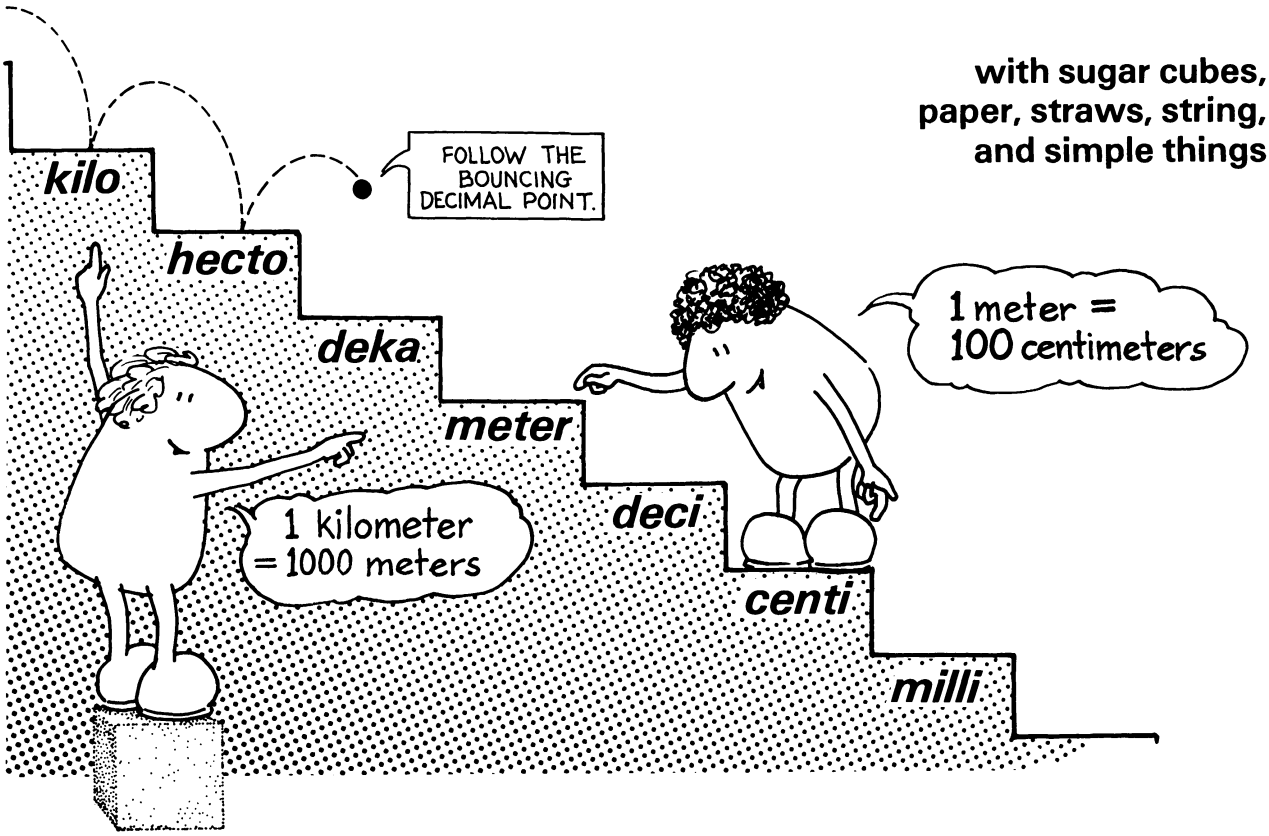
METRIC MEASURING

with sugar cubes, paper, straws, string, and simple things



SCIENCE WITH SIMPLE THINGS SERIES

Conceived and written by

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Illustrated by

PEG MARSON

TOPS LEARNING SYSTEMS

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CONTENTS

INTRODUCTION

TEACHING NOTES

REPRODUCIBLE STUDENT ACTIVITY SHEETS

GETTING IT TOGETHER

You hold within your hands a **complete teaching resource.** This book contains 20 reproducible hands-on science lessons together with all necessary information to help you teach each lesson successfully. All you add are the simple materials listed at the bottom of the page.

Look it over. This modest list contains everything you need to teach **every** lesson. Most of the materials you already have. Get the rest from your local supermarket or have your students bring the required items from home.

Each item is **listed in order** of first appearance in the student activities. To start getting it together, begin at the top of this list and work down. Gather everything at once, or collect materials as your students progress through each lesson.

Needed quantities depend on several factors: how you teach, how many students you have and how you organize them into activity groups. The numbers listed by each item correspond to the main teaching strategies in use today. Find the one that suits your teaching style and gather quantities accordingly.

From time to time the teaching notes contain suggestions for additional activities called EXTENSIONS. Materials for these optional experiments are not listed here nor under MATERIALS in the teaching notes. Read instead the extension itself to find out what new materials, if any, are required.

Once you collect the needed materials, place them on an equipment table or on open shelves that are accessible to your students. Items of special value may require a locked cabinet or a special check-out box near the teacher's desk.

Many of the materials you use in this module are used in other TOPS modules as well. As you continue with other TOPS modules and build your inventory, you'll find that gathering materials requires less and less effort!

Q_1

Resource Center
Activity Corner
Parent-Child Activity
Demonstrations

There is enough material so that 1 student or group of students can complete all the activities.

If you multiply Q_1 by 2, then there will be enough materials for two groups to work on the same activity or, perhaps, for three or more groups to simultaneously work on different activities.

Q_2

Individualized Approach

Initial activities require almost as much duplication as the traditional approach. But quantities soon drop off as groups "spread out" within the module, doing different activities at different times.

Students group naturally and informally according to academic or social preferences. Group membership tends to change as slower members fall back into slower groups and faster members move up into faster groups.

Quantities in Q_2 assume a total class size of about 30 students working in 10 groups of 3 each. Modify as necessary to fit your own particular requirements.

Q_3

Traditional Class Lessons

The teacher introduces each lesson to the class as a whole, then everyone does the activity together. Time at the end of the period is reserved for summarizing and reinforcing key concepts.

Quantities in Q_3 again assume a class size of about 30 students working in groups of 3. The numbers are sometimes higher than Q_2 because greater duplication of materials is needed when everyone works simultaneously on the same worksheet.

MATERIALS

Q_1	/Q_2	/Q_3	
10	/70	/70	sheets of lined notebook paper— square corners preferred
1	/9	/9	pairs of scissors
30	/270	/270	sugar cubes equivalent to 1 teaspoon — see teaching notes 1
1	/9	/9	rolls of cellophane tape
1 box			paper clips
1 roll / 2 rolls			adding machine tape
1 ball			kite string
1	/3	/9	hand calculators (optional)
3	/27	/27	3x5 index cards
1	/3	/9	large grocery bags
4	/36	/36	plastic soda straws
5	/40	/40	straight pins — see teaching notes 7
1	/30	/30	wooden spring-action clothespins
2	/35	/40	soda pop cans with pull tabs attached
10	/130	/150	small styrofoam cups
10	/100	/250	U.S. pennies minted after 1982
2 ea.	/9 ea.	/18 ea.	pre-1982 U.S. pennies plus U.S. nickles and quarters with any date
3	/12	/24	U.S. dimes
1 handful			uncooked long-grain rice
1	/3	/9	deep plastic tubs — dishwashing size
10	/200	/200	sheets of medium to heavy 8½x11 paper — see teaching notes 13
1 pkg.			table salt
1 pkg.			plastic sandwich bags
1	/3	/9	empty quart milk cartons
1 pkg.			granulated sugar
1	/6	/18	spoons
1 pkg.			corn meal

SEQUENCING ACTIVITIES

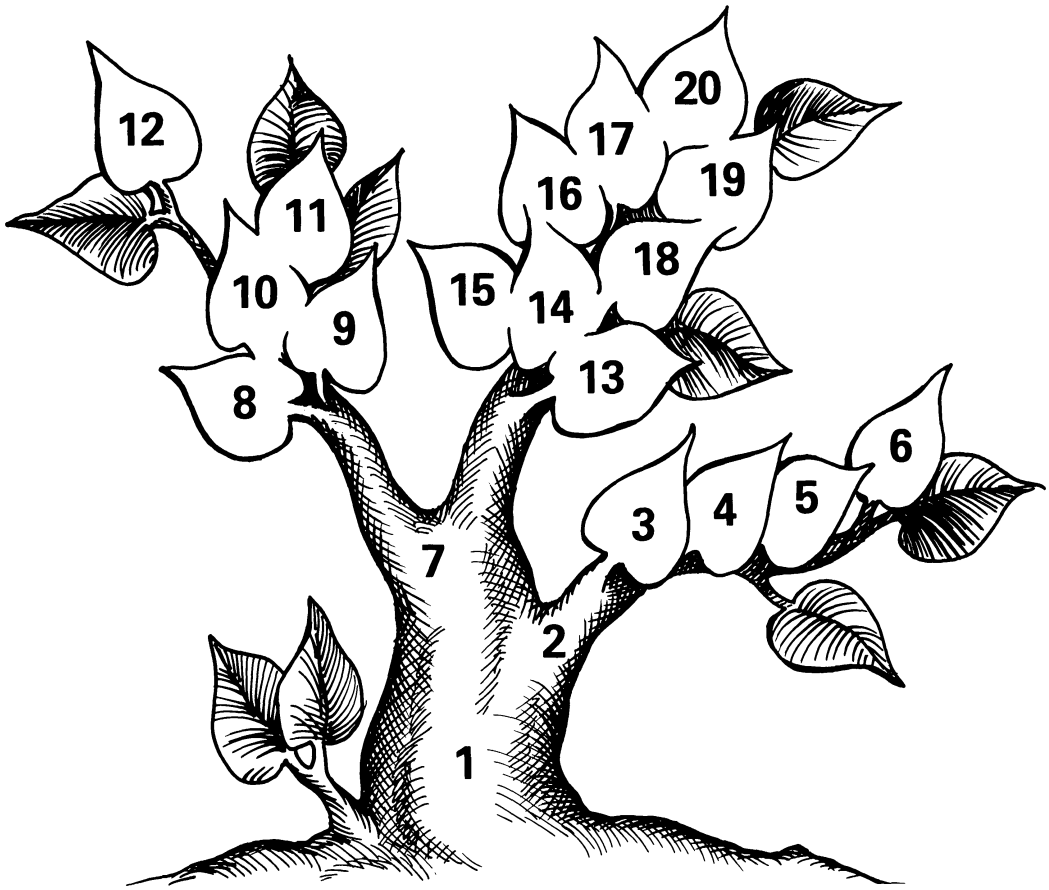
This logic tree shows how all the worksheets in this module tie together. In general, students begin at the trunk of the tree and work up through the related branches. As the diagram suggests, the way to upper level activities leads up from lower level activities.

At the teacher's discretion, certain activities can be omitted or sequences changed to meet specific class needs. The only activities that *must* be completed in sequence are indicated by leaves that are linked vertically with an *open space* in between. In this case the lower activity is a prerequisite to the upper.

When possible, students should complete the worksheets in numerical sequence, from 1 to 20. If time is short, however, or certain students need to catch up, you can use the logic tree to identify concept-related *horizontal* activities. Some of these might be omitted since they serve only to reinforce learned concepts rather than to introduce new ones.

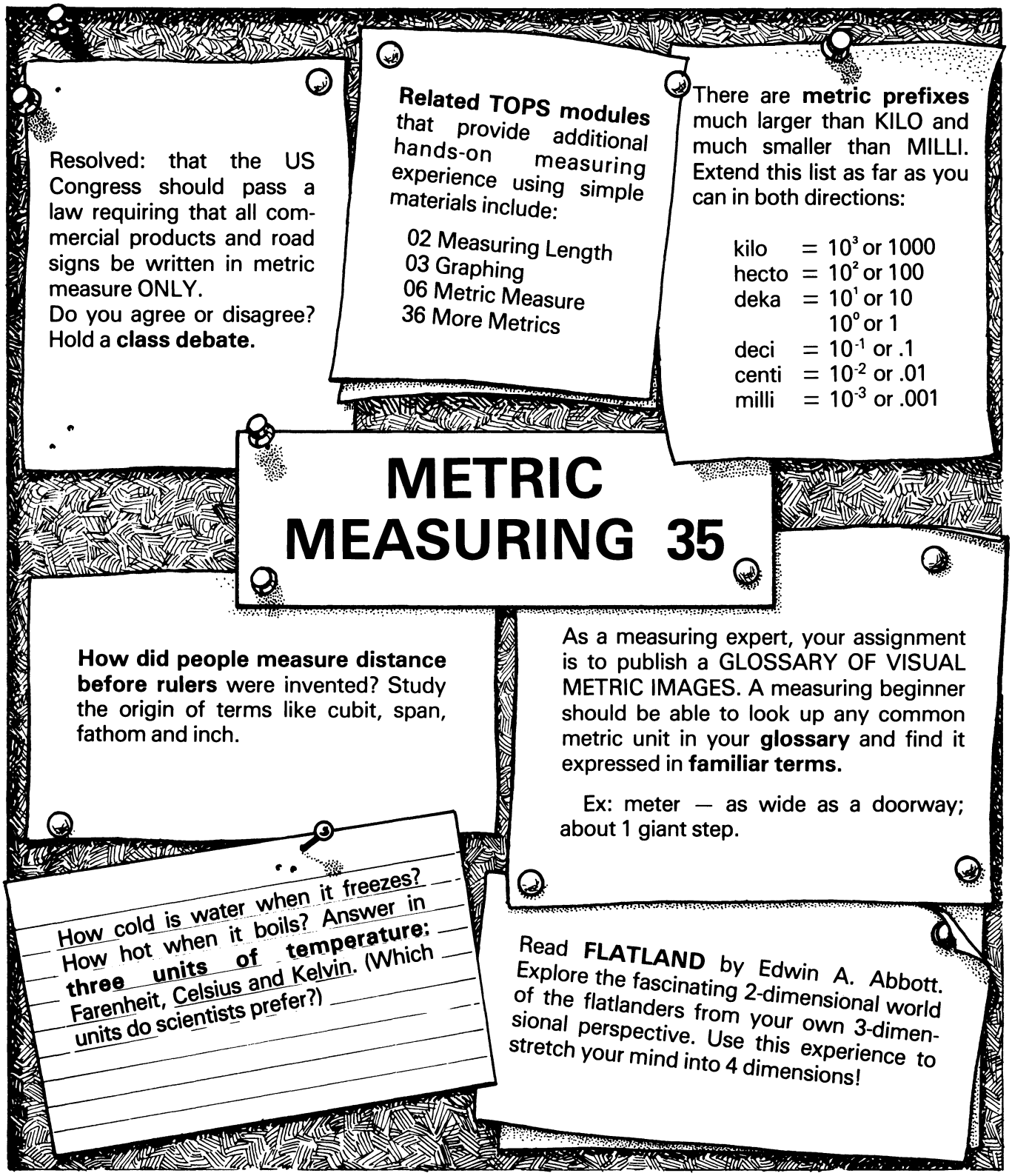
On the other hand, if students complete all the activities at a certain horizontal concept level, then experience difficulty at the next higher level, you might go back down the logic tree to have students repeat specific key activities for greater reinforcement.

For whatever reason, when you wish to make sequence changes, you'll find this logic tree a valuable reference. Parentheses in the upper right corner of each student worksheet allow you this flexibility: they are left blank so you can pencil in sequence numbers of your own choosing.



GAINING A WHOLE PERSPECTIVE

Science is an interconnected fabric of ideas woven into broad and harmonious patterns. Use "Extensions" in the teaching notes plus the outline presented below to help your students grasp the big ideas–to appreciate the fabric of science as a unified whole.

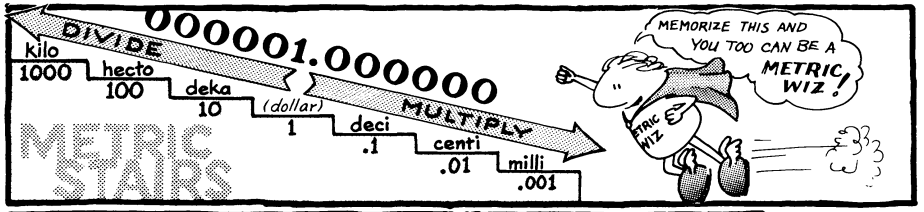


Task Objective (TO) understand the language of metric prefixes. To learn how to make metric conversions by moving the decimal point.

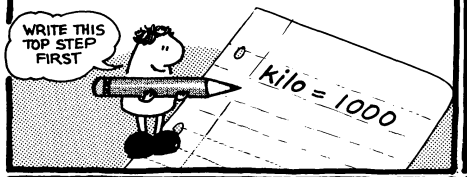
NAME: CLASS:

Metric Measuring( )$_1$

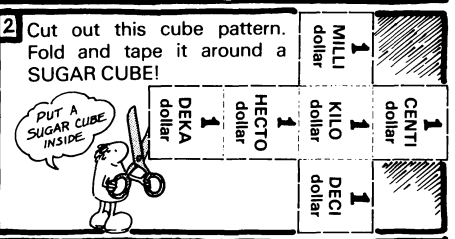
METRIC STAIRS (1)



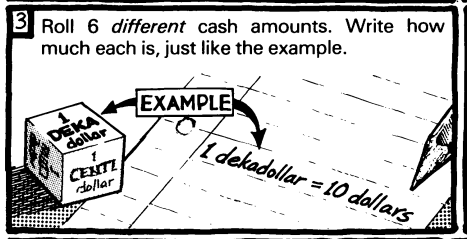
1 On a piece of lined notebook paper, write 6 equations, 1 for each metric step.



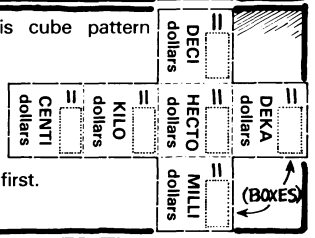
2 Cut out this cube pattern. Fold and tape it around a SUGAR CUBE!



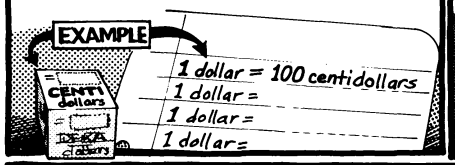
3 Roll 6 *different* cash amounts. Write how much each is, just like the example.



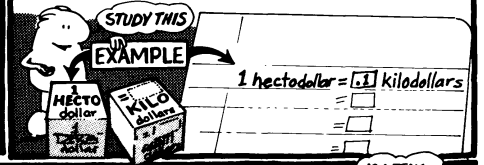
4 Cut out this cube pattern with boxes. Fold and tape it around a sugar cube like you did with the first.



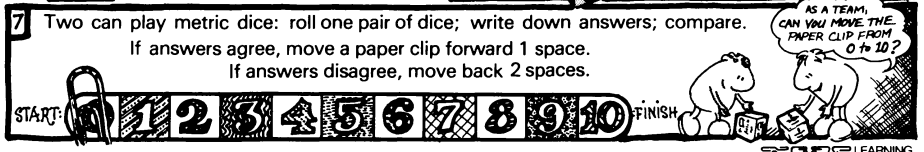
5 Throw this "box" cube 8 times. Each time it lands find the missing number that *makes one dollar.* (STUDY THE EXAMPLE!)



6 Toss *both* cubes 12 times. Copy each equation (first the *"1"* cube, then the *"box"* cube), then find the missing number.



7 Two can play metric dice: roll one pair of dice; write down answers; compare.
If answers agree, move a paper clip forward 1 space.
If answers disagree, move back 2 spaces.



TOPS LEARNING SYSTEMS

Why has almost the whole world, even the English adopted the metric system? That's not difficult to understand. Converting from one metric unit into another is as easy as moving a decimal point. (They hardly weigh anything at all!)

Why is only the United States still clinging to 12 inches make a foot, 3 feet make a yard, 1,760 yards make a mile . . . ? That's hard to fathom. In or out of the U.S., almost anyone who understands metrics will prefer using metrics.

To begin to understand, let's make sure your class appreciates the computing power of decimals. Turn to the DECIMAL FLOW CHART between Teaching Notes 3 and 4.

1. Kilo is another way of saying 1,000, hecto means 100 and so on, right down the stairs. Notice that the "ones" step has no prefix at all. Here you can substitute any kind of measure you want—dollars, meters, feet, apples, elephants—anything. Thus, a ***deka***elephant means ***10*** elephants, probably more than you'd want to feed; a ***deci***foot means ***1/10*** foot, a little longer than an inch.

3. You translate prefixes into numbers again, this time within the context of dollars. The cube is not really needed here, but we ask students to throw it anyway. This helps them learn how to write equations from the top of the cube.

5. Your students are going to need lots of help to make it through this step. For the first time they must convert from one set of units (dollars) into another set of units (whatever turns up their on their cube). So, call a temporary halt to class activity and hold this class discussion:

Metric stairs help you change one unit of measure into another without losing or gaining anything. To maintain this equality, just follow the arrows and move the decimal point accordingly.

To go ***down*** the stairs and stay equal, move the decimal to the ***right*** (multiply) in the same direction you descend. Thus,

1. dollar =
10. decidollars =
100. centidollars =
1000. millidollars.

In like manner, to go ***up*** the stairs and stay equal, move the decimal to the ***left*** (divide) in the same direction you climb. Thus,

.001 kilodollars =
.01 hectodollars =
.1 dekadollars =
1. dollar.

Use as many blackboard examples as necessary to reinforce this division-multiplication process.

Teaching Notes 1

6. By tossing ***both*** cubes your students will learn they can use the decimal stairs to find equivalents from ***any*** step (not just the middle one) to any other step.

The process is always the same: begin with what you're given, then multiply down or divide up, moving the decimal right or left until you reach the unit you want. As your students repeat this process over and over, they will soon forget about the staircase analogy. Of course there are 100 centimeters in a meter. They'll say it's obvious!

7. This a cooperative, self-checking metric conversion game. As your students play it, metric logic will become an integral part of their thinking.

Worksheet Answers

1. kilo = 1000 deci = .1
hecto = 100 centi = .01
deka = 10 milli = .001

3. 1 kilodollar = $1,000 1 decidollar = 10¢
1 hectodollar = $100 1 centidollar = 1¢
1 dekadollar = $10 1 millidollar = 1/10¢

5. $1 = .001 kilodollars $1 = 10 decidollars
$1 = .01 hectodollars $1 = 100 centidollars
$1 = .1 dekadollars $1 = 1000 millidollars

6. There are 36 possible combinations that can turn up on the cubes. Here are just a few.
1 kilodollar = 1,000,000 millidollars
1 hectodollar = 10,000 centidollars
1 millidollar = .000001 kilodollars
1 centidollar = .0001 hectodollars
1 dekadollar = 1 dekadollar

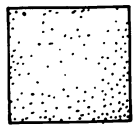
Evaluation

Q: Draw a metric staircase with 7 steps. Label all numbers and prefixes.

A: Students should draw and label a staircase similar to the one on their worksheet.

Materials

- ☐ Lined notebook paper.
- ☐ Scissors.
- ☐ Sugar cubes. You must use cube shapes (not bricks) equivalent to 1 teaspoon each (not ½ teaspoon). C and H brand "cubelets" are available in the West; other brands in the East. Match yours against this actual-size pattern. If you can't locate teaspoon cubes in your area, order direct from TOPS. We'll ship 252 cubes per 2 lb box (specify quantity), and bill you our cost plus shipping and handling.
- ☐ Cellophane tape.
- ☐ A paper clip.



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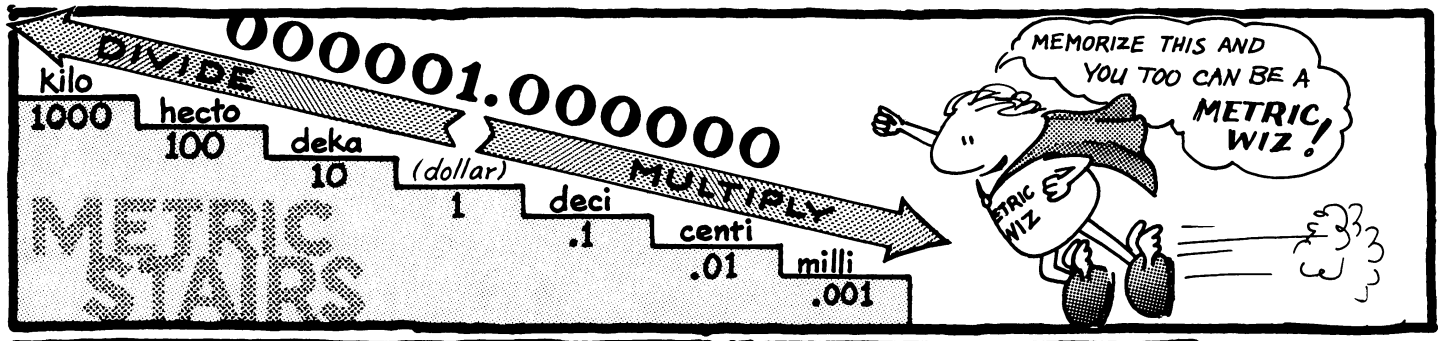

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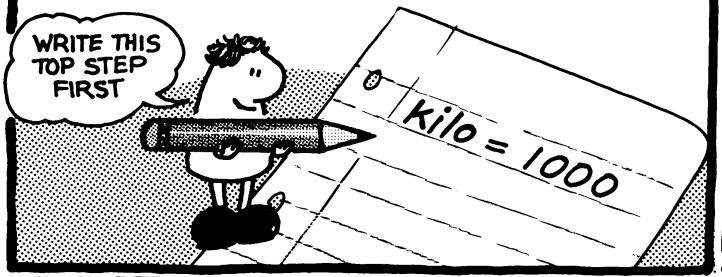

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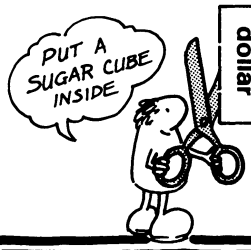

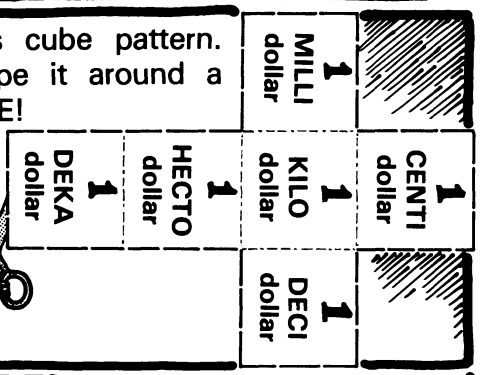

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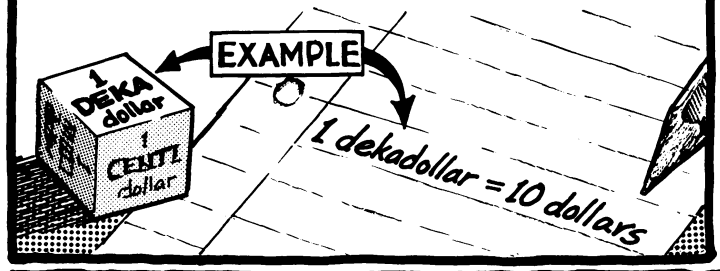

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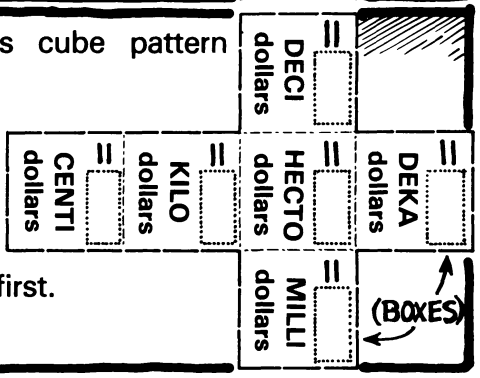

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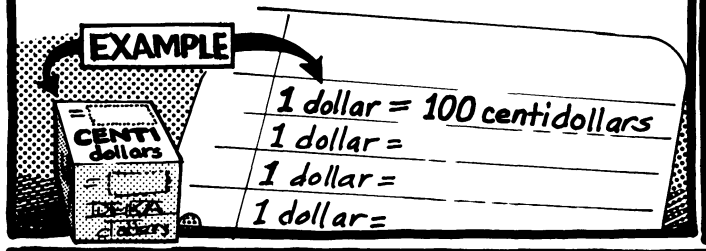

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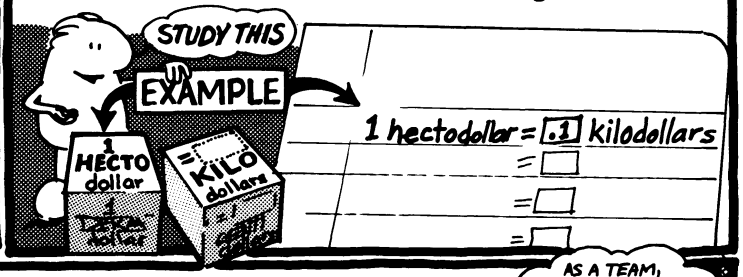

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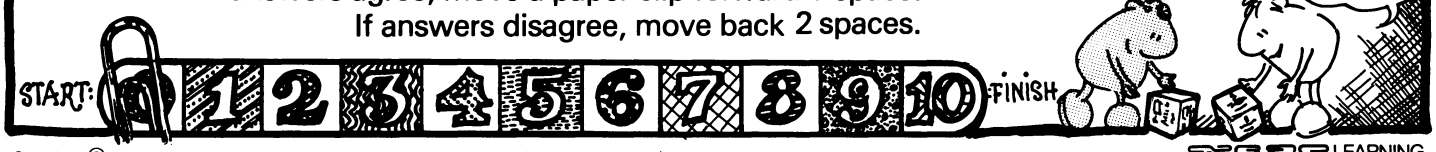

TOPS LEARNING SYSTEMS