EXPLORATIONS

Activity 1

Aim High, Aim Low

Teacher Notes

Concept

- Place Value and Number Sense

Skill

- Finding largest and smallest possible solutions for given digits and operations

Applicable Calculator Functions

- STO▶, [RCL]

Materials

- Student Activity Sheets (page 5)
- TI-30X IIS/TI-34 II calculator
- 3 x 5 cards

Objective

- Students will explore patterns related to place value in calculations

Prerequisites

Students need no prior calculator experience. It would be helpful if they are familiar with the STO▶ and [RCL] keys on the calculator.

Problem

Students will use given digits and problems to find the largest/smallest solutions possible.

Activity

Write 1, 3, 5, 7, and 9 on separate cards. Ask students to use each of these digits once to create a problem containing a one-digit number multiplied by a four-digit number. List some of the students' problems with their solutions on the board. Then ask students to estimate the largest possible product for this problem (using the same digits). Students should realize that the largest product would be obtained by using 9 as the single-digit factor and 7531 as the other factor.

Next, ask a student to explain why he/she used 9 as the single-digit multiplier. It should help students whose understanding of place value is weak to hear that using 9 (the largest digit available) as the multiplier produces the largest value in each place value position (9 ones, 9 thirties, 9

five hundreds, and 9 seven thousands), whereas, using 7, for example, as the multiplier times 9531 produces the same number of thousands, but a smaller value in each of the other place value positions.

Now, allow students to work in pairs to complete Question #1 on the Student Activity sheet and compare their answers. Using the [STO▶] and [RCL] keys can help students compare the results of their various attempts.

Example:

When working with the first row of Question #1, the students might try 2468 X 9 and store the sum, then recall that sum to compare it with other sums, replacing the original sum whenever a larger sum is obtained, as shown in the Keystrokes chart.

Be sure to elicit explanations about why students are confident their solution is the largest one possible for each part of the problem. Part (b) will probably surprise some students. Breaking down the problem into partial products, as shown below, can help strengthen student understanding of place value and hence improve their number sense. Compare this breakdown with similar expanded notation for 98 x 642 and 96 x 842.

	4 x 2=	8
	+ 4 x 60 =	240
For 862 x 94	+ 4 x 800 =	3200
	+ 90 x 2=	180
	+ 90 x 60 =	5400
	+ 90 x 800 =	72000
		81028

Students should have more success with Question #2 after the discussion of the first problem. Note that part (d) has several solutions since exchanging digits in the same place value position(s) of the addends does not change the sum. Thus, some students will likely need to see and discuss 982 + 65 compared with 985 + 62, 962 + 85, and 965 + 82.

After they complete Questions #1 and #2, have students verbalize strategies for producing the largest sum, difference, or product, using the given digits. Point out to students that for Questions #3 and #4 they are to find the smallest possible solutions. Ask whether this will affect their strategies. Discuss Question #3 before students attempt #4, including the effects of place value.

After they complete Questions #3 and #4, have students verbalize strategies for producing the smallest sum, difference, or product, using given digits. For Questions #5 and #6, you may want students to work alone so you can assess individual performance.

Of course, the problems do not have to be used for a single activity. Using one question (or even part of a question) every few days as a warm-up activity can be quite effective as well.

Wrap-Up

Have students write paragraphs about what they found and learned. Be sure these questions are answered:

- *How does the place value of digits determine the size of the solution for different operations?*

  Some possible answers:

  - For addition, the largest digits should be used in the largest place value positions to maximize the sum. The smallest digits should be used in the smallest place value positions to minimize the sum.
  - For subtraction, the minuend should be as large as possible and the subtrahend as small as possible to maximize the difference. The minuend should be as small as possible and the subtrahend as large as possible to minimize the difference.
  - For multiplication, in general, the largest digits should be used in the largest place value positions to maximize the product and the smallest digits should be used in the largest place value positions to minimize the product. However, for abc X de, where a-e represent the digits for the given problem in descending order, the largest product is obtained by multiplying bce X ad.

- *What strategies did you learn about finding the largest/smallest solution using given digits?*

  Some possible answers:

  - Use a systematic list to check out each arrangement of the digits.
  - Start with a simpler problem (fewer digits).
  - Once you solve a particular kind of problem, such as adding a one-digit number and a four-digit number, use your result to help you find the solution to other similar problems. For this example, a two-digit and a three-digit number and subtract a one-digit number from a four-digit number.

Assessment

As indicated above, you can use Questions #5 and #6 for assessment. Alternately, use similar problems to have students repeat this process.

Extensions

- Have students explore the effect(s) of using 0 as one of the digits in problems like those in this activity.

  Example:

  Using 0, 4, 6, 7, and 8, find the largest possible product for __ __ x __ __ __. (840 x 76 *or* 760 x 84)

- Have students explore strategies for problems of this type with division.

  Example:

  Using 1, 2, 5, 8, and 9, find the smallest possible quotient for __ __ __ / __ __ .(125 / 98)

  (For a real challenge, require the use of two decimal points: .125 / 98.)

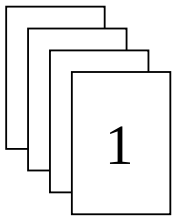
- Have students write challenges for each other. During the school year, these challenges could expand to include integers.

Student Activity

Name _____

Date _____

Activity 1



Aim High, Aim Low

Objective: *You will explore patterns related to place value in calculations.*

Problem: *Use a calculator and your number sense to complete each problem. Use each digit once in each answer.*

Question 1:

2 4 6 8 9

							Largest Possible Answer
				x		=	_____
			x			=	_____
			–			=	_____
				–		=	_____

Question 2:

2 5 6 8 9

							Largest Possible Answer
			x			=	_____
				x		=	_____
				–		=	_____
		+				=	_____

Question 3:

1 3 4 7 8

							Smallest Possible Answer
		+				=	_____
			–			=	_____
				x		=	_____
			x			=	_____

Question 4:

3 4 5 7 8

							Smallest Possible Answer
		x				=	_____
	x					=	_____
			–			=	_____
		+				=	_____

Question 5:

1 4 6 7 8

							Largest Possible Answer
			+			=	_____
	+					=	_____
			x			=	_____
			–			=	_____

Question 6:

1 2 4 5 7

							Largest Possible Answer
			x			=	_____
			–			=	_____
			+			=	_____
	x					=	_____

Explain a strategy you used in this activity and why it works.

Aim High, Aim Low
Keystrokes for the TI-34 II

Example: *Find the largest product for _ _ _ _ x _ , using the digits 2, 4, 6, 8, and 9.*

Try a possible solution:

PRESS	DISPLAY
2 4 6 8 × 9 ENTER	22212
STO▶	A B C D E (use arrow key, if needed, to underline A)
ENTER	Ans → A 22212

Try another possible solution and compare the answers:

8 6 4 2 × 9 ENTER	77778
2nd [RCL]	A B C D E 22212

Since the second answer is larger, store it in place of the first one:

STO▶ ENTER	Ans → A 77778

The new value is now stored and will be displayed when you press 2nd [RCL].

Aim High, Aim Low
Keystrokes for the TI-30X IIS

Example: *Find the largest product for _ _ _ _ x _ , using the digits 2, 4 ,6 ,8, and 9.*

Try a possible solution:

PRESS	DISPLAY
2 4 6 8 [×] 9 [ENTER]	22212
[STO▶]	A B C D E (use arrow key, if needed, to underline A)
[ENTER]	Ans → A 22212

Try another possible solution and compare the answers:

8 6 4 2 [×] 9 [ENTER]	77778
[2nd] [RCL]	A B C D E 22212

Since the second answer is larger, store it in place of the first one:

[STO▶] [ENTER]	Ans → A 77778

The new value is now stored and will be displayed when you press [2nd] [RCL].