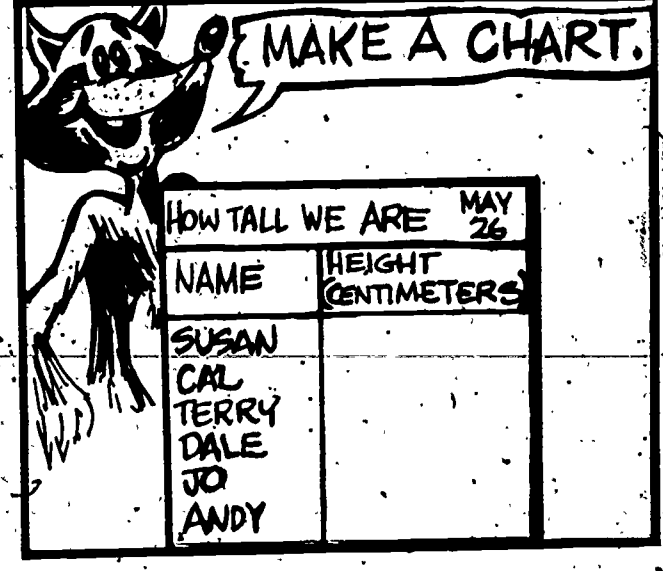
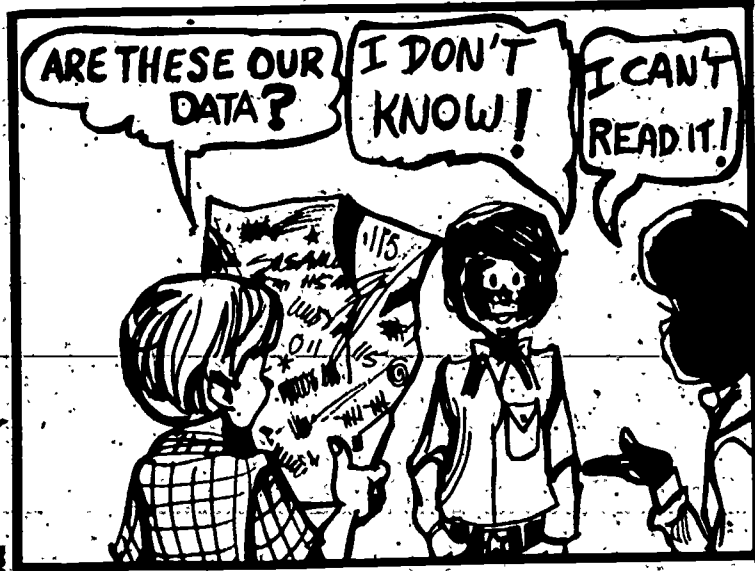
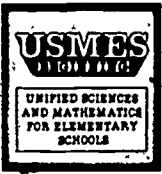
John M. Evans John W. Saalfeld

Production Assistance

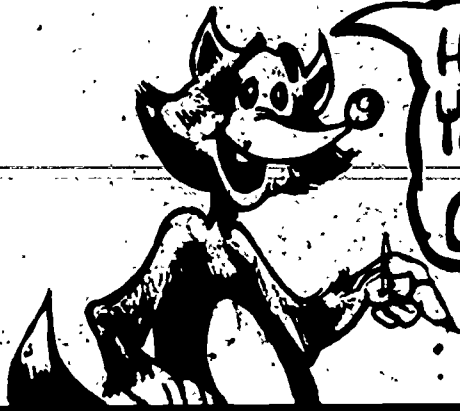
Paula Lakeberg

edc

RECORD DATA



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HERE ARE SOME THINGS YOU SHOULD PUT ON A CHART LIKE THIS.

TELL WHAT THE CHART IS ABOUT.



TITLE →

HOW TALL WE ARE ^{MAY 26}	
NAME	HEIGHT (CENTIMETERS)
SUSAN	
CAL	
TERRY	
DALE	
JO	
ANDY	

TELL WHEN YOU WROTE THE DATA.

DATE →

HOW TALL WE ARE ^{MAY 26}	
NAME	HEIGHT (CENTIMETERS)
SUSAN	
CAL	
TERRY	
DALE	
JO	
ANDY	

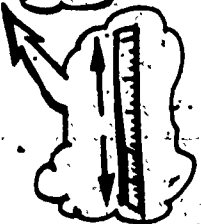
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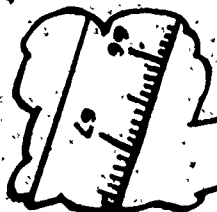
HOW TALL WE ARE ^{MAY 26}	
NAME	HEIGHT (CENTIMETERS)
SUSAN	
CAL	
TERRY	
DALE	
JO	
ANDY	

HOW TALL WE ARE ^{MAY 26}	
NAME	HEIGHT (CENTIMETERS)
SUSAN	
CAL	
TERRY	
DALE	
JO	
ANDY	

TELL WHAT YOU ARE MEASURING.



TELL WHAT UNIT YOU WILL USE.

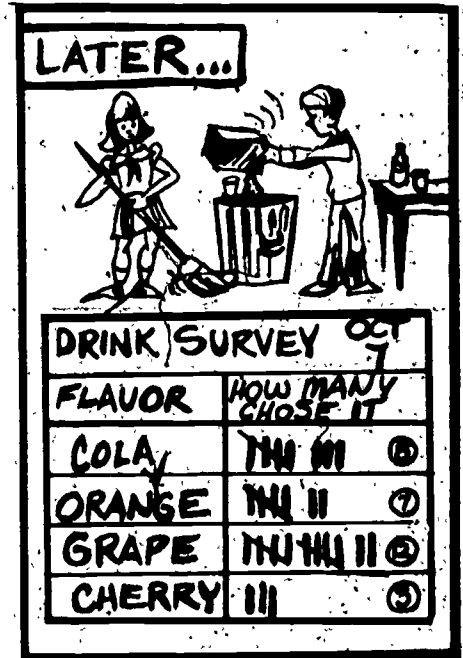
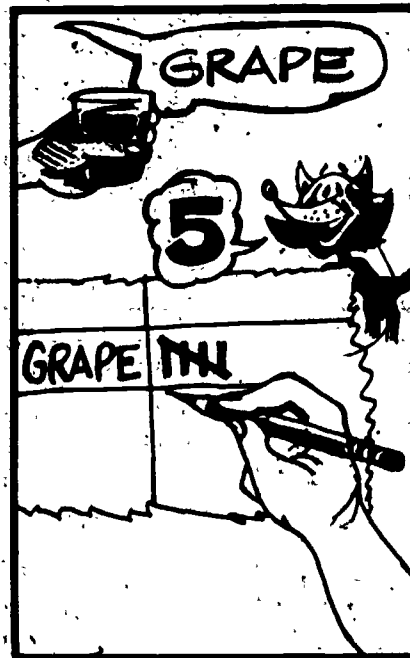
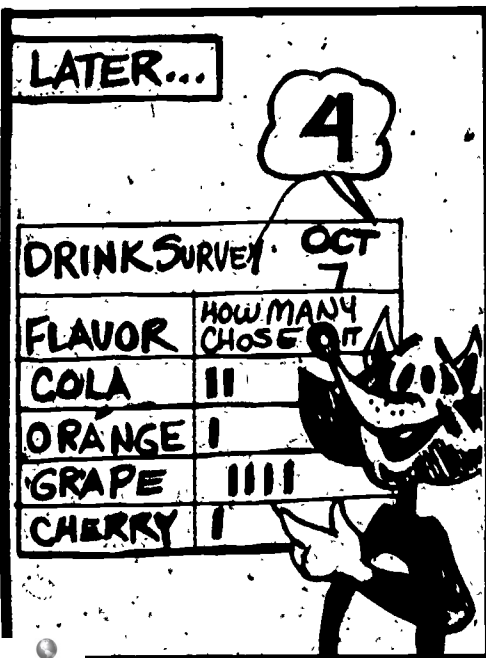
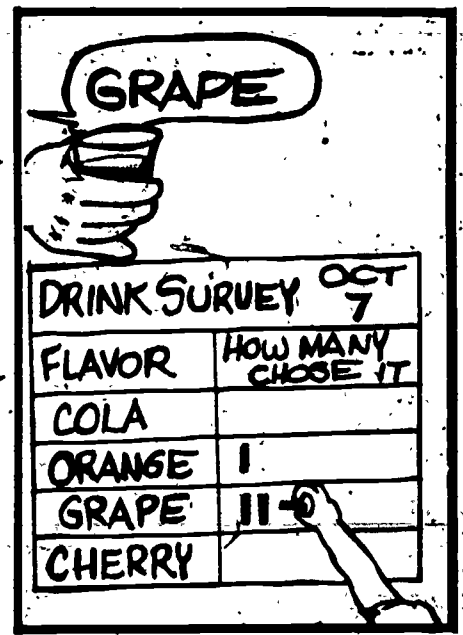
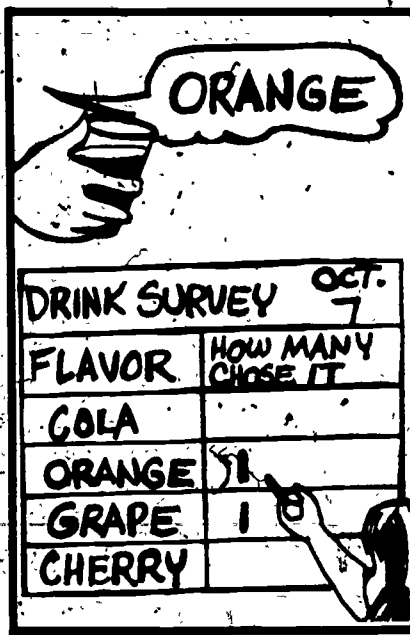
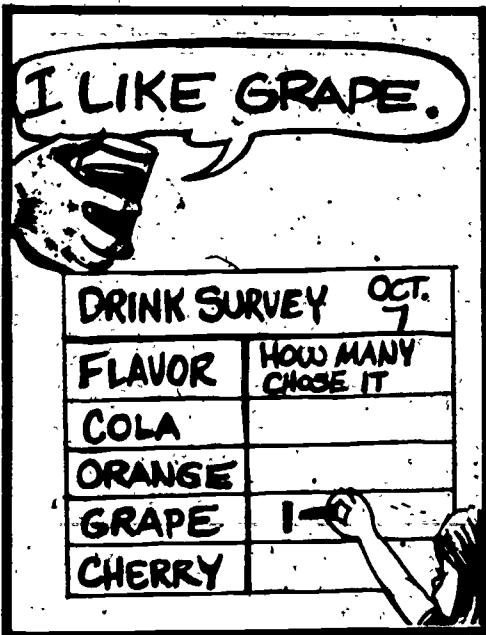
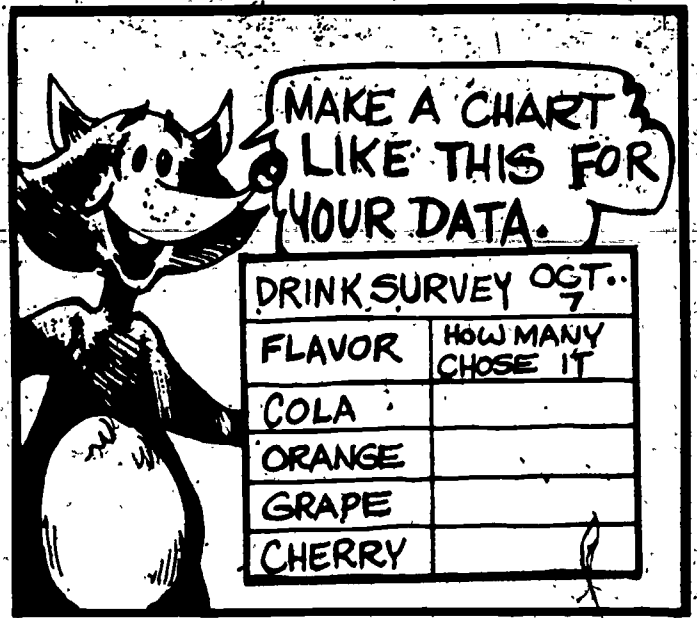


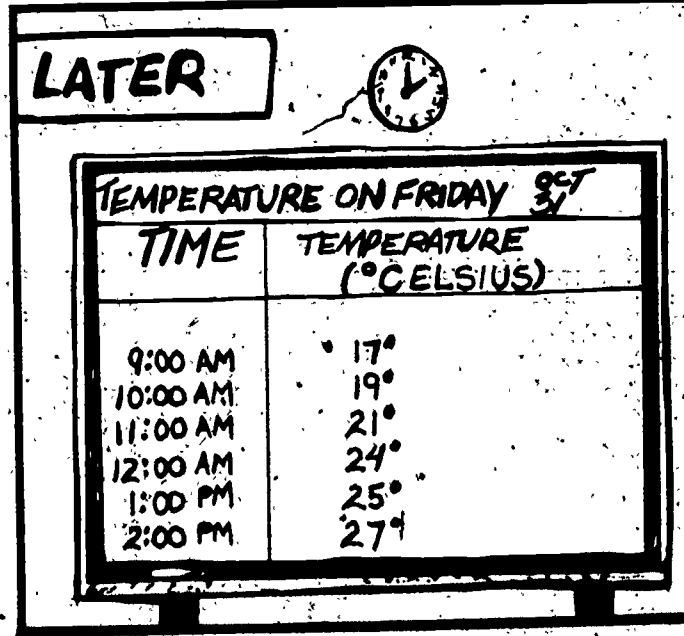
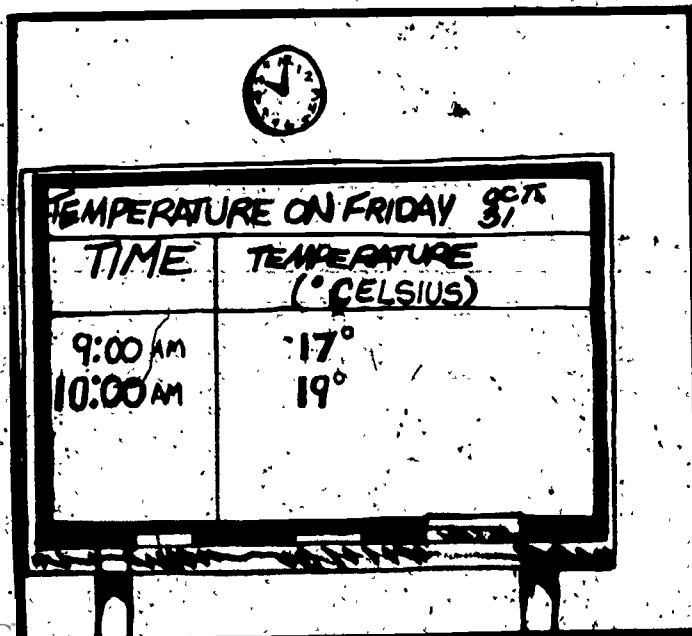
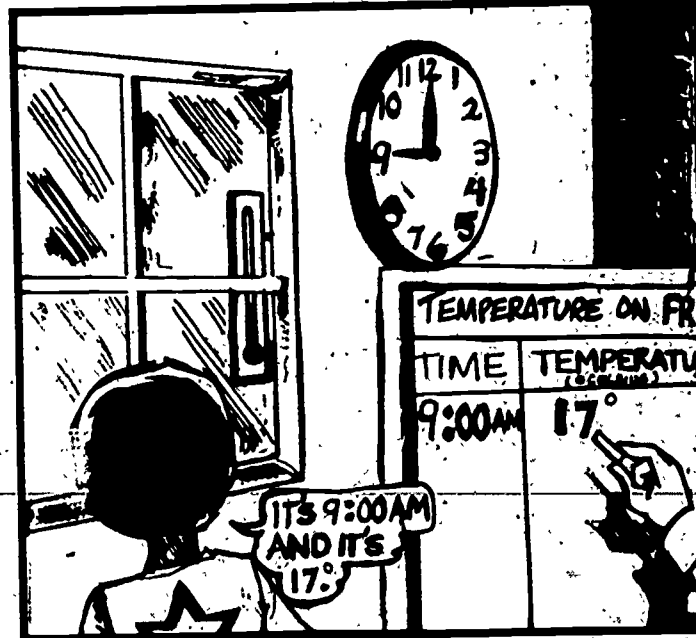
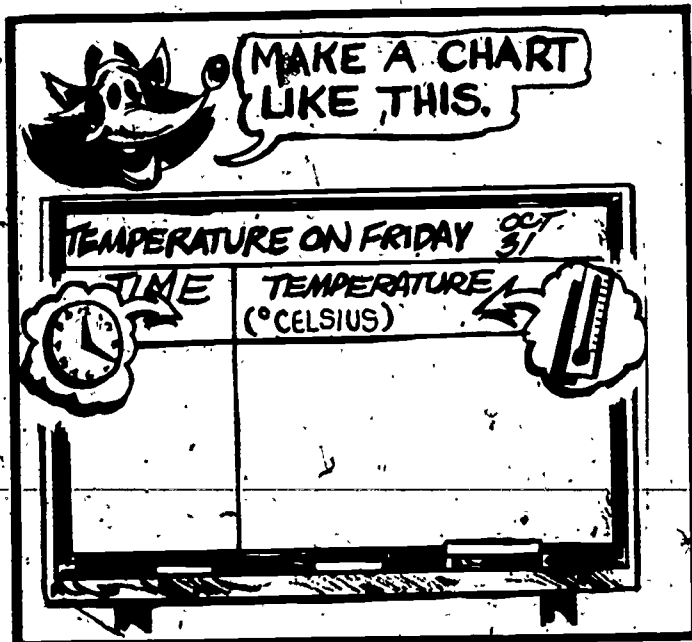
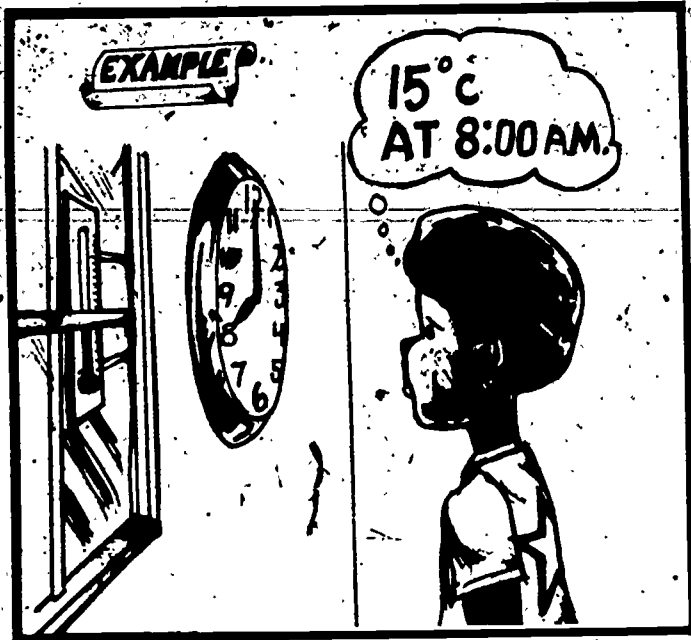
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NAME	HEIGHT (CENTIMETERS)
SUSAN	
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TERRY	
JO	
ANDY	

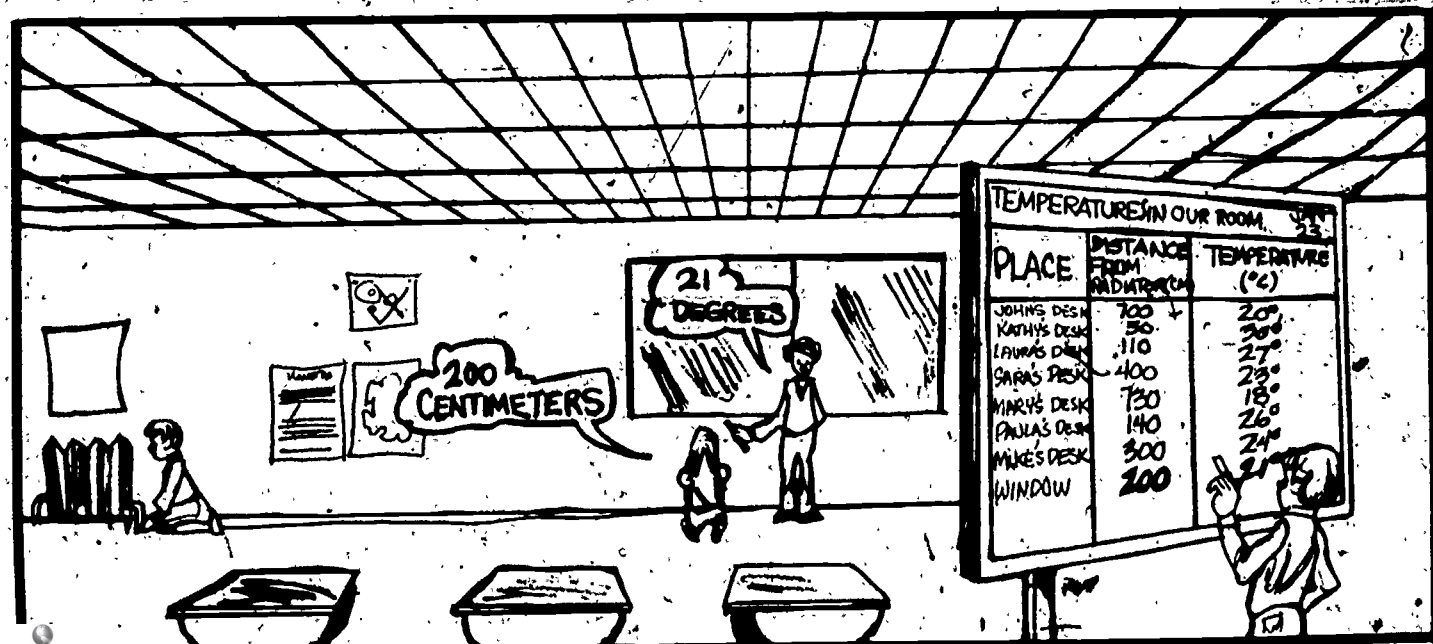
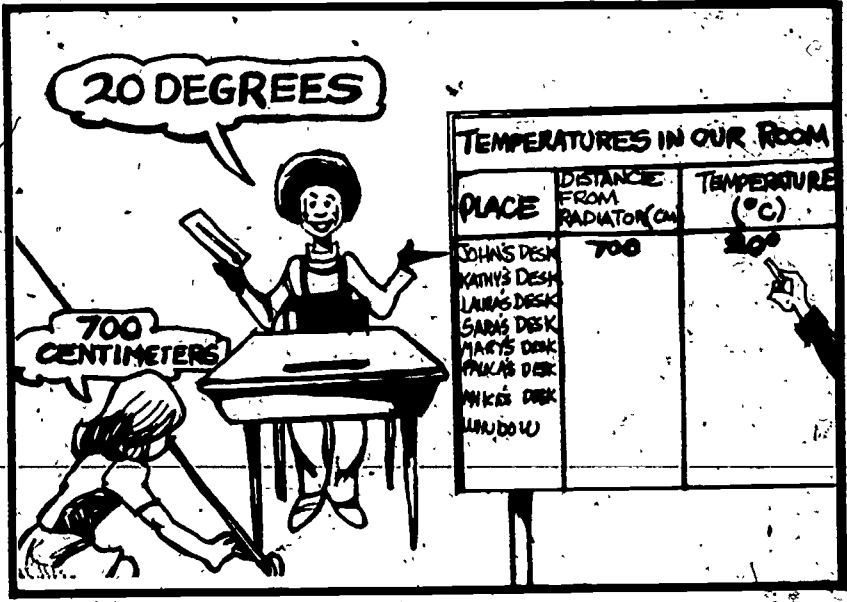
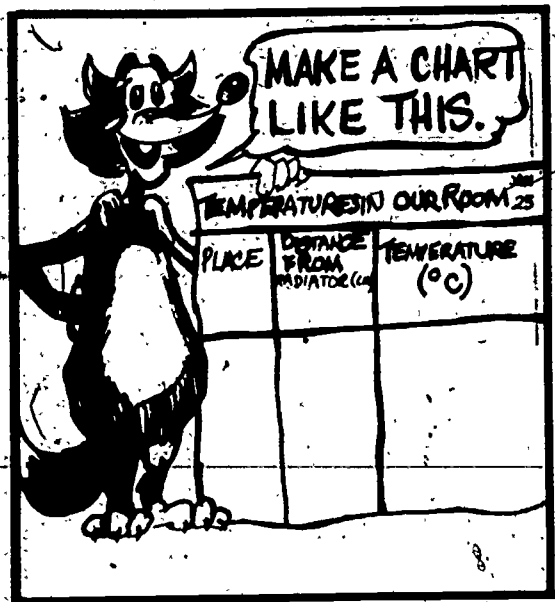
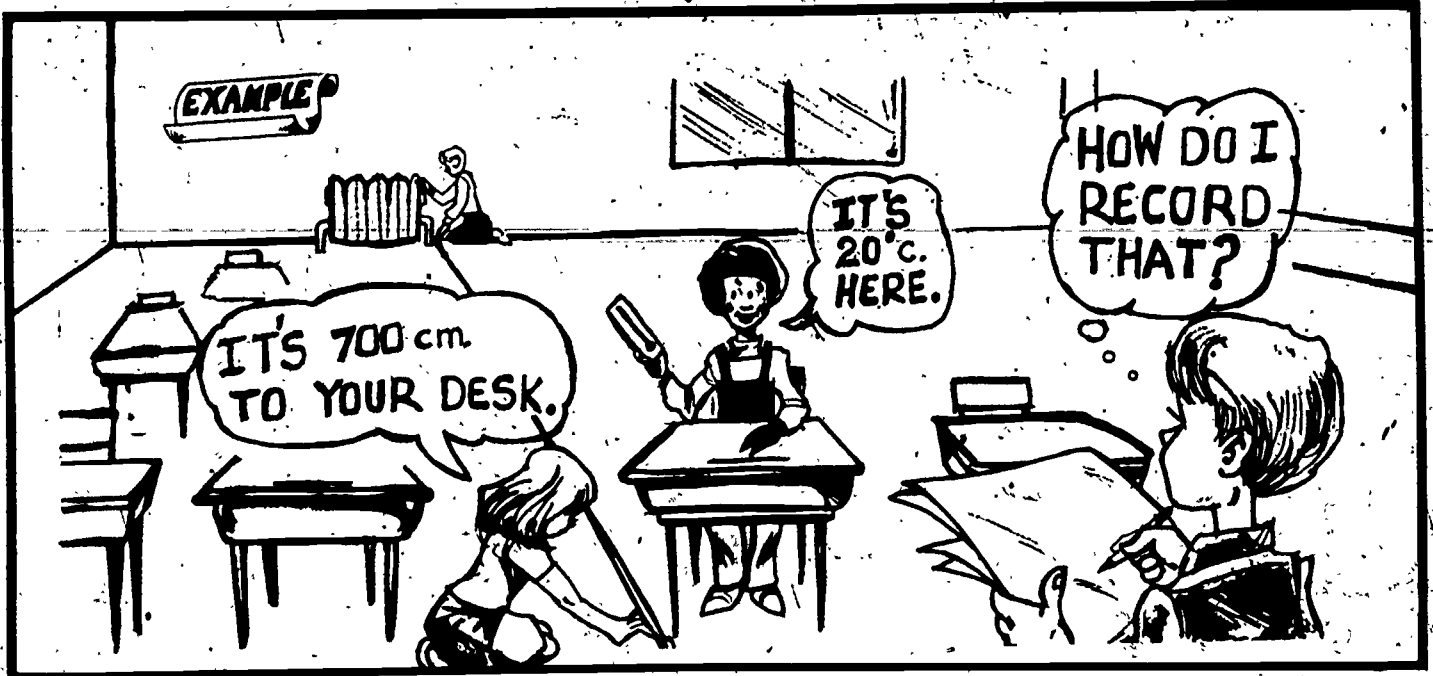
TELL WHO YOU ARE AND WHO HELPED YOU.

JOSE S. CONNER
CAL
TERRY
DALE
JO
ANDY

HOW TALL WE ARE ^{MAY 26}	
NAME	HEIGHT (CENTIMETERS)
CAL	
TERRY	
DALE	
JO	
ANDY	







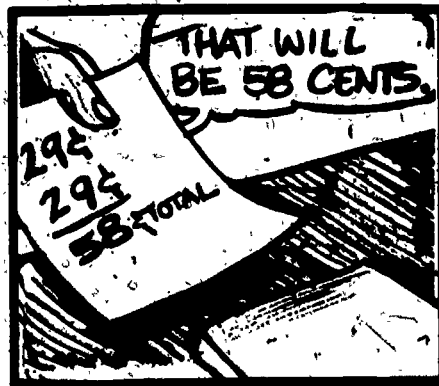
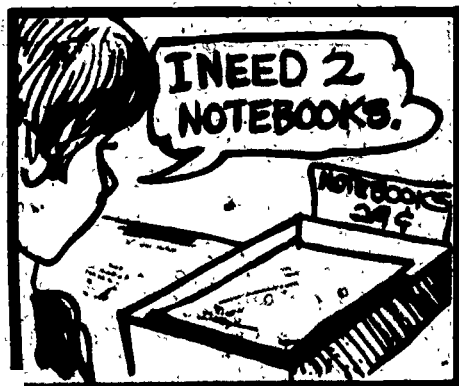


NEXT TIME MAKE A CHART LIKE THIS TO KEEP TRACK OF YOUR SALES.

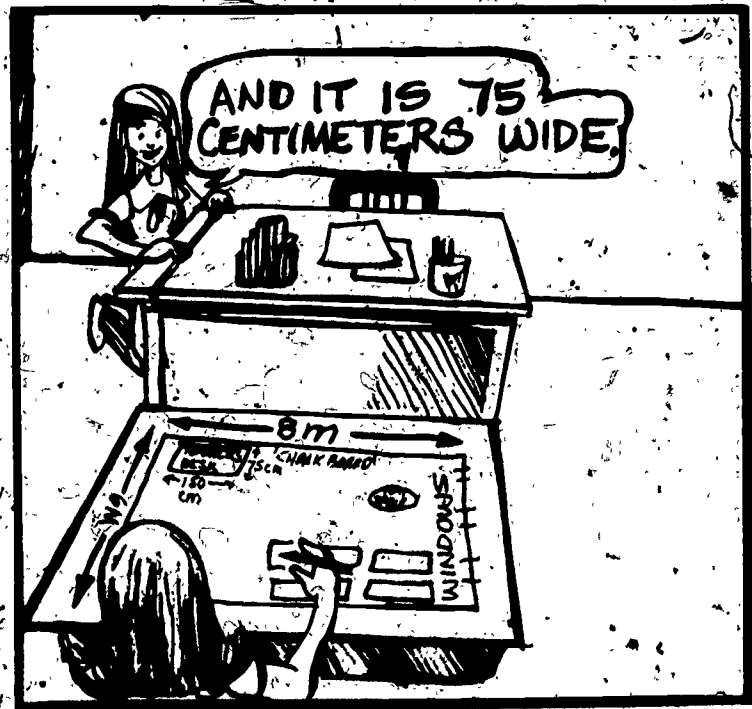
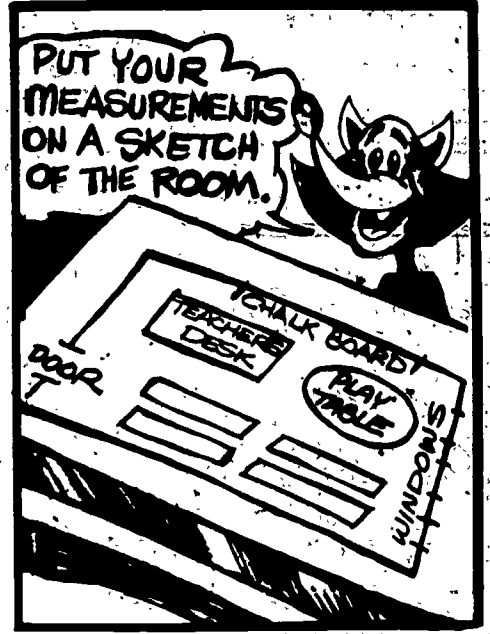
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ITEM	PRICE	HOW MANY SOLD	TOTAL AMOUNT

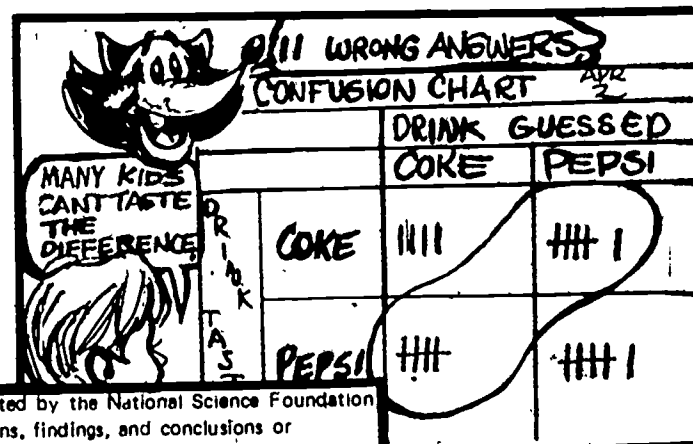
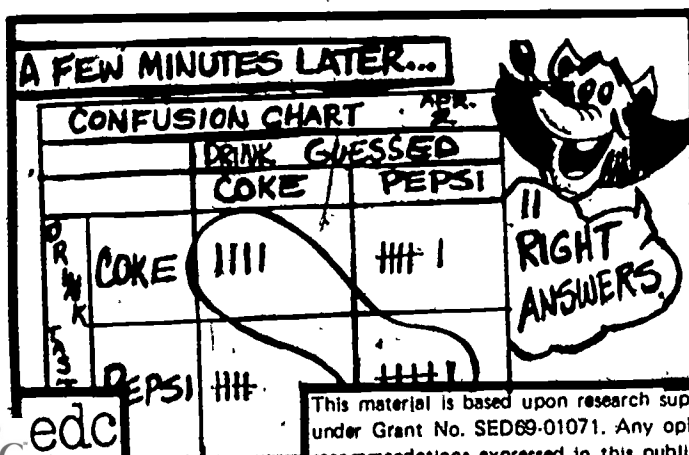
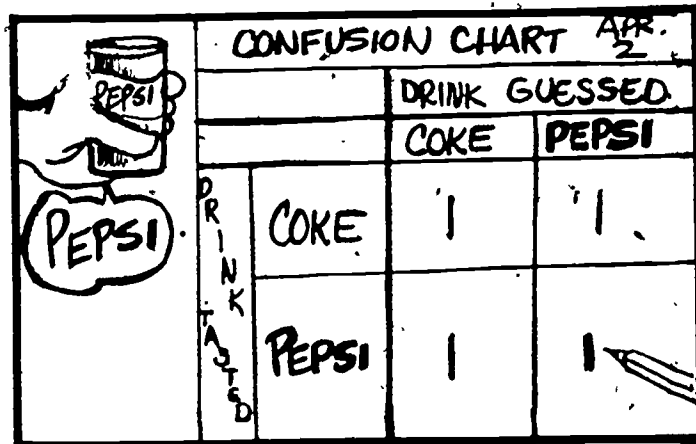
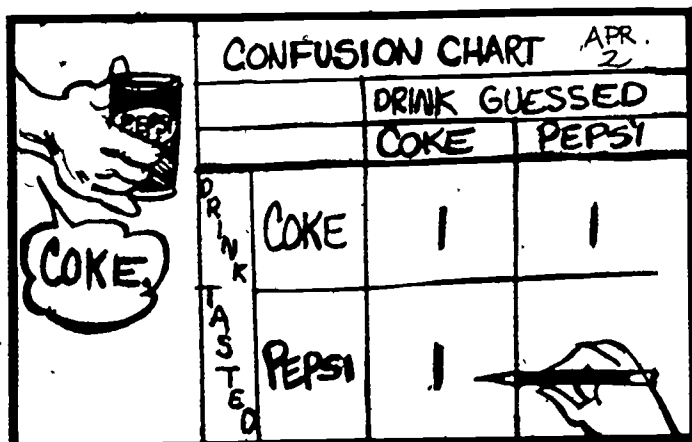
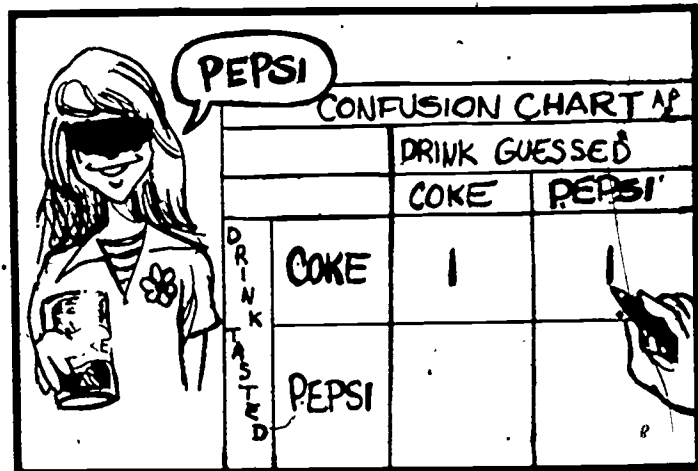
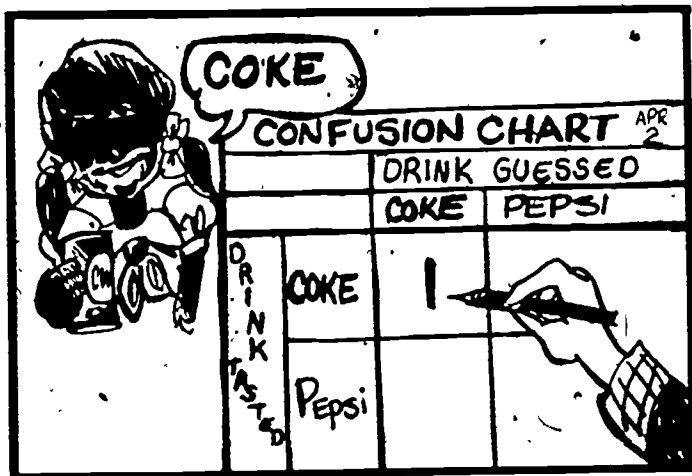
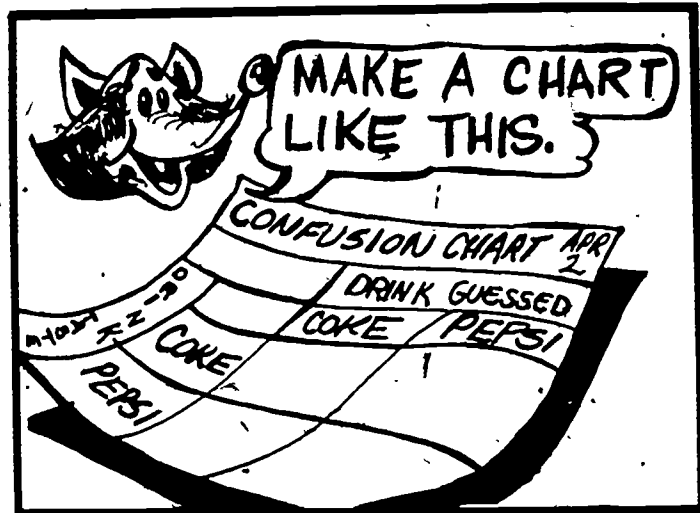


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ITEM	PRICE	HOW MANY SOLD	TOTAL AMOUNT
PEN	15¢	3	45¢



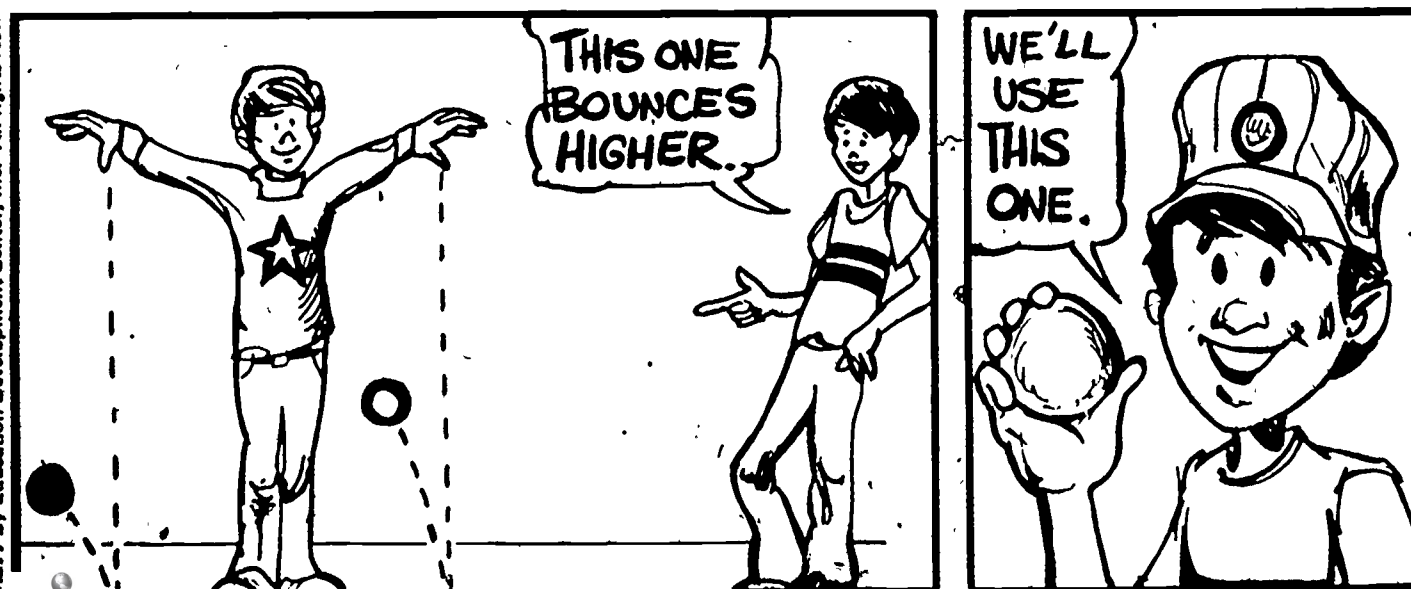
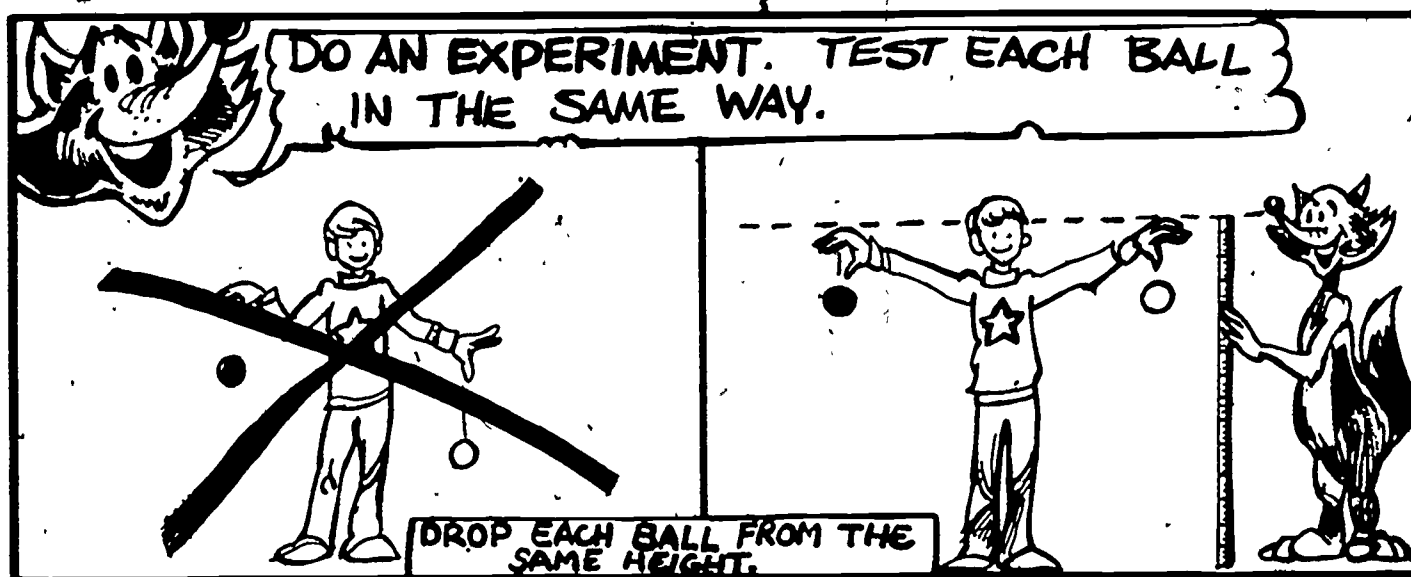
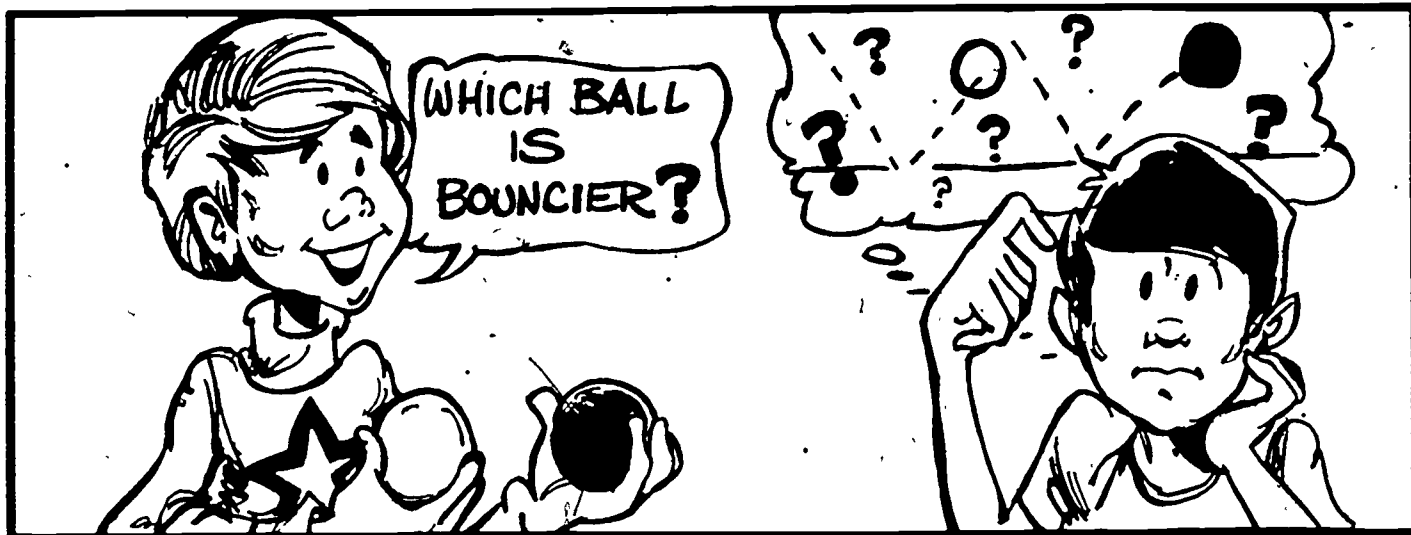
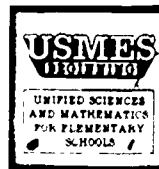
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PEN	15¢	3	45¢
NOTE BOOK	29¢	2	58¢



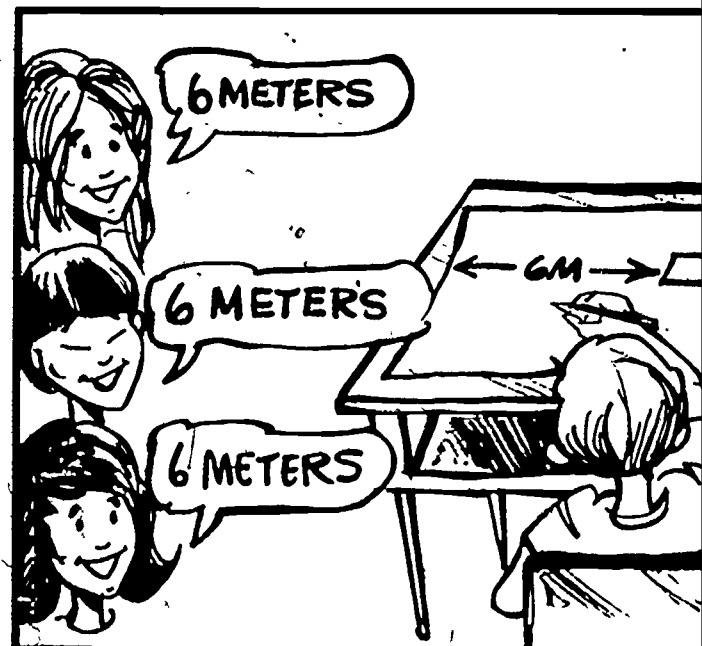
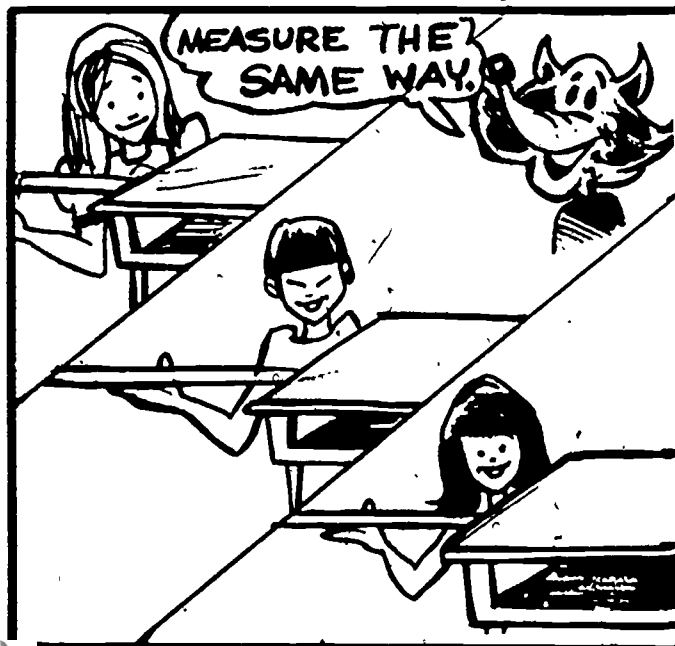
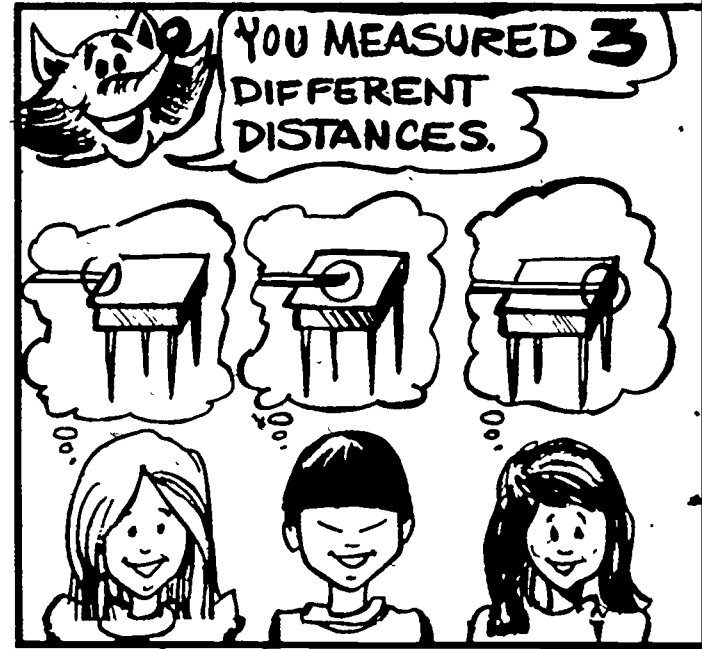
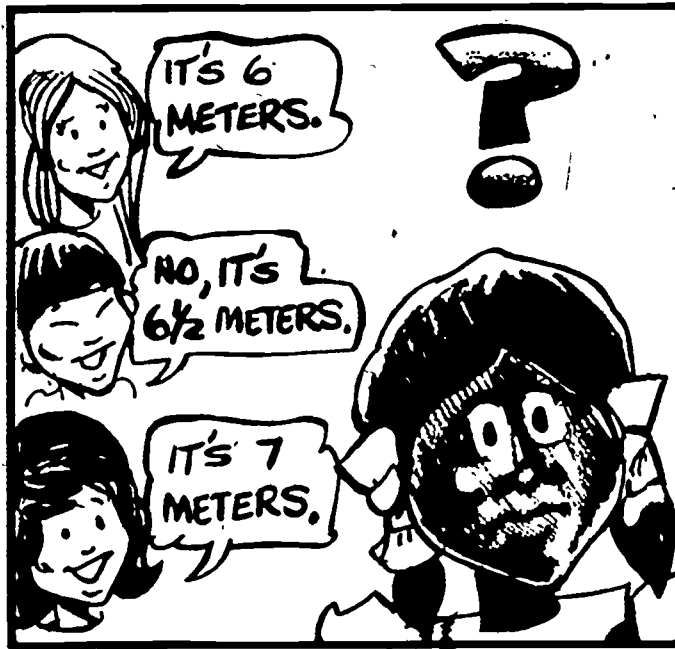
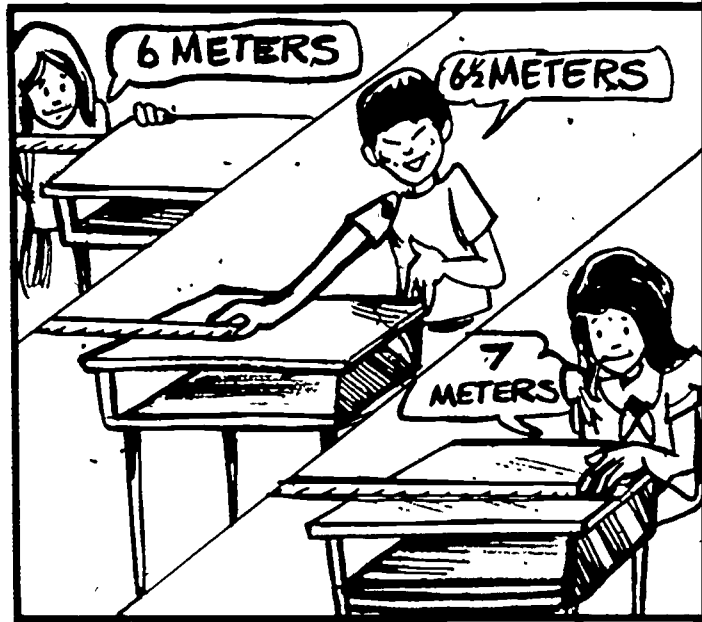
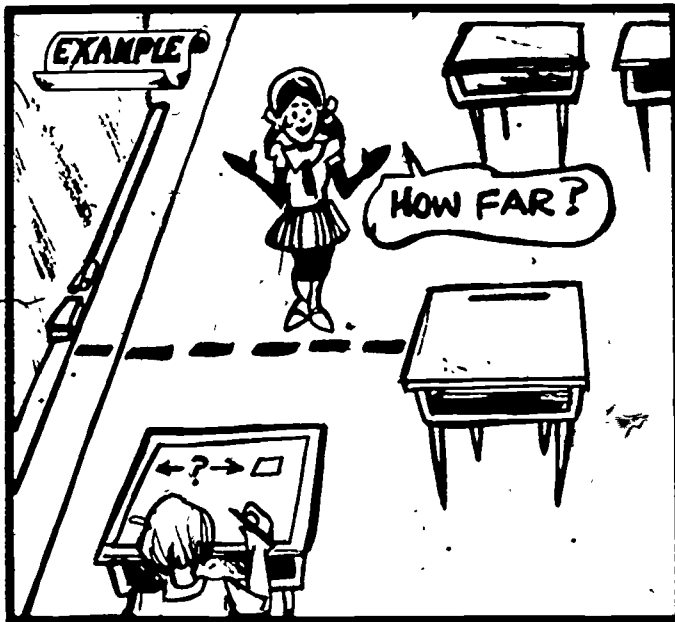


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HOW TO DO AN EXPERIMENT

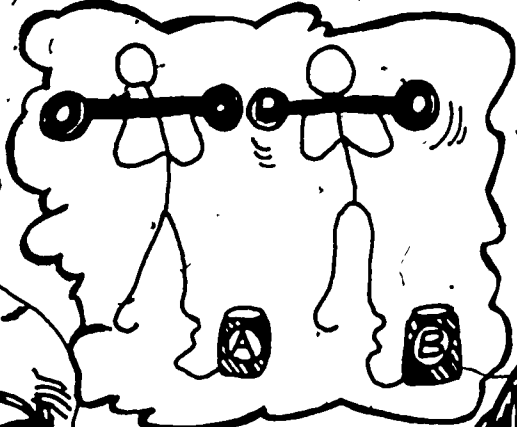


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EXAMPLE

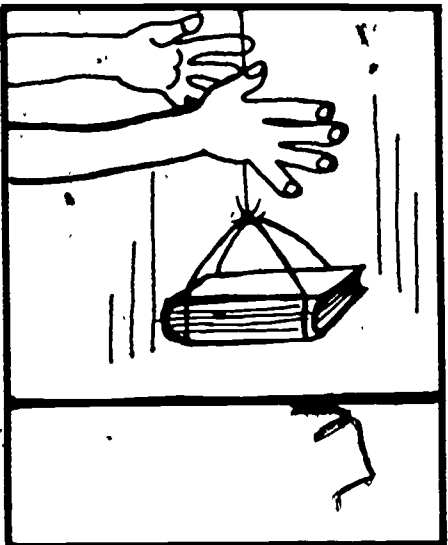
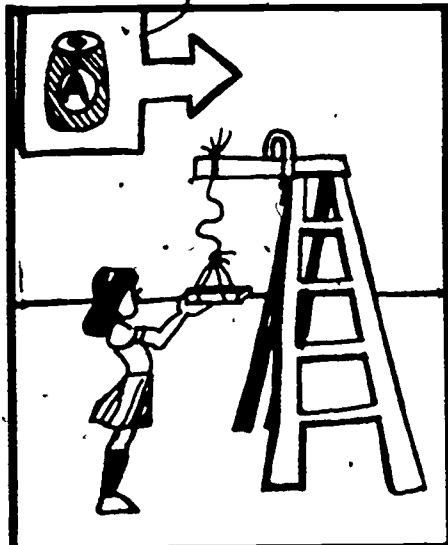
WHICH STRING IS STRONGER, BRAND A OR BRAND B?



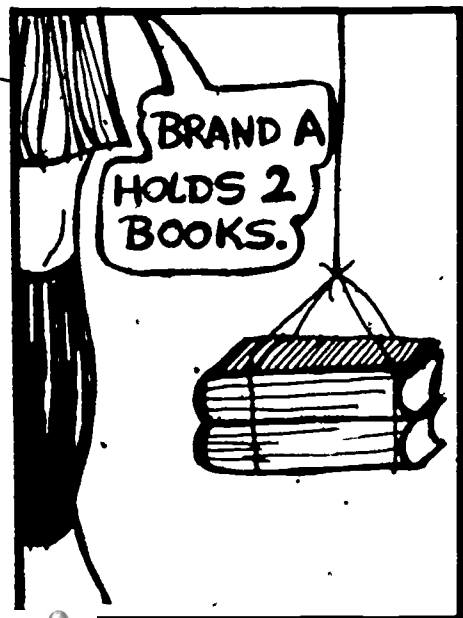
A

B

WE'LL TEST THEM BY DROPPING BOOKS TIED TO THEM.



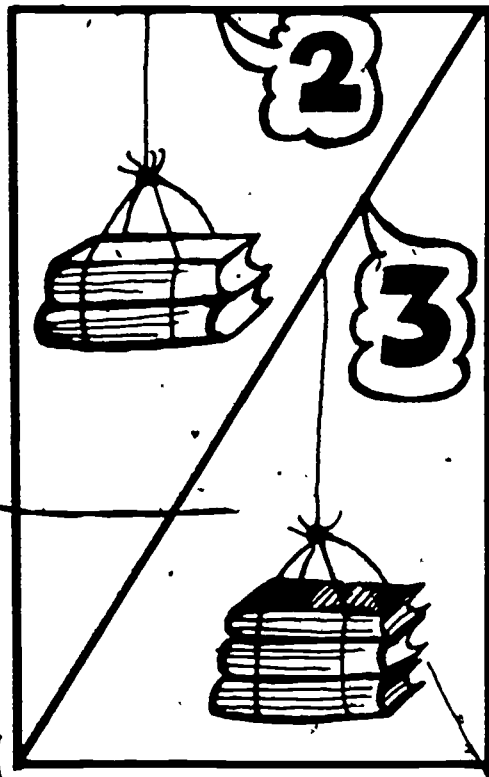
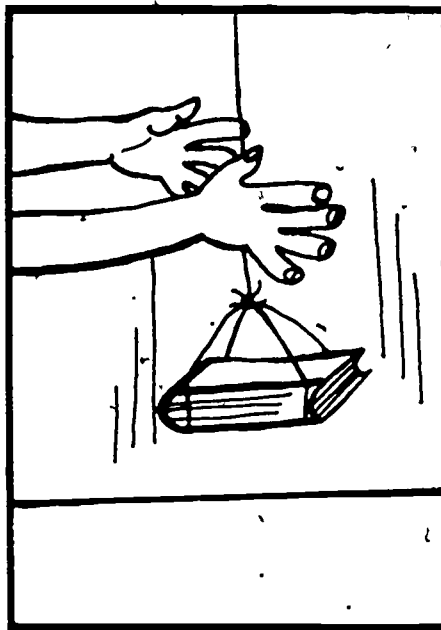
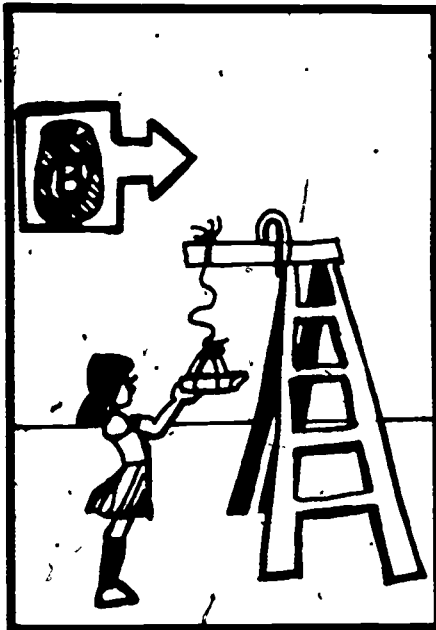
BRAND A HOLDS ONE BOOK.



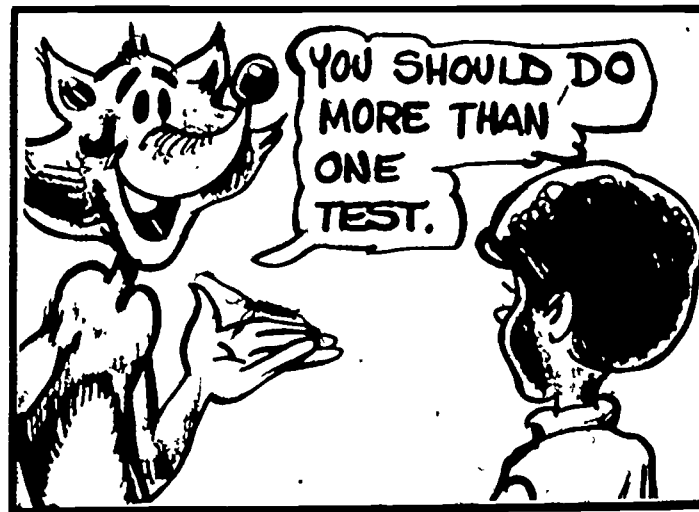
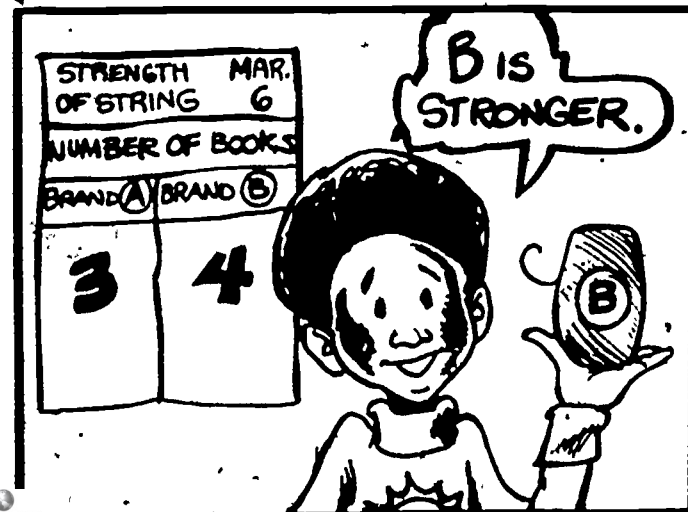
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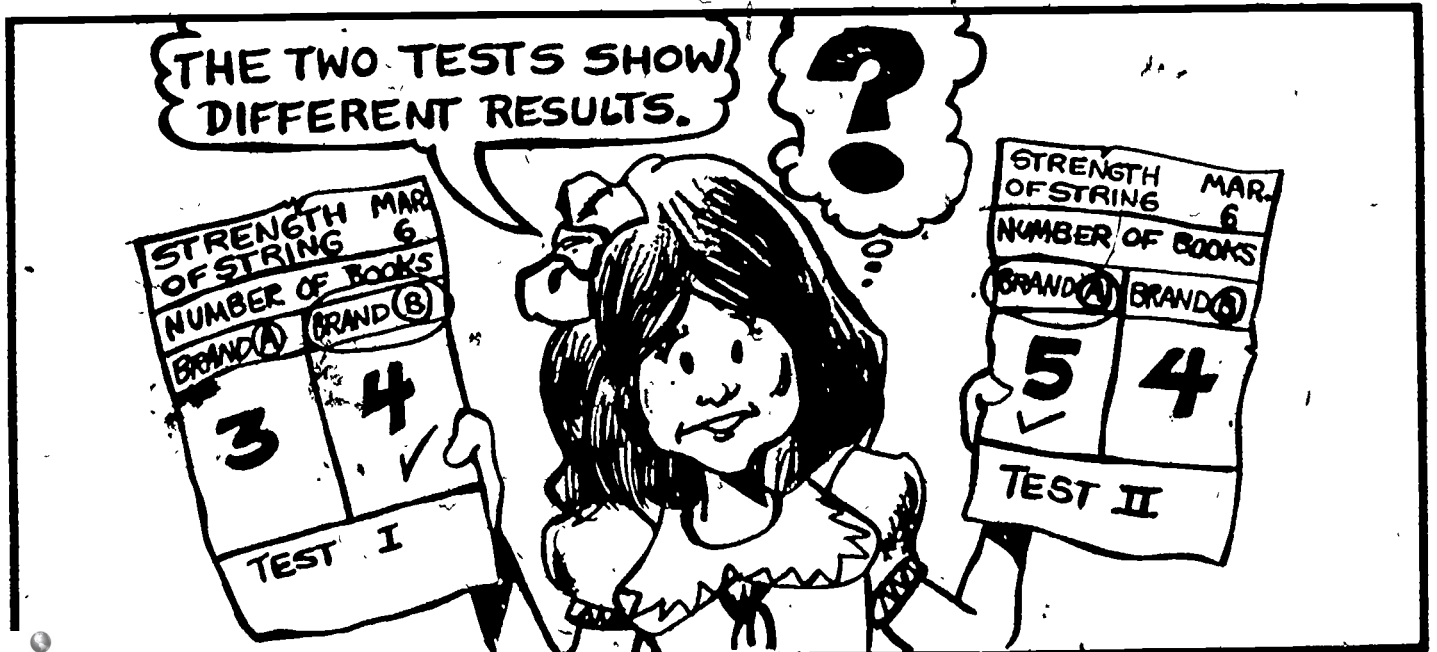
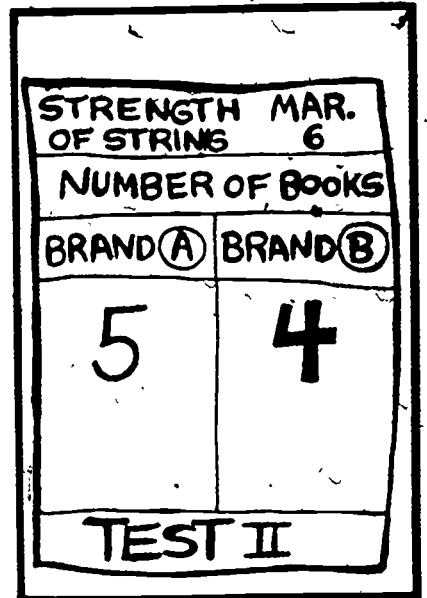
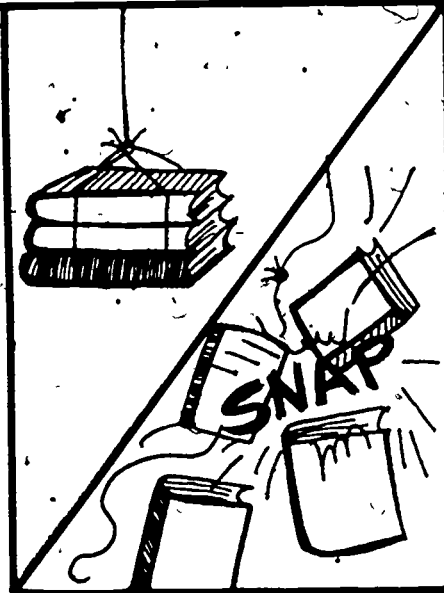
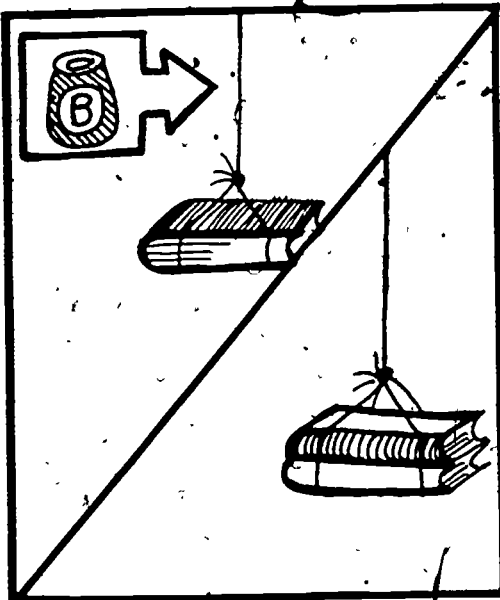
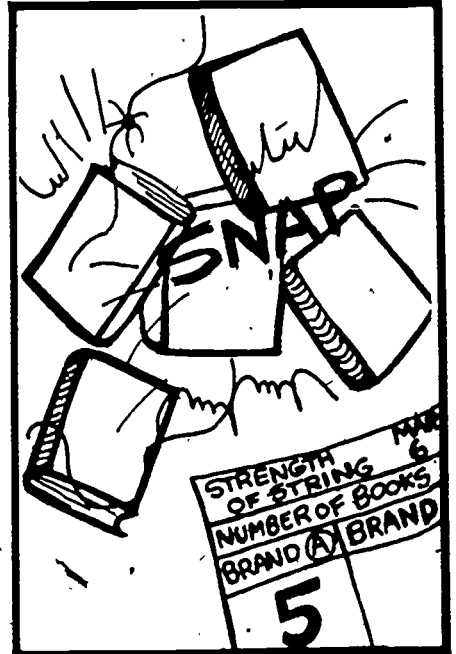
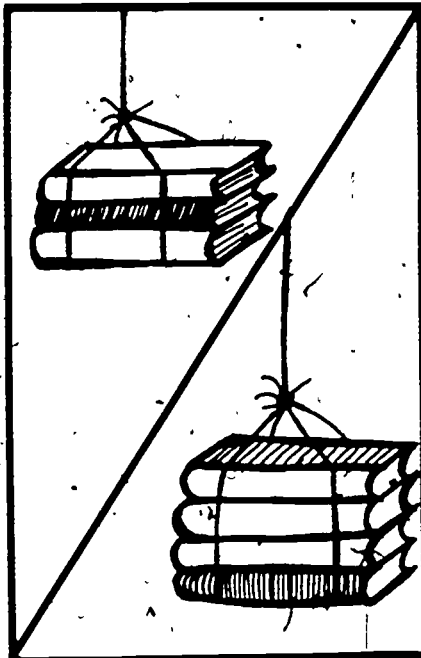
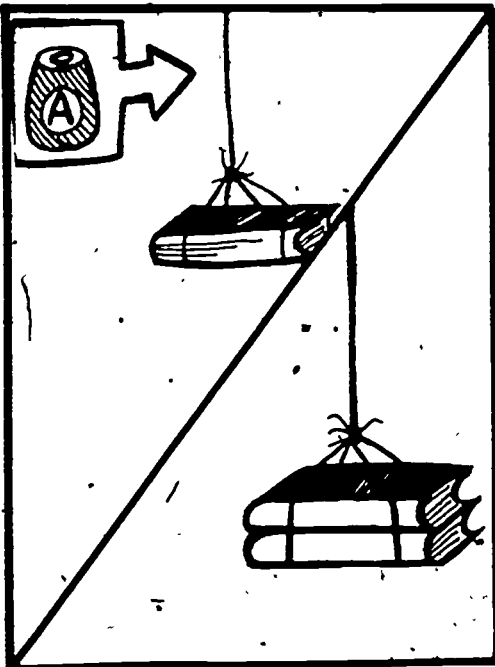


STRENGTH MAR. OF STRING	
6	
NUMBER OF BOOKS	
BRAND (A)	BRAND (B)
3	

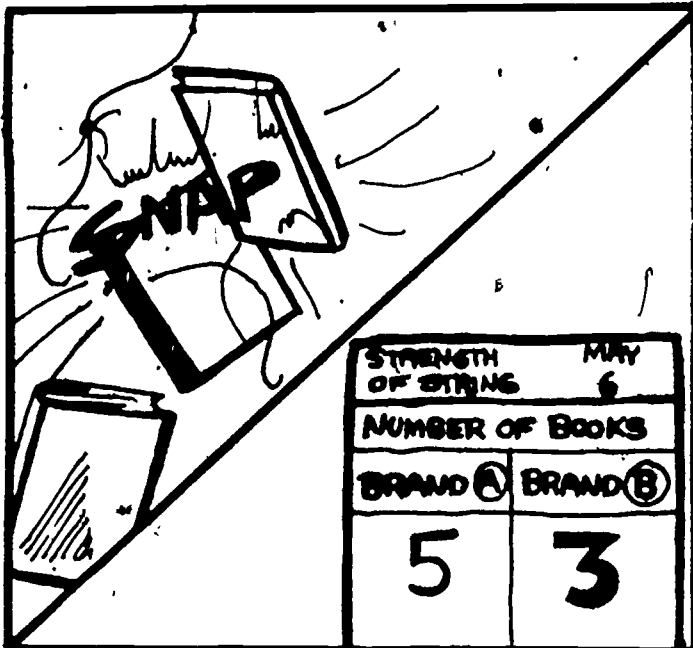
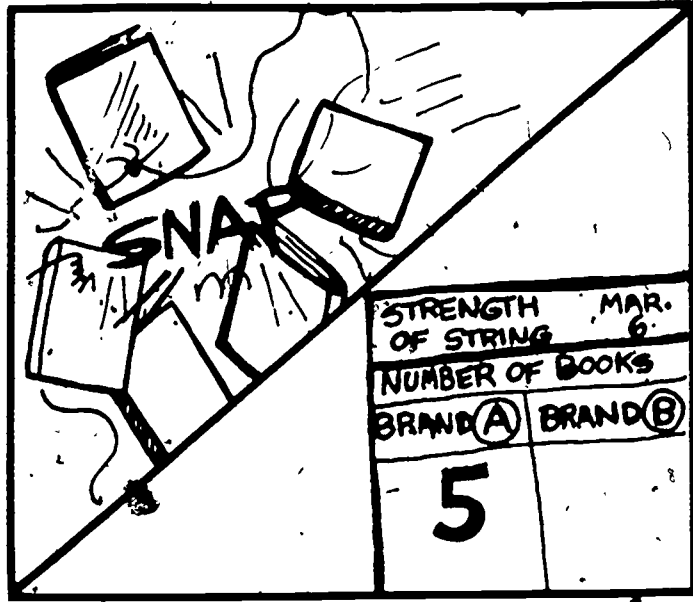
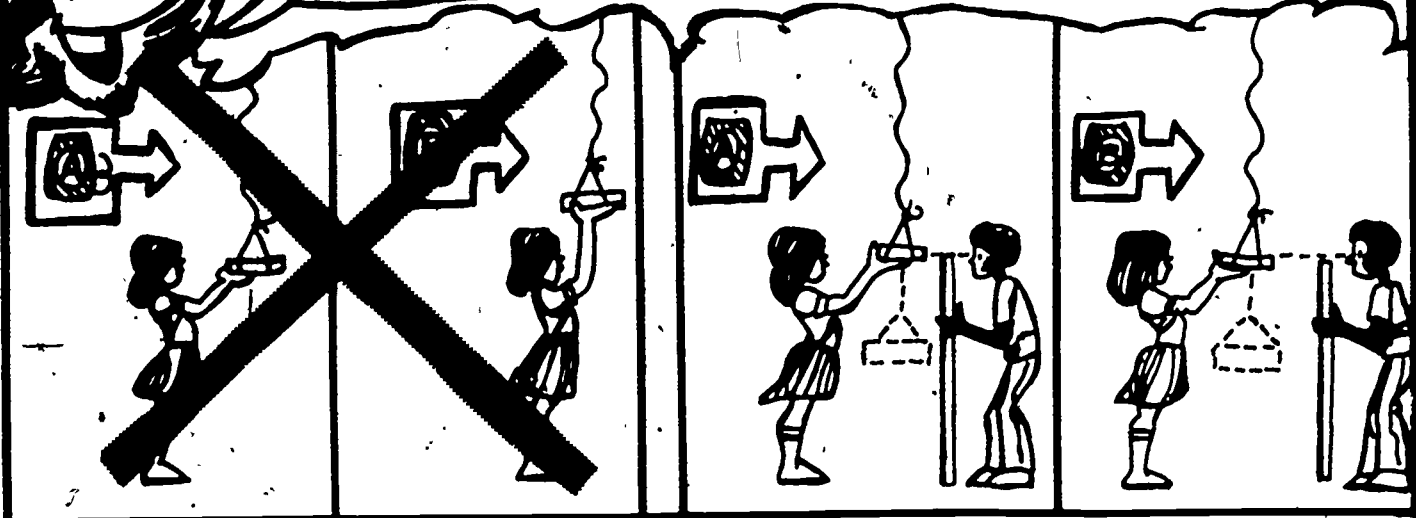


STRENGTH MAR. OF STRING		6
NUMBER OF BOOKS		
BRAND (A)	BRAND (B)	
3	4	





DROP THE BOOKS FROM THE SAME HEIGHT.





STRENGTH OF STRING		MAR. 6
NUMBER OF BOOKS		
BRAND (A)	BRAND (B)	
5	3	
5		



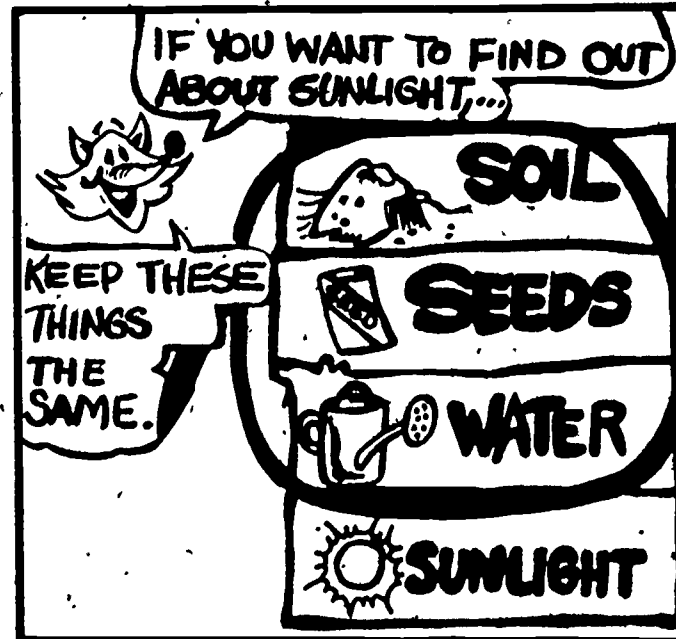
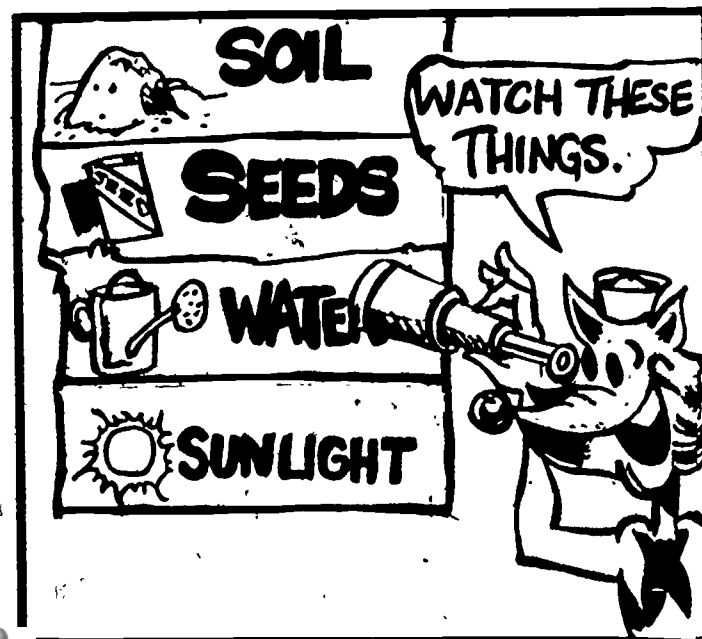
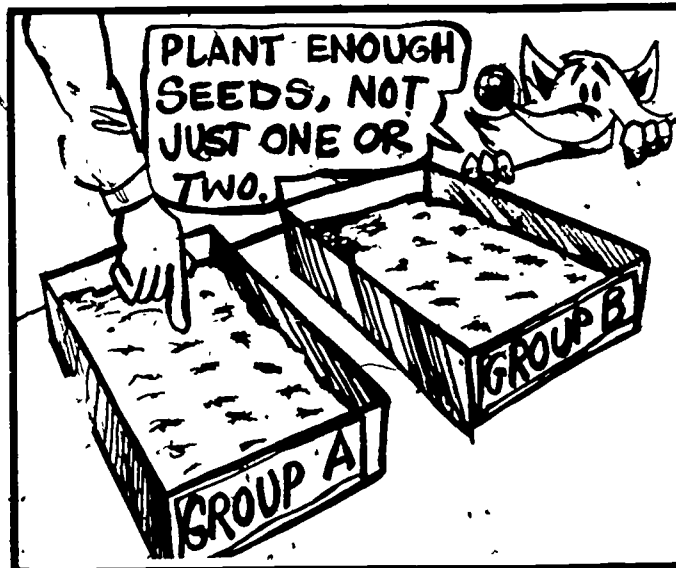
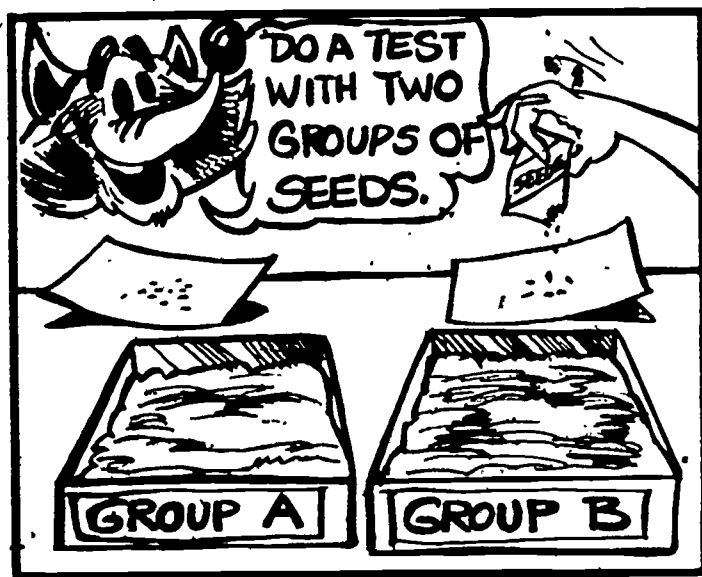
STRENGTH OF STRING		MAY 6
NUMBER OF BOOKS		
BRAND (A)	BRAND (B)	
5	3	
5	4	


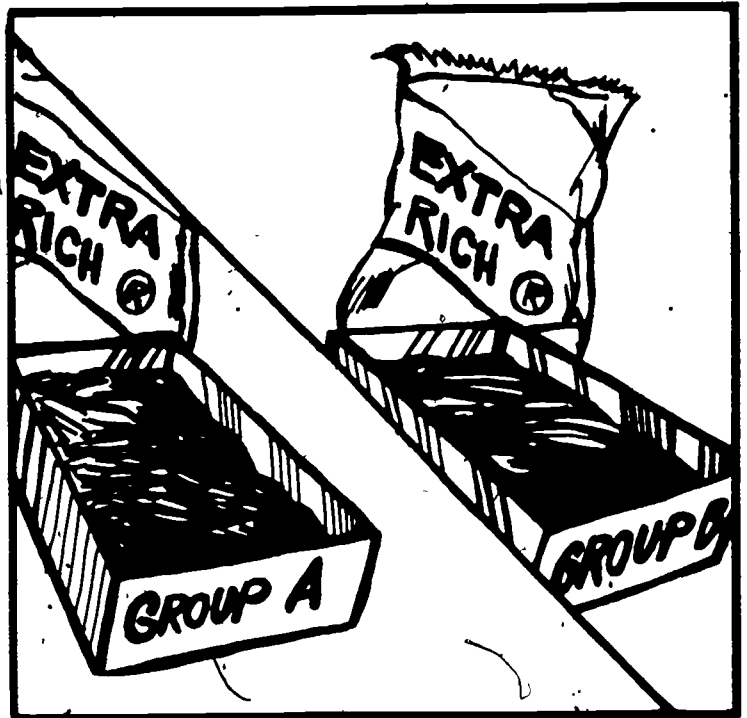
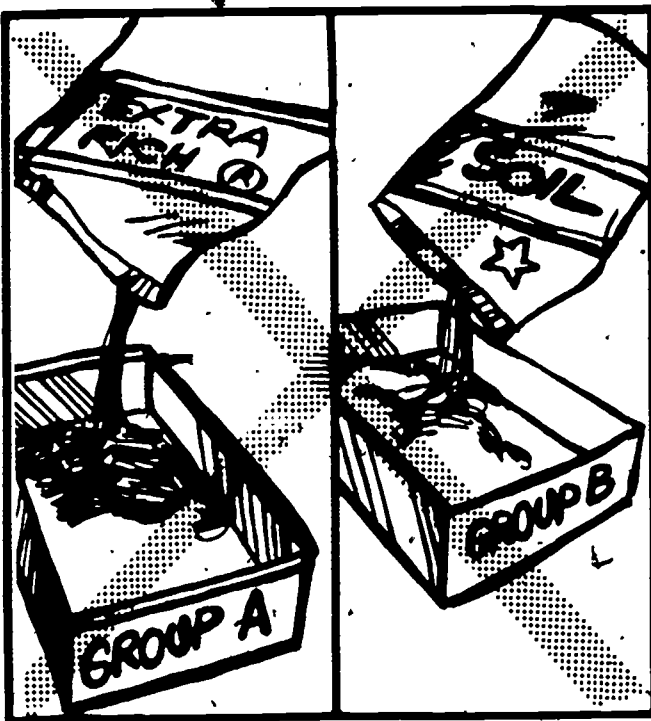
LATER

STRENGTH OF STRING		MAR. 6
NUMBER OF BOOKS		
BRAND (A)	BRAND (B)	
5	3	
5	4	
6	5	
4	4	
7	5	


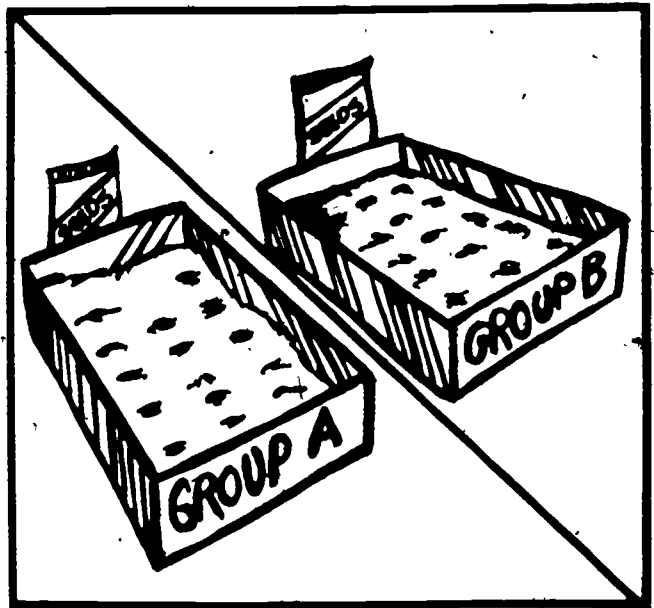
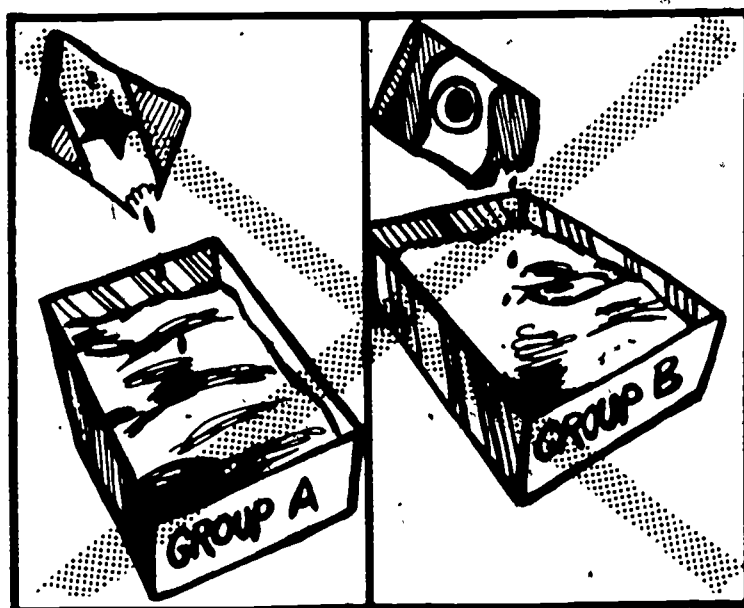
BRAND A USUALLY HOLDS MORE BOOKS.



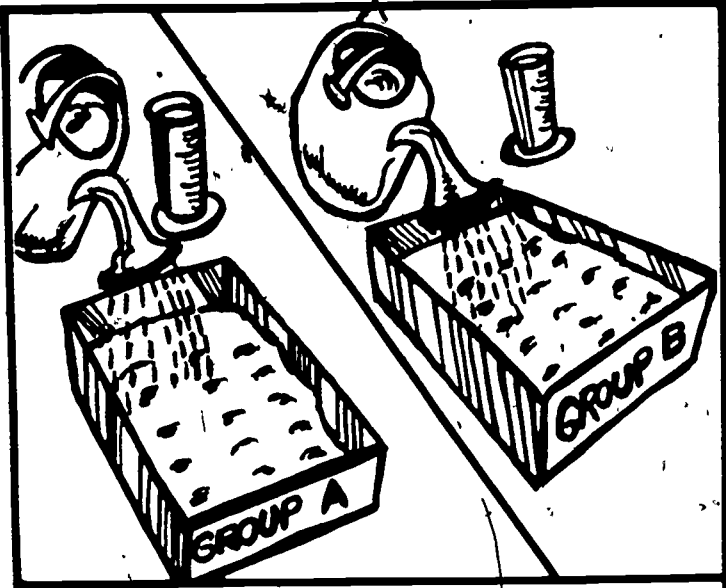
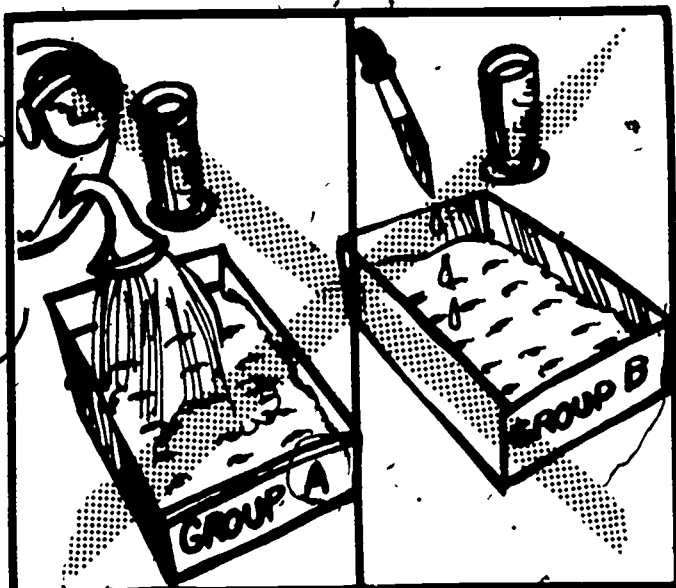




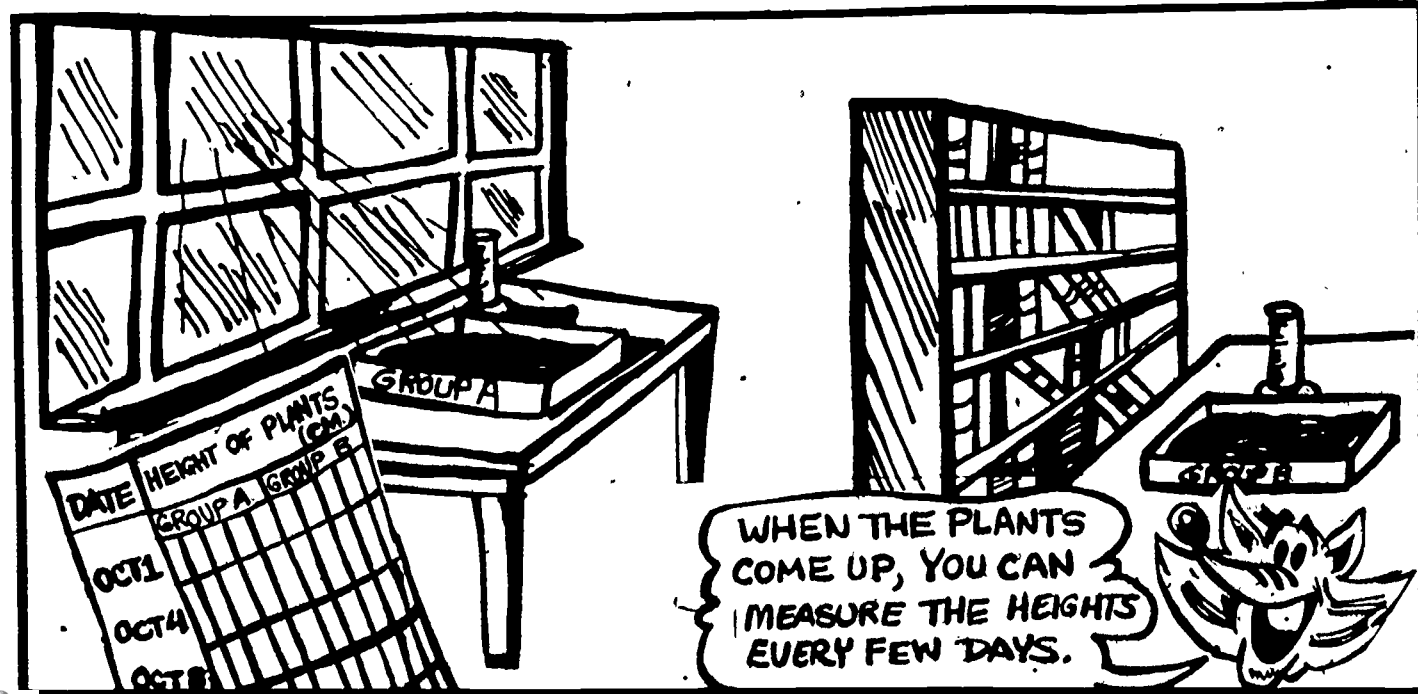
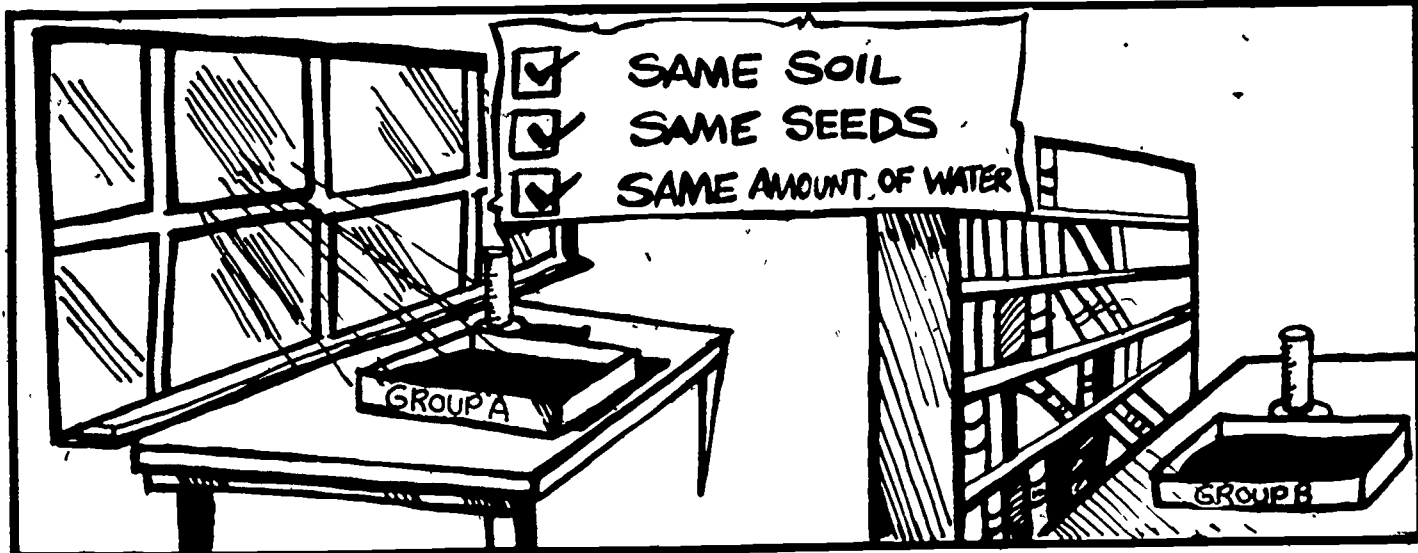
USE THE SAME KIND AND AMOUNT OF SOIL IN THE SAME SIZE BOXES.

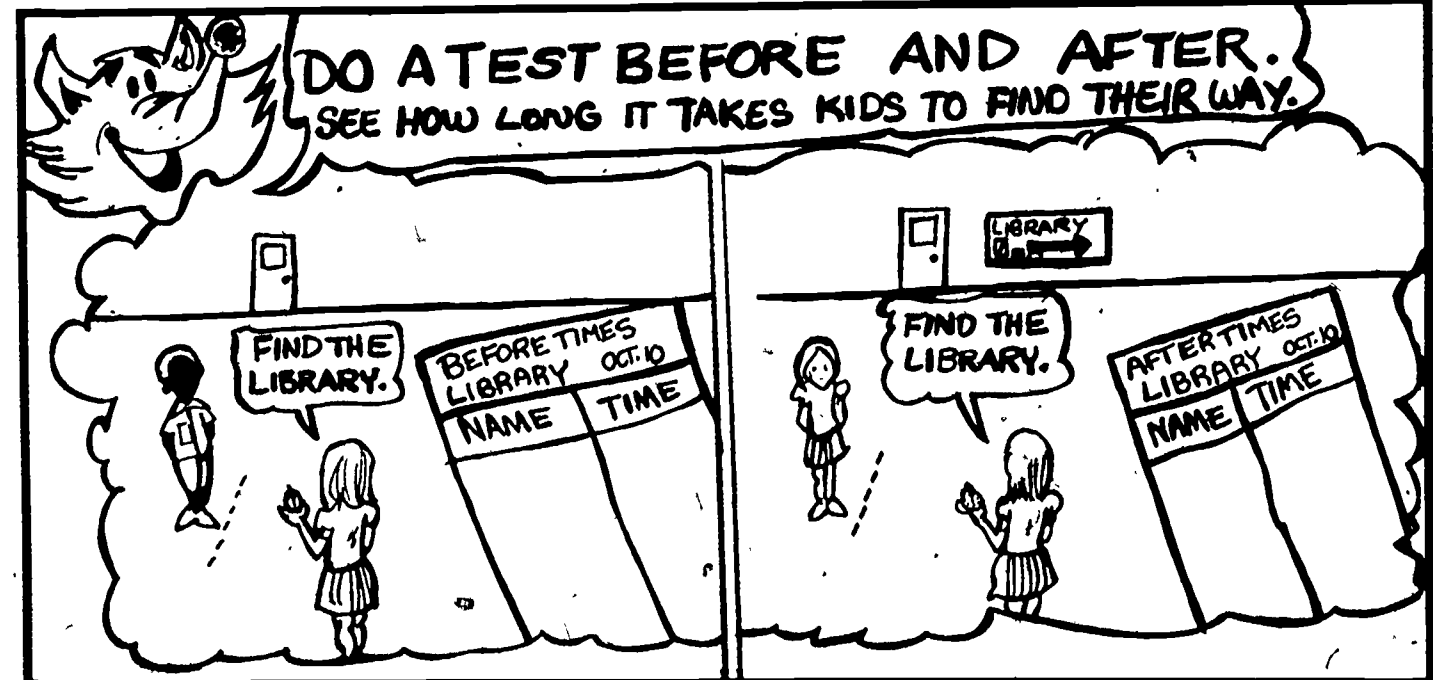
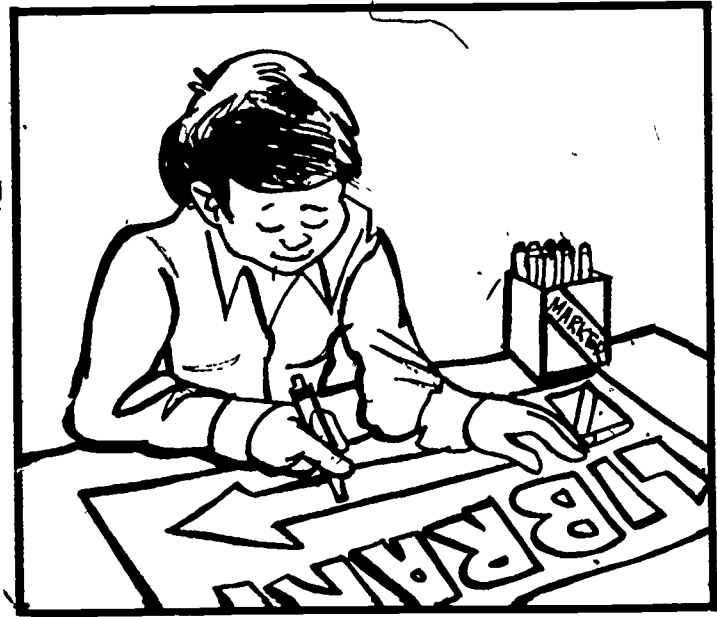


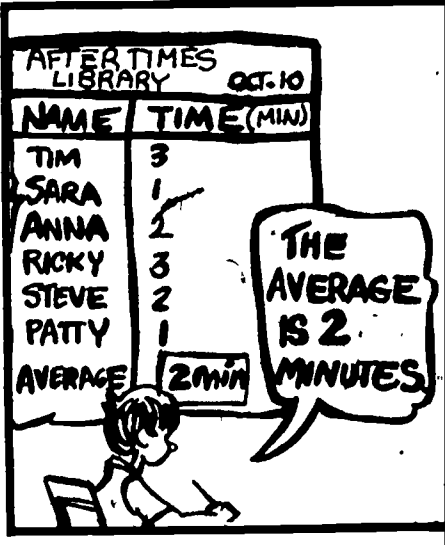
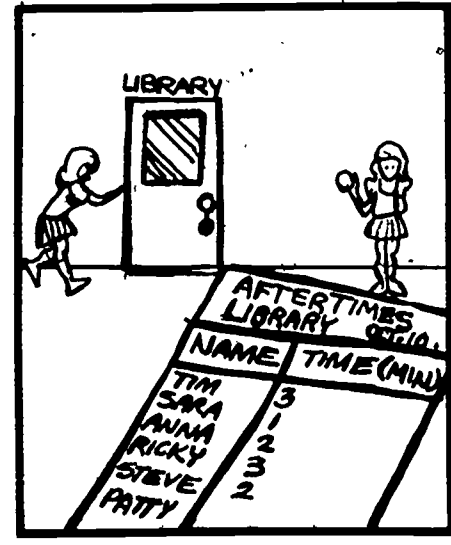
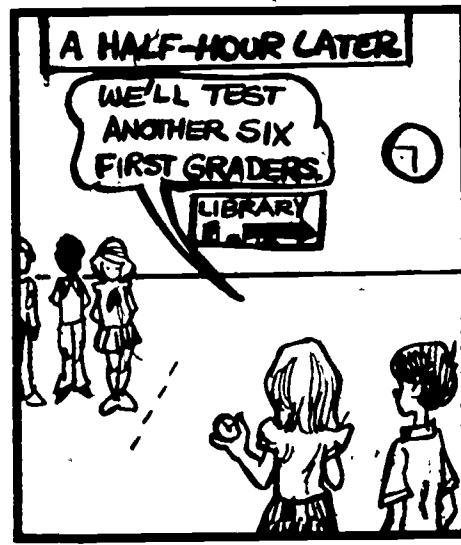
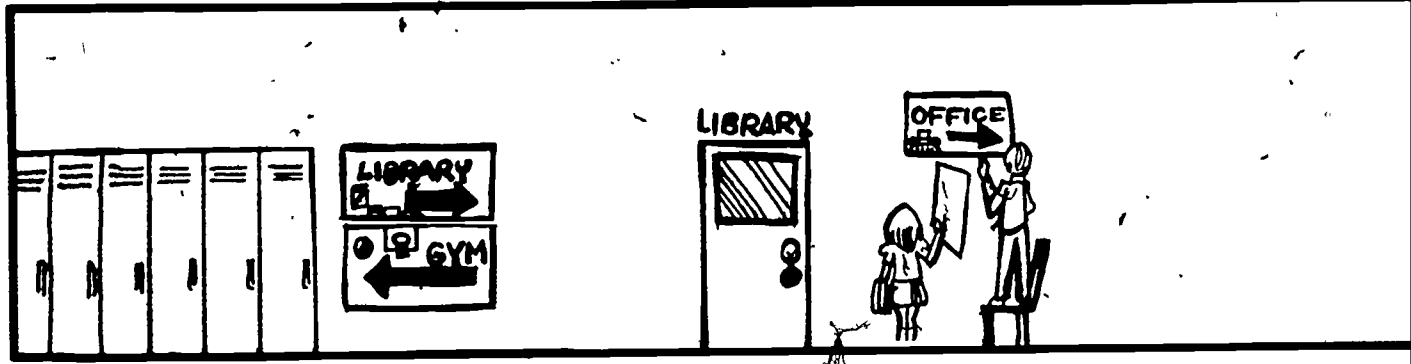
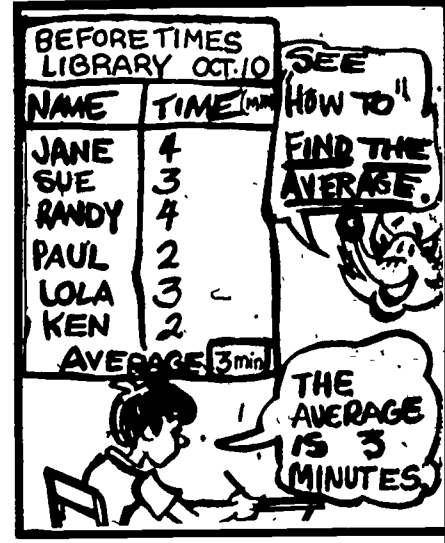
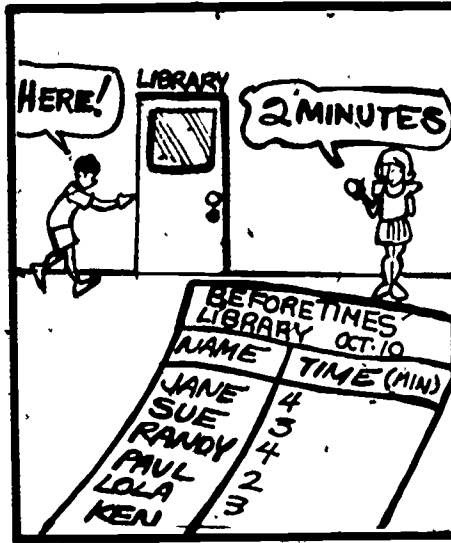
PLANT THE SAME KIND OF SEEDS AT THE SAME DISTANCE AND AT THE SAME DEPTH.



USE THE SAME AMOUNT OF WATER.







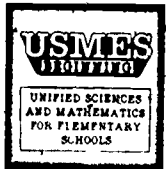
BEFORE (MIN)	AFTER (MIN)
4	3
3	1
4	2
2	3
3	2
2	1
3 MINUTES	2 MINUTES
AVERAGE	

THE POSTERS HELP.

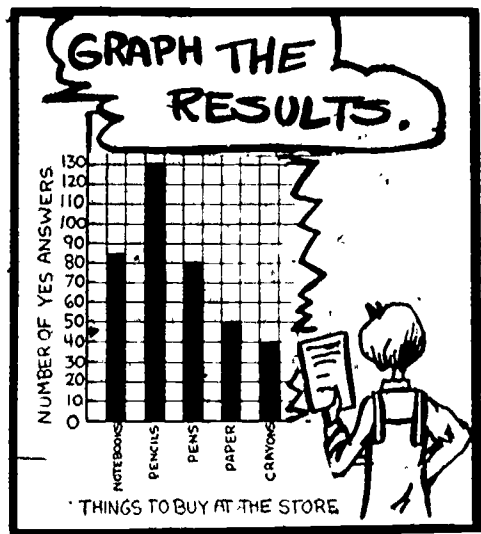
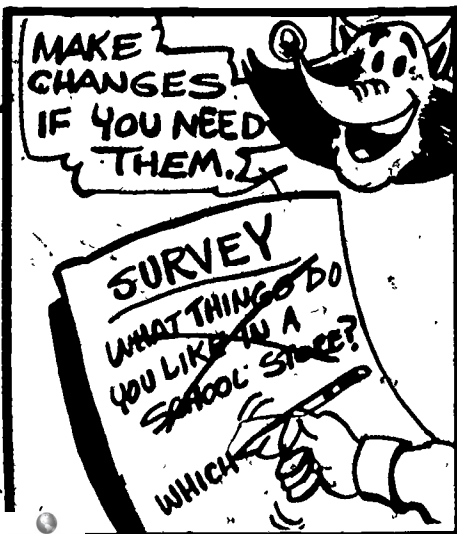
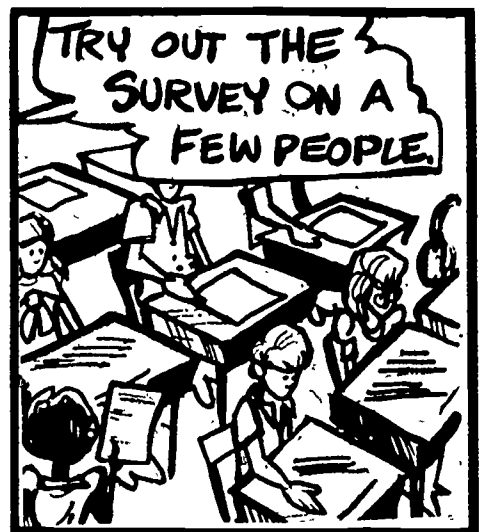
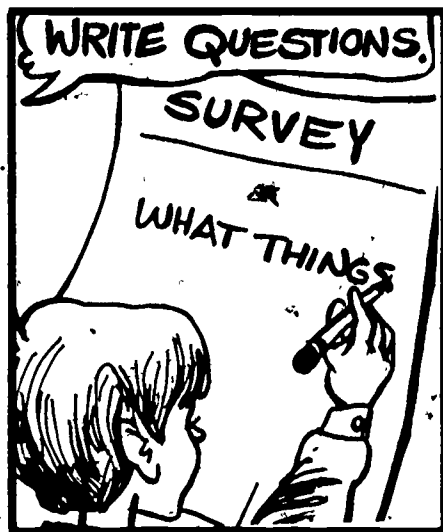
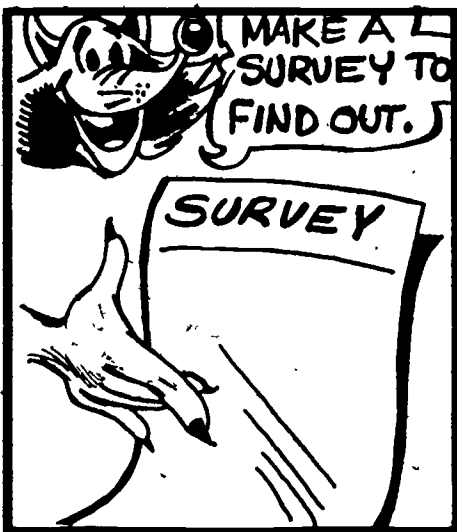
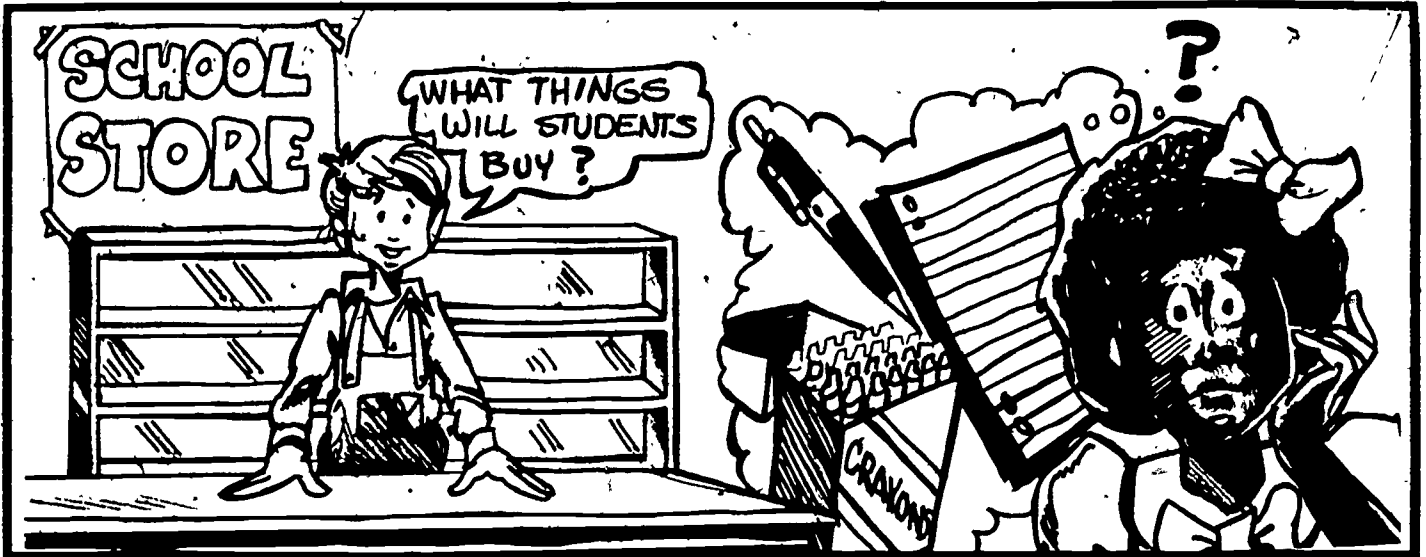


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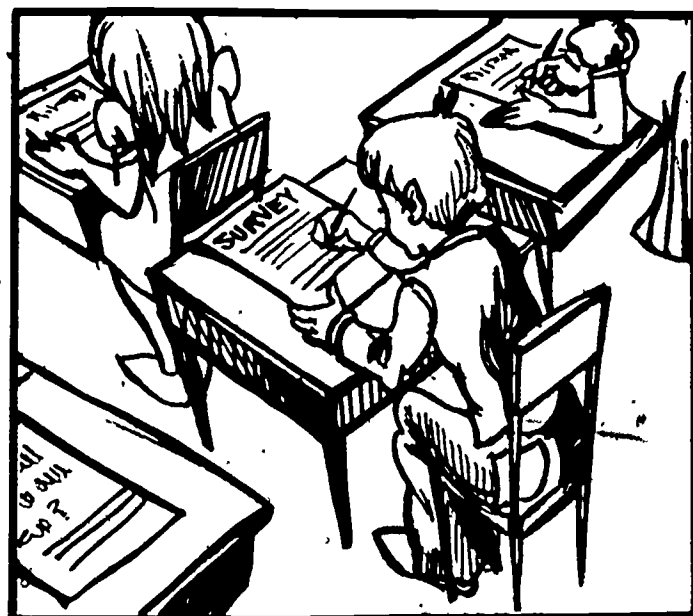
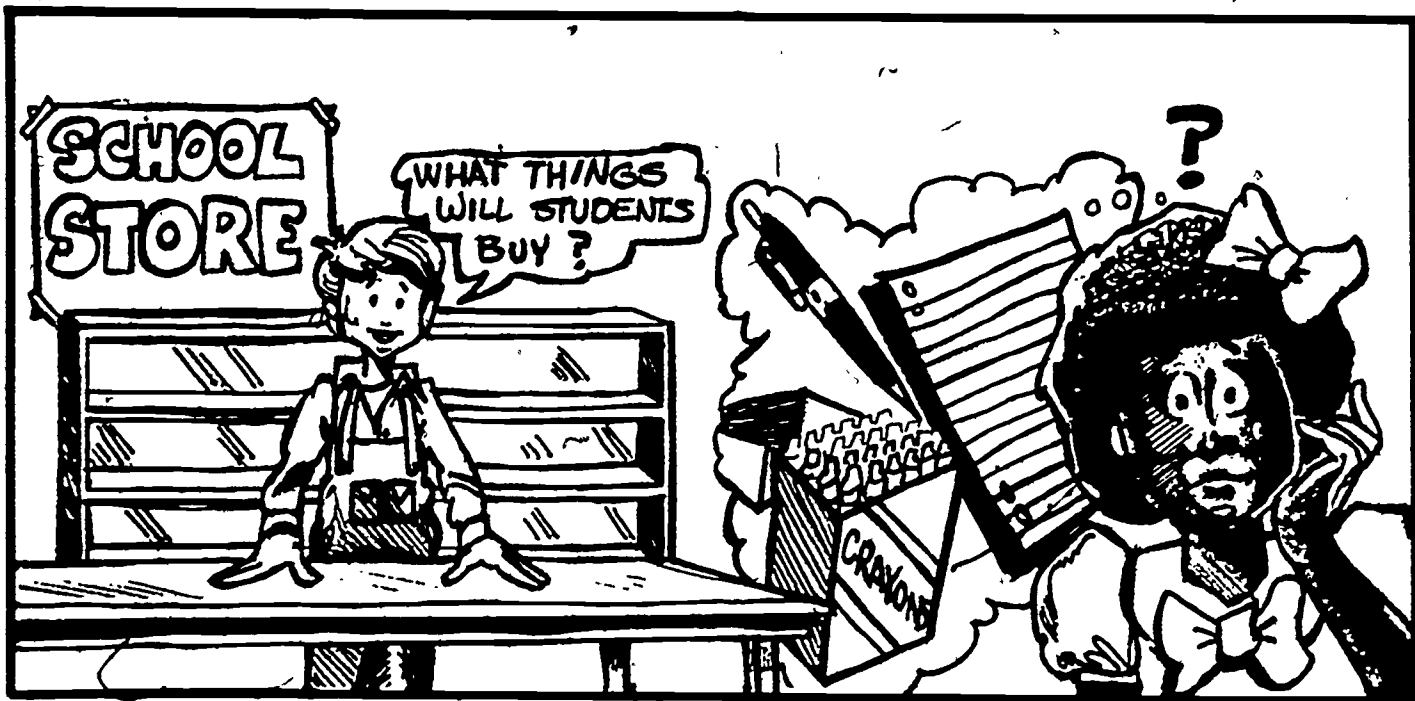
HOW TO

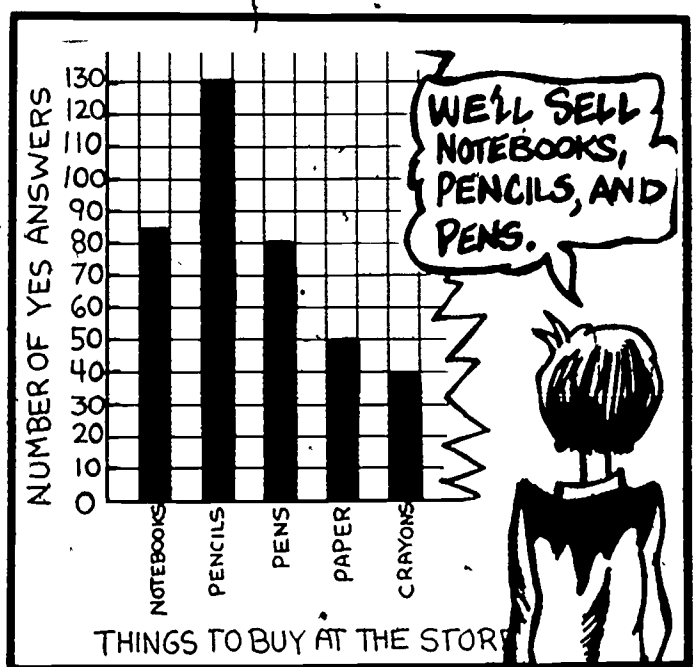
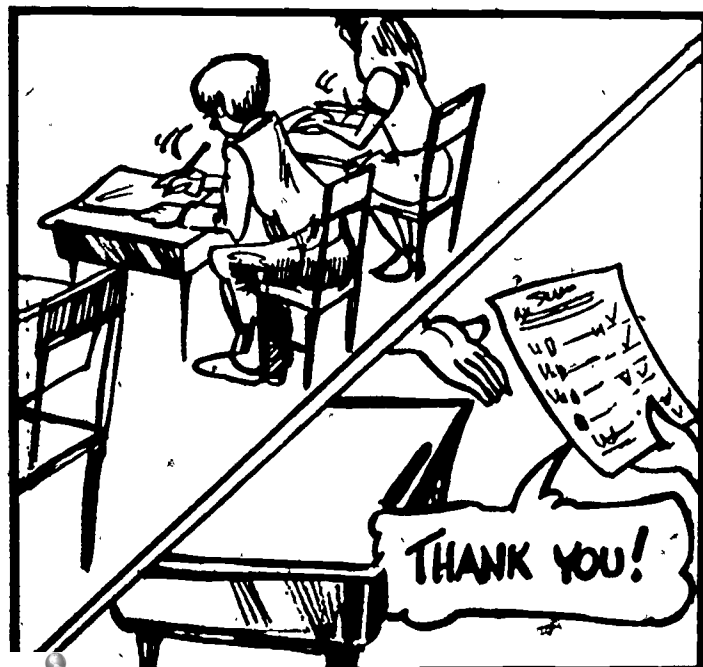
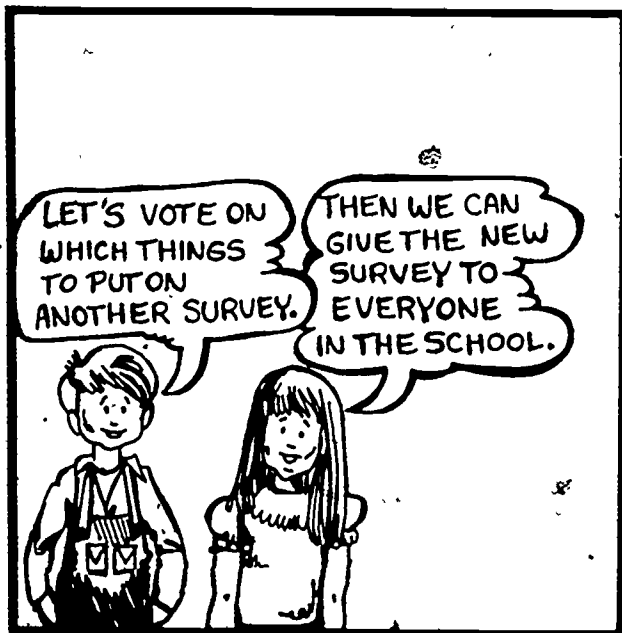
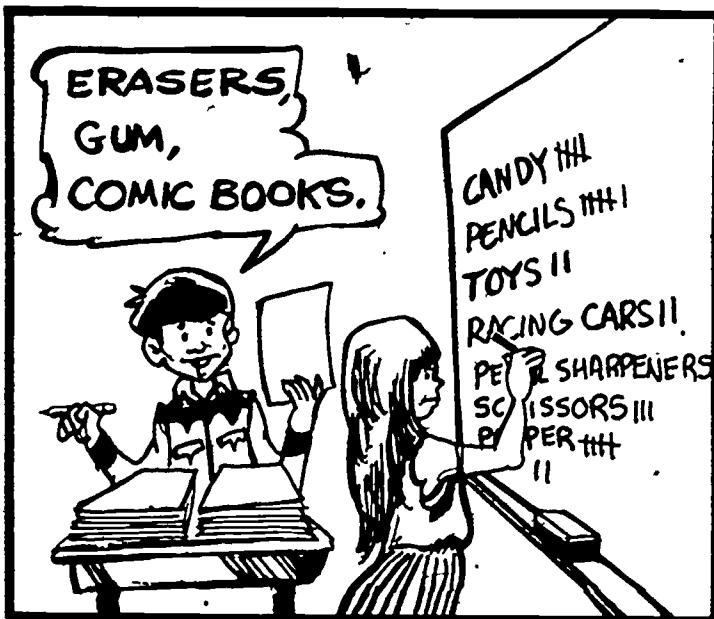


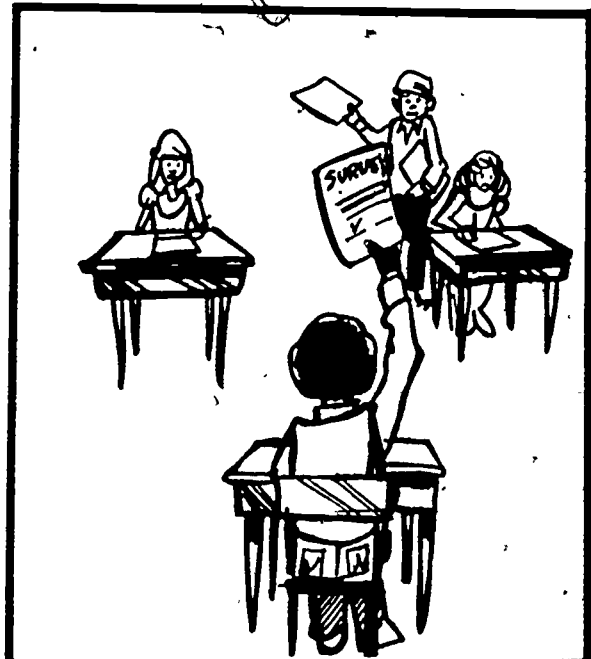
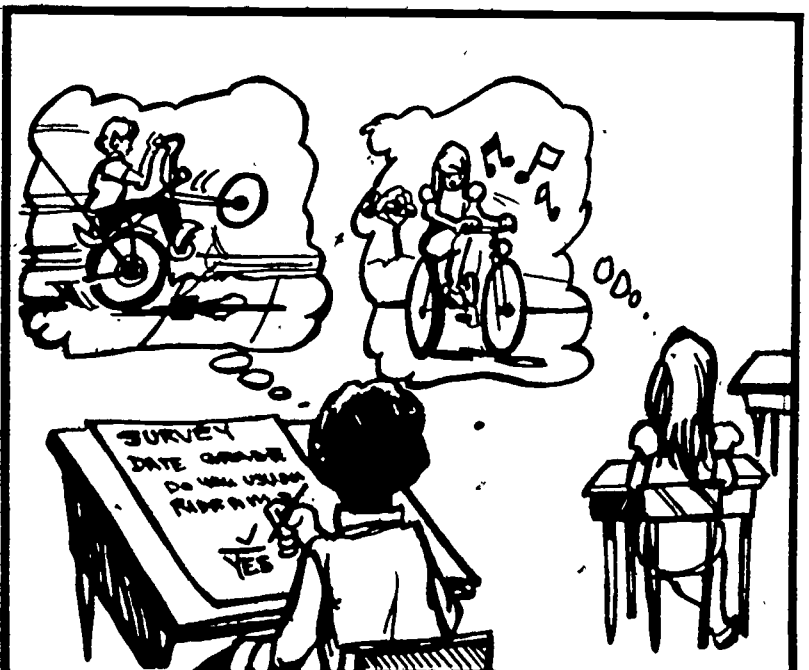
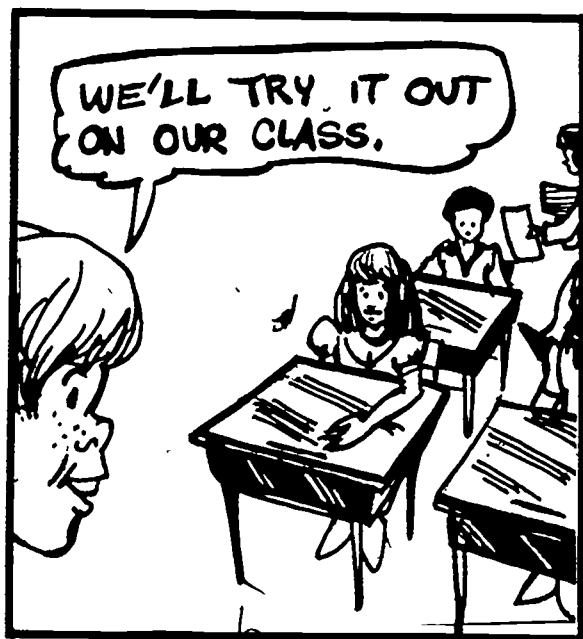
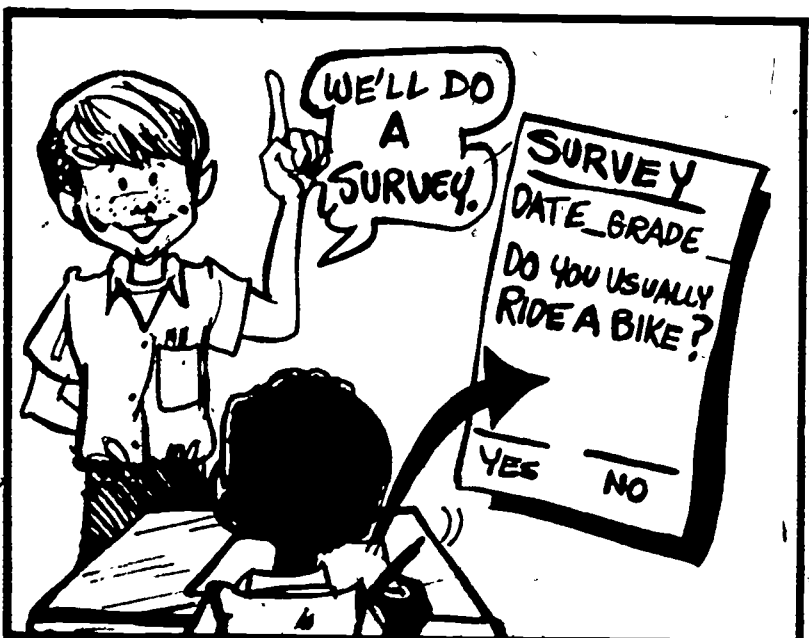
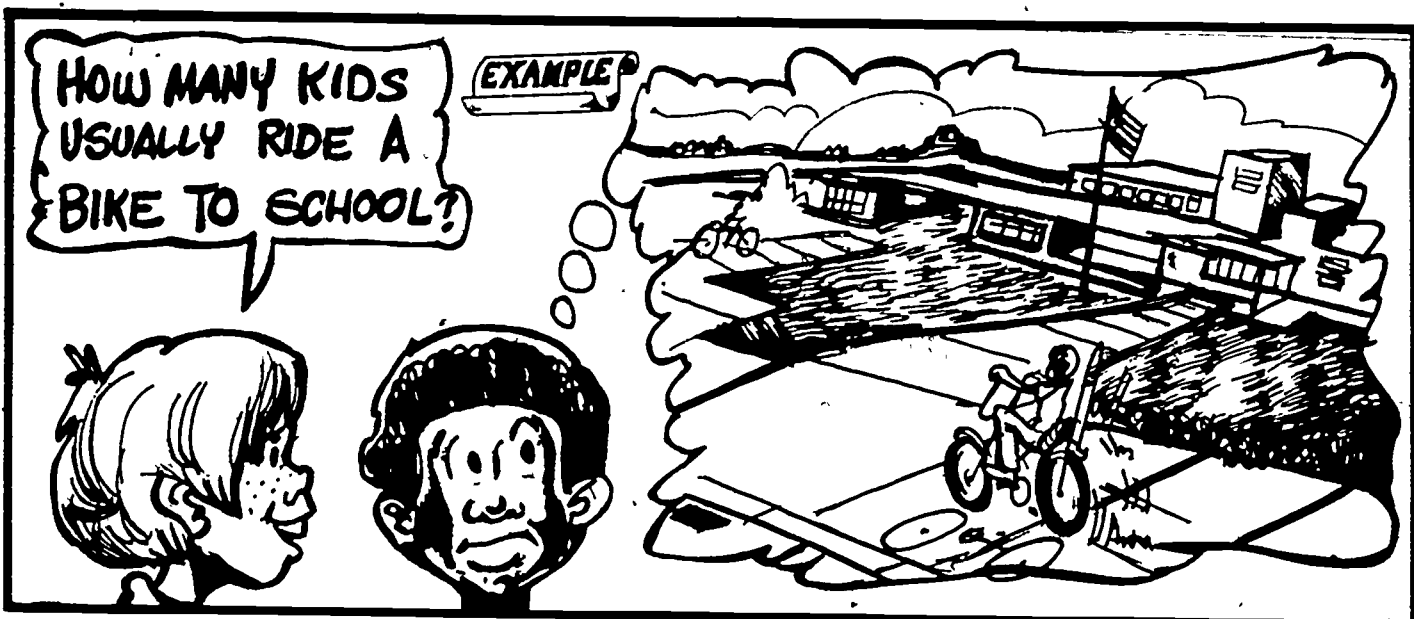
MAKE AN OPINION SURVEY

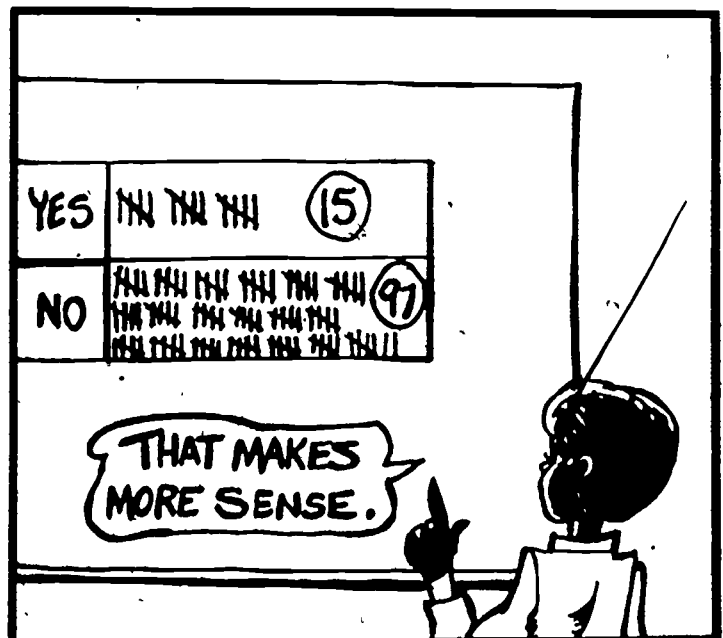
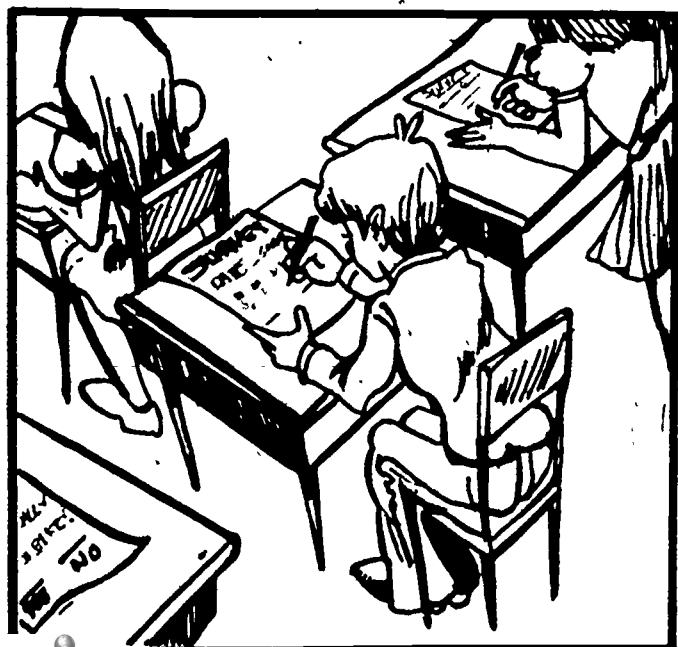
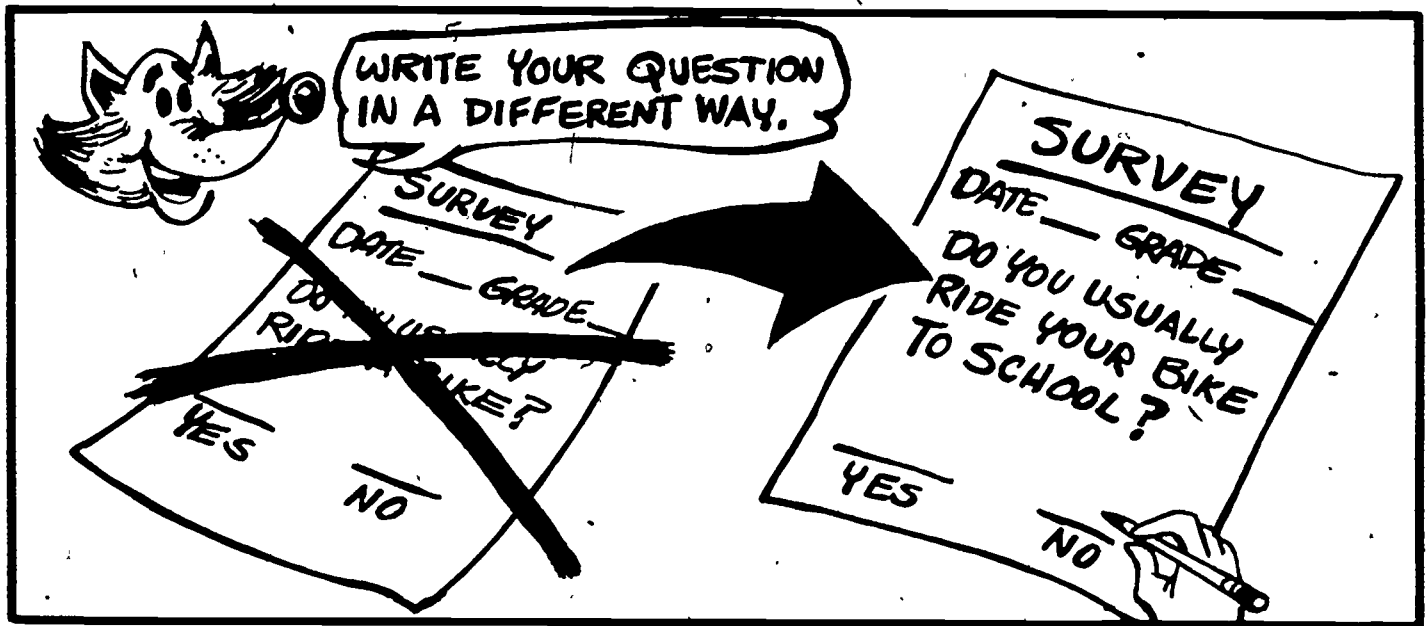
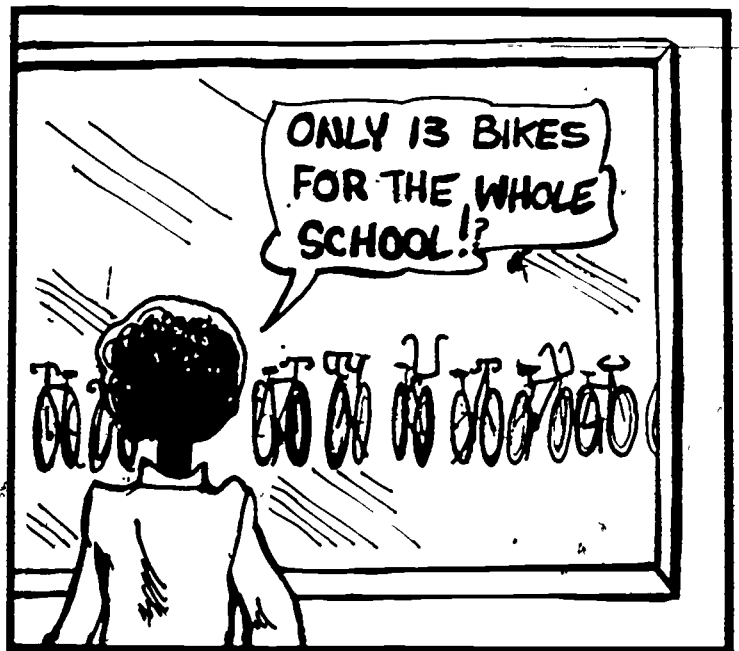
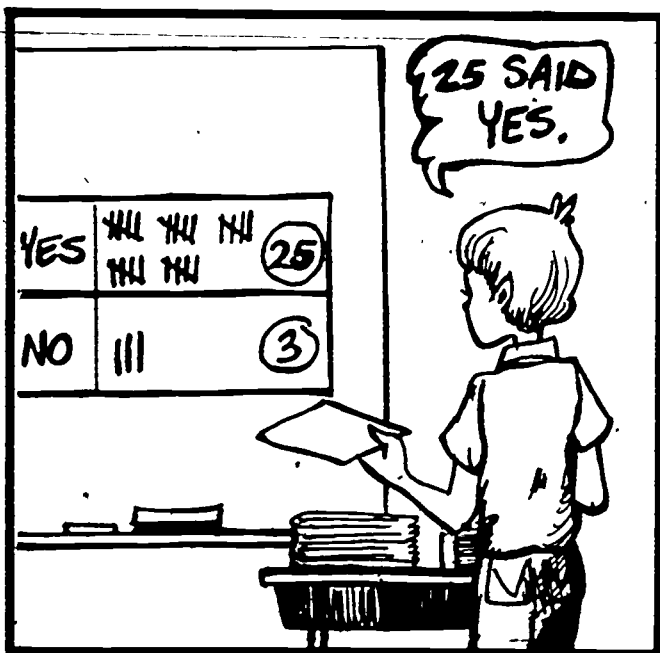


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EXAMPLE

SURVEY OF DESIGN LAB PROBLEMS

	YES	NO	TOTAL
1. PEOPLE DON'T CLEAN UP	140	50	190
2. WAITING TO USE TOOLS	36	154	190
3. HARD TO FIND THINGS	87	103	190
4. PROJECTS GET RUINED	69	46	115
5. NEED MORE MATERIALS	81	34	115

WHICH PROBLEM IS THE MOST IMPORTANT?

OOPS! I FORGOT TO ASK QUESTIONS #4 AND #5.

PROBLEM 1 HAD THE MOST YES ANSWERS.

THAT MAKES THE TOTALS DIFFERENT. WE CAN'T COMPARE YES ANSWERS.

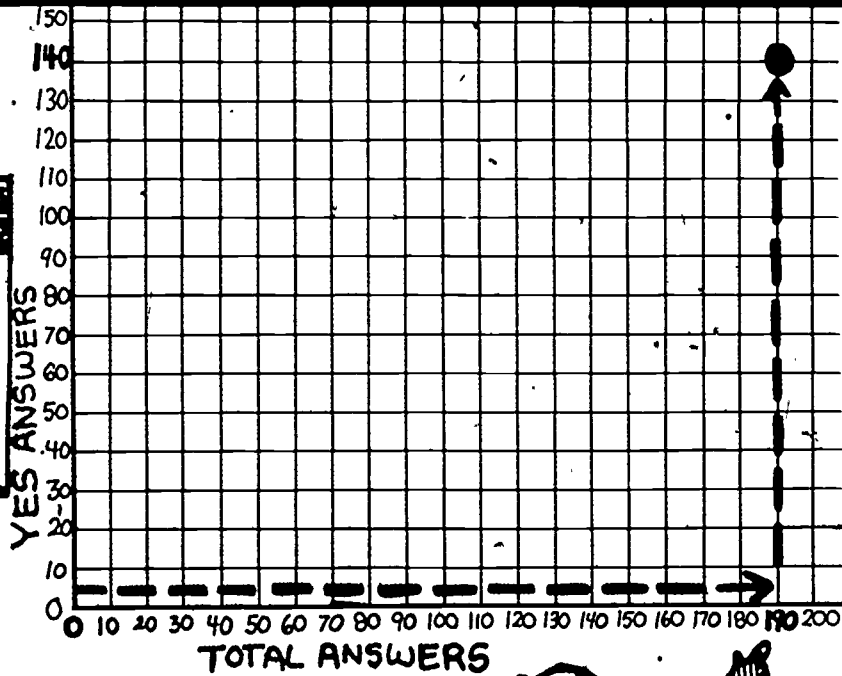
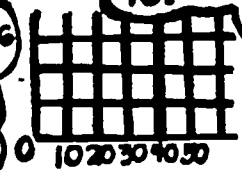
A SLOPE DIAGRAM WILL TELL US WHICH PROBLEM GOT THE LARGEST PERCENTAGE OF YES ANSWERS.

THE NUMBERS ARE TOO BIG FOR OUR GRAPH PAPER.

LET'S MAKE EACH SPACE STAND FOR 10.

YES ANSWERS	TOTAL ANSWERS
1. 140	190
2. 36	190
3. 87	190
4. 69	115
5. 81	115

DIFFERENT



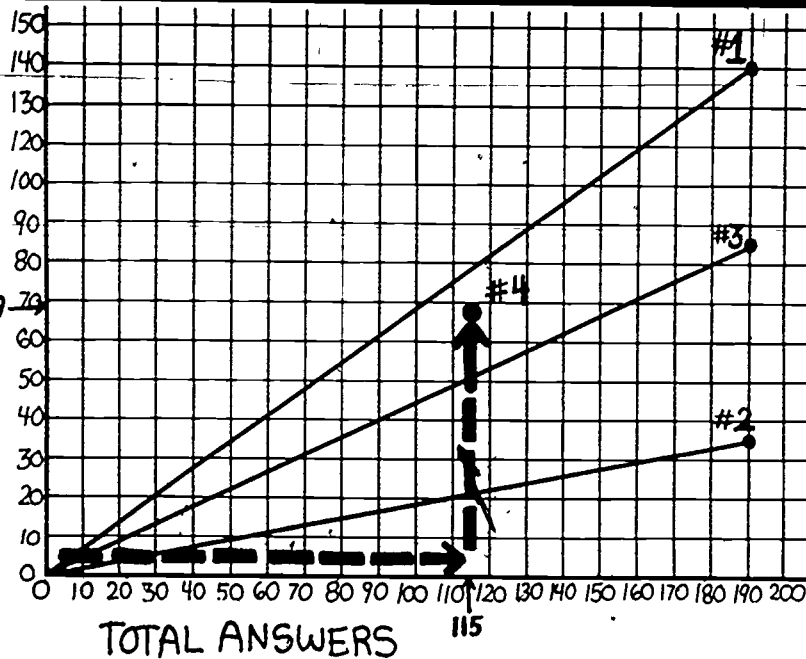
PROBLEM	YES ANSWERS	TOTAL ANSWERS
1	140	190
2	36	190
3	87	190
4	69	115
5	81	115

...AND UP TO THE LINE FOR 140.

FOR PROBLEM #1, WE WANT TO FIND $\frac{140}{190}$. WE'LL GO OVER TO THE LINE FOR 190...

YES ANSWERS		TOTAL ANSWERS	
① $\frac{140}{190}$	③ $\frac{87}{190}$	④ $\frac{69}{115}$	
② $\frac{36}{190}$	⑤ $\frac{81}{115}$		

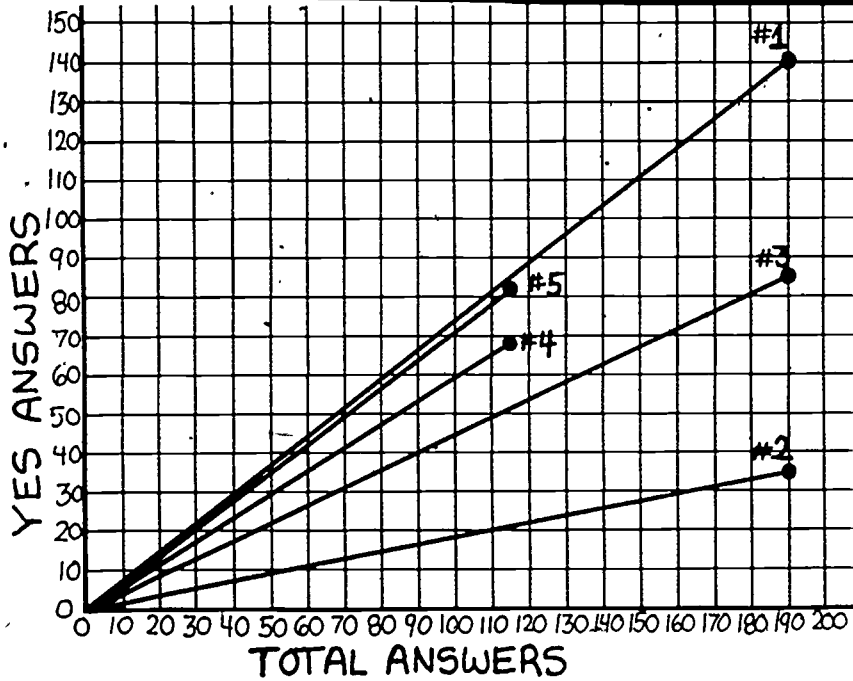
YES ANSWERS



FOR PROBLEM #4, I PUT 115 BETWEEN 110 AND 120. THEN I WENT UP ALMOST TO THE 70 LINE FOR 69.



YES ANSWERS		TOTAL ANSWERS	
① $\frac{140}{190}$	③ $\frac{87}{190}$	④ $\frac{69}{115}$	
② $\frac{36}{190}$	⑤ $\frac{81}{115}$		



THE LINES FOR #1 AND #5 HAVE ALMOST THE SAME SLOPE.
IT LOOKS AS IF THEY ARE TIED FOR FIRST PLACE.



WE SHOULD WORK ON THOSE PROBLEMS FIRST.



SURVEY

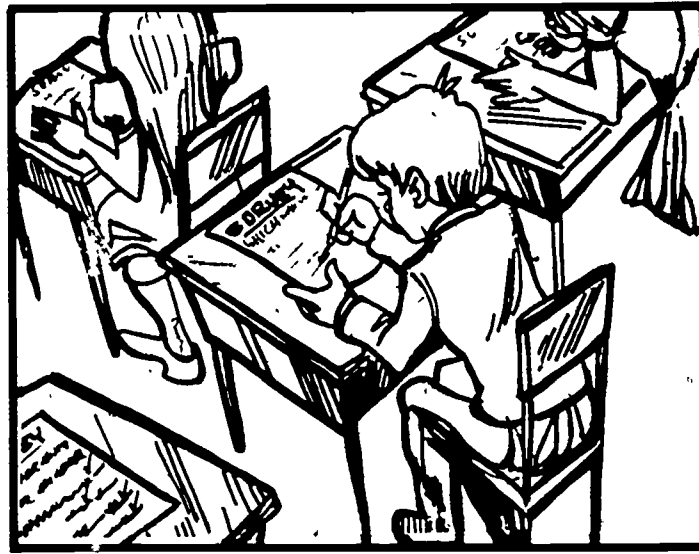
WHICH NAMES DO YOU LIKE FOR OUR DRINK?
VOTE FOR 1 OR 2.

SUPER RED

CHERRY BOMB

BIG BOB

FIZZ KING



NAME	VOTES	TOTAL
SUPER RED		
CHERRY BOMB	I	
BIG BOB		
FIZZ KING		

LATER....

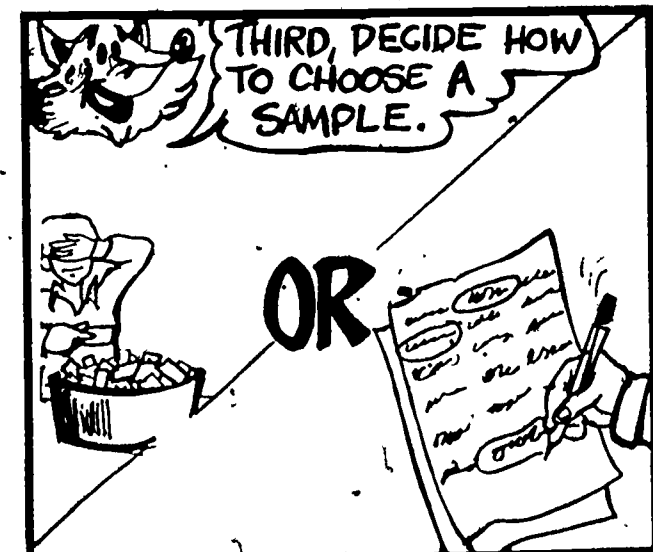
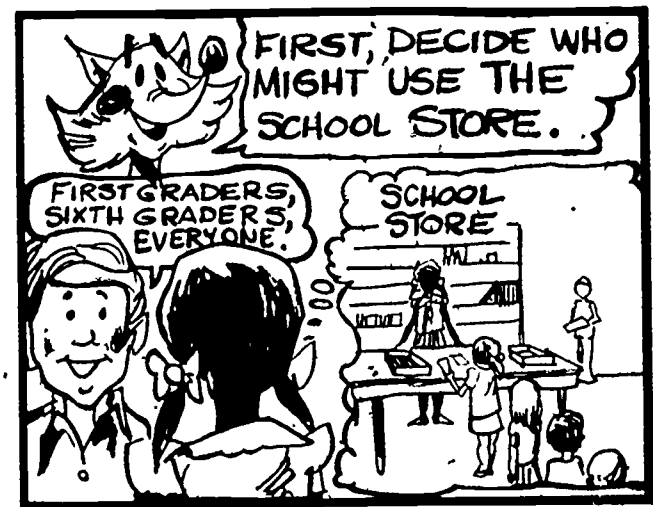
NAME	VOTES	TOTAL
SUPER RED	### ### ### ### ### ### ### ### II	42
CHERRY BOMB	### ### ### ### ### ### ### ### ### ### ### ###	60
BIG BOB	### ### ### ### ### II	27
FIZZ KING	### ### ### ### ### ### ### ### ### II	47

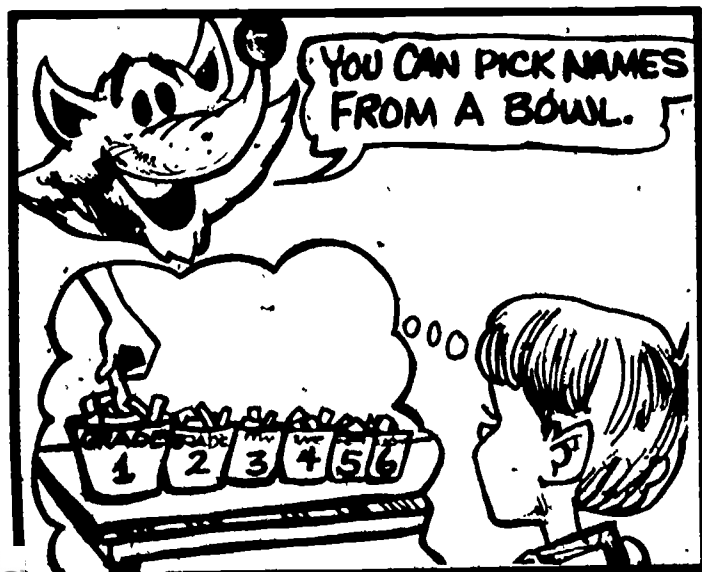
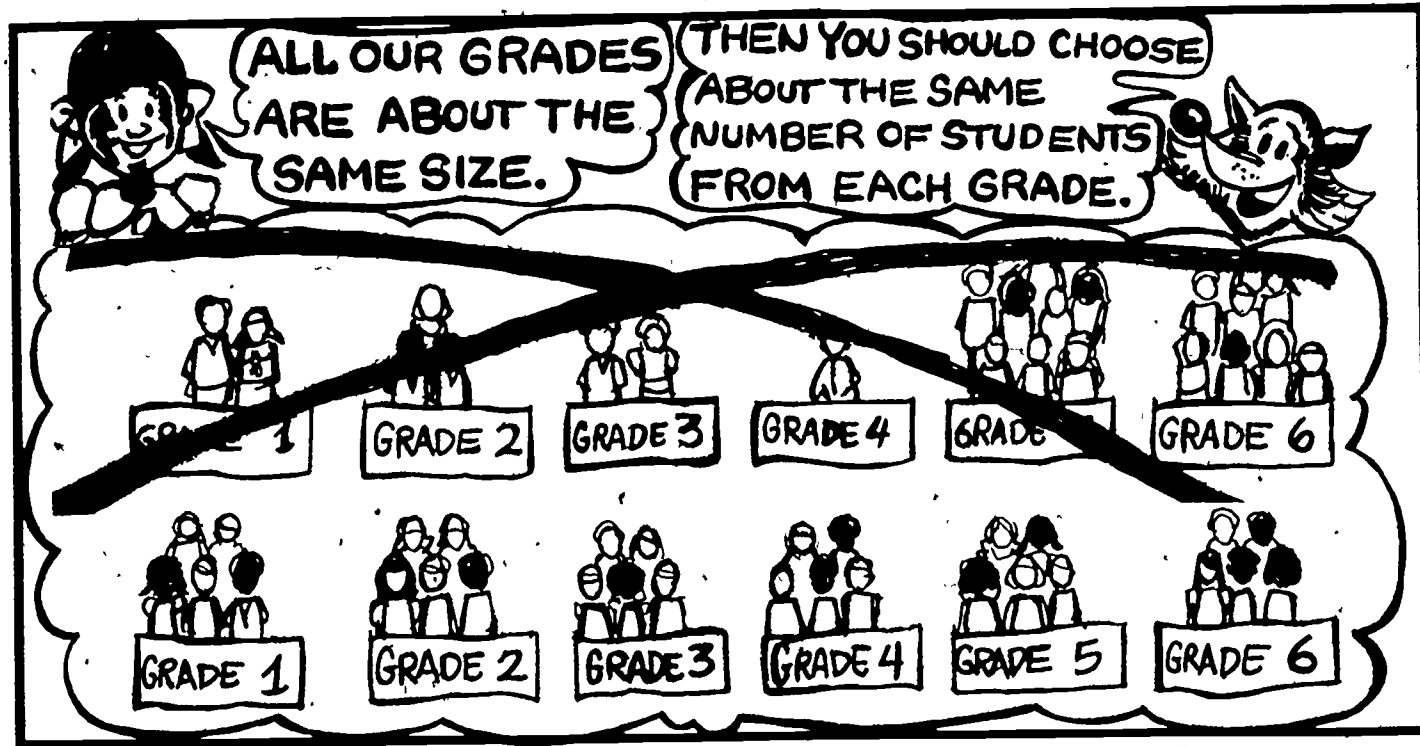
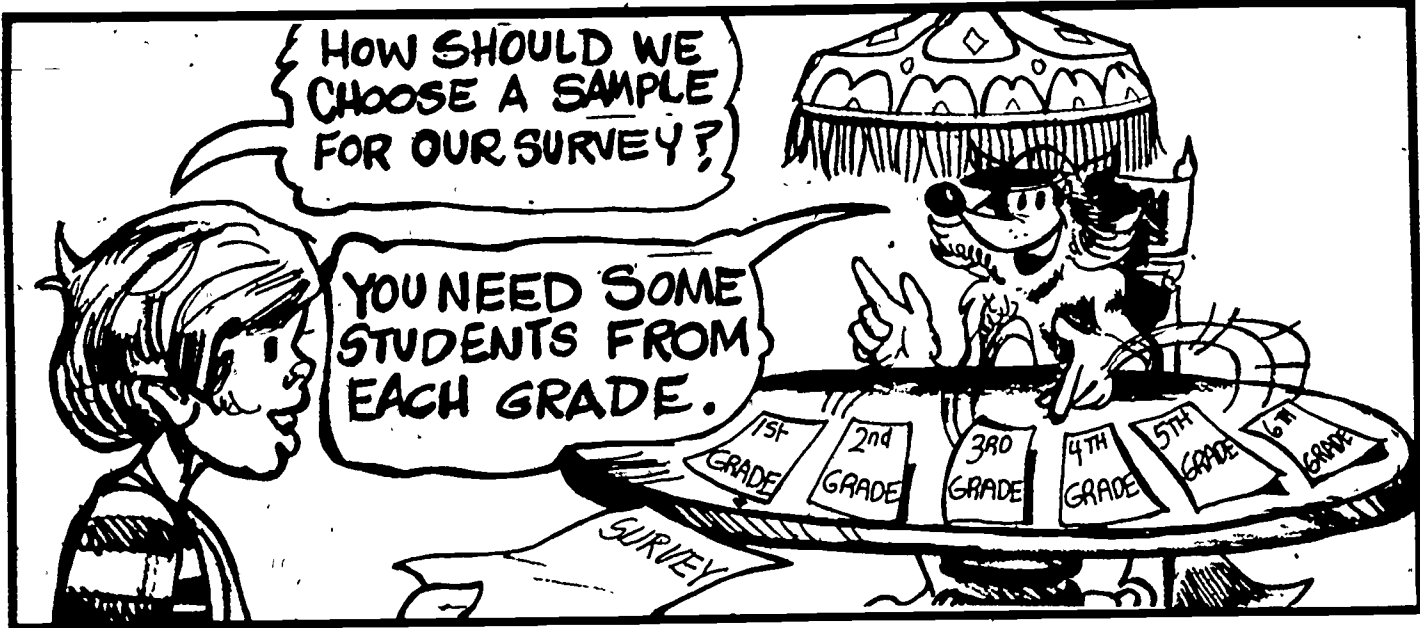
CHERRY BOMB GOT THE MOST VOTES.

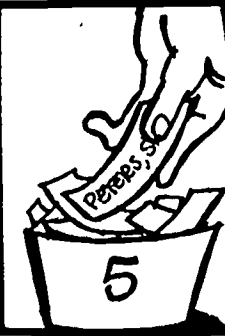
CHERRY BOMB WINS!

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HOW TO CHOOSE A SAMPLE

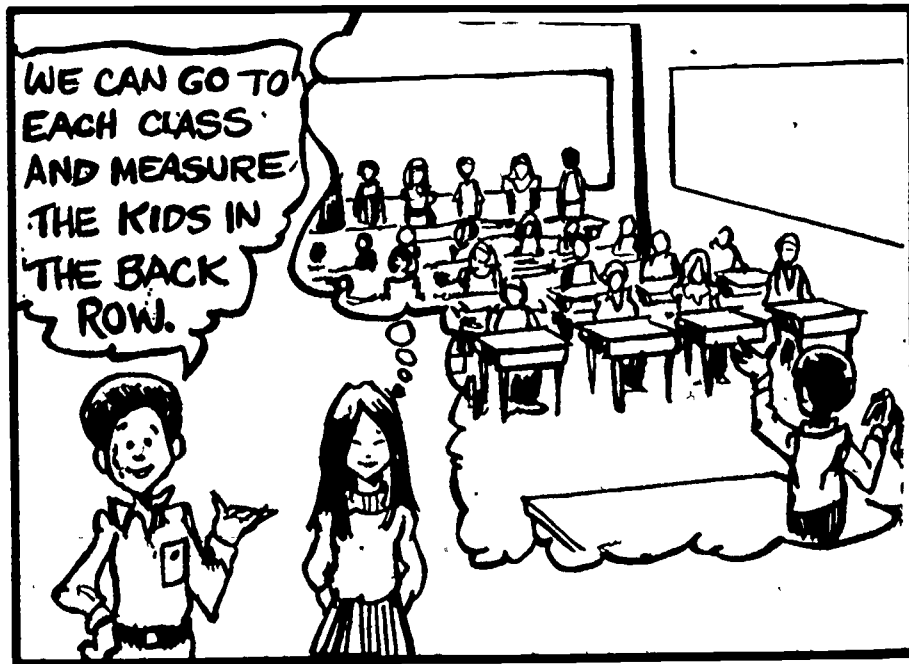
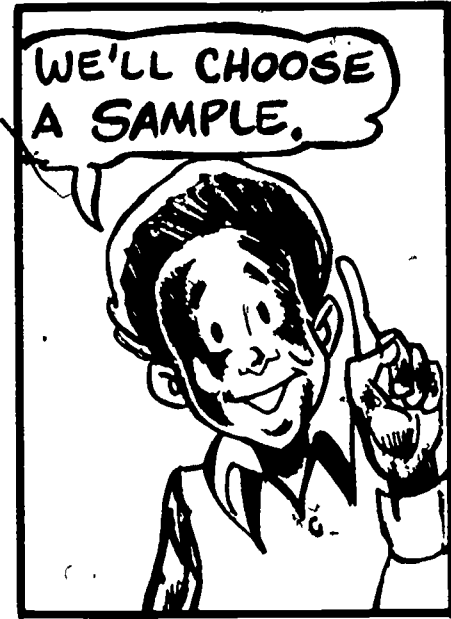
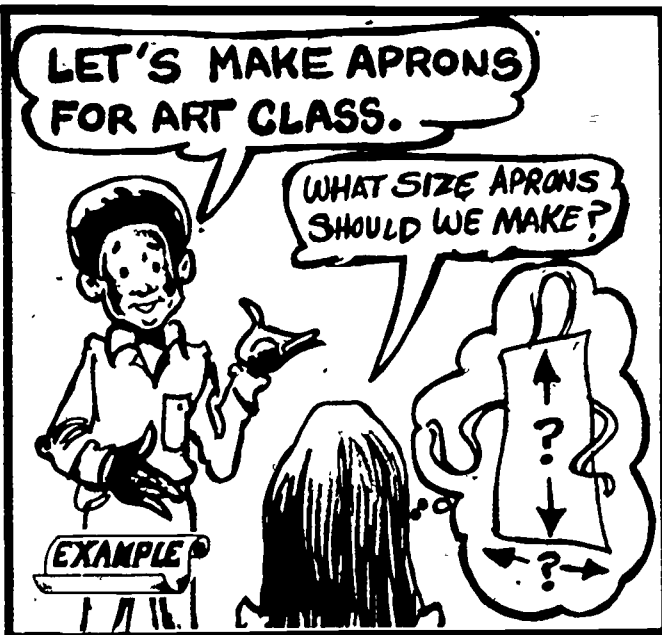


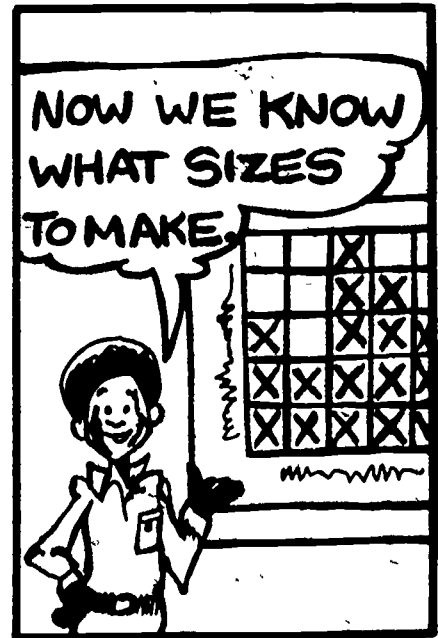
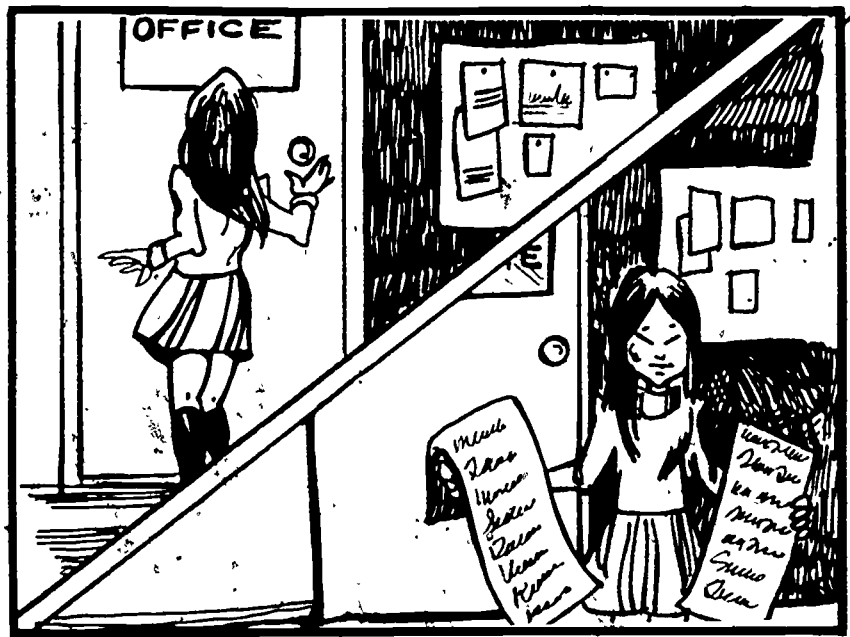
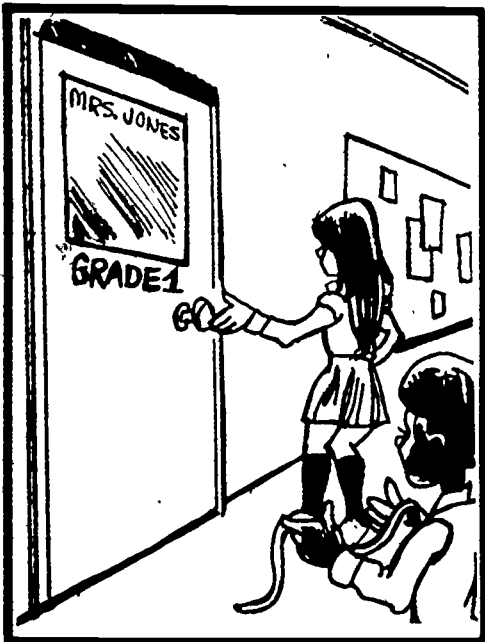


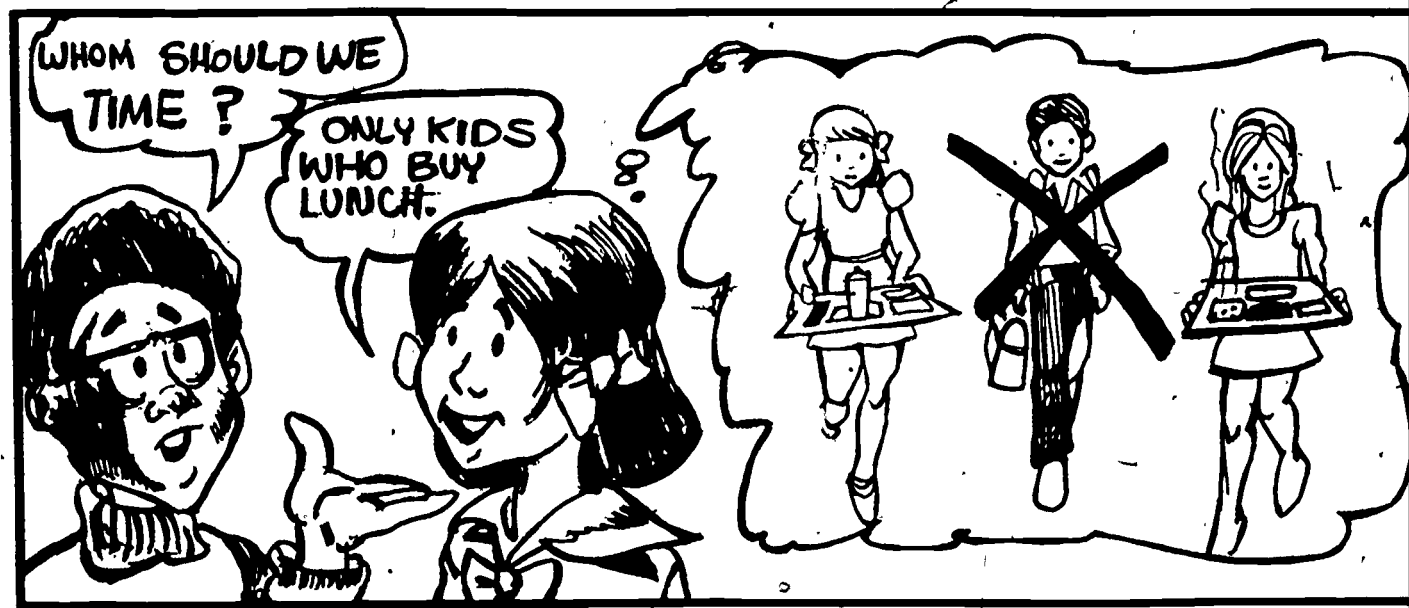
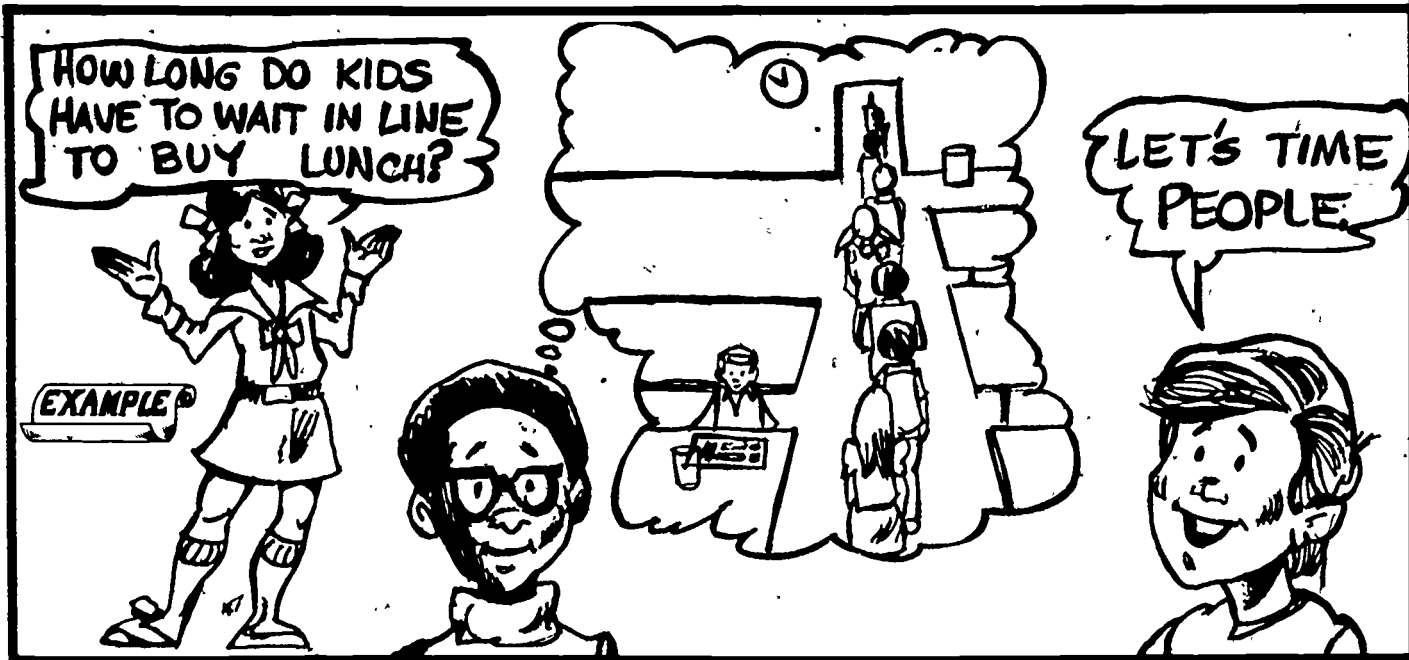


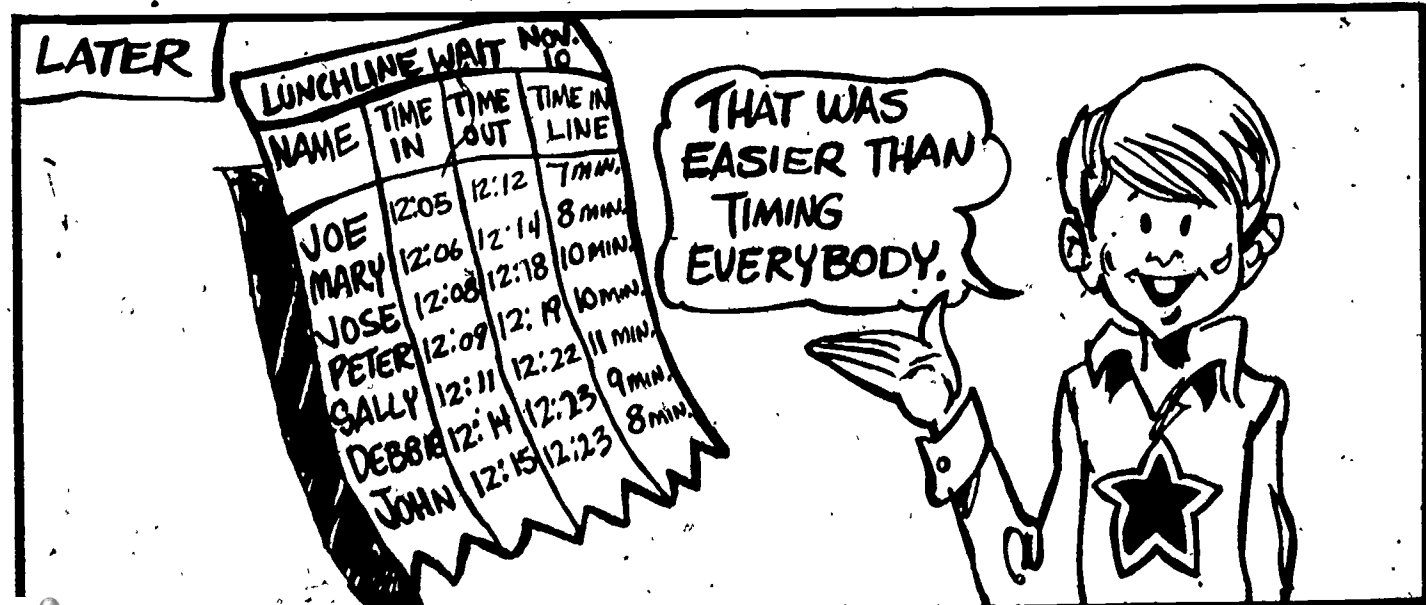
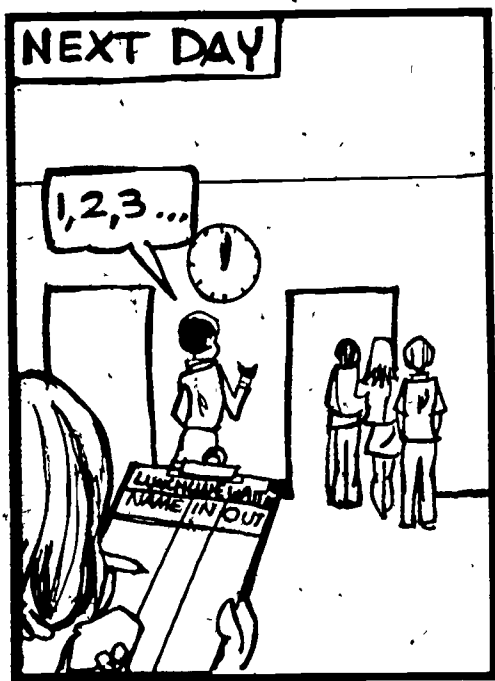
OUR SAMPLE		
GRADE 1 ARANO, JOSE ELIOT, FAITH YATES, MANUEL NEAL, MARTHA GALLO, CARL	GRADE 2 NELSON, KRIS FRENCH, DIANE DOWNING, SARA SAGAN, FRANCIS BANKS, CONNIE	GRADE 3 JOHNSON, MAY RYAN, BRIGET LEARY, THOMAS BERG, DINAH WHITE, NEIL
GRADE 4 JENKINS, RAY MYERS, BRENDA FORREST, JOHN ELMIRA, DONNA BERGEN, SAM	GRADE 5 PETERS, SUSAN BLACK, KEVIN HOBSON, GWEN RIVKIN, LARRY JACKSON, ALAN	GRADE 6 GRILLO, PERRY MEADOWS, TROY WATERS, LEE PARKER, DARIN WILKINS, HAROLD

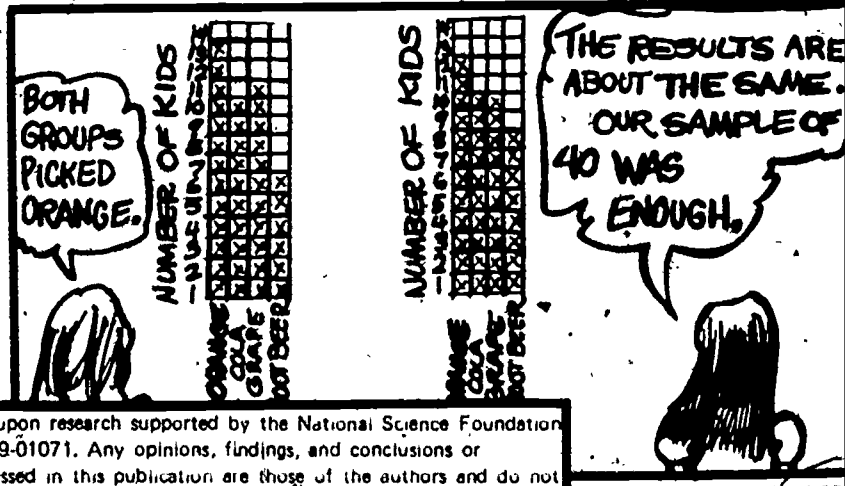
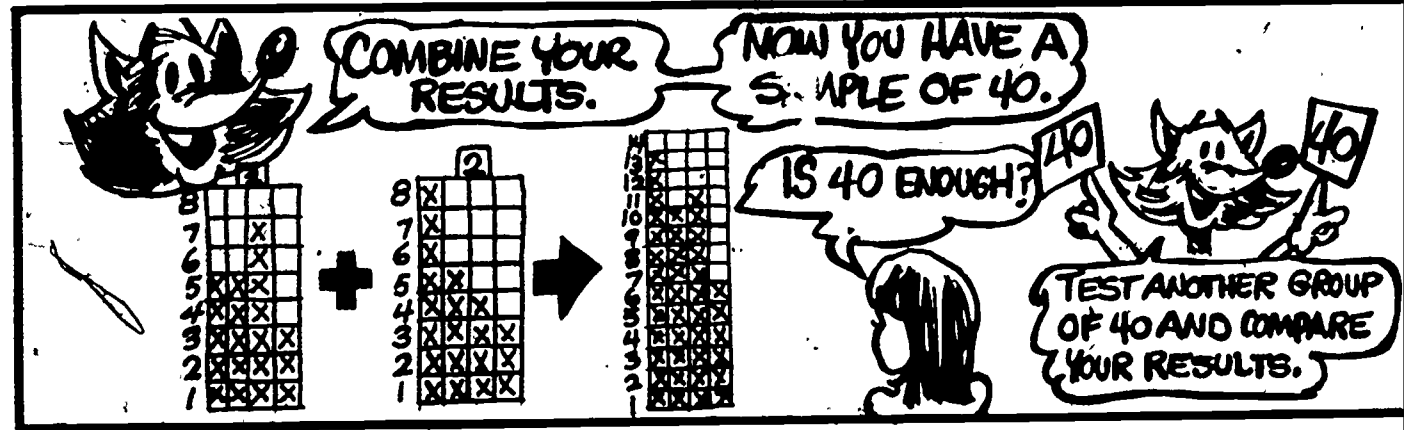
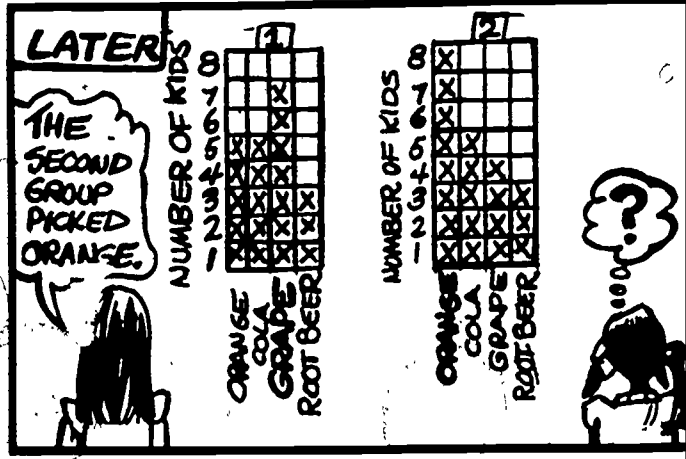
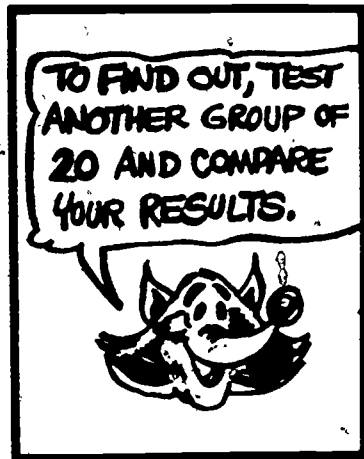
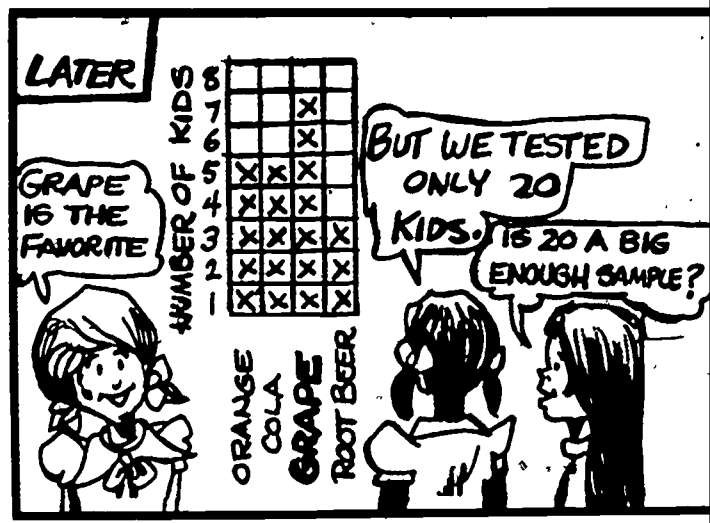
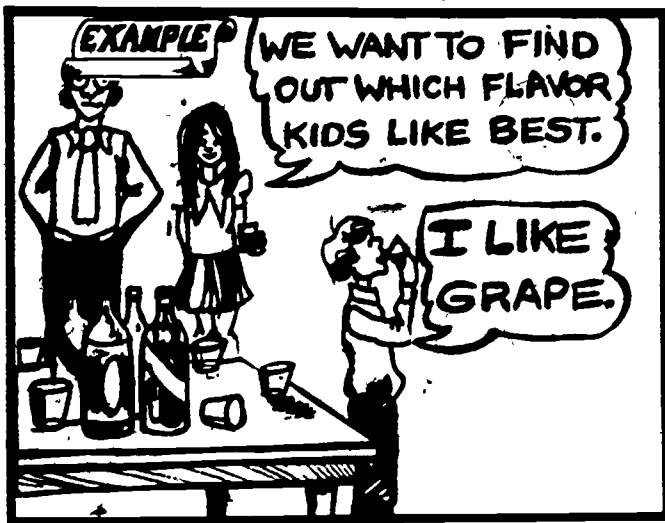












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