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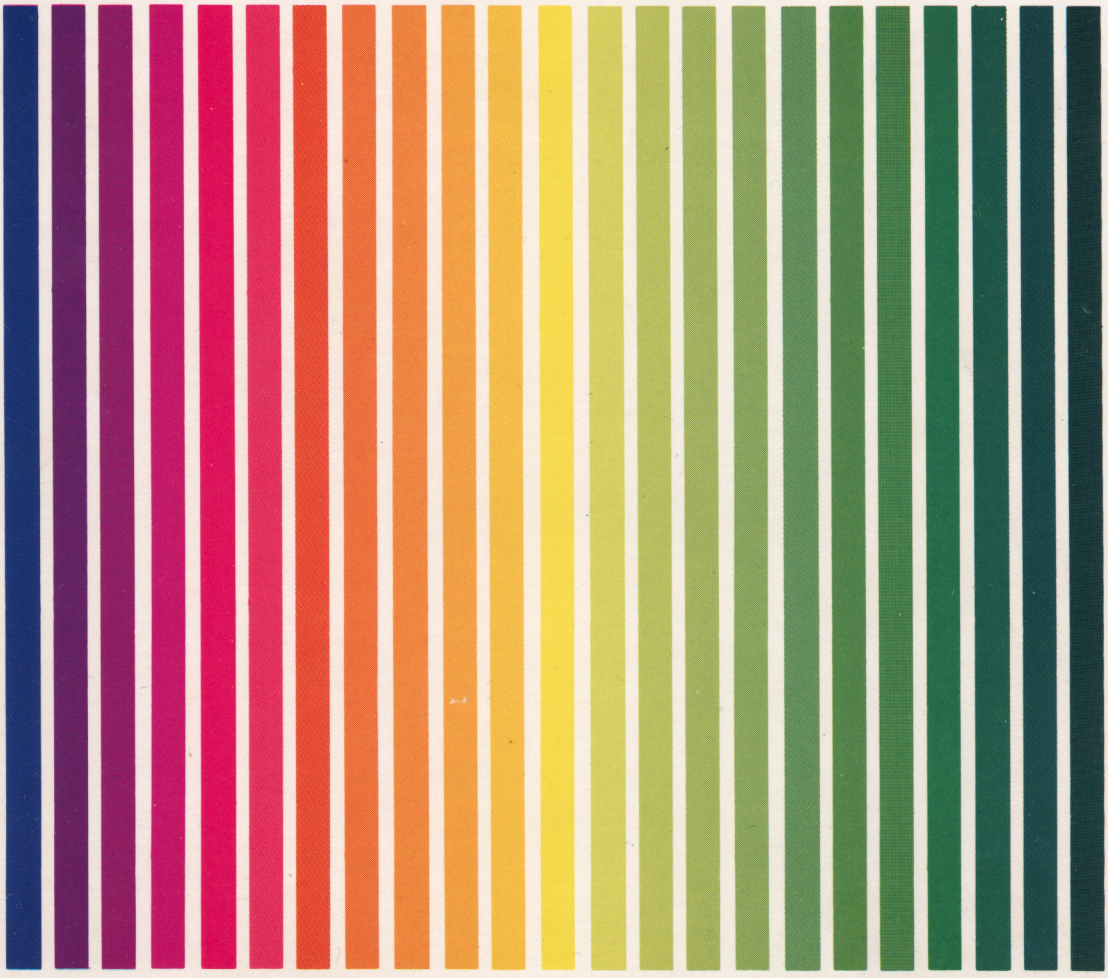

Minnesota Educational Computing Consortium

METRIC AND PROBLEM SOLVING

Learn the metric system (grades 2-6)

Diskette: 16K (APX-20138)

User-Written Software for ATARI Home Computers

Minnesota Educational Computing Consortium

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METRIC & PROBLEM SOLVING

by

Minnesota Educational Computing Consortium

Distributed By

The ATARI Program Exchange
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METRIC AND PROBLEM SOLVING

Version 1

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2520 Broadway Drive
St. Paul, Minnesota 55113

February 15, 1982

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INTRODUCTION

The Metric and Problem Solving module consisting of one diskette and this support booklet has been designed for use with elementary grade levels two through six. The diskette will operate on either an ATARI 400 or an ATARI 800 Computer. This support booklet provides information necessary to use the diskette effectively in a classroom setting.

METRIC ESTIMATE, METRIC LENGTH, and METRIC 21 provide drill and practice in working with metric units, estimation and conversion. BAGELS is a game of logic, and HURKLE is a game for teaching coordinate systems, direction, and point location. NUMBER is a game of logic that uses varying ranges of numbers, while TAXMAN teaches about factors of a number and prime numbers.

Handout pages in this booklet may be duplicated for use with students. These pages are numbered sequentially in the upper right corner, for example, Handout 1 - Name of Handout.

Code numbers following some objectives refer to sections in Some Essential Learner Outcomes (SELOs), produced by the Minnesota State Department of Education. The objectives in this booklet are taken from the Mathematics Education SELOs.

INDEX TO PROGRAMS ON DISKETTE

BAGELS
A game of logic with the student using clues to guess a 2-4 digit number randomly selected by the computer.

HURKLE
A game for learning to locate points on a number line or teaching the coordinate system.

METRIC ESTIMATE
A timed drill for estimating lengths of line segments in centimeters and millimeters.

METRIC LENGTH
A drill on converting from one metric unit to another using centimeters and millimeters.

METRIC 21
A game of Blackjack for improving skill in approximating metric lengths.

NUMBER
A game of logic that can use various ranges of numbers. The computer chooses a number and gives clues.

TAXMAN
A game that teaches about factors of a number and prime numbers.

A GUESSING GAME WITH NUMBERS

Specific Topic: Logic, place values

Type: Educational Game

Reading Level: 2.6 (Spache Test)

Grade Level: 3-6

DESCRIPTION...

BAGELS is a number game in which the computer randomly generates a two-, three- or four-digit number. Students guess a number, and the computer gives clues as to whether any digits in their guess are in the secret number. The clues are given in the form of three words:

PICO	means one digit is correct but in the wrong place
FERMI	means one digit is correct and in the right place
BAGELS	means none of the digits is correct

OBJECTIVES...

1. to improve the ability to reason and make logical guesses.
2. to acquire a better understanding of place value.
3. to discover an optimum strategy for guessing the number in the fewest tries.
4. to use reasoning of some of the following kinds to draw conclusions:
   cause effect relationships
   use of proof by exhaustion of possibilities
   induction
   deduction (Mathematics SELO IV-D-1).

BACKGROUND INFORMATION...

BAGELS is an educational game providing a student with practice in using logic and place value. The computer chooses numbers at random making every run of the game different. The computer never uses the same digit twice; therefore it would not pick a number like 223. As the students play the game, they must use logic to put clues together and discover the number.

If the computer generates the number 123, and the student guesses 456, the computer will give the clue **BAGELS** because none of the digits is correct.

If the student guesses 145, the computer will print **FERMI** because the 1 is in the correct place.

If the student guesses 245, the computer will print **PICO** because the 2 is correct but in the wrong place.

If the student guesses 142, the computer will print **FERMI PICO** because 1 is the correct digit in the correct place, and 2 is the correct digit but in the wrong place.

USE IN AN INSTRUCTIONAL SETTING...

Preparation

Before playing BAGELS individually on the computer, students might play a few rounds "by hand," with the teacher thinking of a two digit number, to become aware of the type of logical thinking involved. Demonstrating the program to the whole class, with the class jointly deciding on each next guess, is also an effective way to introduce BAGELS.

As students play BAGELS with the computer, the teacher may wish to select the number of digits. The more digits, the more difficult the game.

Using the Program

To discover an optimum strategy for guessing the number in the fewest tries, the student could use Handout 1 - BAGELS. If all guesses are recorded, the student can study the pattern and try to develop a strategy for increasing their speed in guessing the correct number. The number should not repeat the same digit, and zero can be used.

The program can be used in the following ways:

1. as an independent activity to develop logic and strategy (use Handout 1 - BAGELS to record your guesses and the computer responses)

2. as a method to motivate students to use logic and strategy by playing a competitive game (use Handout 1 - BAGELS to create a game in which you have an opponent)

3. as an entire class or group activity by dividing the group in half and seeing which group guesses the number in the least number of tries

4. as a record of improvement in use of logic, understanding of place value and strategy using Handout 2 - BAGELS.

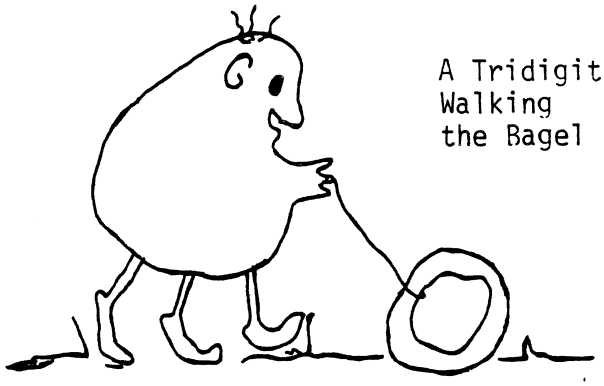
Follow-up

The following activities are suggested for students who would like to pursue practice in logic and strategy:

1. Without the aid of the computer, use a four-digit numeral to play the game.

2. Play the game using the letters of the alphabet instead of numbers. Discuss why this game is more difficult than the number game.

BAGELS



A Tridigit
Walking
the Bagel

BAGELS - No digits correct

PICO - One digit correct — wrong place

FERMI - One digit correct — right place

My Number Is_____ Number of Digits_____

Possible Digits 0 1 2 3 4 5 6 7 8 9

Opponent's Guesses Digits			Responses			My Guesses Digits			Responses		
1st	2nd	3rd	PICA	FERMI	BAGELS	1st	2nd	3rd	PICA	FERMI	BAGELS

BAGELS

NAME: _____

BAGELS - No digits correct

PICO - One digit correct—wrong place

FERMI - One digit correct—right place

The number was _____
It took me _____ guesses.

The number was _____
It took me _____ guesses.

The number was _____
It took me _____ guesses.

The number was _____
It took me _____ guesses.

The number was _____
It took me _____ guesses.

The number was _____
It took me _____ guesses.

The number was _____
It took me _____ guesses.

The number was _____
It took me _____ guesses.

SAMPLE RUNS

```
The computer will think of a number
and you will try and guess what the
number is.  You will have 18 tries to
attempt to guess it.

How many digits do you want
in the number? (2-4 only)
```

Players decide how many digits the number will contain, then the computer "thinks" of a number and asks players to guess what it is.

EXAMPLES OF SCREEN OUTPUT

```
The computer has a 3 digit number...
---------------------------------------
     GUESS  CLUE
  1) ?123   FERMI
  2) ?456   BAGELS
  3) ?789   FERMI
  4) ?145   BAGELS
  5) ?425   FERMI
  6) ?

(To see the answer, enter all zeroes)
```

Players have up to 18 tries to guess the correct number. They can see the correct number at anytime by typing zeros.

LEARNING TO LOCATE POINTS

Specific Topic: Locating points, graphing, number line

Type: Educational game

Reading Level: 2.2 (Spache)

Grade Level: 2-6

DESCRIPTION...

The HURKLE, an imaginary creature, hides on a grid or number line. Students find it with the aid of computer clues in the form of directions such as south or northeast. Students work with a vertical number line, a horizontal number line, a 10 x 10 grid or a -5 x +5 grid.

OBJECTIVES...

1. to locate points on a horizontal line, vertical line, positive coordinate system (0 to 10), or coordinate grid from -5 to +5.
2. to reinforce concepts of direction.
3. to recognize when one or more particular strategies are appropriate (Mathematics SELO IV-B-1).

BACKGROUND INFORMATION...

HURKLE was developed to help students learn the concept of direction and use strategy to locate the Hurkle on a grid or number line.

What is a Hurkle? A Hurkle is a happy beast that lives in another galaxy on a planet named Lirth with three moons. Hurkles are favorite pets of the Gwik, the dominant race of Lirth and . . . to find out more, read "The Hurkle Is A Happy Beast" in A Way Home by Theodore Sturgeon.

In each option the Hurkle hides on a point which students try to locate and gives clues by describing in which direction the user should move: north, south, east or west. The object is to find the Hurkle in the least number of guesses.

HURKLE has four options.

1. A horizontal line
2. A vertical line
3. A 10 x 10 grid
4. A -5 x +5 grid

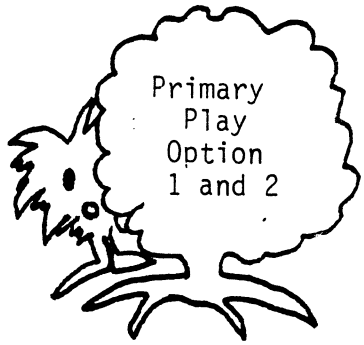
When using one of the grids, students should discover where a good first guess might lie (near the center of a 10 x 10 or the origin of -5 x 5). What is the minimum number of guesses needed to locate HURKLE if one uses the optimal strategy? Is it harder to find HURKLE on the grid than on the straight line? Why?

Students should be allowed and encouraged to discover for themselves that when the HURKLE is on a single line, a good first guess is at the middle of the line —not at one end. Some students might be able to figure out through experience the minimum number of guesses it will take to find the HURKLE by considering all possible situations.

Options 3 and 4 are designed to enable the student to discover the concept of ordered pairs of numbers as the label of a point on coordinate axes. Most students have difficulty understanding and remembering that the horizontal value x is listed first, then the vertical value y. By entering an ordered pair, e.g., 1,4 and observing the corresponding point that appears on the grid, the students learn through their own experience which number is the x value and which is the y value.

Expect mistakes to be made at first; they are an important part of this learning process. The students will say, "But I wanted the point over there, why did it show up here?" They will then realize that they entered the numbers in reverse order of what they intended.

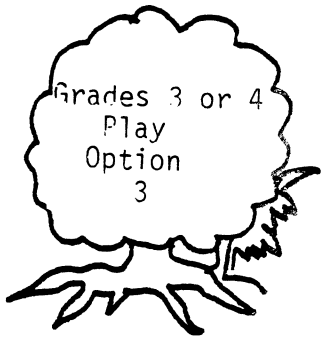
USE IN AN INSTRUCTIONAL SETTING...



Preparation

To effectively use HURKLE to reinforce direction and strategy, it will be necessary for the student to be familiar with direction (north/south/east/west) as well as with horizontal, vertical, and a grid. It would also be necessary to know about a -5 x +5 grid in order to use option 4. It is suggested that a student begin with option 1 and move on to options 2, 3, and 4, as the student is ready.

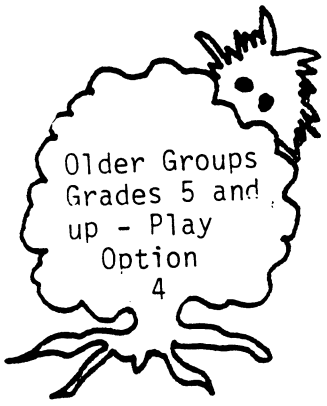
Option 3 and 4 are not recommended for use with primary students because they involve the use of a coordinate system.



Teachers may wish to adjust the volume on the television or monitor so that the sound does not disturb the class. For option 4, -5 x 5 grid students will need to use the (-) minus key, which is 2 keys left of RETURN on the ATARI.

Using the Program

The program can be used in the following ways:



1. Have a student try to locate the HURKLE in the least number of tries. Plan for effective strategy to locate the HURKLE.

2. Have the students work in small groups, trying to find the HURKLE in the least number of tries. As a group, discuss finding effective strategy to locate the HURKLE.

3. When introducing the coordinate system, have students use Option 3. Using Handout 3 - HURKLE, have students select a point, plot it on the handout and then enter it into the computer. Have students check to see if the point they plotted on their worksheet is the same on the computer graph. This will give students a chance to check their work against the computer.

4. Play Option 4 of HURKLE. This may be too advanced for grades lower than sixth. This option could be used by a few students to play on their own, or it could be used in the class in the same way as Option 3. Use Handout 4 - HURKLE with Option 4.

USE IN AN INSTRUCTIONAL SETTING (Continued)

Follow-up

The following activities are designed to assist students in using logic, direction and strategy:

1. Have students use Handout 3 - HURKLE and Handout 4 - HURKLE to check their work against the computer and study ways to improve their logic and strategy.

2. For primary students, draw a picture of how you imagine a HURKLE would look.

3. Introduce the fantasy of the HURKLE (see Background Information) and have students write a description of the HURKLE or write a HURKLE adventure story.

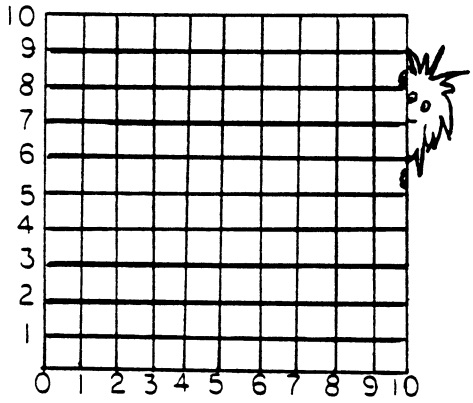
4. Using a map and working in small groups, practice moving a toy car in specific direction, e.g., southeast, etc.

5. List and discuss other games the students have played that involve strategy (e.g., checkers, chess, Othello, BAGELS, etc.). How does one discover a good strategy to coin? Could there be more than one good strategy for a given game?

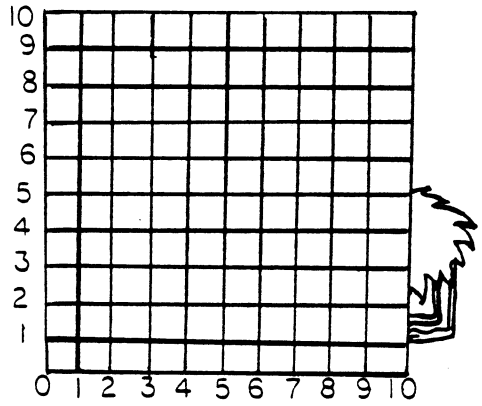
6. List and discuss instances in which a coordinate system (grid) is used, e.g., the game Battleship, a street system, some tables/charts, a multiplication table, etc.

3

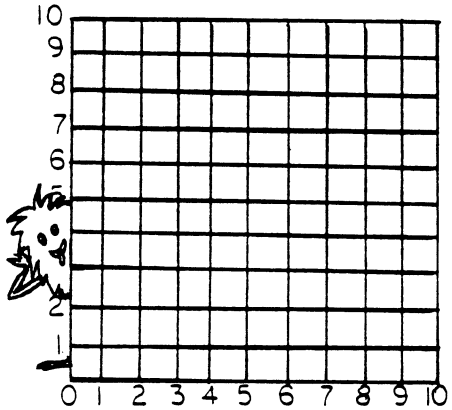
HURKLE



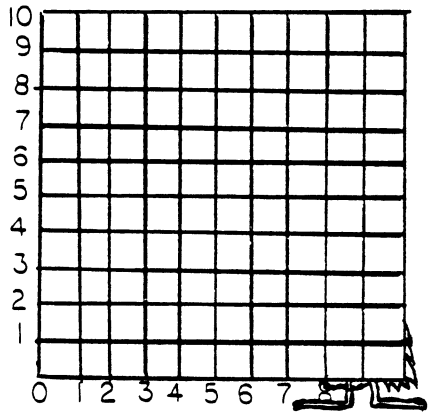
I found the HURKLE in____tries.
I did not find the HURKLE____.



I found the HURKLE in____tries.
I did not find the HURKLE____.



I found the HURKLE in____tries.
I did not find the HURKLE____.

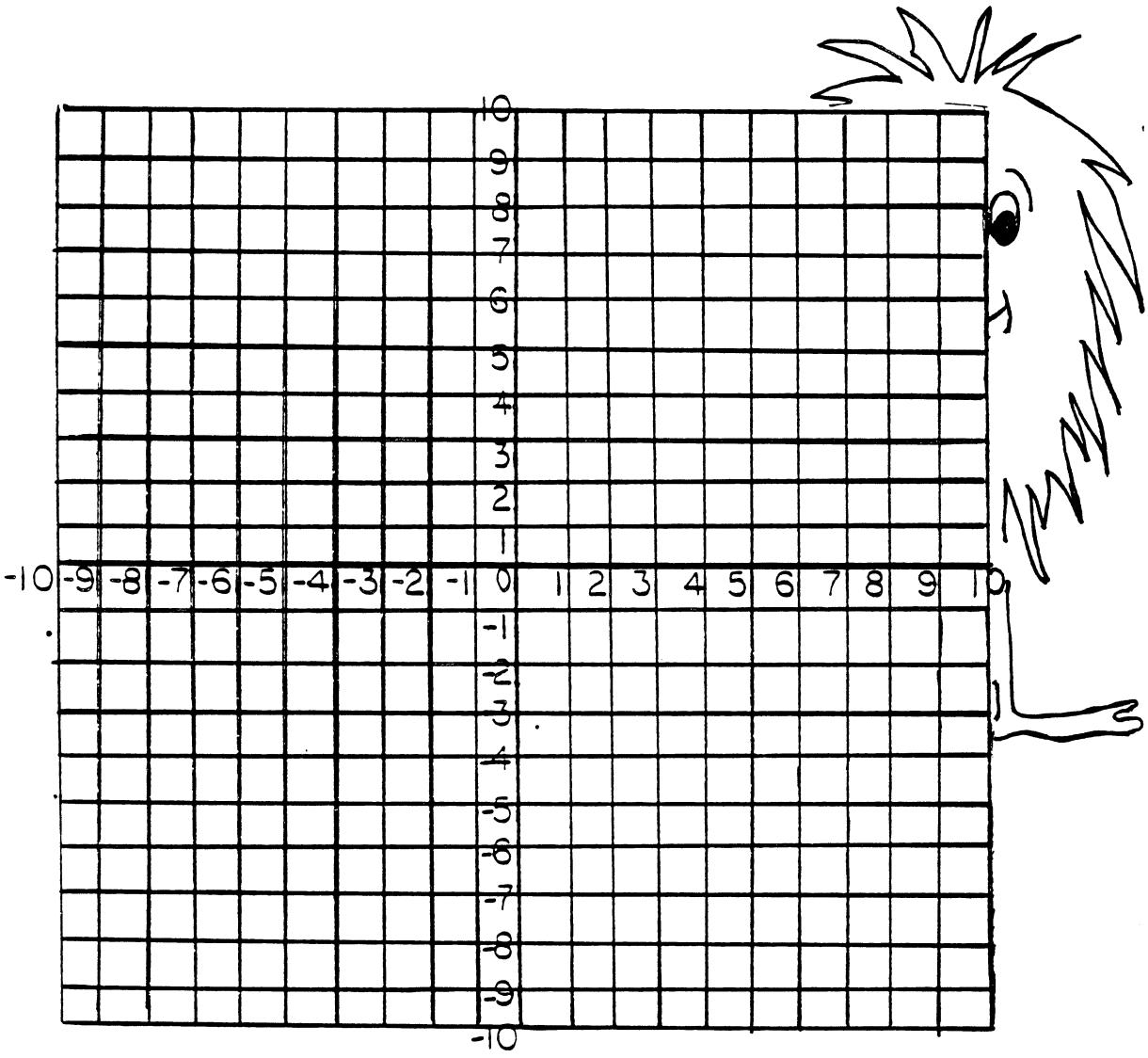


I found the HURKLE in ____tries.
I did not find the HURKLE____.

MECC

4

HURKLE



I found the HURKLE in____tries.
I did not find the HURKLE____.

SAMPLE RUNS

```
1] On a horizontal line
2] On a vertical line
3] On a 10 by 10 grid
4] On a -5 by +5 grid

Where should Hurkle hide?
```

There are four options for finding the Hurkle, ranging from relatively easy to difficult. The teacher may specify the option or let students choose.

EXAMPLES OF SCREEN OUTPUT

```
10 . . . . . . . . . . .
 9 . . . . . . . . . . .
 8 . . . . . . . . . . .
 7 . . . . . . . . . . .
 6 . . . . . . . . . . .
 5 . . . . . . . . . . .
 4 . . . . . . . . . . .
 3 . . . . . . . . . . .
 2 . . . . . . . . . . .
 1 . . . . . . . . . . .
 0 . . . . . . . . . . .
   0 1 2 3 4 5 6 7 8 9 10

Where do you think it is
(Type two numbers separated
by a comma)? 5,5
```

The computer gives directional clues to locate where the Hurkle is hiding. (In options 3 and 4, students respond by typing in two numbers separated by a comma.) The computer will tell how many turns it took to find the Hurkle or whether it took too many turns.

ESTIMATING METRIC LENGTHS

Specific Topic: Measurement estimation

Type: Drill and practice

Reading Level: 3.8 (Spache)

Grade Level: 4-6

DESCRIPTION...

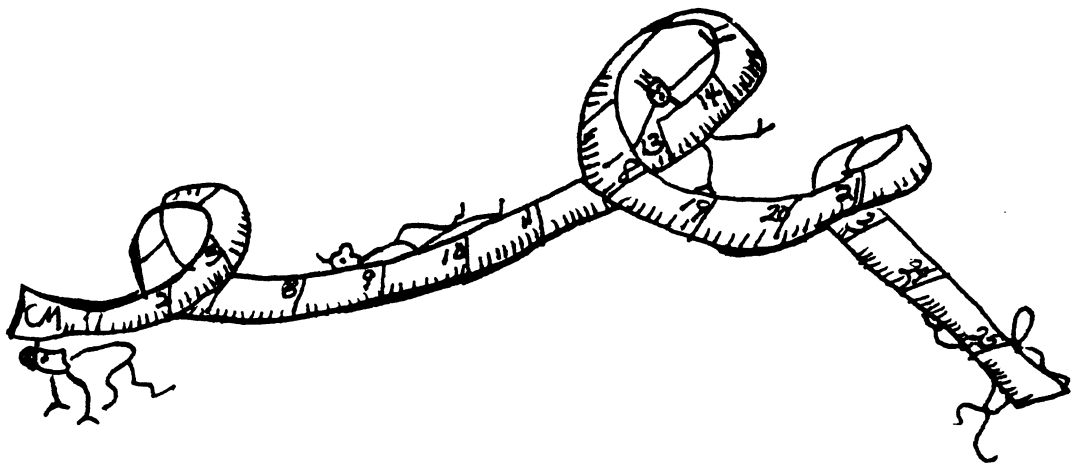
Students are shown a line segment and are asked to estimate its length in centimeters or millimeters.

OBJECTIVES...

1. to use metric measures as units of length.
2. to estimate the length of a segment to the nearest centimeter or millimeter.
3. to select and use appropriate units to measure length (Mathematics SELO III-E-1).
4. to determine whether or not a proposed answer is reasonable (Mathematics SELO III-B-1).
5. to use metric prefixes (Mathematics SELO II-F-1).

BACKGROUND INFORMATION...

The program provides practice in estimating lengths in centimeters or millimeters. Because of the varying size of television screens, it is essential that a sample line segment be measured before the students use the program. At the beginning of the first run, the computer asks that two lines be measured and that their values be entered in millimeters. The answer must be in millimeters. Once the two line lengths are measured, the measurements should be filled in on the top section of the student Handout 5 - Metric Estimate. It is not necessary for each student to repeat this procedure. When working at the computer, students can answer in either centimeters or millimeters, although centimeters will be easier for most students. If the student is working with millimeters, estimates within one millimeter will be considered correct. If the answer is within a close range (8 millimeters, 2.2 centimeters) the message "CLOSE" is printed. The true value is given and another line segment is generated.



USE IN AN INSTRUCTIONAL SETTING...

Preparation

Introduce the concept of centimeters and millimeters. With a metric ruler have students measure familiar items to acquaint them with the length of a centimeter and millimeter, and have them check one another's work.

Using the Program

Have students use the program METRIC ESTIMATE individually, and record results on the handout.

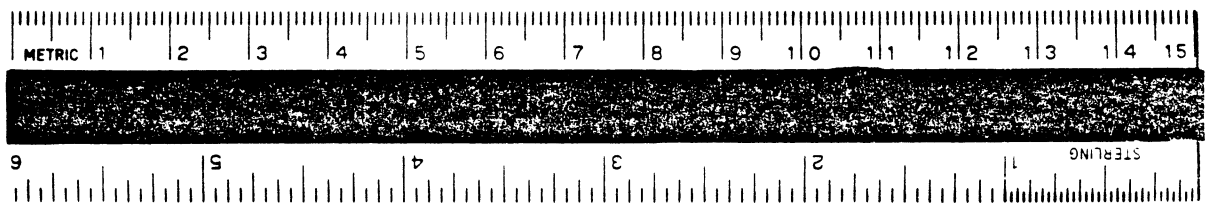
Hold a metric-by-computer contest with individual students or small groups running the program. Handout 5 - METRIC ESTIMATE can be used by each team for record keeping. Teams may earn two points for a correct answer on first try and one point for a correct answer on the second try. The team with the most points wins.

Follow-up

Students interested in improving their abilities in metric estimate might:

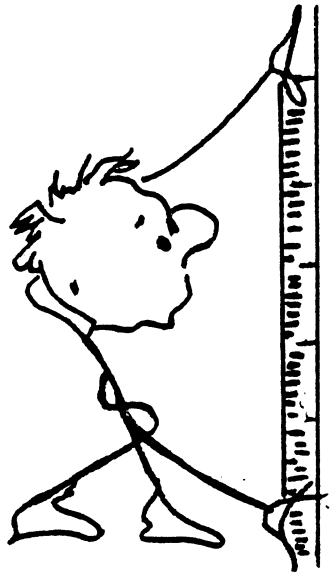
1. Continue to estimate objects in their environment in metric units.

2. Once students have an idea of the length of a centimeter, organize a scavenger hunt. Give students a list of various lengths in centimeters, and have them find objects for the given lengths. The first group or individual to complete the activity is the winner.



5

METRIC ESTIMATE



Name: _____

Measurement #1: _____

#2: _____

Number of problems: _____

Measure in Centimeters: _____

in Millimeters: _____

Number Tried: _____

Number correct - first try: _____

- second try: _____

Number tried: _____

Number correct - first try: _____

- second try: _____

Number tried: _____

Number correct - first try: _____

- second try: _____

Number tried: _____

Number correct - first try: _____

- second try: _____

Number tried: _____

Number correct - first try: _____

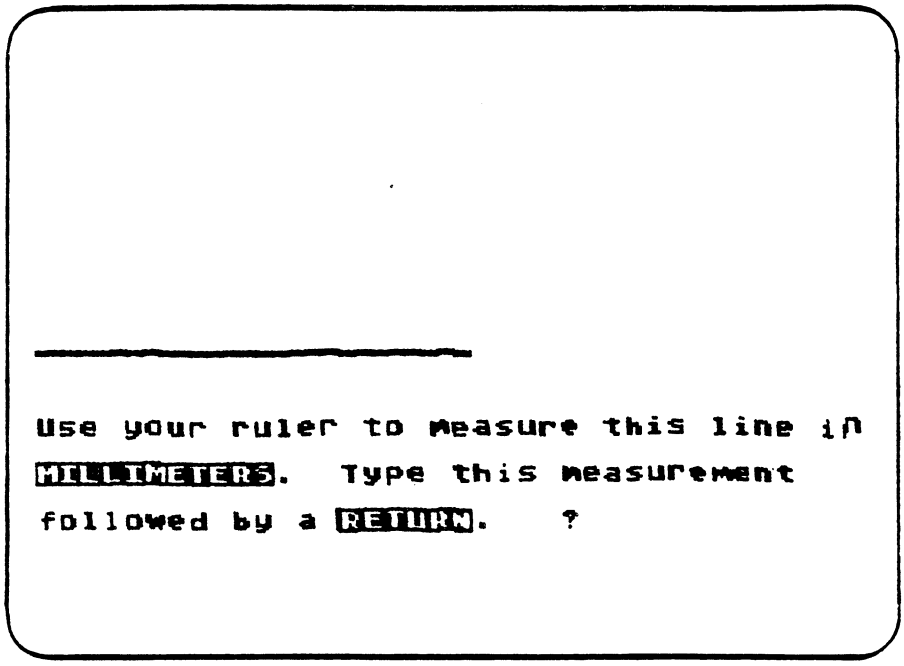
- second try: _____

Number tried: _____

Number correct - first try: _____

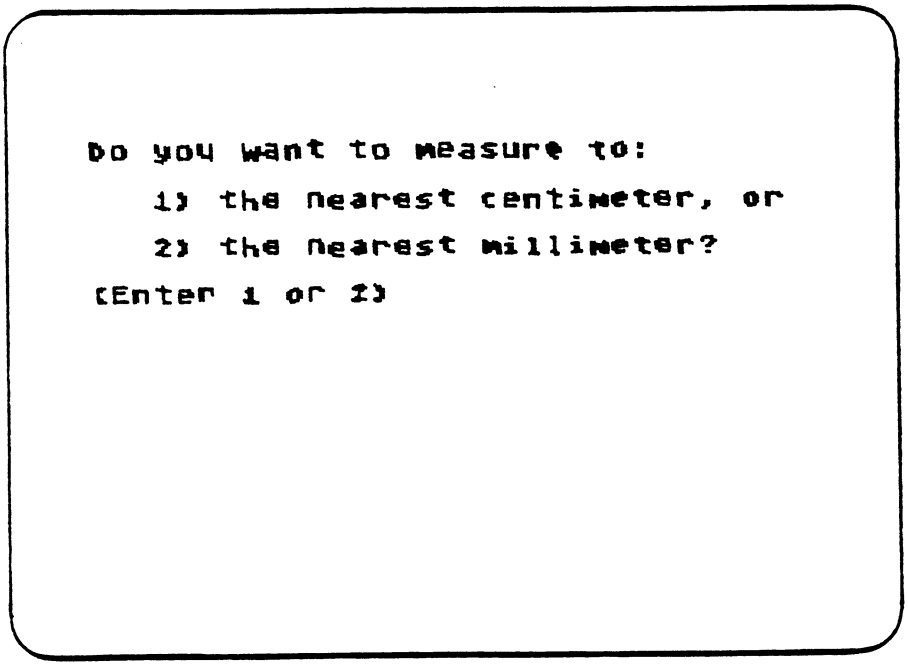
- second try: _____

SAMPLE RUNS



After printing instructions, the computer will direct the student to adjust measurements for the individual television screen size by typing in the length of the line displayed in millimeters.

EXAMPLES OF SCREEN OUTPUT



Students may choose between measuring in centimeters or in millimeters by entering a 1 or 2. With this unit specified, answers in millimeters are given in whole numbers. Answers in centimeters may be given in decimals.

WORKING WITH METRIC UNITS

Specific Topic: Metric length, measurement

Type: Drill and Practice

Reading Level: 3.4 (Spache)

Grade Level: 4-6

DESCRIPTION...

This program gives a student practice in converting units within the metric system using millimeters, centimeters, meters and kilometers.

OBJECTIVES...

1. to practice converting within the metric system.
2. to reinforce the meaning of the prefixes milli, centi and kilo.
3. to use metric prefixes (Mathematics SELO II-F-1.)

BACKGROUND INFORMATION...

This program includes conversions from the most common units, i.e., millimeters, centimeters, meters and kilometers. A conversion chart is as follows:

10 millimeters (mm) = 1 centimeter (cm)

100 centimeters (cm) = 1 meter (m)

1000 meters (m) = 1 kilometer (km)

That means ...

10 millimeters (mm) = 1 centimeter (cm)

Students choose the number of problems they want to work on and have two chances to answer each problem correctly. A summary score is provided at the end.

This is a drill in converting from one unit of metric length to another. The units used will include the millimeter (mm), centimeter (cm), meter (m) and kilometer (km). The student is given a length in one unit and is asked to convert it to another unit.

USE IN AN INSTRUCTIONAL SETTING...

Preparation

Students need to be familiar with the different units of metric measurement and to understand how to convert from one unit to another. The program works with conversions from the most common units, i.e., millimeters, centimeters, meters and kilometers.

Using the Program

This program may be used either individually or with students working in pairs.

1. to develop skill in metric conversion.

2. to reinforce the meanings of prefix.

Use Handout 6 - METRIC LENGTH to record students' scores.

Follow-up

The following activities are suggested for students who want to do further work with metric length and conversion.

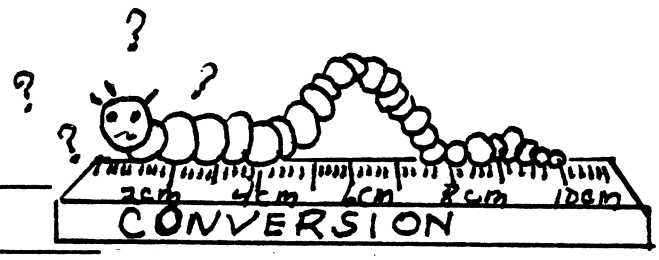
1. Use Handout 6 - METRIC LENGTH to keep a record so that students can keep track of progress.

2. Measure items found in a student's environment. Measure in one unit (cm) and convert to another unit (mm).

3. List objects that are best measured by millimeters, by centimeters, by meters, by kilometers.

6

METRIC LENGTH



Name: _____

Number of Problems: _____

Number Tried: _____ Number tried: _____

Number correct - first try: _____ Number correct - first try: _____

- second try: _____ - second try: _____

Number tried: _____ Number tried: _____

Number correct - first try: _____ Number correct - first try: _____

- second try: _____ - second try: _____

Number tried: _____ Number tried: _____

Number correct - first try: _____ Number correct - first try: _____

- second try: _____ - second try: _____

SAMPLE RUNS

```
                PROBLEM #2

176 MM = 1760       CM
  That's not right...Try again!

176 MM = 17.6       CM

Right on!


      Press RETURN to continue.
```

Students convert from one metric unit to another and are given two tries to get the correct answer.

EXAMPLES OF SCREEN OUTPUT

```
**************************
*                        *
*  Number tried...10     *
*                        *
*                        *
* Number correct         *
*                        *
*  First try..... 7      *
*                        *
*  Second try..... 2     *
*                        *
**************************
```

After problems are completed the computer shows the number of problems tried and the number correct on each try.

APPROXIMATING LINE LENGTHS

Specific Topic: Metric measurement

Type: Educational Game, Drill and Practice

Reading Level: 3.6 (Spache)

Grade Level: 4-6

DESCRIPTION...

Students play a game of metric Blackjack with the computer. Line segments of from 1 to 10 centimeters long are given. Using their knowledge of the metric system, students determine when their line segments add up to 21 centimeters.

OBJECTIVES...

1. to approximate the length of a segment from 1 to 10 centimeters.
2. to practice metric approximation in a game format.
3. to practice addition of whole numbers whose sum is normally less than 21.
4. to use metric prefixes (Mathematics SELO II-F-1).

BACKGROUND INFORMATION...

METRIC 21 is a game of Metric Blackjack. It like the card game of Blackjack or 21. The object is to get lines that add up to 21 centimeters but do not go over.

Each player will be given two lengths. The computer will be the dealer and take two lengths. Players will see only its first length until all of them have finished.

The game then begins with the first player. The players should look at their two line segments and determine if they total close to but not over 21 centimeters. A maximum of five line segments may be requested. Each player then goes through the same procedure.

The computer will then show its second length. The computer continues to take lengths until the total is between 17 and 21 centimeters.

If the computer's total goes over 21 centimeters, the players who have not gone over 21 win. If the computer wins, it gets two points and the player -1. If there is a tie, the computer gets one, and the players get zero. If the computer loses, the player gets one, and the computer gets -2.

The process is the same for 1, 2, or 3 players. Each player is given two line segments, then player one may take additional segments or stop. A maximum of five segments may be requested. Then players 2 and 3 take their turns. The computer plays last.

USE IN AN INSTRUCTIONAL SETTING...

Preparation

A student would need to understand the game of Blackjack. The object is to get line segments to add up to exactly 21 centimeters.

In order to adjust the line segments to different televisions, the computer will always ask the length of a line segment at the beginning of the game. If the student or teacher measures the line segment once on the television used in the classroom and records it on the worksheet, the students will not have to measure the line each time that television is used.

Using the Program

Have students divide into groups of 2-3 and play Blackjack with the computer. Use Handout 7 - METRIC 21 for record keeping.

The program can be used in the following ways:

1. as an independent activity to develop the skill of identifying approximate length of a segment from 1 to 10 centimeters.

2. to develop skill in adding to 21.

3. to develop game strategy on how close one can come to 21 without going over.

Follow-up

The following activities can be used with students who have a special interest in metric approximation.

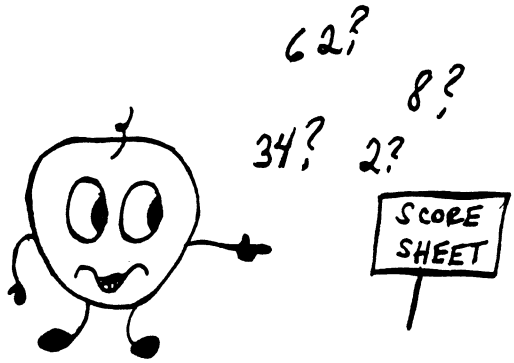
1. Have students research and describe other versions of Blackjack (with cards).

2. Discuss with the class strategies the students have developed for playing METRIC 21.

3. Discuss with the class the use of metric measurement (pros and cons).

4. Divide the students into teams, and run a tournament with Blackjack.

METRIC 21



Name: _____

Measurement: _____ cm.

Number of Games Played: _____

Player #1 _____: Score _____

Player #2 _____: Score _____

Player #3 _____: Score _____

Computer : Score _____

Number of Games Played: _____

Player #1 _____: Score _____

Player #2 _____: Score _____

Player #3 _____: Score _____

Computer : Score _____

Number of Games Played: _____

Player #1 _____: Score _____

Player #2 _____: Score _____

Player #3 _____: Score _____

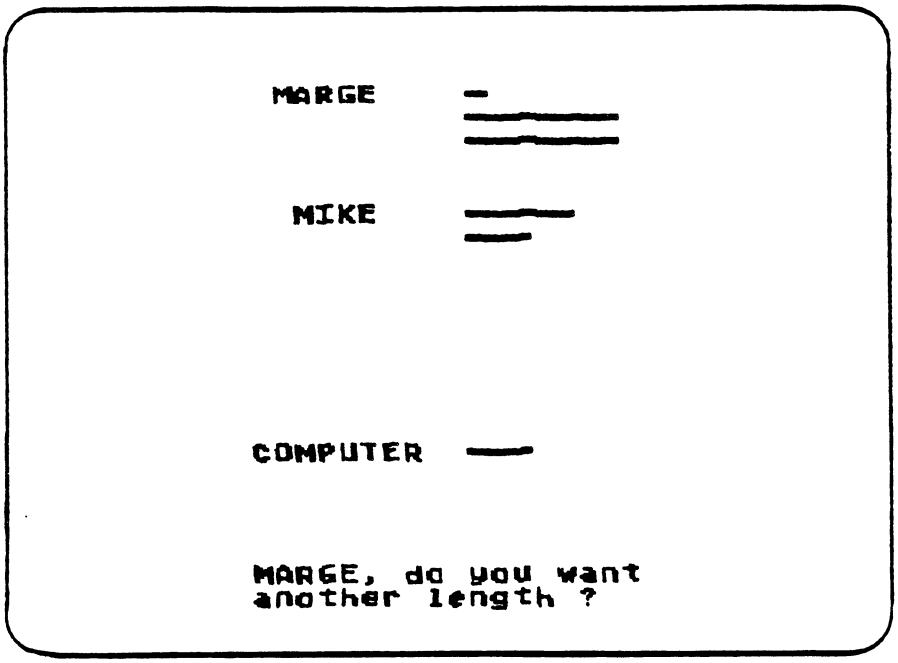
Computer : Score _____

SAMPLE RUNS

```
How many players are there?
```

The computer asks the player to measure the line on the display in centimeters. It will then give instructions and ask for the number of players.

EXAMPLES OF SCREEN OUTPUT



Players try to reach 21 centimeters but not go over with five or fewer lengths.

GUESSING BY LOGIC

Specific Topic: Ordering numbers

Type: Educational Game

Reading Level: 1.9 (Spache)

Grade Level: 1-5

DESCRIPTION...

Students try to guess the number that the computer has chosen. The computer gives clues either "too big" or "too small." The program can be adapted for different grade levels by specifying the range of numbers from which the computer selects the number.

OBJECTIVES...

1. to practice ordering numbers.
2. to develop strategies for guessing a number.
3. to use appropriate strategies in solving mathematics problems (Mathematics SELO IV-A-1).

BACKGROUND INFORMATION...

The computer randomly selects a number between one and a limit set by the student. If students are studying the order of numbers 1-10, the limit would be 10. The number chosen can be any number less than 99999. The students must try to guess the number the computer has chosen. The computer gives clues of "too big" or "too small." By using logic the students should be able to find the number.

If the students choose a range of numbers less than 13, the computer will represent the numbers graphically on a number line as a help to younger students in learning the order of numbers.

An effective strategy is to select a number halfway between one and the largest number. Students should continue selecting on that principle, using the clues of "too big" or "too small" until they get the correct number.

USE IN AN INSTRUCTIONAL SETTING...

Preparation

Play the NUMBER game with the class without the use of the computer. Have one student write a number between 1 and 100 (or 1 to 10 for younger students) on a sheet of paper and keep it secret. Have other students guess a number. Give clues by saying "too big" or "too small." Students can record their guesses and clues at their desks or have a student write them on the blackboard. Example:

Number on paper	Guess	Clue
8	25	too big
	13	too big
	6	too small
	8	That's it!!

Using the Program

This program can be used in the following ways:

1. Have a student try to guess the number in the least number of tries. Discover an effective strategy to guess the number.

2. Have students work in small groups, trying to guess the number in the least number of tries. As a group discuss effective strategies to find the correct number.

3. Divide the class into groups of 3 or 4. Each group goes to the computer and runs NUMBER six to ten times. Record the fewest and largest number of guesses required.

4. If working with older students, average the number of guesses for their group. The group with the lowest average is the winner. With older groups, discuss the strategy that worked best to guess the number in the fewest attempts. Use Handout 8 - NUMBER for record-keeping.

USE IN AN INSTRUCTIONAL SETTING (Continued)

Follow-up

The following activities are designed to assist students in using logic, direction and strategy.

1. Have students play other number guessing games such as answering a question by yes/no, e.g., is it greater than 50?

2. Have students play the game with the alphabet. Answer that the letter is closer to or farther from A each time.

3. Discuss which is easier, numbers or letters.

NUMBER

Name: _____

_____

Largest number: _____

Number of guesses: _____

Largest number: _____

Number of guesses: _____

Largest number: _____

Number of guesses: _____

Largest number: _____

Number of guesses: _____

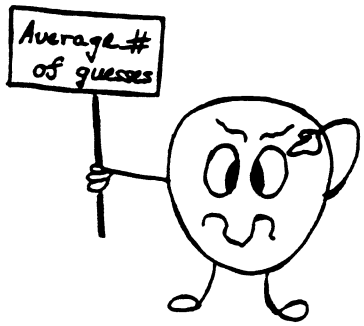
Largest number: _____

Number of guesses: _____

Average number of guesses: _____

Largest number: _____

Number of guesses: _____



Largest number: _____

Number of guesses: _____

N U M B E R

SAMPLE RUNS

```
What is the largest number that
you want ?
```

After giving the students instructions, the computer will randomly choose a number between 1 and the upper limit set. This limit can be no larger than 99999. (Do not use commas when entering numerical data.) Start with a lower limit like 10 or 100 until students understand the game, then adjust the limit.

EXAMPLES OF SCREEN OUTPUT

```
OK, start trying to guess the number.

     Guess #  1?500        too big.
     Guess #  2?80         too small.
     Guess #  3?
```

The student guesses a number, for example "80," and the computer responds with "too big," "too small" or "you guessed it."

STUDYING FACTORS OF NUMBERS

Specific Topic: Primes, composites and factors

Type: Educational Game

Reading Level: 3.3 (Spache)

Grade Level: 5-6

DESCRIPTION...

TAXMAN provides practice in factoring of a number and in recognizing prime numbers. Students choose a number from a list, and the "taxman" gets all the factors of that number that remain in the list. The students compete with the taxman for the high score. These numbers are deleted from the list, and the new list is displayed. The user must again choose a number that has factors, and the taxman gets any factors. This continues until no factors are left.

OBJECTIVES...

1. to discover factoring properties of composites and distinguish between primes and composites.
2. to develop different strategies for use with TAXMAN.
3. to analyze the results of strategies to learn why some work and others fail.
4. to recognize when one or more particular strategies are appropriate (Mathematics SELO IV-B-1).
5. to use reason to draw conclusions (Mathematics SELO IV-D-1).

BACKGROUND INFORMATION...

TAXMAN is an educational game designed to give the student practice in factoring numbers and recognizing prime numbers. It is necessary for the student to be familiar with factor properties of composites and to be able to distinguish between primes and composites.

The rules for TAXMAN should be viewed at the beginning of play. The game starts when the player chooses the upper maximum of a list of sequential numbers (range 2 to 50). The first time students use the program, they should use numbers from one to ten. The computer will display the number list on the screen as follows:

1 2 3 4 5 6 7 8 9 10

The player takes a number, and the computer (or taxman) takes all the factors of the number, i.e., all the numbers that divide evenly into the selected number. For example, if a player chooses 8, the computer will 4, 2 and 1. This gives the player 8 points and the computer 4 + 2 + 1 or 7 points. If the player chooses 9, on the first play the computer will take 3 and 1, giving the player 9 points and the computer 3 + 1 or 4 points.

The numbers taken by the player and the computer are then removed from the list. Players cannot take a number unless there are some factors on the list for the taxman. When no factors are left the computer gets all the remaining numbers.

Students should develop their own strategies for playing the game. A typical game is as follows:

Move 1: 1 2 3 4 5 6 7 8 9 10
(A good first move is to take the largest prime number on the list. One is a factor of all numbers, and by taking the largest prime the player gets a large number while the computer gets only one.)

Player takes 7
Computer takes 1

Move 2: New List
2 3 4 5 6 7 8 9 10
(The player tries to take numbers that have only one factor on the list. Nine is a good choice.)

Player takes 9 Total: 9 + 7 = 16
Computer takes 3 Total: 3 + 1 = 4

BACKGROUND INFORMATION (Continued)

Move 3: New List
2 4 5 6 8 10
(If a player takes 8, 2 and 4 are lost. If a player takes 10, 2 and 5 are lost. But if 6 is taken only 2 is lost, and 8 and 20 can still be taken.)

Player takes 6	Total: 6 + 16 = 22
Computer takes 2	Total: 2 + 4 = 6

Move 4: New List
4 5 8 10

Player takes 10	Total: 22 + 10 = 32
Computer takes 5	Total: 6 + 5 = 11

Move 5: New List
4 8

Player takes 8	Total: 40
Computer takes 4	Total: 15

USE IN AN INSTRUCTIONAL SETTING...

Preparation

To effectively use TAXMAN the students need to understand the rules of the game. It is also necessry that students understand primes, composites and factors.

It is recommended that the teacher give a classroom demonstration, before students use the program alone or in pairs. Students should be reminded that the more numbers they select, the more difficult the program.

Using the Program

The program can be used in these ways following the study of factors of a number.

1. Play the game with the computer a few times with the entire class participating. Keep a score sheet on an overhead or the blackboard. Use these records to study strategy and analyze results.

2. Play the game as an individual activity to develop skill in understanding primes and factors and to devise a strategy to win.

3. As a group activity, have groups of students confer to discuss strategies and to see if a method could be generalized.

4. Use Handout 9 - TAXMAN to record your scores and the computer's score.

5. Keep a written record of your selections and what the computer (TAXMAN) takes. Study these to develop a greater understanding of prime numbers and factors.

6. Have students work in pairs to develop strategy to beat the TAXMAN.

Follow-up

The following activities are suggested for students who would like to pursue practice and develop skills in prime numbers and factors.

1. The student may list the prime numbers less than 50 or 100.

2. The students may wish to research the sieve of Eratosthenes (a method for determining prime numbers).

9

T A X M A N

Name: _____

My number list was to: _____

TAXMAN score: _____

My score: _____

My number list was to: _____

TAXMAN score: _____

My score: _____

My number list was to: _____

TAXMAN score: _____

My score: _____

My number list was to: _____

TAXMAN score: _____

My score: _____

My number list was to: _____

TAXMAN score: _____

My score: _____

My number list was to: _____

TAXMAN score: _____

My score: _____

My number list was to: _____

TAXMAN score: _____

My score: _____

My number list was to: _____

TAXMAN score: _____

My score: _____

My number list was to: _____

TAXMAN score: _____

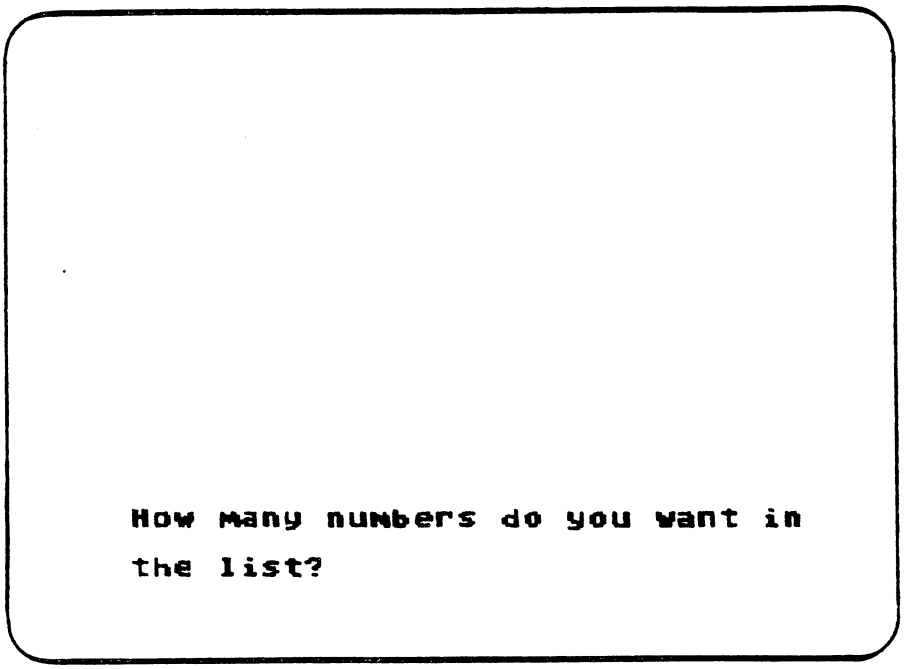
My score: _____

My number list was to: _____

TAXMAN score: _____

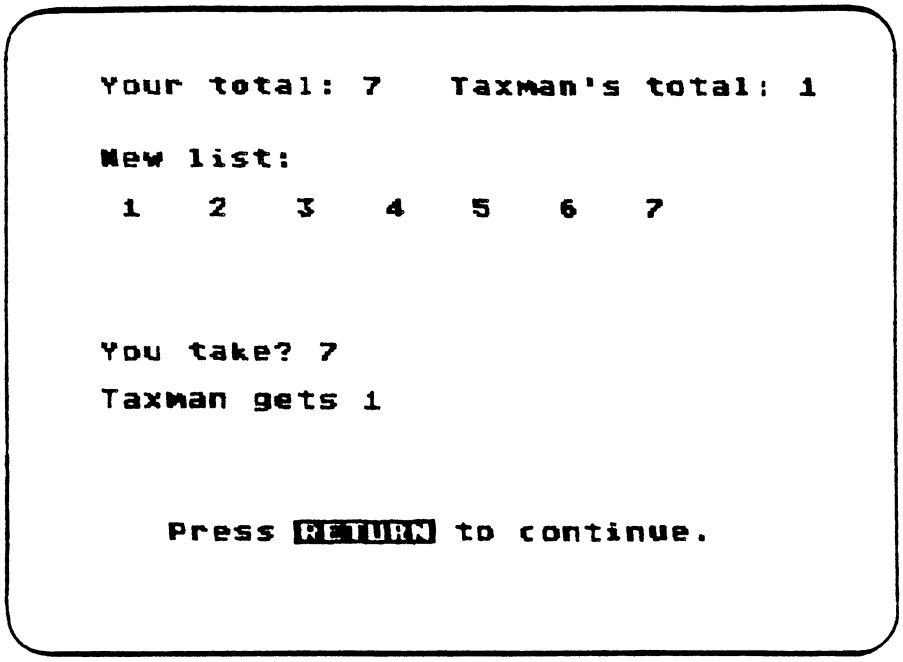
My score: _____

SAMPLE RUNS



Following the instructions, the computer asks how many numbers students want on the list. The longer the list, the more difficult the game.

EXAMPLES OF SCREEN OUTPUT



An example of a list of numbers from 1 to 7 is displayed on the screen. If the players choose 7, the TAXMAN gets 1 and the new list will be 2 3 4 5 6.

APPENDICES

GETTING TO KNOW YOUR ATARI COMPUTER

Equipment

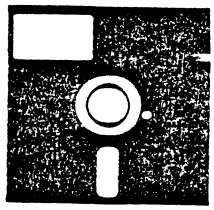
ATARI COMPUTER CONSOLE: The computer and keyboard.

BASIC LANGUAGE CARTRIDGE: A cartridge (containing the BASIC computer language) that is inserted into the console above the keyboard.

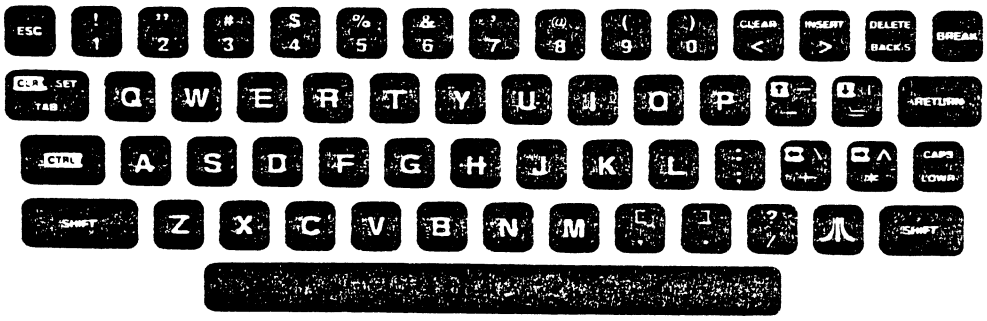
TELEVISION: A television set used to display information.

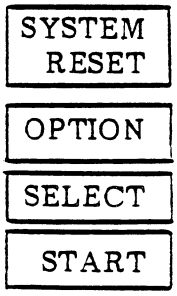
DISK DRIVE: A unit that holds and reads the diskette.

DISKETTE: A 5¼ inch "record" that contains a series of computer programs.



ATARI Computer Keyboard





The ATARI Computer keyboard looks much like the keyboard of a typewriter. Some special keys are noted below:

RETURN Key—When you are finished typing either a response to a question or a line in a program, you send the information to the computer by pressing the **RETURN** key.

BACK S (Backspace) Key—Each time you press the **BACK S** key, the cursor backs up one space and erases each letter it passes over. This feature allows you to correct typographical errors easily.

BREAK Key—Press this key to stop the execution of a program. The program will remain in the computer memory and may be run again. If **BREAK** doesn't work to stop the program, try the **RESET** key.

SYSTEM RESET

RESET Key—Like the **BREAK** key, the **RESET** key stops program execution. It also clears the screen. To restart, type RUN"D:HELLO".

ESC (Escape) Key—While you are using MECC diskettes, press the **ESCAPE** key in response to a question to stop program execution. The computer will ask whether you wish to run the program again. If you do not, the computer will display the diskette menu, and you may choose another program.

SHIFT Key—Use the computer SHIFT key like that of a typewriter. If a key displays two characters, you may hold down the **SHIFT** key while typing to print the upper character. For example, holding down the **SHIFT** key and typing  will print !.

CAPS/LOWR (Capitals/Lower case) Key—When you press this key, the computer begins typing in lower-case letters. To capitalize individual letters, you must hold down the **SHIFT** key as with a typewriter. To switch back to all capitals, hold down the **SHIFT** key, and press the **CAPS/LOWR** key again.

CTRL (Control) Key—Hold down the **CONTROL** key while pressing another key if indicated by the computer instructions.

Keys That Can Cause Confusion

0 (Zero)—The zero is on the top row of keys. Do not use the letter O interchangeably with this number key.

1 (One)—The number one is on the top row of keys. Do not use it interchangeably with a lower-case L (l).

USING A MECC DISKETTE

Using the Computer

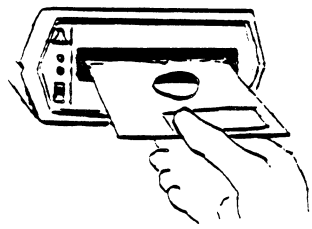
1. Make certain that the ATARI Computer, BASIC language cartridge, disk drive and television are plugged in and connected to each other properly. (See the ATARI Computer New User's Guide by MECC for detailed instructions.)

2. Turn on the television.

3. Turn on the disk drive. The PWR ON and BUSY lights will come on. After about 10 seconds the BUSY light will go off, and the whirling sound will stop.

   Turn on the disk drive before you turn on the computer.

4. Press the rectangular release button below the disk drive to open the door. Insert a diskette into the disk drive, exposed oval part first, with the diskette label up. Diskettes are sensitive to dust, heat, cold and magnetic fields, so handle them with care. (See the User's Guide for information on diskette care.)



5. Close the door on the disk drive.

6. Turn on the ATARI Computer. The power switch is located on the right side near the power cord. The disk BUSY light will turn on, and you will hear a whirling sound from the disk drive.

   If the disk BUSY light does not go off in about 10 seconds, turn the computer off, and make sure that the diskette is placed correctly in the disk drive. Then turn the computer on.

   If no display appears on your television screen at this point, and the television is set at channel 2 or 3, the computer may be set for the wrong channel. The channel select switch is on the back of the ATARI 400 Computer. Switch it to the opposite position.

7. A MECC logo will appear on the screen with the diskette name. Then a "menu" will appear. The menu gives a list of programs on the diskette. To run a program, type the number shown in front of the program name, then press the **RETURN** key. To access any available teacher options on the diskette, hold down the CTRL key and type A.

8. Follow the directions given in the program. Remember to press the **RETURN** key after each answer.

9. To return to the menu while running a program, press the **ESC** (Escape) key in response to any question.

   The screen will then ask whether the current program is to be run again or not. If not, the menu is automatically displayed.

10. To use a different diskette, select the END option from the menu, and follow the directions on the screen.

Turning Off The Computer

1. Take the diskette out of the disk drive, and store it in its protective envelope.

2. Turn off the ATARI Computer, the disk drive and the television.

DEFINITIONS OF TERMS

BACKGROUND INFORMATION—The information that explains or enriches program content or provides technical information on the program.

COURSEWARE—A collection of computer programs together with accompanying support materials.

DOCUMENTATION—The written material for the teacher to use with the computer program (also called a support booklet or support materials).

DRILL AND PRACTICE—A computer program that provides repetitive practice on a skill or a set of facts.

EDUCATIONAL GAME—A computer program that presents an instructional purpose in a game format.

GRADE LEVEL—The range of grades for which the program was designed.

HANDOUTS—The pages of the support booklet that may be duplicated for student or teacher use.

MODULE—The package containing the computer program(s) and the support booklet.

OBJECTIVES—The results to be achieved by using the program and support materials.

PROBLEM SOLVING—A computer program that processes data for a problem defined by the student.

PROGRAM—The routines and operations that instruct the computer.

READING LEVEL—The readability of the text that appears on the computer screen.

SAMPLE RUNS—The pages of the support booklet that show examples of computer screen output and accompanying explanations to outline the program flow.

SELO—Some Essential Learner Outcomes prepared by the Minnesota State Department of Education. When applicable these are included with the objectives in MECC support booklets.

SIMULATION—A computer program that approximates a real-world environment for examination.

SUPPORT BOOKLET—The written material (also called documentation) that provides the information a teacher may need to use the program in a classroom.

TEACHER AID—A computer program designed to assist a teacher with classroom management tasks.

TUTORIAL—A computer program that provides new information to teach a concept and may include drill and practice.

CREDITS

Metric & Problem Solving

The Metric and Problem Solving module is a conversion and revision of materials MECC designed for other computing systems. Support material was prepared by Doris Bower, MECC. This module is a product of MECC Instructional Services.

Some computer programs in this manual have evolved over the years through the creative efforts of many individuals and take their place in the growing collection of "computer folklore." Exact identifications of their authors is at times impossible, but wherever it is felt that a substantial contribution exists either by an individual or an organization, credit is given. Any readers who are informed on program sources are invited to share that information for inclusion in future printing.

BAGELS

BAGELS, a commonly used computer program, originated with PEOPLE's Computer Company in Menlo Park, California and has appeared in various forms on many different computers, large and small. The MECC version has been modified to work with 2- 3- or 4-digit numbers by Bob Jamison. The ATARI version was converted by Don Rawitsch.

HURKLE

The original version of HURKLE was developed by PEOPLE's Computer Company. MECC staff modified HURKLE to work with a horizontal line, vertical line, or -5 x +5 grid and then added the graphics by Mike Stein and Kent Kehrberg when converting it for the Apple II. The ATARI version was done by Lance Allred.

METRIC ESTIMATE

The original author of METRIC ESTIMATE, then called ESTMAT, was Don Holznagel, formerly of T.I.E.S. MECC has revised the program to be screen-oriented and has included the options of millimeters or centimeters. The conversion to the ATARI was completed by Cynthia Schroeder.

METRIC LENGTH

The METRIC LENGTH program was created by Bob Jamison, formerly of the MECC staff. The conversion to the ATARI was completed by Lance Allred.

METRIC 21

The original METRIC 21 was done by David Dye, Mathematics Consultant for the Minnesota State Department of Education. The program has been modified by MECC staff for the Apple II. The ATARI conversion was done by Tony Prokott.

NUMBER

The NUMBER program originated with PEOPLE's Computer Company of Menlo Park, California. That version has been modified by Rick Crist, MECC staff, to include a range of numbers and a graphic option for numbers under 15. The ATARI conversion was done by John Brisky.

TAXMAN

The TAXMAN program was introduced to the MECC collection of software from the former Southern Minnesota Schools Computer Project. Documentation first appeared in publications by PEOPLE's Computer Company. Conversion to the ATARI was done by Charles Erickson.

METRIC AND PROBLEM SOLVING SUPPORT BOOKLET

The content of this support booklet is in large part a revision of material written and designed for the APPLE version of these programs by Shirley Keran, MECC. The APPLE support booklet, in turn, included much material from the book Elementary My Dear Computer developed by Marge Kosel and Geraldine Carlstrom for timeshare computing. Teachers from throughout the state of Minnesota contributed ideas to that effort.

METRIC AND PROBLEM SOLVING

TECHNICAL INFORMATION

BAGELS
Main Program: BAGELS

HURKLE
Main Program: HURKLE
Binary Files: HURKLE.RNT

METRIC LENGTH
Main Program: METLEN

METRIC ESTIMATE
Main Program: METEST

METRIC 21
Main Program: MET21
Chains to: MET21A

NUMBER
Main Program: NUMBER

TAXMAN
Main Program: TAXMAN

MECC INSTRUCTIONAL SERVICES ACTIVITIES

PURPOSE: The primary purpose of the Minnesota Educational Computing Consortium (MECC) is to assist users and educational member systems in coordinating and using computing resources through cooperative planning and decision making. MECC also provides current computing methods and materials.

SERVICES: All MECC activities in instructional computing are the responsibility of the Director of Instructional Services (Telephone: **612/376-1105**). Direct any questions related to MECC policy, procedures, or regulations to this office. The MECC Instructional Services Division is organized as follows:

Instructional Systems Development—This group is responsible for the production, coordination, and refinement of MECC instructional computing courseware products, computer programs, and their related user support material. Direct any questions on operations within this area to the Manager, Instructional Systems Development (Telephone: **612/376-1103**).

Technical Services—This group is responsible for operation and operating systems maintenance of the MECC Timeshare System (MTS), a 400+ port, all-purpose, multiple language computer, which serves all Minnesota public higher education institutions and 300 school districts. Technical Services also establishes and maintains the MTS telecommunications network. Direct any questions on operations within this area to the Manager, Technical Services (Telephone: **612/376-1141**).

User Services—This group is responsible for timeshare and microcomputer user communications and training and the distribution of computing equipment and MECC courseware products. A staff of instructional computing coordinators is located throughout Minnesota to promote and facilitate computer usage. Direct all questions on operations in this area to the Manager, User Services (Telephone: **612/376-1101**).

GENERAL INFORMATION: MECC provides the above information to assist individuals who wish to contact the MECC office with specific questions. Direct all written requests for information to the appropriate office at MECC, 2520 Broadway Drive, St. Paul, MN 55113. The following two items address many routine questions:

MECC Publications and Programs Price List
MECC distributes this free list upon request and suggests that you obtain it quarterly. Contact the MECC Publications Office (Telephone: **612/376-1118**).

MECC USERS Newsletter
MECC distributes this free newsletter regularly during the school year to individuals on the mailing list. Contact the User Services Office (Telephone: **612/376-1117**).

All requests for visits to MECC must be scheduled in advance by calling **612/376-1130.**

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EVALUATION SHEET

Please comment on this manual and the accompanying diskette. MECC will carefully consider user suggestions and incorporate them into future documentation whenever practical.

COMMENTS ON COMPUTER PROGRAM

Diskette Name _____ Vol. No. _____ Version _____
Program Name _____

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COMMENTS ON MANUAL

Title of Manual _____
Program Name _____
Page No. _____

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APX ATARI® PROGRAM EXCHANGE
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Santa Clara, CA 95055

Review Form

We're interested in your experiences with APX programs and documentation, both favorable and unfavorable. Many of our authors are eager to improve their programs if they know what you want. And, of course, we want to know about any bugs that slipped by us, so that the author can fix them. We also want to know whether our instructions are meeting your needs. You are our best source for suggesting improvements! Please help us by taking a moment to fill in this review sheet. Fold the sheet in thirds and seal it so that the address on the bottom of the back becomes the envelope front. Thank you for helping us!

1. Name and APX number of program.

2. If you have problems using the program, please describe them here.

3. What do you especially like about this program?

4. What do you think the program's weaknesses are?

5. How can the catalog description be more accurate or comprehensive?

6. On a scale of 1 to 10, 1 being "poor" and 10 being "excellent", please rate the following aspects of this program:

_____ Easy to use
_____ User-oriented (e.g., menus, prompts, clear language)
_____ Enjoyable
_____ Self-instructive
_____ Useful (non-game programs)
_____ Imaginative graphics and sound

7. Describe any technical errors you found in the user instructions (please give page numbers).

8. What did you especially like about the user instructions?

9. What revisions or additions would improve these instructions?

10. On a scale of 1 to 10, 1 representing "poor" and 10 representing "excellent", how would you rate the user instructions and why?

11. Other comments about the program or user instructions:

From

STAMP

ATARI Program Exchange
P.O. Box 3705
Santa Clara, CA 95055

[seal here]