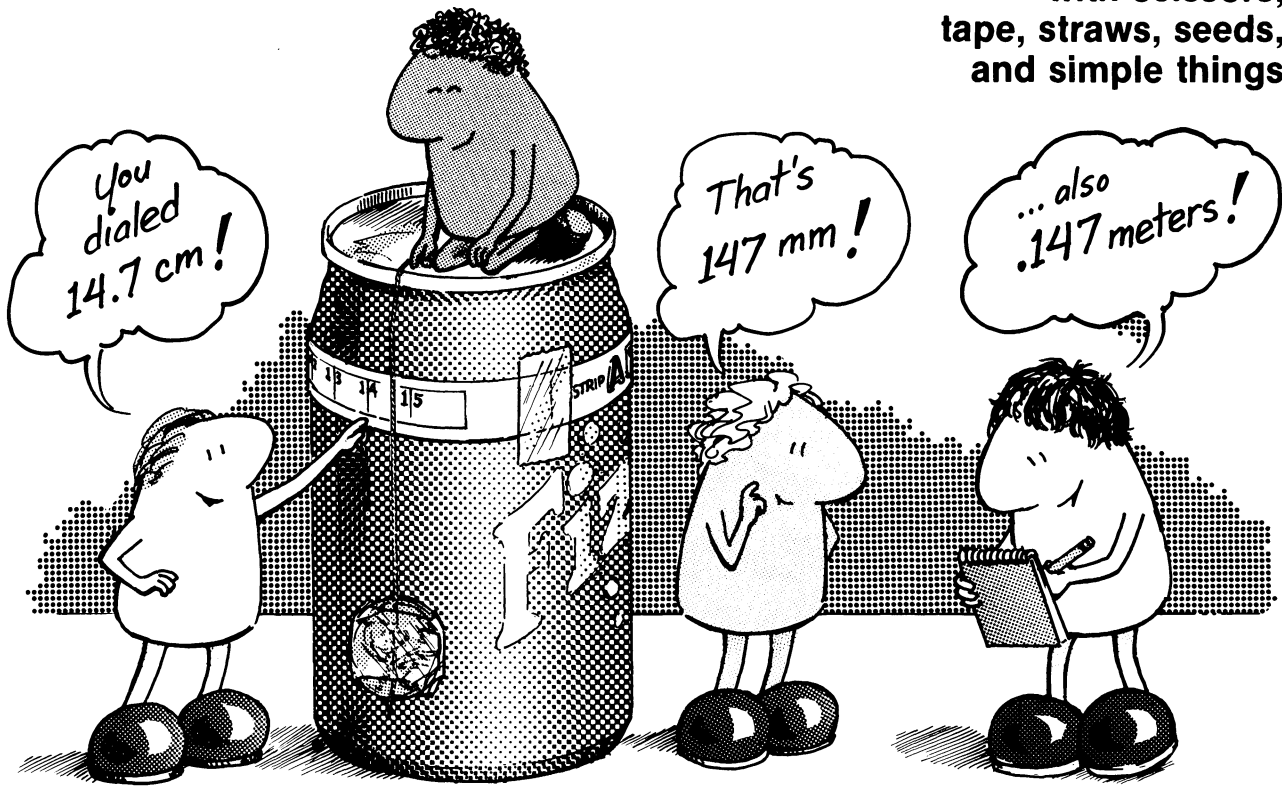
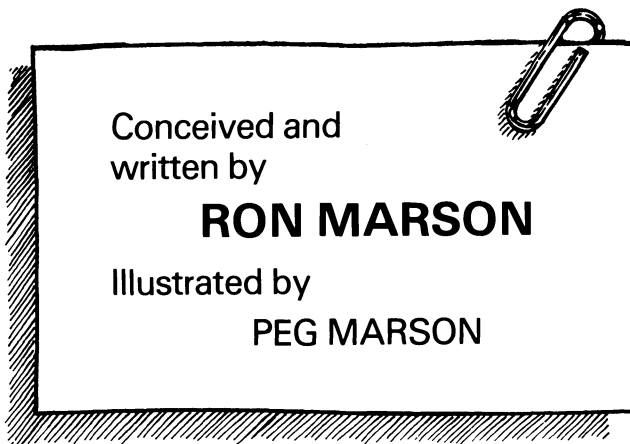


# MORE METRICS

with scissors,  
tape, straws, seeds,  
and simple things



## SCIENCE WITH SIMPLE THINGS SERIES



**TOPS** LEARNING  
SYSTEMS

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## 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 3 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 <sub>1</sub>	Q <sub>2</sub>	Q <sub>3</sub>
<p><b>Resource Center Activity Corner Parent-Child Activity Demonstrations</b></p> <p>There is enough material so that 1 student or group of students can complete all the activities.</p> <p>If you multiply Q<sub>1</sub> 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.</p>	<p><b>Individualized Approach</b></p> <p>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.</p> <p>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.</p> <p>Quantities in Q<sub>2</sub> 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.</p>	<p><b>Traditional Class Lessons</b></p> <p>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.</p> <p>Quantities in Q<sub>3</sub> again assume a class size of about 30 students working in groups of 3. The numbers are sometimes higher than Q<sub>2</sub> because greater duplication of materials is needed when everyone works simultaneously on the same worksheet.</p>

### MATERIALS

	Q <sub>1</sub>	/Q <sub>2</sub>	/Q <sub>3</sub>		Q <sub>1</sub>	/Q <sub>2</sub>	/Q <sub>3</sub>	
	1	/30	/30	sheets of lined notebook paper	1	/20	/30	staples
	1	/20	/30	pairs of scissors	3	/90	/90	disposable cups - paper or styrofoam - 6 oz. or more
	1	/30	/30	wooden spring-action clothespins	1	/10	/10	sources of water - from a sink or pitcher
	1	roll		masking tape	1	/4	/10	teaspoons - should approximate standard teaspoon capacity
	3	/1 box		paper clips	1	sheet		aluminum foil
	1	/30	/30	soda pop cans	1	bottle		plain uncoated aspirin - 5 grain tablets
	1	/10	10	rolls cellophane tape	several			pkgs. candy, nuts or raisins - see teaching notes 20
	1	spool		thread				
	2	/50	/60	pennies				
	2	/50	/60	3x5 index cards				
	1	piece		butcher paper (optional - see teaching notes 13)				
	4	/150	/150	plastic soda straws				
	2	/60	/60	long straight pins				
	1	pkg. ea.		pinto beans, popcorn, lentils, long-grained white rice				

# CONTENTS

## **PART I**

### INTRODUCTION

- A Getting It Together — Materials
- B Sequencing Activities
- C Building an Effective Teaching Strategy
- D Diary of a Teacher
- E Long Range Objectives
- F Gaining a Whole Perspective

## **PART II**

### TEACHING NOTES

- |                              |                          |
|------------------------------|--------------------------|
| 1. Milli, Centi, Deci & More | 11. Line Measure         |
| 2. Kilometer Rule            | 12. Meter Measure        |
| 3. Metric Squares            | 13. Body Measure         |
| 4. Face-Up                   | 14. Build a Microbalance |
| 5. Metric Rummy              | 15. Seeds and Such       |
| 6. The Last Digit            | 16. Milligram Masses     |
| 7. Certain and Uncertain     | 17. Seed Graphs          |
| 8. A Second Look             | 18. Water Domes          |
| 9. Dial A Measure            | 19. Metric Drips         |
| 10. Agree/Disagree           | 20. Consumer Science     |

## **PART III**

### REPRODUCIBLE STUDENT ACTIVITY SHEETS

## SEQUENCING ACTIVITIES

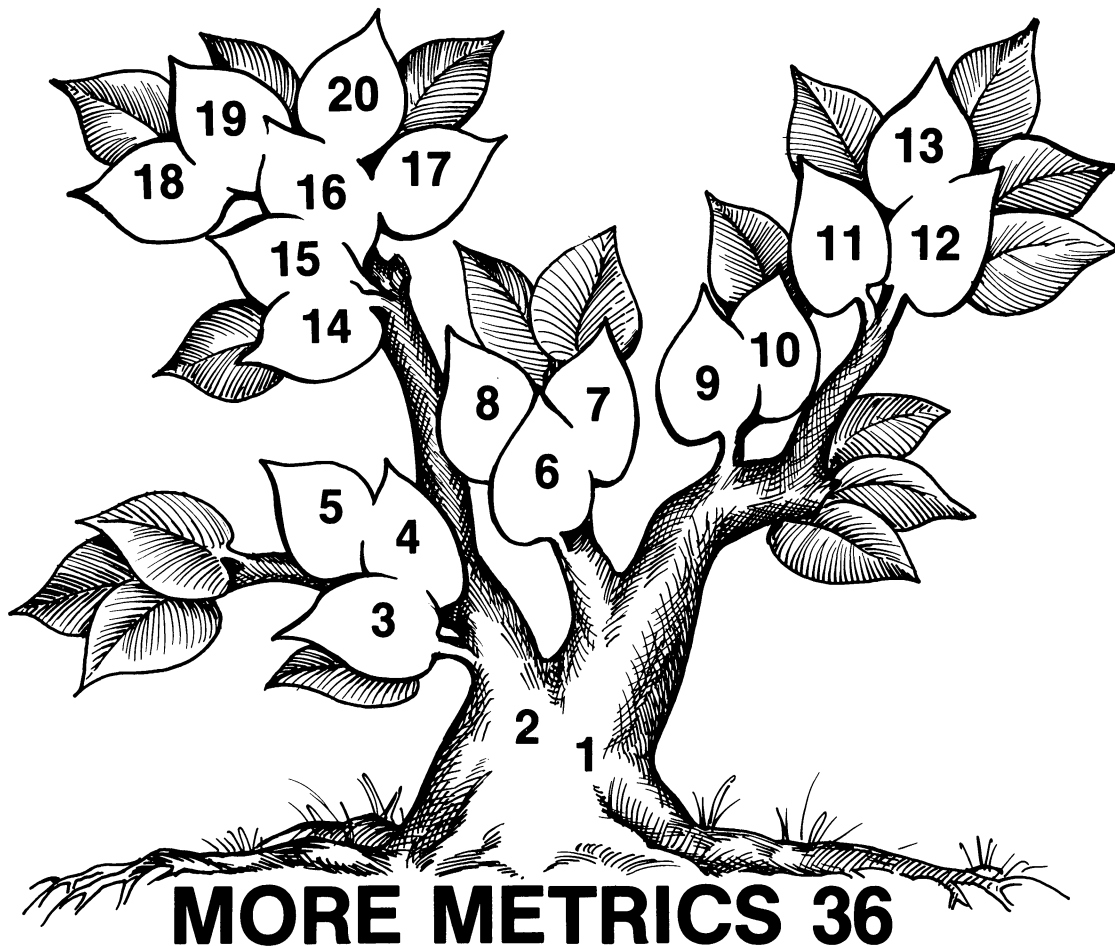
This logic tree shows how all the worksheets in this module tie together. In general, students begin at the trunk of the tree and work up through the related branches. As the diagram suggests, the way to upper level activities leads up from lower level activities.

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 unified whole.

Imagine that you are living long, long ago. Nobody in your culture has ever dreamed about measuring anything before. Write a story telling how you **invented the process of measuring for the first time.**

How long is a meter? Who first decided? How is it defined today? Go to the library to **research the history of the meter.**

**Related TOPS modules** that provide additional hands-on measuring experience using simple materials include:

- 02 Measuring Length
- 03 Graphing
- 06 Metric Measure
- 35 Metric Measuring

## MORE METRICS 36

Have inventors ever been able to improve upon the accuracy of a ruler? Write a report on the **vernier caliper.**

Can you **list 100 measuring units that are all different?** Go for a record! (No fair writing the same unit with a different prefix. If you list “meter” you can’t list “centimeter”. If you write “inch” you can’t write “half inch”.)

An **astronomer, a surveyor, and a pharmacist** are all together at a party “talking shop”. What kind of confusion might result? Write a dialogue.

How big is our planet? How far around? What is the capacity of our oceans? **Write a book of Earth Facts.** Include units of measure that are easy to visualize and understand.

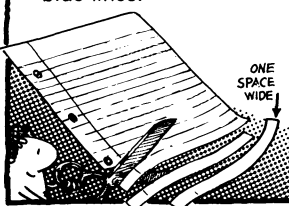
**Task Objective (TO)** understand metric prefixes as simple multiples of ten. To estimate numbers by comparing lengths.

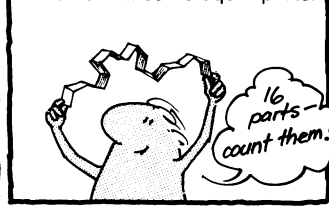
NAME: \_\_\_\_\_

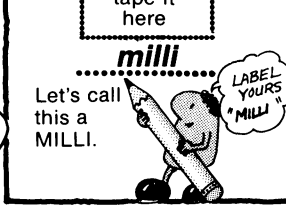

CLASS: \_\_\_\_\_

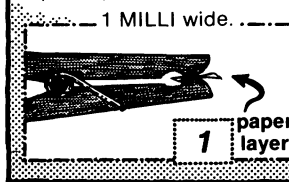
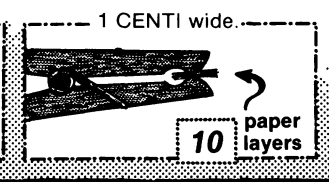
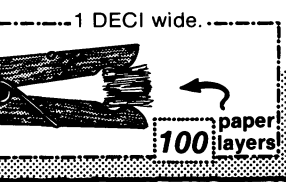
More Metrics ( )

**MILLI, CENTI, DECI & MORE**

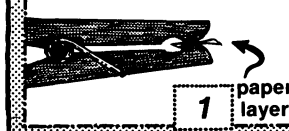
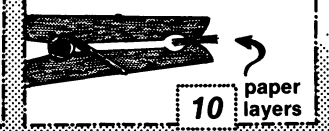

**1** Cut off 7 strips of notebook paper along the blue lines. 


**2** Fold one strip in half 4 times, then unfold it. This makes 16 equal parts. 


**3** Cut off just 1/16 and  tape it here  
.....**milli**.....  
Let's call this a **MILLI**. 

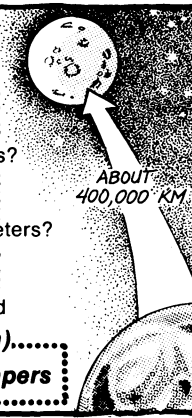
**4** One **milli** is only one paper thick. Open a clothespin clip ...  Ten **milli** make one **centi**. Now open your clip ...  Ten **centi** make one **deci**. Now open your clip ... 

----- 1 **MILLI** wide. ----- 1 **CENTI** wide. ----- 1 **DECI** wide.

 **1** paper layer  **10** paper layers  **100** paper layers

**5** Draw a line showing how far 1000 layers will reach. \_\_\_\_\_  
(approximately 8 cm) 

**6** Estimate how many sheets of paper you can stack from floor to ceiling. Write how you did it. \_\_\_\_\_  
**Cut a strip of paper to size. Use it to count up the wall 1000 sheets at a time.**  
**A ceiling 2½ m high contains roughly 30,000 sheets.** 

**7 Stack to the moon?**  
If 1,000 papers stack about 8 cm, how many reach 4 cm?  
(Half the distance) **500 papers**  
How many sheets reach 4 meters?  
(100 times farther) **50,000 papers**  
How many sheets reach 4 kilometers?  
(1,000 times farther) **50,000,000 papers**  
How many sheets of paper would stack to the moon?  
(100,000 times farther) **5,000,000,000 papers** (5 trillion) 

**More Metrics 36** is all new — totally different from **Metric Measuring 35**. It provides an additional 20 lessons that will help your students understand this all-important measuring system. Like all modules in our Science With Simple Things series, **More Metrics 36** has no prerequisites. We always start with basic principles and build from there. You can teach this module independently or as a sequel to **Metric Measuring 35**.

4b. To make 10 layers, it's much easier to fold 1 strip into 10 parts than to cut each piece individually.



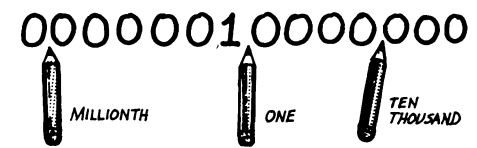
Less coordinated students may need help. These many layers tend to "squirt" out of the clothespin jaws unless placed firmly inside.

5. Notebook paper is generally quite thin. We estimate that 1000 sheets will stack about 8 cm high. Your students may draw lines longer than this because they fail to compensate for the folds in the paper that flare out on each side.



6. Allow each student to follow an independent strategy. Some may cut paper to size; others will want to use string or thread. Mathematicians might measure the wall, then divide by the length of the line.

7. To solve this problem, it is essential that students understand decimal multiplication and division. Write a row of zeros on your blackboard with a "1" in the middle. Use a pencil to place your decimal point. Ask your students to count in unison as you move the pencil right or left. Your class should chorus "one, ten, hundred, thousand ..." as you multiply right and, "one, tenth, hundredth, thousandth ..." as you divide left.

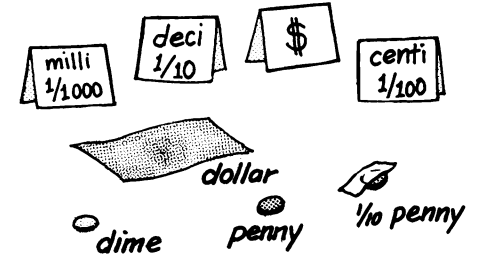


**Discussion**

If milli, centi and deci are unfamiliar terms, relate them to something that is familiar — money.

**Teaching Notes 1**

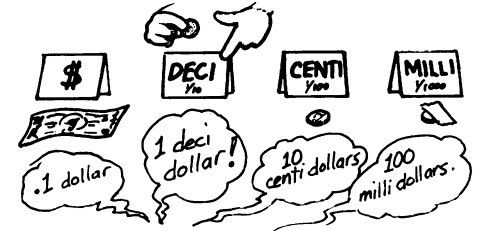
Write this metric vocabulary, and a dollar sign, on 4 index cards folded to stand upright. Use large bold lettering, visible from the back of your room. Display these cards on a table (in no particular order) together with a dollar bill, a dime, a penny and 1/10 penny. (Represent 1/10 penny by covering all but a tenth of it with masking tape.)



Match the dollar bill with the dollar sign. Then challenge your class to pair the other 3 coins with their correct prefix classification.

\$	deci	centi	milli
dollar	dime	penny	1/10 penny

Next, place all money and signs in descending order. Holding up any one, ask your class to name the other 3 in terms of the one in your hand.



Repeat for all 4 denominations.

**Evaluation**

- Q.** If this line measures a "centi". \_\_\_\_\_
- Draw a "milli" here: \_\_\_\_\_
  - Draw a "deci" here: \_\_\_\_\_
- A:** a. (Students should draw a line ten times shorter than the "centi" line above.)  
b. (Students should draw a line ten times longer than the "centi" line above.)

**Materials**

- Lined notebook paper.
- Scissors.
- Clear tape.
- A clothespin.
- A sturdy table or chair. Your students will need to reach the ceiling safely in step 6



# MILLI, CENTI, DECI & MORE

**1** Cut off 7 strips of notebook paper along the blue lines.

**2** Fold one strip in half 4 times, then unfold it. This makes 16 equal parts.

**3** Cut off just 1/16 and tape it here

**4** One *milli* is only one paper thick. Open a clothespin clip . . .

Ten *milli* make one *centi*. Now open your clip . . .

Ten *centi* make one *deci*. Now open your clip . . .

**5** Draw a line showing how far 1000 layers will reach.

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**7** Stack to the moon?

If 1,000 papers stack about 8 cm, how many reach 4 cm?

(Half the distance)

How many sheets reach 4 meters?

(100 times farther)

How many sheets reach 4 kilometers?

(1,000 times farther)

How many sheets of paper would stack to the moon?

(100,000 times farther)