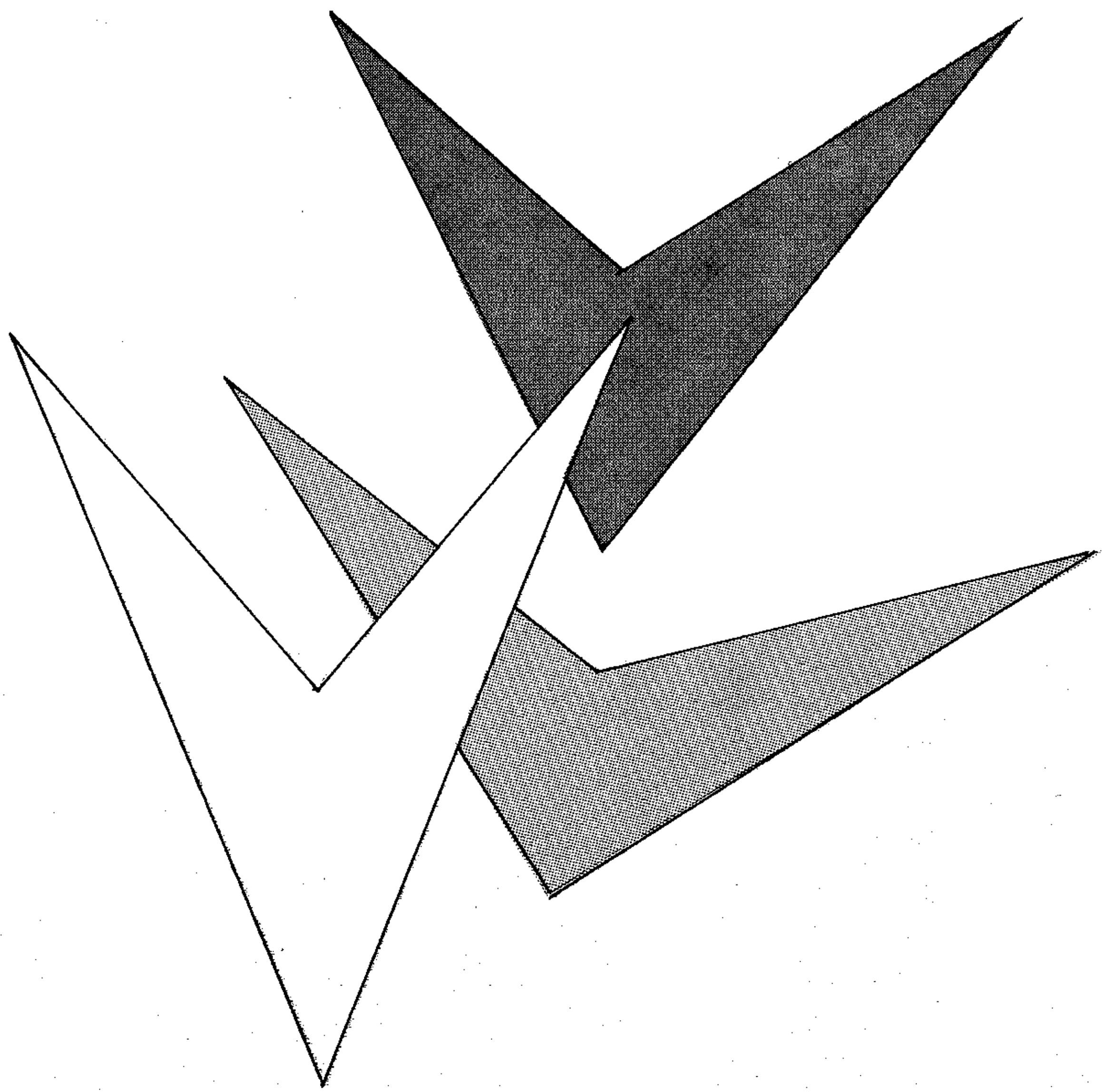
T.C.T.M.

TEXAS MATHEMATICS TEACHER



Texas Council of Teachers of Mathematics

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TEXAS MATHEMATICS TEACHER

Texas Council of Teachers of Mathematics

Volume XXXIII JANUARY, 1986 No. 1

PRESIDENT'S MESSAGE

Well, the 1985 Conference for the Advancement of Mathematics Teaching and the associated Annual Meeting of the Texas Council of Teachers of Mathematics are history. Our contribution to the CAMT meeting, as has been the case in recent years, was to conduct on-site registration. While much of the work was done by persons who were not members of TCTM (see the list below), the registration went smoothly. We will also likely be responsible for the same task next year, and I hope that we can get more of our members directly involved. I can testify that it is a good way to get to know teachers and other professionals from around the state and beyond. If you would like to have an opportunity to participate, let me know; I promise that we will be able to work you in.

Another activity in which we participated was the sale of NCTM materials in the exhibit area. Despite some problems with ordering the materials, and with a great assist from our journal editor J. William Brown, the sales went reasonably well, our profit amounting to over $200.00 This is another CAMT activity that we need more assistance in carrying out next year.

The greatest disappointment at the CAMT meeting from my point of view was the attendance at the Annual Meeting of TCTM. Fewer than twenty people were present for the business meeting and the open forum which followed. Plans are already being made on ways to increase attendance and active participation in next year's meeting;,watch for announcements regarding this matter in the journal and in the mail.

While attendance at the meeting was small, the quality of discussion and of suggestions for future meetings and other activities was high. Many suggestions related to the journal were discussed, as were ways in which TCTM could be of more service to its members. We wish all of you had come and shared your ideas with us.

I call your attention to the inside front cover of this journal. Notice the list of officers; there are some changes since the last issue. They reflect both the results of our last election and a new face at TEA. You are encouraged to contact these officers if you have questions or suggestions, especially if they are from your area of the state.

Finally, a large "THANK YOU" to the following persons who assisted us at CAMT: Anita Hopkins, who had handled pre-registration and performed outstanding service at the registration desk; Irene Briones and Fran Cobb, staff personnel from UT Austin, who spent long hours there also; Patricia Rhodes, Pat Kenney, Kevin Jones, Bill Sliva, and Linda Griffith, graduate students in Mathematics Education at UT Austin, who helped both in the sale of NCTM materials and at the registration desk. If I have missed any of those stalwart helpers, I apologize; and, if you are a TCTM member and helped out, we thank you, too. And to all TCTM members everywhere, we thank you in advance for your participation and assistance next year at CAMT and in our Annual Meeting.

PROPOSED DATES FOR CAMT

1986: October 9 – 11	**1989: June 22 – 24**
1987: August 3 – 5	**1990: June 20 – 22**
1988: August 2 – 4	**1991: June 19 – 21**

Note your mailing label for renewal date of TCTM membership!

STUFF Strategic Tactics Ultimately For Fun

Dear T.C.T.M. Members,

We've have had it! We are tired of writing this (blank) column and it's going to be blank if we don't get more stuff. We know that you are studying for the T.E.C.A.T., but we need help. Take a few minutes out to send in your ideas. Thank you, Kathyrn Clegg from Rancho Isabella Elementary School in Angleton I.S.D. She is our grand prize winner for this edition and will receive a free membership. Stuff tee shirts are still to be won! Check your October 1985 issue to see what to do with your May, 1985 issue. If you don't do something soon we may tell you what to do with the January issue. Send your materials to Judy Tate, Harris County Department of Education, 6208 Irvington Boulevard, Houston, TX 77022.

Stuff Staff

Betty and Judy

PRIMARY

GEOMETRY HOKEY POKEY

Here is a fun activity for all preschool and first grade students. Each student will need an envelope with the shapes described. The song is to the tune of "Hokey Pokey."

You put your circle up
You put your circle down
Your put your circle up
And you give it a good look.
You see that it is round
Then you put it right back down.
That's what it's all about!

You put your square up
You put your square down
Your put your square up
And you give it a good look.
You see that it's four sided
It's a square, you've decided
That's what It's all about!

You put your triangle up
You put your triangle down
Your put your triangle up
And you give it a good look.
And "Tri" means three plus angle
Then you put it right back down.
That's where we get triangle!

You put these shapes up
Into an evelope
You put the envelope down
And now look all around
You see geometry
Can be learned so easily
And that's what it's all about!

HOW HOT IS IT IN METRIC?

To figure what kind of day it will be (metrically speaking), remember the following poem:

Thirty is hot
Twenty is nice
Ten is cool
Zero is ice

INTERMEDIATE GRADES

PAPER PLATE FRACTIONS

1. Give each child a paper plate (the cheap kind). Show them how to fold the plate in half to make equal parts. Have each child use a ruler to draw a straight line on the fold. Cut the plate on the folded line. Label one part of the plate with the fraction 1/2. Color that half blue.
2. Then show the children how the other half can be folded into two equal parts. Cut on the folded line and label one of the parts with the fraction 1/4. Color that part red.
3. Fold the remaining piece into two equal parts and cut it on the folded line. Tell the students that each of those parts is equal to 1/8 of the original plate. Have them write 1/8 on each piece and color each of them yellow.
4. Let the children work in small groups, sharing their pieces of plates. Ask them to make a whole plate using just 1/2 pieces. Be sure they realize that it takes two 1/2 pieces to make the plate. Introduce the idea that the top number of the fraction tell how many and the bottom number tells what kind. Repeat with 1/4 and 1/8.

Kathryn Clegg, Third Grade
Rancho Isabella Elementary School
Angleton, Texas

FIVE SUMS IN A ROW

Purpose: To reinforce addition
To use strategy to choose the correct numerals to add together to arrive at a needed number on the board

Materials: Game Board
4 number cubes numbered: 0-1-2-3-4-5
1-2-3-7-8-9
3-4-5-6-7-8
0-4-6-7-8-9
Discs for markers (about 10 for each player)

Directions: First player throws all 3 dice then chooses 3 to add together. He places a disc on that sum.

On his next turn he wants to study the dice he throws in order to choose 3 numbers to give him a sum as close as possible to the last number he marked.

Object: To get 5 numbers (sums) in a row.

FIVE SUMS IN A ROW

FIRST PLAYER		SECOND PLAYER
	18	
	17	
	16	
	15	
	14	
	13	
	12	
	11	
	10	
	9	
	8	
	7	
	6	
	5	
	4	
	3	
	2	
	1	

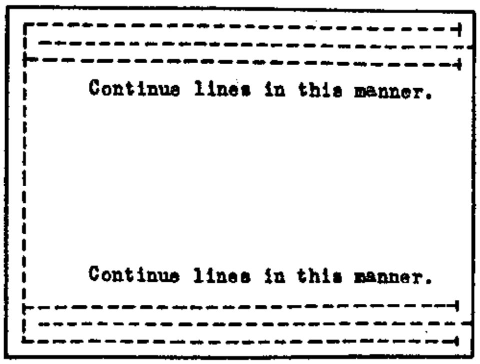
MIDDLE SCHOOL

THINGS AREN'T WHAT THEY SEEM!

WALKING THROUGH A HOLE CUT IN A SHEET OF NOTEBOOK PAPER?

If someone were to tell you that he could cut a hole in a piece of notebook paper that you could walk through, would you believe him? Believe it or not, it can be done and here's how.

You will need a piece of notebook paper and a pair of scissors. Draw lines on the sheet of paper similar to those in the diagram below and use the scissors to cut along the lines. Observe the results.



(Start cutting along outside dotted line.)

After practicing with lines on a sheet of notebook paper, try cutting the hole without them. The nearer you can cut along the edge of the paper, the larger the hole will be. After a little practice, you should be able to cut a hole in paper that you can easily walk through. Even a small piece of paper, instead of the sheet of notebook paper will do. When you are sure you can perform the trick, you are ready to try it on a friend who is unfamiliar with the outcome.

If you want to make the trick more difficult, announce that you can walk through a hole that you will cut in a piece of paper four inches square, then follow the procedure given above to do just that. Good luck!

EASTER

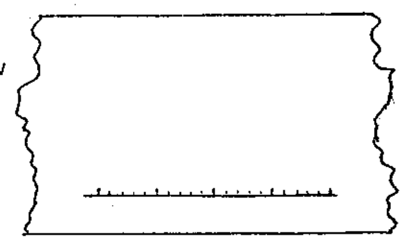
Easter Sunday is celebrated on the Sunday following the first full moon after the vernal equinox. It must fall between March 22nd and April 25th. To find out the date of Easter this year:

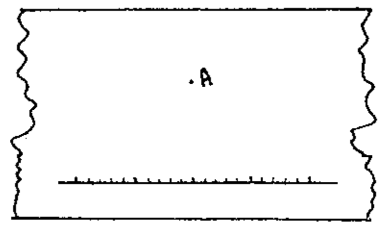
1. Divide the number of the year by 19. Let the remainder = A.
2. Divide the number of the year by 4. Let the remainder = B.
3. Divide the number of the year by 7. Let the remainder = C.
4. Multiply 19 times A and add 24. Divide this by 30. Let the remainder = D.
5. Take (2 x B) + (4 x C) + (6 x D) + 5 and divide by 7. Let the remainder = E.
6. Easter day will be on 22 + D + E. If your number is larger than 31, then it goes over into April.

SENIOR HIGH

CREASING CONICS

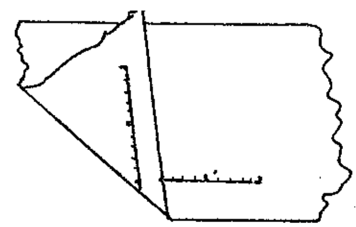
I. Start with a sheet of waxed paper 30 cm long. Draw a line segment 20 cm long, parallel to and 3 to 4 cm about the bottom edge. Mark every cm on the segment.

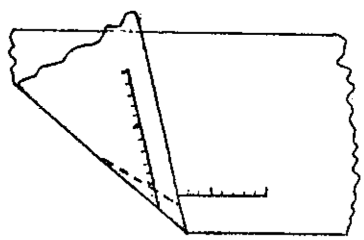




Place a point, A, 10 cm above the midpoint of the segment.

Fold the paper so the first cm mark lies on top of point A. Crease along the fold.





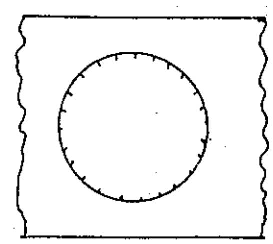
Re-fold so the second cm mark is on point A. Crease again. The two creases will intersect.

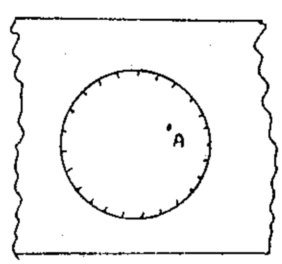
Repeat for the remaining cm marks. Crease carefully each time.

Unfold and look at the design. What is the name of the geometric shape?

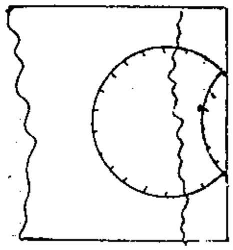
CREASING CONICS

II. Take a sheet of waxed paper 35 cm long. Draw a circle with 8 cm radius. Mark every 25 degrees on the circumference.





Put a point, A, inside one circle, about 4 cm from the edge.



Fold the paper so one of the 15 degree marks is on top of point A crease.

With another sheet of waxed paper, try placing point A closer to the center. How is the shape changed?

Another geometric design:

For a different design put point A outside the circle, about 4 cm from the edge. Fold like above.

Name the new shape!!

WILL SNOOPER CATCH SNICKER?

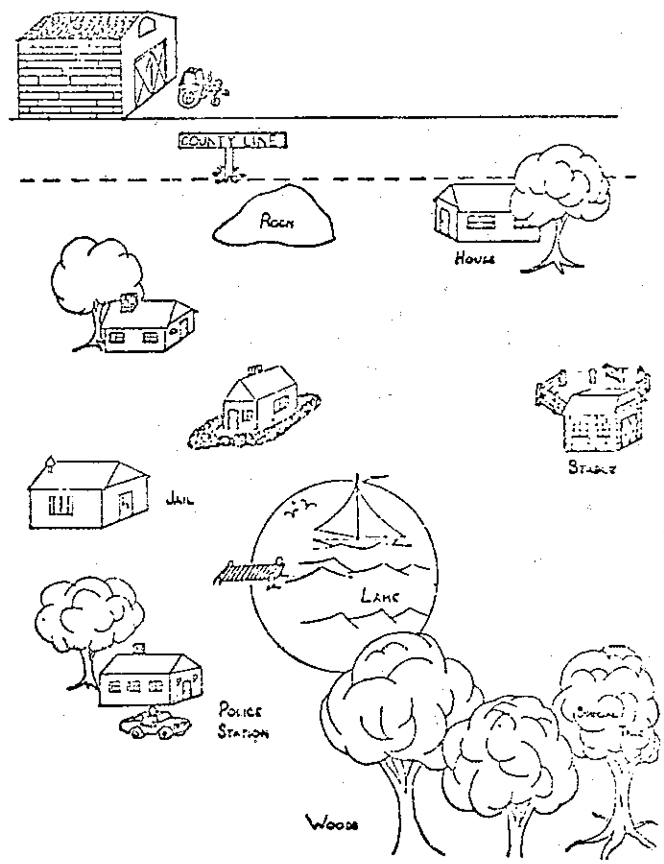
GEOMETRY

The small town of Snipelyville came unexpectedly to life on Friday, April 13. At 8:00 a.m. Fred Farkel escaped with a small radio from the county jail. The only thing Fred knew about the region around Snipelyville was that some woods were located about 800 meters southeast of his location. He started in this direction.

At 8:15 Lt. Columbo called the jail reporting the escape of Snicker Smarkes from the questioning department at the police station. At about this same time, Fred heard an important announcement on the radio. This gave a description of Snicker Smarkes. He heard another announcement right after that about his own escape. He thought over the situation and decided that since Snicker would have to avoid the town, he would probably come this way, too.

At this time Snicker came running up from behind and tackled him. Fred saw who it was and screamed at him, telling him they were in the same boat (they had the same situation to cope with). Snicker waited for an explanation. For about five minutes they exchanged ideas and opinions. Fred found out an important thing about Snicker – that he was a former geometry student. They climbed the nearest tree and surveyed the situation. There was an old abandoned barn just across the border line. If they could get across the border, they would be completely safe. But they had to avoid the town to the west, a house, and a large circular lake (Fred couldn't even dog-paddle).

Snicker drew an imaginary tangent from the tree trunk of the Special Tree to the east side of the lake. At the point of tangency he made a right angle toward the stable. When he reached the stable he made a 60-degree angle with the path from the lake toward the wouthwest corner of a big rock. When he reached the rock he made a 22.5-degree trun toward the barn. From the tree to the lake was 450 meters, and from the lake to the stable was, 100 meters. From the stable to the rock was 500 meters, and from the rock to the barn was 200 meters. The border line (and safety) was parallel to the long side of the barn and crossed the path from the rock to the barn at the midpoint of the path. The criminals left the tree at 8:30 traveling at a rate of 126 meters per minute. The sheriff and police left the jail at 8:24 with their bloodhound, Snooper, tracking at a rate of 140 meters per minute. The police were delayed half a minute at the tree. Use compass and straight edge to construct the criminals' path shown on the map. Find out if they reached the border before the police, or if they were sniffed out by Snooper.



ALLEVIATING THE TABS-TEAMS ANXIETY

Nora Kay Holmes
Lubbock Independent School District, Lubbock, Texas

With the current emphasis on teacher competency as well as student performance, the scores from the Texas Educational Assessment of Minimum Skills (TEAMS), formerly the TABS Test, make excellent evaluation tools. This emphasis on performance has led to an anxiety among many teachers who feel a responsibility to achieve high standards. An analysis of TABS (test used for five years prior to the introduction of TEAMS) has revealed common misconceptions and a general lack of knowledge about the specifics of the test within the teaching body. This TABS-TEAMS related anxiety can be alleviated through a better understanding of the measured objectives and the structure of the test. Only then can TEAMS be a highly successful and valuable experience for teachers.

To enable teachers to feel more confident about TABS--TEAMS, an inservice program was developed that emphasizes the mathematics section of the test. In preparation for the inservice, attention was centered on the test's structure and objective skills that repeatedly showed the lowest percentage of mastery (Table 1).

The mathematics section of the third grade TEAMS Test is divided into eleven objectives, each equally weighted and measured by four multiple-choice items. The multiple-choice items have four response choices, only one of which is correct. Mastery of an objective is achieved by students who give correct responses to three of the four questions relating to that objective.

TABLE 1
Percent of Students Mastering Objectives on TABS

Objectives	State Wide Results 1982	1983	1984
7. Multiply Whole Numbers	93	94	94
9. Identify Values of Money	90	92	92
3. Add Whole Numbers	88	90	91
1. Read and Write Whole Numbers	86	88	88
5. Solve Word Problems: +, -	85	88	88
8. Identify Fractional Parts	83	88	90
6. Complete Number Patterns	83	83	88
4. Subtract Whole Numbers	73	76	80
*2. Order Whole Numbers	59	71	79
*10 Select Units of Measurement	57	64	71

*Low percentage of mastery
(T.E.A., 1984)

Each objective has very specific criterion that form the basis of the criterion-references test items. Table 2 identifies the objectives of TEAMS and gives a description of each skill. These skill descriptions are designed to enhance the teacher's concept of how mastery will be measured. In order to correlate the newly-introduced TEAMS objectives with TABS, the number of the objective as it previously appeared in TABS will be included in parentheses beside each TEAMS objective.

As indicated in Table 1, results from previous administrations of TABS have identified the objectives that deal with "ordering numbers" and "selecting units of measurement" to be the weakest areas. These objectives are now a portion of TEAMS and therefore, continued attention needs to be given to these areas.

TABLE 2
TEAMS Objectives

(TABS #2)	1.	Arrange a group of three whole numbers from least to greatest or greatest to least (up to three digits). (Two items of each type)
	2.	Identify the place value for a given digit of a three- or four-digit whole number.
	3.	Express whole numbers in expanded notation (three- or four-digit).
(TABS #6)	4.	Complete a pattern involving multiples of two, three, four, five, or ten.
(TABS #3)	5.	Add whole numbers having as many as three-digits, with or without regrouping (two- and three-digit numbers with two or three addends). (Two items of each type)
(TABS #4)	6.	Subtract whole numbers having as many as three-digits, with or without regrouping. (Two items of each type)
(TABS #5)	7.	Solve one-step word problems involving addition of whole numbers (no regrouping).
(TABS #5)	8.	Solve one-step word problems involving subtraction of whole numbers (no regrouping).
(TABS #8)	9.	Use pictorial models to identify fractional parts of a whole or of a group of like objects (limited to 1/2, 1/3, 1/4, 2/3, and 3/4).
	10.	Identify pictorial models of two- and three-dimensional shapes (restricted to circles, squares, rectangles, triangles, cubes, cylinders, spheres, and cones).
	11.	Select the unit of measurement used to determine length, weight/mass, or capacity/volume.

(T.E.A., 1985a)

Before the percentage scores of these weakest areas can be substantially raised, teachers need information on the study of skill descriptions for these two objectives. "The more lucidly that a teacher comprehends the nature of the competency being taught, the more success the teacher will have in both explaining the competency to students and, even more importantly, in designing instructional sequences to promote that competency" (T.E.A., 1980, p. 3).

Each year that TABS has been administered, Objective 10 (now Objective 11 of TEAMS) has had the lowest percentage of mastery (T.E.A., 1984). This objective evaluates student knowledge of units of measurement. A misconception found among many teachers is the belief that Objective 10 measures the student's ability to give numerical values for various units of measurement and make conversions between metric and customary units. However, the objective is actually designed to evaluate the ability to make practical applications of units from both systems. Students are not required to convert centimeters to meters or to respond to "how many cups make a pint", but rather are asked to select an appropriate unit of measurement for a particular task.

A sample test item clarifies the type of question used to test for mastery of Objective 10.

The length of a pencil would be measured in:

- centimeters
- kilograms
- grams
- liters

(T.E.A., 1985a, p. 15).

Instructional guidelines for TABS (T.E.A., 1980, pp. 31-32) suggests that students should have ample opportunities to become familiar with similar practice items and units of measurement as they may appear on the test.

Description of the test items for this objective as they will appear on the new TEAMS test limits the units of measurement that may be used to these: (a) centimeter, meter, kilometer; (b) gram, kilogram; (c) liter; (d) inch, foot, yard; (e) pint, quart, gallon; and (f) pound.

As students are getting acquainted with units of measurement, many actual measuring opportunities should be provided. Teachers may help students to conceptualize the size of the units by drawing attention to things that correspond in size. For example, a centimeter is about the size of the nail on your little finger or a paper clip weighs approximately a gram.

Students may color or cut out pictures of objects, foods or lengths that could be measured using metric or customary units. Each picture should be labeled with the most appropriate unit of measurement and then combined with others to form a measurement picture booklet.

Encouraging students to talk about their pictures and the units of measurement they have learned will assist them in synthesis of this new material. Students who are able to make practical applications of these units should master the objective.

The other difficult objective, Objective 2 (now Objective 1 of TEAMS), relates to sequencing whole numbers. Two of the test items ask students to designate the numbers that are arranged from least to greatest, while the remaining two items reverse the order and require students to select a sequence of greatest to least. One possible explanation for low scores on this objective is that students may be confused by the working or inattentive to the instruction given. To combat this, students should be acquainted with the phrases of least to greatest and greatest to least, understanding that the test questions may appear in either form. A sample test item could ask:

Which group below shows the three numbers in order from greatest to least?

- 131 128 121
- 128 121 131
- 131 121 128
- 121 131 128

(T.E.A., 1985a, p. 4)

Adequate practice with sample test items and a background strong in place values concepts are positive factors in the mastery of this objective.

Number vests are useful for teaching students to sequence numbers. Vests are made from large paper sacks or white trash bags cut to fit the students. Three- and four-digit numbers are printed on each vest. Each student should wear a vest. The teacher calls specific students to come to the front of the class. The objective is for the students to place themselves in an order that is designated by the teacher, which may be least to greatest or greatest to least.

There are many variations that can be made in using the number vests. For example, the teacher may instruct only students who have vests that show a three in the ten's place to stand. This type of activity is beneficial in developing place value concepts.

In order to assist students in mastery of the objective skills, an instructional program was designed taking into consideration the theories of Jean Piaget and Robert Wirtz. Piaget places most third graders at the concrete operational stage. His theory states that students at the concrete stage learn best by physical manipulation and concrete experiences. After sufficient hands-on learning experiences, students are able to generalize newly acquired knowledge to similar situations. The need to deal with hypothetical problems remains difficult in this stage unless there is a background of concrete experiences (Ripple, Biehler, & Jaquish, 1982).

Robert Wirtz (1976, p. 176), who specializes in instructional styles related to mathematics, has created a model for developing mathematical abilities. The three stages of his model progress form manipulative to representational to abstract. Applying his theory to a classroom situation, teachers would begin instruction with manipulative experiences related to the competency being taught. In the representational stage, instruction would involve pictures that represent the competency. Finally, as the students progress, the instruction and practice will be given in numerical form, the most abstract of the three stages.

Third grade teachers at Hardwick Elementary School (Lubbock, Texas) applied the concepts of these two theorists in their classrooms. The instruction for TABS objectives began with actual manipulatives. Scales, rulers, and balances were used to give manipulative experiences for Objective 10. For Objective 2, place value charts and counters were used.

Students then progressed to pencil and paper activities in the form of games designed to strengthen the objective skills. As students exhibited a concrete knowledge of the skills. Results were used to determine if remediation or reinforcement was needed before TABS.

By utilizing knowledge of the skill descriptions for each objective and intellectual developmental theory, third grade teachers at Hardwick prepared students for TABS. This resulted in an increase of 24 percentage points on Objective 10 (select units of measurement) over the previous year. Percent of students mastering Objective 10 rose from 64 to 88. On Objective 2 (ordering whole numbers), an increase of 5 percentage points was noted (Table 3).

The results of the efforts made at Hardwick indicate that teachers who are knowledgeable of TABS-TEAMS and its competencies can be successful in achieving high standards of performance. "Teachers who really comprehend the subject matter can be far more effective in promoting student mastery of that material" (T.E.A., 1980, p. 3). Teachers will then feel confident to believe TABS-TEAMS make excellent evaluation tools.

TABLE 3
TABS Summary for Hardwick Elementary

Objectives		Percent of Students Mastering Objectives 1985	1984
#10	Select Units of Measurement	88	64
# 2	Ordering Whole Numbers	88	83

(T.E.A., 1985b)

(CONTINUED ON PAGE 10)

AN ANALYSIS OF STOPPING DISTANCES: A SIMPLE INTEGRATION APPLICATION

Bonnie H. Litwiller and David R. Duncan, Mathematics and Computer Science Department
University of Northern Iowa, Cedar Falls, Iowa

Teachers and their students should constantly be questioning data that they find in various publications. They will often find that significant mathematics has been used in generating the given data. One such example is found in the Iowa Driver's Manual, an instructional booklet for people who wish to take the driver's test. Every state publishes a comparable book.

One of the topics covered in the booklet concerns the relationship between speed and stopping distances on a dry surface. The data is displayed in Table 1.

TABLE 1

Velocity (ft/sec)	Perception-reaction distance (ft)	Braking distance (ft)	Total stopping distance (ft)
30	45	22	67
45	68	50	118
60	90	89	179
75	113	139	252
90	135	200	335
105	158	272	430

Part of the basis for this data is described in the booklet, namely, the perception-reaction distance. The writers assume that 1 1/2 seconds is needed for perception-reaction; that is, from the instant the driver perceives a problem until the instant the driver's foot begins to depress the brake takes 1 1/2 seconds. Consequently, the perception-reaction distance is 1.5 times the speed of the car. This is reflected in the first two columns of Table 1.

The origin of the third column, braking distance, is not explained in the manual. From where does the data come?

We assume that when brakes are depressed, the car decelerates at a constant rate until it comes to a complete stop.

Let V_0 indicate the initial velocity of the car before the brakes are applied and let r represent the deceleration rate. The time required for a car to come to a complete stop after the brakes are applied is then $\frac{V_0}{r}$.

$$t_d = \frac{V_0}{r}, \quad r > 0 \qquad (1)$$

For example, if the initial velocity of a car is 60 ft/sec and the deceleration rate is 10 feet per second per second (or 10 ft/sec^2), then for each second of time the velocity of the car will decrease by 10 feet per second. At this rate it will take 6 seconds to come to a complete stop.

Note that $\frac{60}{10} = 6$ as had been asserted.

At any time t after the deceleration has begun, the velocity of the car will be $V_0 - rt$.

$$V(t) = V_0 - rt, \quad r > 0 \qquad (2)$$

For instance, consider the example just cited in which the initial velocity is 60 ft/sec and the deceleration rate is 10 ft/sec^2. At the end of 2 seconds, the velocity of the car is $60 - 2(10) = 40$ ft/sec.

In calculus, we learn that the derivative of the distance traveled as a function of time yields velocity. Or stated another way, the definite integral of a velocity as a function of time yields the distance traveled in a specific direction. This provides the basis for generating the data in column 3 of Table 1.

Let D (t) be the distance traveled in the t seconds after the brakes are applied (the braking distance) and let V (t) be the velocity of a car t seconds after the brakes are applied. Then

$$D(t) = \int_0^t V(t)\,dt \qquad (t > 0)$$

$$D(t) = \int_0^t (V_0 - rt)\,dt$$

(We start the clock at the instant the brakes are applied; by formula 2, $V(t) = V_0 - rt$.)

$$D(t) = \left[V_0 t - \frac{rt^2}{2}\right]_0^t$$

Then:

$$D(t_d) = V_0\left(\frac{V_0}{r}\right) - \frac{r}{2}\left(\frac{V_0}{r}\right)^2$$

$$D(t_d) = \frac{(V_0)^2}{2r} \qquad (3)$$

We can now calculate the value the manual assumes for r. Since 22 feet of braking distance are required to stop a car having an initial velocity of 30 ft/sec, formula 3 yields

$$22 = \frac{(30)^2}{2r}$$

$$44r = 900$$

$$r = \frac{900}{44}$$

$$= 20.5 \text{ ft/sec}^2.$$

In other words, the manual assumes a constant deceleration of 20.5 ft/sec^2 for a 30 ft/sec speed.

Is the manual consistent? To investigate this, rewrite formula 3 as

$$D(t_d) = \frac{(V_0)^2}{2(20.5)} = \frac{(V_0)^2}{41}.$$

Replacing V_0 with 45, 60, 75, 90 and 105 yields, respectively, $D(t_d)$ values (rounded) of 49, 88, 137, 198, and 269. These values are approximately the same as those in column 3 of Table 1.

Challenges for the reader:

1) Is the assumption of a 1 1/2 second perception-reaction time for all drivers appropriate or is this simply a "typical" (median?) reaction time for all drivers? If it is not a constant, what range of values might occur for different drivers?

(CONTINUED ON PAGE 10)

DOES IT ALWAYS WORK?

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In my "Introduction to Mathematics" class recently we were studying rational numbers. One problem was to order the three numbers 3/14, 4/15, and 5/16. In finding the common denominator and new numerators the students were surprised to learn that the order agreed with the ordering of the original numerators. The question was raised as to whether this type of ordering would work every time when numerators and denominators involved consecutive integers. For example, is $3/7 < 4/8 < 5/9$ also a true inequality? A proof for a 'positive' conclusion to the question is given below.

Assume $1 \leq a < b$ where a and b are positive integers. Consider the fractions a/b, (a+1) / (b+1), and (a+2) / (b+2). We need to prove that

$$a/b < (a+1)/(b+1) < (a+2)/(b+2)$$ for a and b as positive integers.

The common denominator will be b(b+1) (b+2). The numerators transform as follows:

a becomes $a(b+1)(b+2) = a(b^2 + 3b + 2) = ab^2 + 3ab + 2a$ (1);

a+1 becomes

$b(a+1)(b+2) = b(ab + 2a + b + 2) = ab^2 + 2ab + b^2 + 2b$ (2);

and a+2 becomes

$b(a+2)(b+1) = b(ab + 2b + a + 2) = ab^2 + 2b^2 + ab + 2b$ (3).

Since the denominator will be the same for all three fractions, we only need to compare the numerators (1), (2) and (3) above. Since $1 \leq a < b$, we know that

$$a < ab < bb \text{ or } b^2.$$

The terms of the numerators can be expanded and compared as follows: (underlined terms determine the inequalities)

(1)	(2)	(3)
$ab^2+\underline{2a}+\underline{ab}+ab+ab$	$ab^2+\underline{2b}+\underline{bb}+\underline{ab}+ab$	$ab^2+2b+bb+\underline{bb}+ab$

Therefore, since (1) < (2) < (3), the original fractions also have the same order.

So $a/b < (a+1)/(b+1) < (a+2)/(b+2)$

for a and b as positive integers with $1 \leq a < b$.

That is, $2/3 < 3/4 < 4/5$

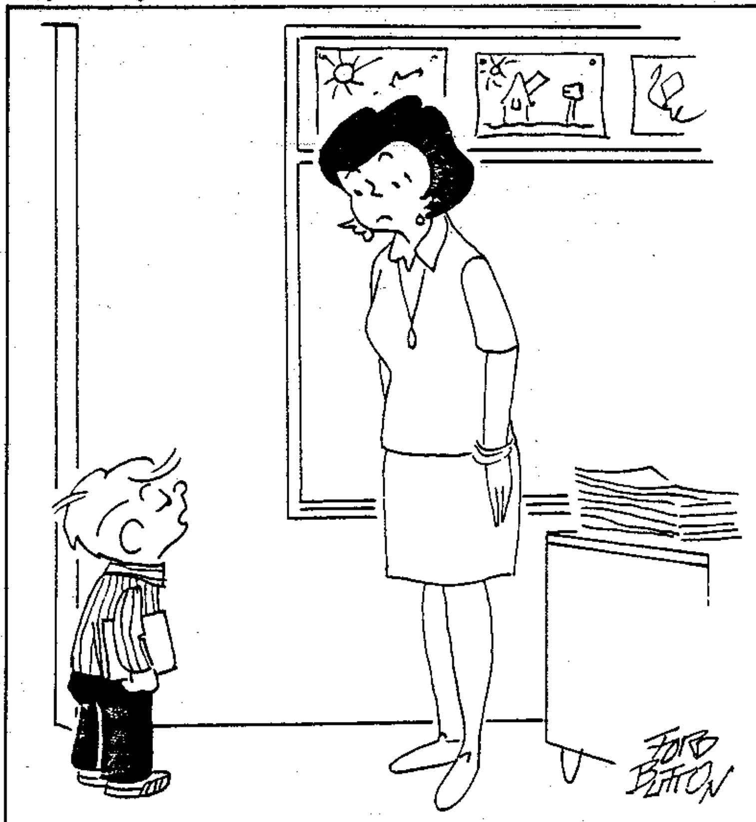
and $45/56 < 46/57 < 47/58$

are examples of true inequalities.

(CONTINUED FROM PAGE 9)

2) Although a constant deceleration rate (20.5 ft/sec^2) for a given car on a given surface might be correct, is this rate the same for all cars on all surfaces? How might the rate be adjusted for cars with different types of braking systems and roads of different compositions?

3) Compute the number of seconds actually required to stop a car once the brakes are applied. to do so, set $V(t) = V_0 - 20.5t$ equal to 0, and then solve for t for various values of V_0.



"What did I learn today? My mother will want to know."

(CONTINUED FROM PAGE 8)

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