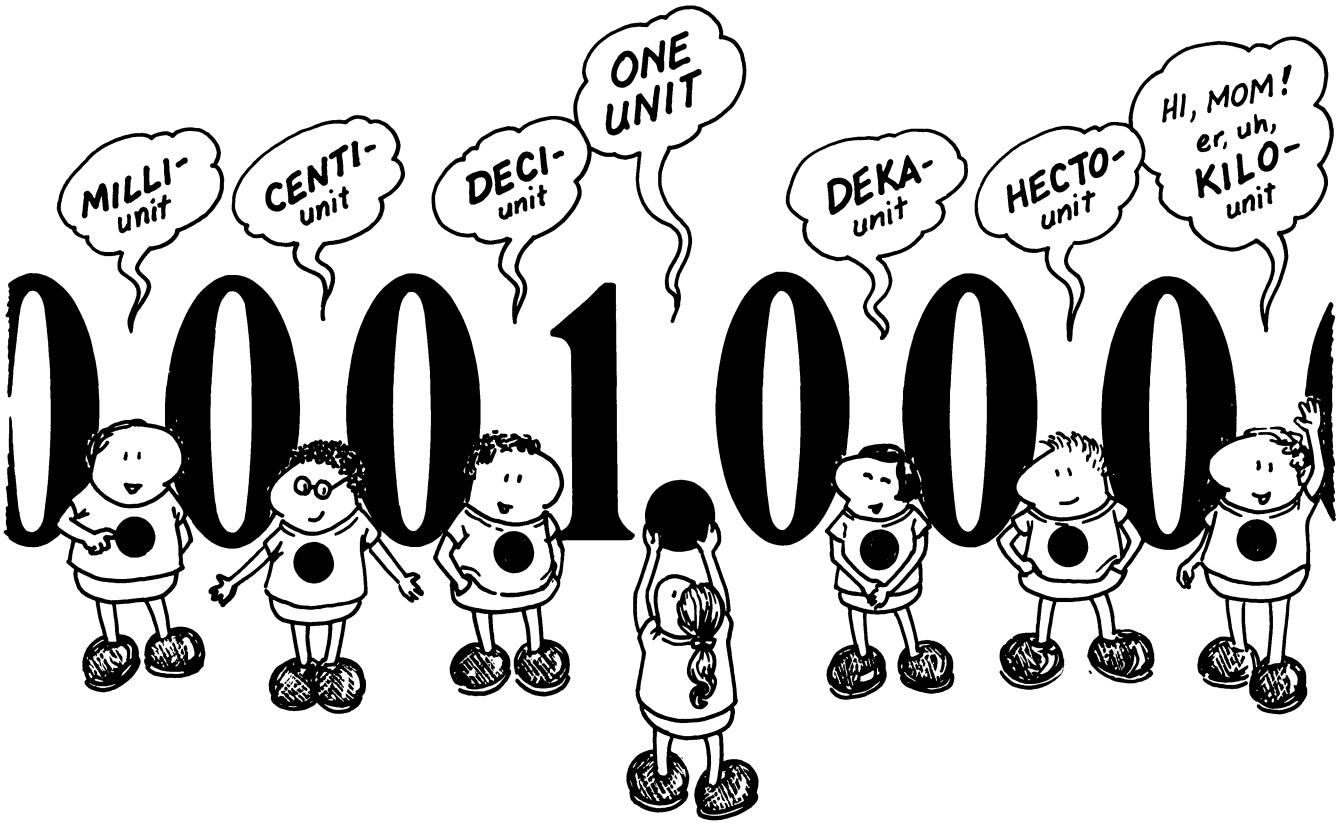
MEASURING LENGTH



TASK CARD SERIES

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TOPS LEARNING SYSTEMS

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CONTENTS

INTRODUCTION

TEACHING NOTES

REPRODUCIBLE STUDENT TASK CARDS

Gathering Materials

Listed below is everything you'll need to teach this module. You already have many of these items. The rest are available from your supermarket, drugstore and hardware store. Laboratory supplies may be ordered through a science supply catalog. Hobby stores also carry basic science equipment.

Keep this classification key in mind as you review what's needed:

special in-a-box materials: Italic type suggests that these materials are unusual. Keep these specialty items in a separate box. After you finish teaching this module, label the box for storage and put it away, ready to use again the next time you teach this module.	general on-the-shelf materials: Normal type suggests that these materials are common. Keep these basics on shelves or in drawers that are readily accessible to your students. The next TOPS module you teach will likely utilize many of these same materials.
(substituted materials): A parentheses following any item suggests a ready substitute. These alternatives may work just as well as the original, perhaps better. Don't be afraid to improvise, to make do with what you have.	*optional materials: An asterisk sets these items apart. They are nice to have, but you can easily live without them. They are probably not worth the extra trip, unless you are gathering other materials as well.

Everything is listed in order of first use. Start gathering at the top of this list and work down. Ask students to bring recycled items from home. The teaching notes may occasionally suggest additional student activity under the heading "Extensions." Materials for these optional experiments are listed neither here nor in the teaching notes. Read the extension itself to find out what new materials, if any, are required.

Needed quantities depend on how many students you have, how you organize them into activity groups, and how you teach. Decide which of these 3 estimates best applies to you, then adjust quantities up or down as necessary:

$Q_1 / Q_2 / Q_3$

- **Single Student:** Enough for 1 student to do all the experiments.
- **Individualized Approach:** Enough for 30 students informally working in 10 lab groups, all self-paced.
- **Traditional Approach:** Enough for 30 students, organized into 10 lab groups, all doing the same lesson.

KEY: *special in-a-box materials* (substituted materials) general on-the-shelf materials *optional materials

$Q_1 / Q_2 / Q_3$	
1/1/1	box paper clips
1/10/10	scissors
1/10/10	*index cards
5/50/50	meters of adding machine tape
1/1/1	roll clear tape
1/20/20	meters of string
1/10/10	clean empty cans — 15 ounce size is best
1/1/1	roll masking tape
3/35/40	sheets notebook paper
1/2/5	*state road maps*
1/10/10	pennies
1/5/10	*calculators
1/10/10	*nuts and bolts — 5/8 inch size is best, about one inch long*
1/1/1	bottle white glue
1/5/10	straight pins
1/1/1	small piece aluminum foil

Sequencing Task Cards

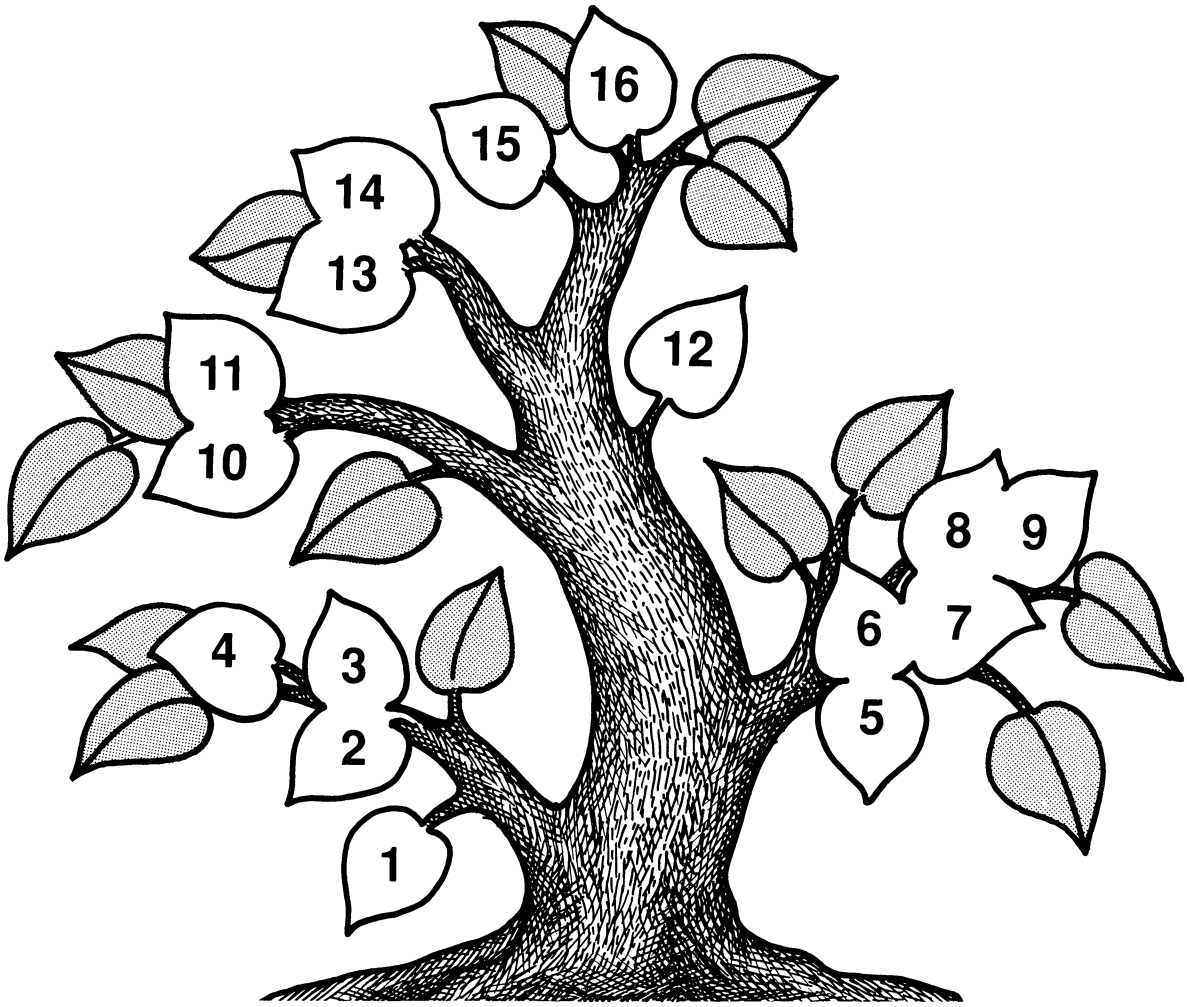
This logic tree shows how all the task cards in this module tie together. In general, students begin at the trunk of the tree and work up through the related branches. As the diagram suggests, the way to upper level activities leads up from lower level activities.

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 open *vertically* into the ones above them. In these cases the lower activity is a prerequisite to the upper.

When possible, students should complete the task cards in the same sequence as numbered. 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 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 task card allow you total flexibility. They are left blank so you can pencil in sequence numbers of your own choosing.



MEASURING LENGTH 02

Review / Test Questions

Photocopy the questions below. On a separate sheet of blank paper, cut and paste those boxes you want to use as test questions. Include questions of your own design, as well. Crowd all these questions onto a single page for students to answer on another paper, or leave space for student responses after each question, as you wish. Duplicate a class set and your custom-made test is ready to use. Use leftover questions as a review in preparation for the final exam.

task 1

Two students walk the length of a field to measure its length. One measures 71 paces; the other 82 paces.

a. Why does each student get a different answer?

b. Describe a better way to measure the field.

task 1-2

This line is 1 unit long.

a. Draw a line that is 1 deka-unit long.

b. Draw a line that is 3 deci-units long.

c. Is the top of your test paper wider than 1,000 centi-units?

task 2

A yard is 36 inches long. How long is...

a. 1 centi-yard?

b. 1 milli-yard?

c. 1 kilo-yard?

task 2, 4

Is a kilo-yard longer than a mile? Explain.

task 3

Balance each equation with the correct number.

a. 1 meter = ? cm

b. 5 cm = ? mm

c. 20 mm = ? cm

d. 2 km = ? m

e. 50 m = ? dkm

f. 30 cm = ? dm

task 3, 4

Roughtly estimate each distance using the most appropriate units of measure — mm, cm, m or km.

a. Height of your room.

b. Four times round the school track

c. Length of your little finger.

d. Thickness of 2 pennies.

task 4

Add *equal, greater than,* or *less than* symbols between each set of numbers to make each statement true.

a. 2 km ? 1 mi

b. 5 mi ? 8 km

c. 10 km ? 16 mi

d. 100 mi ? 160 k

e. 1.6 mi ? 1 k

f. 40 km ? 25 mi

task 5-6

Summarize the rules for measuring in significant figures.

task 5-9 A

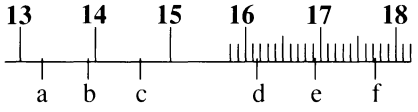
Two students correctly measure the diameter of a nickle as 2.14 cm and 2.15 cm respectively. Explain why they get different answers.

task 5-9 B

Two scientists correctly measure the length of the same pencil as 14.65 cm and 14.7 cm. Describe the calibrations that are on each of their rulers.

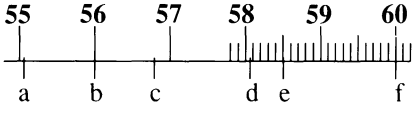
task 5-9 C

Write each measure in significant cm.



task 5-9 D

Write each measure in significant cm.



task 5-9 E

a. Use this ruler to measure the length of a paper clip in significant figures.

b. Use this ruler to measure the diameter of a penny in significant figures.

task 10-11

a. Use just a single paper clip to measure the length of this test paper in paper clips. Estimate your uncertainty as a plus or minus figure.

b. How might you check whether your uncertainity is reasonable?

task 10-11

A student with feet that each measure 20.0 ± .3 cm paces off exactly 100 steps heel to toe.

a. How far did he travel in cm? Include measuring uncertainty in your answer.

b. How far did he travel in meters?

task 12

Explain how you would use a bicycle to accurately measure the length of a field in meters.

task 12

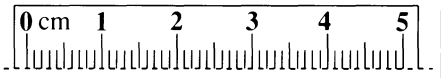
The diameter of a car tire measures .7 meters.

a. Find its circumference.

b. How far does it travel in 100 revolutions? Show your work.

task 13-14

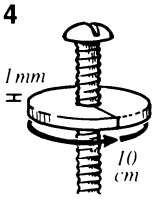
Fold this test paper along the dashed line to make a small metric ruler.



Use it to measure the thickness of a leaf in your textbook to an accuracy of .001 mm. Show your work.

task 13-14

A disk with a 10 cm circumference moves up or down a threaded bolt at 1 revolution per millimeter.



When measuring with this instrument, should you report the thickness of a nickle as 1.9 mm, 1.93 mm, 1.931 mm, or 1.9306 mm? Explain.

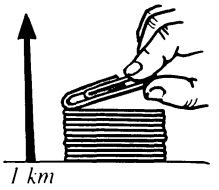
task 15

Finish this equation to find the number of cm in 3 km: $\frac{3\text{ km}}{1} \times$ ____

task 3, 15

a. A standard-sized paper clip is very close to 1 mm thick. Use it to draw a decimeter ruler to scale. Show all millimeter divisions in the first centimeter only.

b. Use unit analysis to show how many clips would stack 1 km high.



task 12, 16

A student measures a meter stick to be 99.5 cm long. Compute her percent error.

task 16

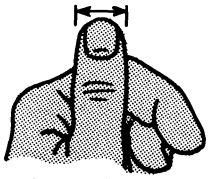
Your climbing party wishes to practice rappelling down a cliff face (lowering oneself on a rope). You need at least twice as much rope as the distance you'll drop. How can you be sure you have enough?

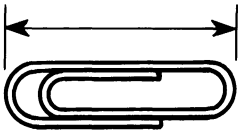
Task Objective (TO) measure length with thumb widths, paper clips and centimeters. To evaluate each unit as a measuring standard.

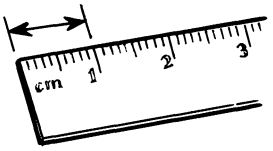
ALL KINDS OF MEASURE ○ **Measuring Length ( )**

1. Measure the length of this task card, as accurately as possible...

a. ...in "thumb widths." b. ...in "paper clips." c. ...in centimeters.







2. Discuss the advantages and disadvantages of each type of measure.

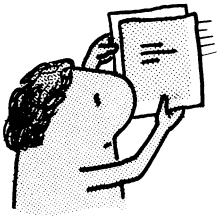
3. Draw 3 lines on your paper with these lengths, while a lab partner does the same.

4.5 thumb widths

4.5 paper clips

4.5 centimeters

4. Compare your lines with your lab partner's: superimpose them while holding both papers up to good light. What can you conclude?



 1

Answers / Notes

1a. length = 8 1/2 thumb widths 1b. length = 4 2/3 paper clips 1c. length = 15.25 centimeters

2. Thumb widths are a convenient unit of measure because you always have them right at hand. But thumb size varies from person to person. It is not a standard unit of measure.

Paper clips are also convenient. If there is just a single brand of clips circulating in your classroom, then everyone would measure the card using the same standard. The size of the paper clip is not universally agreed upon, however. People in other places likely use other brands that are larger or smaller than this class standard.

Centimeters are the best unit of measure to use because their size is agreed upon around the world. A centimeter ruler used by a scientist in Egypt, for example, is exactly the same size as a centimeter ruler in Canada.

3.

4.5 thumb widths

4.5 paper clips

4.5 centimeters

4. Lines measured in thumb widths likely show the widest variation, since this is a non-standard unit.

Lines measured in paper clips may show variation as well, because errors accumulate as the paper clip is placed end to end. *(If both students use a chained paper clip ruler, however, line lengths will be much closer.)*

Lines measured in centimeters should nearly match if they are carefully drawn, since everyone is using a common measuring standard.

Materials

☐ Paper clips. Students may choose to lay just 1 clip end to end, or chain several together.

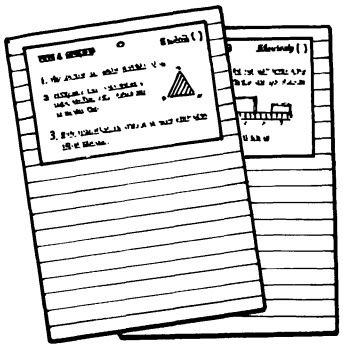
☐ A centimeter ruler. Supply commercial metric rulers. Or photocopy the supplementary page at the back of this book — one sheet for every two students. Direct them to carefully cut out the 20-cm ruler. No white space should remain as a border under the mm subdivisions.

☐ Scissors for cutting out the cm ruler.

☐ A straight edge. An index card or ruler will serve.

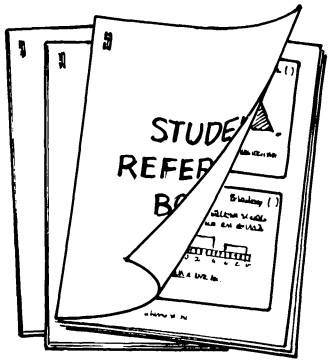
Task Cards Options

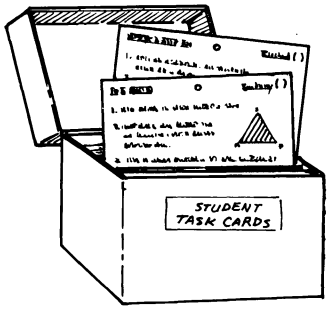
Here are 3 management options to consider before you photocopy:



1. Consumable Worksheets: Copy 1 complete set of task card pages. Cut out each card and fix it to a separate sheet of boldly lined paper. Duplicate a class set of each worksheet master you have made, 1 per student. Direct students to follow the task card instructions at the top of each page, then respond to questions in the lined space underneath.

2. Nonconsumable Reference Booklets: Copy and collate the 2-up task card pages in sequence. Make perhaps half as many sets as the students who will use them. Staple each set in the upper left corner, both front and back to prevent the outside pages from working loose. Tell students that these task card booklets are for reference only. They should use them as they would any textbook, responding to questions on their own papers, returning them unmarked and in good shape at the end of the module.





3. Nonconsumable Task Cards: Copy several sets of task card pages. Laminate them, if you wish, for extra durability, then cut out each card to display in your room. You might pin cards to bulletin boards; or punch out the holes and hang them from wall hooks (you can fashion hooks from paper clips and tape these to the wall); or fix cards to cereal boxes with paper fasteners, 4 to a box; or keep cards on designated reference tables. The important thing is to provide enough task card reference points about your classroom to avoid a jam of too many students at any one location. Two or 3 task card sets should accommodate everyone, since different students will use different cards at different times.

ALL KINDS OF MEASURE ○ Measuring Length ( )

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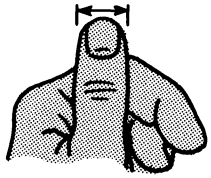
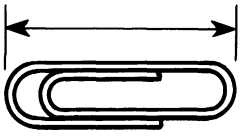
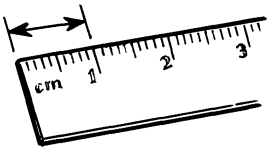
a. ...in "thumb widths." b. ...in "paper clips." c. ...in centimeters.







2. Discuss the advantages and disadvantages of each type of measure.

3. Draw 3 lines on your paper with these lengths, while a lab partner does the same.

4.5 thumb widths

4.5 paper clips

4.5 centimeters

4. Compare your lines with your lab partner's: superimpose them while holding both papers up to good light. What can you conclude?

METRIC PREFIXES ○ Measuring Length ( )

1. The metric system defines decimal places by prefix. Put time and money into metric dimensions by completing these tables.

1 unit

0.0.0.1|0.0.0.

milli- centi- deci- deka- hecto- kilo-

Metric Time

milli-minute	
1 minute	*1 minute*
deka-minute	10 minutes

Metric Money

deci-dollar	10 cents
1 dollar	*1 dollar*

2. Cut adding machine tape to the length of one hecto-paper-clip (a hecto-clip). Draw and label examples of all possible subdivisions.

a. Name something as long as a milli-clip.

b. Name something as long as a kilo-clip.