GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

i) demonstrate an understanding of the connection between relevant, concrete experiences and the mathematical language and symbolism of the four basic operations

SCO: By the end of grade 3, students will be expected to

B1 recognize several meanings for multiplication

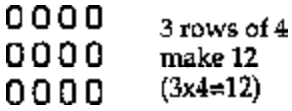
B2 recognize several meanings for division

When children have number sense, they understand not only the relationships between numbers but also the effects of arithmetical operations on numbers. They exhibit confidence in their answers and willingness to investigate new situations. (Curriculum and Evaluation Standards, Addenda Series, Third-Grade Book, p. 9)

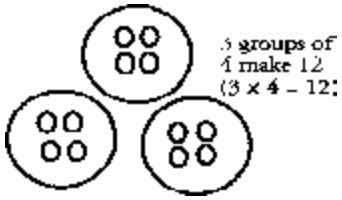
Suggestions for Teaching and Learning

B1/B2 At this level, it is important that students understand that there are different ways of looking at the concept of multiplication. They need to be aware that the product may be determined by

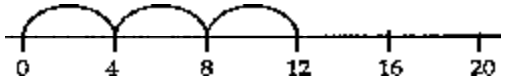
- the total number in an array - for example,



- making sets of equal groups - for example, students can create equal-sized groups with actual items



- repeated addition - for example, 4 + 4 + 4 can be written as 3 x 4



It is equally important that students see division can mean

- sharing - A number of objects is shared fairly among the members of a group. How many objects will each member of the group receive? For example: Twelve cookies are shared fairly among four people. How many will each person get?
- how many groups - We know how many objects will be in each group. The question is, how many groups will there be? For example: There are 12 cookies. Each package must contain 4 cookies. How many packages of cookies will there be?

In both cases, students need to understand that a ÷ b is equivalent to repeatedly subtracting b from a and counting the number of subtractions to reach zero.

To help students understand the relationship between the two meanings of division, it is beneficial to use concrete materials. Demonstrate that, in sharing 12 items among 3 people, for example, the actual giving of 1 item to each person is the same as creating a group of 3. In other words, sharing among 3 people is equivalent to finding how many groups of 3 can be formed. Give students situations in which there are remainders and ask them to determine how to deal with them.

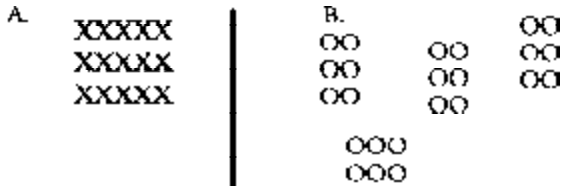
GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

Performance

B2.1 Have the student enter 35 on a calculator and repeatedly subtract 7. Ask him/her to record these subtractions on paper until they reach 0. Have him/her express what happened in terms of a division.

B1/2.1 Ask the student to record multiplication and division statements based on the drawings shown.



B1.1 Provide the student with some toothpicks. Ask him/her to use them to make 5 squares and then state a multiplication sentence which describes how many toothpicks have been used.

B1.2 Ask the student to use counters to show why the result is even if you multiply two even numbers.

Pencil and Paper

B2.2 Ask the student to write a division story about 30 ÷ 5.

B1.3 Have the student draw a picture to show what 4 x 6 means.

Interview

B1.4 Ask the student what 6 x 3 tells about tricycle wheels.

B2.3 Ask the student to describe a situation for which you might have to find the answer to 16 ÷ 2.

Portfolio

B1/2.2 Ask the student to draw pictures showing various situations in which either multiplication or division might be used.

Resources

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

i) demonstrate an understanding of the connection between relevant, concrete experiences and the mathematical language and symbolism of the four basic operations

SCO: By the end of grade 3, students will be expected to

B2 recognize several meanings for division (Cont'd)

KSCO: By the end of grade 3, students will be expected to

ii) recognize and explain the relationships among the four basic operations

SCO: By the end of grade 3, students will be expected to

B3 recognize the relationship between multiplication and division

Suggestions for Teaching and Learning

B2 (Cont'd)

Remember to delay the formal writing of multiplication and division sentences until students understand the meaning of the operation.

When creating multiplication and division problems, use contexts in which things actually come in groups, for example, packaged foods - eggs (6 x 2), juice packs (1 x 3), hamburger buns (2 x 4).

❑ Invite students to brainstorm activities suitable for various numbers of people, such as 1 person (reading, drawing, etc.); 2 people (tennis, chess, etc.); 3 people (skipping, marbles, etc.); and so on. Ask students to choose an activity and decide how many equal groups are possible for the whole class. Discuss which group sizes work well and why.

B3 It is important students understand that for every multiplication situation there is a related division situation and vice versa. For example, the array below can be thought of as

x x x x
x x x x • 2 groups of 4 (2 x 4)

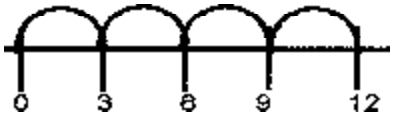
- 8 shared among 2, which is written 8 ÷ 2, or how many groups of 4 can be made from 8, which is written 8 ÷ 4.

Similarly, this diagram could be interpreted as

0 0 0 0 0 0
0 0 0 0 0 0

- 3 x 4 = 12 (There are 3 groups of 4.)
- 12 ÷ 3 = 4 (Using the concept of sharing, 12 shared among 3 gives each person 4.)
- 12 ÷ 4 = 3 (Using the "how many groups" concept, one might ask, "How many sets of 4 can you make with 12 ?")

Using a number line also helps students see the relationship between multiplication and division.



4 x 3 = 12 12 ÷ 3 = 4

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

Presentation

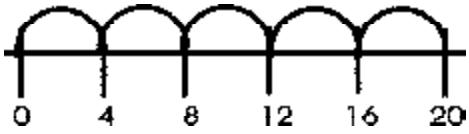
B1/2.3 Invite a group of students to act out a skit modelling either a multiplication or division situation. Ask other students to guess the number sentence being dramatized.

Performance

B3.1 Provide the student with some toothpicks and ask him/her to use 12 to make 4 identical shapes. Ask the student what division and multiplication sentences could describe the creation of the shapes.

Pencil and Paper

B3.2 Show the following number line. Ask the student to record what multiplication and division sentences it might be showing.



B3.3 Show the student the multiplication sentence 5 x 8 = 40. Ask the student to write related division sentences.

Interview

B3.4 Set up a 3 x 4 array and ask the student to give two multiplication and two division sentences which describe it.

B3.5 Explain to the student that 26 ÷ 4 tells you something about the way the students are grouped in the classroom. Ask him/her to talk about the size of the group and the number of groups.

Portfolio

B3.6 Ask the student to explain how the relationship between multiplying and dividing is like the relationship between adding and subtracting.

Resources

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

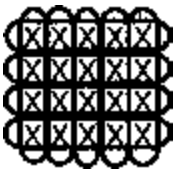
ii) recognize and explain the relationships among the four basic operations

SCO: By the end of grade 3, students will be expected to

B3 recognize the relationship between multiplication and division (Cont'd)

The models that we can use to illustrate division concepts are exactly the same as those for multiplication. In fact, when a division is modelled, the result always looks like a multiplication model. (Elementary School Mathematics, p. 124)

Suggestions for Teaching and Learning



Use arrays to illustrate the commutative (order) property.

This array shows 4 rows of 5 or 4 x 5. If we were to rotate it, or look at it from the side, it would show 5 rows of 4 columns or 5 x 4; therefore, 4 x 5 = 5 x 4.

Point out that 2 x 9, for example, is the same as 9 x 2, but that it tends to be easier to visualize and figure out the answer for 2 groups of 9.

- ❑ Give students lots of practice with materials to help them visualize the operations. Ask questions as they form sets. For example: "Show me 4 groups of 5. How many do you have altogether? How did you divide up the counters?" Encourage the students to respond using the language for describing multiplication and division. For example: "I have 4 groups of 5, which is 20. I started with 20 and divided them into 4 groups: twenty divided by 4 is 5." Extend this learning experience by asking the students to use the same number of counters and divide them in another way.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

B3.7 Ask the student to write problems in which one has to multiply or divide to find the answer. Have him/her illustrate the solutions and describe the multiplication/division relationship.

Resources

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

iii) create and model problem situations involving whole numbers, using one or more of the four basic operations

SCO: By the end of grade 3, students will be expected to

B4 solve and create problems involving addition and/or subtraction

B5 solve and create problems involving multiplication and division with small numbers

Suggestions for Teaching and Learning

B4/B5 Presenting the four operations through meaningful contexts helps students develop a better sense of which operation is required. Encourage the use of calculators to solve real problems which involve calculations with very large or decimal numbers. It is important that students begin to understand when it is appropriate to use a calculator and the importance of estimating when using the technology.

Asking students to create their own word problems requires them to focus on the meaning of the four operations. Encourage them to create problems which include different meanings for all four operations.

Addition/subtraction:	215 and 28 more. How many altogether? 215. One group of 28. Size of other group? 215. 28 gone. How many left? 215 in one group. 28 in another. How many more?
Muliplication/division:	24 items. Groups of 4. How many groups? 24 items. 4 must share. Size of share? 4 groups of 6. How many altogether?

Have students work together in groups to invent problems which are meaningful and of interest to them. Some may like to present their problems for others to solve. Student-created problems are also a valuable tool for teachers to pinpoint areas of difficulty.

Present multi-step problems for the students and encourage them to create some of their own for their classmates.

- ❑ Have students solve and create strategy problems involving the operations. For example, arrange 3, 4, and 5 in the indicated spaces to make the sentence true. ☐ x ☐ + ☐ = 19
- ❑ To encourage problem solving and problem creation, set up a second-hand shop of student-donated items. The store could be open for certain times each day, and students could role-play buying items, adding totals, making change, etc. This would provide an opportunity for students to practise the “adding on” concept for finding the difference.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

Performance

B4.1 Ask the student to count back the change for $5.00, if the bill totalled $3.59.

Pencil and Paper

B4.2 Have the student use only 1s, 2s, and 3s, along with + signs, to get a total of 45.

B4/5.1 Ask the student to create a story problem which is represented by a particular computation, for example, 212 + 35 or 8 x 9 or 145 - 19.

B4/5.2 Provide the student with a list (e.g., food prices, lengths, scores). Ask him/her to use the list to create and solve a problem, using a particular operation.

B4.3 Ask the student to write a subtraction problem that includes $1.40 and 16¢. Solve the problem.

B4.4 Ask the student to write an addition problem that has an answer of 38 and includes the number 50.

Interview

B4.5 Observe how the student finds the time that has passed between 9:42 a.m. and 10:15 a.m.

Portfolio

B4/5.3 Have each student choose an even number between 1 and 100. Ask him/her to create and solve an addition, a subtraction, a multiplication and a division problem in which this number is either in the answer or involved somehow in the problem.

Presentation

B5.1 Have pairs of students choose a mystery object and make up a riddle about it, using a multiplication or division sentence as the clue. For example, I'm thinking of something in this room that shows 4 x 4 (legs on a group of 4 desks).

B4/5.4 Provide students with data of enrolments in a number of local schools. Ask them to create and solve problems, using the data.

Resources

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

iii) create and model problem situations involving whole numbers, using one or more of the four basic operations

SCO: By the end of grade 3, students will be expected to

B4 solve and create problems involving addition and/or subtraction (Cont'd)

B5 solve and create problems involving multiplication and division with small numbers (Cont'd)

KSCO: By the end of grade 3, students will be expected to

iv) apply computatonal facts and strategies with respect to the four basic operations and model addition and subtraction in situations involving whole numbers

SCO: By the end of grade 3, students will be expected to

B6 add and subtract with and without regrouping (up to and including 3-digit numbers)

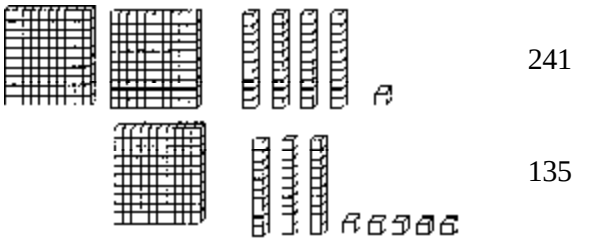
Suggestions for Teaching and Learning

B4/B5 (Cont'd) For example, several items total $1.48. A student pays with a toonie. The clerk says, "$1.48," gives 2 pennies and says, "$1.49, $1.50;" gives a quarter and says, "$1.75;" gives another quarter and says, "$2.00." The difference (change) is 52 cents. The use of counting on as a strategy to solve subtraction problems should be encouraged.

- ❑ Have students solve problems involving time.
  Martha arrived at 7:45 p.m. and left 20 minutes later. What time did she leave?
  Sean finished his test at 10:50 a.m. and Jacob finished at 12:08 p.m. How much longer did it take Jacob to write the test?

B6 Students need to develop and use alternative paper-and-pencil and mental algorithms to solve problems. They need to see these alternatives as being equally as valid as a traditional algorithm. Mixing addition or subtraction problems involving regrouping with those which do not require regrouping forces students to examine each question before selecting a strategy.

When introducing addition and subtraction with 3-digit numbers, use base-ten materials to model the operations. For 241 + 135, for example:



241

135

376

Students may prefer to use the front-end algorithm for the above example.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

Performance

B6.1 Observe the student as he/she adds 125 and 134 or subtracts 134 from 217 using base-ten materials.

B6.2 Provide the following addition or subtraction calculations for the student to complete. Ask the student to explain his/her strategy.

38 + 97 98 - 44 400 - 255

B6.3 Show the student a number of addition and subtraction questions, some of which require regouping and some which do not. Ask him/her to point out, or circle, the questions that require regrouping.

Pencil and Paper

B6.4 Have the student explain in writing why someone might first subtract 30 from 67 in order to calculate 67 - 26. Ask what would be done next.

Interview

B6.5 Display the numbers 124 and 75 with base-ten blocks. Ask the student to describe the addition process as he/she manipulates the models.

B6.6 Tell the student that Sue was to add 36 + 59 and said, "36, 96, 95." Have the student explain Sue's thinking.

B6.7 Ask why someone might find it easier to subtract 123 - 99 than 123 - 87.

B6.8 Ask the student to explain an easy way to find the sum of $1.99, $2.98 and $4.99 without using a calculator.

Portfolio

B6.9 Ask the student to prepare a display showing a variety of ways to calculate 57 - 18, indicating his/her preference and the reason for it.

B6.10 Ask the students to use a sales flyer to create some problems for his/her classmates. Have them include both problems and solutions in their portfolios.

Resources

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

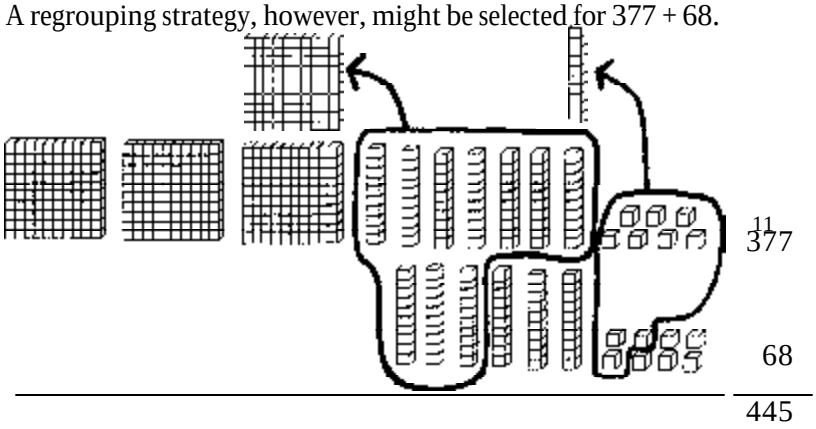
iv) apply computatonal facts and strategies with respect to the four basic operations and model addition and subtraction in situations involving whole numbers

SCO: By the end of grade 3, students will be expected to

B6 add and subtract with and without regrouping (up to and including 3-digit numbers) (Cont'd)

Suggestions for Teaching and Learning

A regrouping strategy, however, might be selected for 377 + 68.



81 - 37 is the same as 84 - 40 which equals 44; or 37 and 3 more make 40, and 41 makes 81, so the difference is 44.

When adding numbers that are close to a multiple of 100, it makes sense to round the numbers and adjust later, rather than adding a number of the higher digits. 298 + 399 + 198 can be solved by adding 300 + 400 + 200, which is 900, and subtracting 5 for the answer of 895.

For subtraction, it may be easier to do the opposite. For example, 500 - 143 can be changed to 499 - 142 (or 499 - 143 and add 1 on).

Note: The word “regrouping” is preferred to terms like “borrowing” or “carrying” which conveys less meaning about the process. Many students should continue to use models to understand regrouping; for others, this will not be necessary.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment	**Resources**

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

iv) apply computatonal facts and strategies with respect to the four basic operations and model addition and subtraction in situations involving whole numbers

SCO: By the end of grade 3, students will be expected to

B7 recognize principles of multiplication and division

B8 relate multiplication and division facts

Suggestions for Teaching and Learning

B7/8 Students should explore multiplication and division situations which will help them to recognize that

- sets can be broken down into subsets

For example, 5 sets of 3  can be

4 sets of 3 + 1 set of 3  , or

3 sets of 3 + 2 sets of 3  , or

5 sets of 2 + 5 sets of 1 

To determine how many sets of 3 there are in 15, one might find

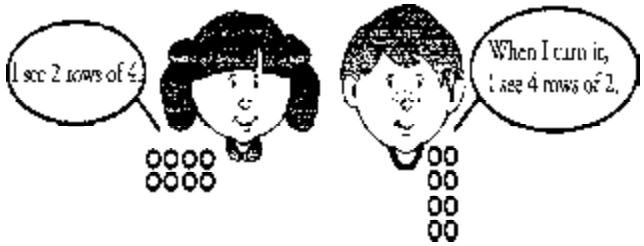
- the number of sets of 3 in 12, plus the number of sets of 3 in 3

or

- the number of sets of 3 in 6, plus the number of sets of 3 in another 6, plus the number of sets of 3 in 3

- 1 x □ simply means one group of □
- order doesn't matter when you multiply because the same array can be viewed differently; for example:

2 x 4 = 4 x 2



- □ x 0 = 0 since many zeros still equal zero
- □ ÷ 1 simply means "how many 1's in □"

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

Performance

B7.1 Display a 5 x 4 array of objects and place a ruler on the line shown.

Ask how this shows that 5 x 4 = 5 x 3 + 5 x 1.
Then ask the student to move the ruler to show another way to find 5 x 4 and explain his/her thinking, and/or provide the student with a piece of paper upon which an array (6 x 5) has been drawn. Ask him/her to fold the paper to show different ways the multiplication can be expressed.

B8.1 Have the student colour in all the places where 12 appears on a multiplication table. Ask him/her to describe what he/she observes.

Pencil and Paper

B7.2 Ask how the diagram below, which shows 3 x 4, also shows 6 x 2.

x x x x x x
x x x x x x

B7.3 Ask the student to explain how knowing 4 x 3 = 12 helps him/her solve the following questions:

4 x 6 = ☐
8 x 3 = ☐
4 x 4 = ☐

Interview

B7.4 Have the student explain why it is easy to multiply by 1 or 0.

B7.5 Ask the student what facts he/she might use to help solve 7 x 4.

B8.2 Ask the student how knowing that 5 x 6 = 30 could help in knowing other multiplication or division facts.

B7.6 Tell the student that to solve 42 ÷ 7, Alan said, "21 ÷ 7 = 3." Ask what he would do next?

Resources

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

iv) apply computatonal facts and strategies with respect to the four basic operations and model addition and subtraction in situations involving whole numbers

SCO: By the end of grade 3, students will be expected to

B7 recognize principles of multiplication and division (Cont'd)

B8 relate multiplication and division facts (Cont'd)

KSCO: By the end of grade 3, students will be expected to

v) apply estimation techniques to predict, and justify the reasonableness of, results in revelant problem situations involving whole numbers

SCO: By the end of grade 3, students will be expected to

B9 continue to estimate in addition and subtraction situations

Suggestions for Teaching and Learning

B7/8 (Cont'd)

Students learn division facts by thinking about corresponding multiplication facts. They can reduce the number of separate multiplication facts to be learned by drawing on a relationship previously explored. For example, any multiple of 4 is twice the same multiple of 2. To help students learn to find one fact based on what they know about another, include, on a regular basis, questions such as How does knowing 5 x 4 = 20 help you to know 6 x 4? What other division fact could help you solve 30 ÷ 6?

After students have had extensive experiences modelling multiplication and division operations and can use strategies to determine muliplication or division facts, they are ready to begin to commit the facts to memory. Games involving number cubes/dice help reinforce facts. It is expected that most students will have mastered the multiplication facts to at least 6 x 6 by the end of grade 3.

B9 Estimation in addition and subtraction situations in grade 3 will extend to working with 3-digit numbers. One method for estimating is rounding. Students might sometimes round to the nearest hundred, but other times it is more appropriate to round to the nearest ten. It is important they understand that the situation should dictate how closely to estimate.

For example, if you have $255 and have to estimate the total of 2 items costing $79 and $172, one might round to the nearest ten dollars. However, if the items cost $96 and $88, estimating to the nearest hundred is sufficient.

Base-ten blocks and number lines are both suitable models to use to assist students in their initial consideration of estimation.

- Number line model: Gas stations are imagined at each multiple of 100 (or 10 if rounding to the nearest 10). To estimate 475 + 392, you would place your "vehicle" on 392 and see that you are almost at 400. Therefore,
  475 + 392 is about 875. It is not always necessary to round both numbers.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

B7.7 Provide the student with a copy of a multiplication grid. Point out the row beginning with 6, 12... . Ask the student to explain why the numbers increase by 6 each time.

Presentation

B8.3 Ask the student to consider the relationships between multiplication and division facts in order to decide the minimum number of facts he/she thinks it might be necessary to memorize in order to know all of them. The presentation should include an explanation of how he/she arrived at the minimum.

Performance

B9.1 Have the student toss three dice and list the six possible numbers that can be formed. Ask the student to give an estimate of how much should be added to each number to get a sum of about 1000.

Pencil and Paper

B9.2 Tell the student that 3 4 + 5 3 is about 900. Ask what might go in the blanks.

Interview

B9.3 Tell the students that a teeter-totter will hold up to 300 kg. Ask them to estimate the number of children their age who could safely play on it.

B9.4 Ask the student which of the following solutions is close to 500.

329 + 189	329 + 217	329 + 287

Ask the student which of the following solutions is closest to 50.

125-30	168 - 115	103 - 82

In both cases, ask the student to explain his/her thinking.

B9.5 Tell the student that you were given a subtraction question for which you estimated the answer to be 100. Ask him/her to list some numbers you might have been subtracting.

Resources

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

v) apply estimation techniques to predict, and justify the reasonableness of, results in revelant problem situations involving whole numbers

SCO: By the end of grade 3, students will be expected to

B9 continue to estimate in addition and subtraction situations (Cont'd)

Suggestions for Teaching and Learning

B9 (Cont'd)

- *Left to right or front-end* method:

The following are examples in which this method makes sense.

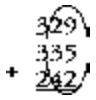
$$\begin{array}{r} 138 \\ +\ \underline{245} \end{array}$$

370 (200 + 100 is 300, 30 + 40 is 70, for an estimate of 370.) Some students may consider the ones in their estimate. For example, the ones are a little more than 10, making the estimate 380.

$$\begin{array}{r} 476 \\ -\ \underline{348} \end{array}$$

130 (400 - 300 is 100, 70 - 40 is 30, 6 and 8 are about the same, so I'll ignore them; my estimate is 130.)

Sometimes a combination of *front-end* and *clustering* works well. In the following example, add the hundreds digits first (300 + 300 + 200, or 800) and then cluster the 29, 35 and 42 together to make an additional 100, for an estimate of 900.



This method is often closer to the actual answer than in rounding situations. It is important for the students to examine the question first in order to select a strategy that will not only give them an estimate near the actual answer, but one that is efficient and makes sense to them.

The goal is for students to estimate on their own, not only when the teacher or textbook requires it. They have to value the skill and they must know the teacher values it. Estimation must precede all pencil/paper and calculator calculations; therefore, it is important that students have efficient estimation strategies. Estimating is a mental activity, one that improves with regular practice. Encouraging students to share their thinking will help provide a range of strategies from which students can choose.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

B9.6 Tell the student that you subtracted a number in the three hundreds from a number in the five hundreds. Ask what the numbers might have been if you have correctly estimated the answer to be 100.

B9.7 Ask him/her to identify situations in which an exact answer would be required and some in which an estimate is sufficient.

B9.8 Show the student the number of sports cards in James' collection.

Baseball 247
Football 124
Hockey 138

Ask the student to estimate the total number of cards in the collection and to describe the strategy used.

Portfolio

B9.9 Ask the students to interview parents/relatives/neighbours to find out when they use estimation. Have them prepare a report and share their findings with the class.

Resources

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

v) apply estimation techniques to predict, and justify the reasonableness of, results in revelant problem situations involving whole numbers

SCO: By the end of grade 3, students will be expected to

B10 begin to estimate in multiplication and division situations

Suggestions for Teaching and Learning

B10 Generally, in multiplication and division situations, students in grade 3 are still working with products less than 100. Therefore, estimates might more likely focus on whether the product is closer to 20, 40, 60, or 80, or the quotient closer to 1, 5, or 10.

Examples such as the following will help students develop strategies for estimating in multiplication and division contexts.

- 7 x 9 will be less than 70 because 7 tens equal 70.
- 56 ÷ 6 is less than 10 because one would need 60 to make 10 groups of 6.
- An estimate for 48 ÷ 8 would not be close to 10 because 10 groups of 8 equal 80. It will be closer to 5 because 5 groups of 8 (one half as much) are 40.
- 3 x 17 is closer to 3 x 20, or 60, than 3 x 10, or 30. A good estimate would be 50.

Many multiplication and division estimation situations deal with money. For example:

The Popsicles in the cafeteria cost 15¢ each. I have a loonie. Can I buy one for myself and each of my five friends?

Student thinking: At 10¢ each, I could buy 10 Popsicles. At 20¢ each, I could buy only 5 Popsicles. So, at 15¢ each, I can buy somewhere in the middle, between 5 and 10 Popsicles.

If erasers are on sale for 19¢, how many would you estimate one could buy with a loonie?

Estimation is a mental activity, one that becomes more precise with practice. Regular attention to estimation activities and the sharing of strategies is necessary and promotes the use of mental math.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

Paper and Pencil

B10.1 Have the student estimate whether the products of the following questions are closer to 20 or 60 and record how he/she knows, without actually calculating the exact answer.

3 x 8.9 7 x 8 5 x 9

Interview

B10.2 Ask the student to tell how he/she knows whether the answers to the following questions are closer to 1, 5, or 10 without actually performing the calculations.

75 ÷ 8 25 ÷ 6 23 ÷ 4

B10.3 Show the student a picture of a hexagon with a side measurement of 19 cm. Ask him/her to estimate the number of centimetres it would be around the outside of the hexagon.

B10.4 Tell the students that you bought 2 dozen hotdogs for a party for seven. Ask them to estimate to decide if this will be enough.

B10.5 Tell the students that Marta has a loonie and wants to buy three more party favours that cost 29¢ each. Ask them if Marta has enough money and to explain their thinking.

B10.6 Tell the student that you have a loonie. Ask: How do you know that I am unable to buy 5 packages of stickers that cost 21¢ each?

B10.7 Show the student the number of library books signed out by each grade level: Grade 1 - 21; Grade 2 - 20; Grade 3 - 19; Grade 4 - 22; Grade 5 - 18

Explain that the librarian said about 100 books were signed out by the five classes. Ask the student to explain the librarian's thinking.

Presentation

B10.8 Have the students ask a grown-up to describe some situations in which they might use estimates involving multiplication and division at a food store. Ask the students to share their findings with their classmates.

Resources

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

vi) select and use appropriate computational techniques (including mental, paper-and-pencil, and technological) in given situations

SCO: By the end of grade 3, students will be expected to

B11 select and use appropriate computational techniques (including mental, paper-and-pencil, and technological) in given situations

Suggestions for Teaching and Learning

B11 When an exact answer is required, students may choose to use a mental math strategy, a pencil and paper algorithm, or a calculator. Continue oral drill of addition and subtraction facts required for mental calculations. To become more efficient in performing mental calculations, students need to develop a variety of strategies, including the following:

- *Making a ten* - For example, for 26 + 7, one might think 26 and 4 make 30, and 3 more is 33.
  This can be extended to 2-digit numbers. For example, for 37 + 26, 37 plus 20 is 57, and 3 more is 60, plus 3 is 63.
- *Front-end* - For example, for 47 + 8, think 40 plus 15 (7 + 8), or 55.

  Consider the following for adding a number of 2-digit numbers using the front-end approach:

  24 Students might say “20, 10, and 30 makes
  12 60. 64, 66, 67 - the answer is 67.”
  31
- *Counting on* - When mentally calculating 50 - 19, think, "One more is 20, and 30 more make 50, so the difference is 31.”
- *Subtract 10 and compensate* - For 31 - 8, many students will subtract 10 and add 2 back on.
- *Balancing* - When subtracting 29 from 54, the difference between the two numbers is the same as subtracting 30 from 55.
- *Using the nearest multiple of ten and compensating* - For 31 - 8, think, “30 minus 8 is 22 and 1 more is 23.”
- *Partner numbers* - Students should know the number combinations which go together to give a sum of 10 (2 and 8, 3 and 7, etc.) and begin to recognize those that sum to 100 (25 and 75, 60 and 40, 45 and 55, 49 and 51, etc.).

It is useful to use a hundreds chart to help students visualize mental calculations. For example, when adding 11, go down one and over one, which is really 10 more plus one.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

Performance

B11.1 Ask the student to add mentally as you draw numbers from a bag, and to stop you when the sum has passed 40.

Pencil and Paper

B11.2 Have the student make a list of calculations involving 2- and 3-digit numbers which would be quicker to do mentally than on paper or with a calculator.

Interview

B11.3 Ask the student to describe a strategy for calculating 48 - 9 (or 76 + 11) mentally.

B11.4 Show pictures of several items with prices less than a dollar. Have the student start with $2.00 and buy as many items as possible. Ask him/her to tell you how much is left after each purchase.

B11.5 Tell the student that to find 37 - 8, Rita said, "37, 27, 29." Have the student explain Rita's thinking.

B11.6 Tell the student that you had 3 quarters and spent 48¢. Ask him/her to explain how one might mentally figure out the change.

B11.7 Ask the student to give the partner number for

82 (18)	49 ( )	65 ( )
75 ( )	60 ( )	91 ( )

B11.8 Tell the student that to subtract 7 from 51 John said that he would rather subtract 6 from 50. Ask him/her if this works and why.

Portfolio

B11.9 Have the student explain why, when adding a single-digit number to a number in the fifties, the answer has to be either in the fifties or sixties.

Resources

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Outcomes

KSCO: By the end of grade 3, students will be expected to

vi) select and use appropriate computational techniques (including mental, paper-and-pencil, and technological) in given situations

SCO: By the end of grade 3, students will be expected to

B12 mentally add and subtract rounded numbers

B13 use technology to solve problems involving larger numbers

Suggestions for Teaching and Learning

B12 Students should be expected to continue to mentally add and subtract rounded numbers; for example, 400 + 500, 100 - 80, 300 - 30, etc.

B13 Students should be encouraged to use calculators as tools in problems requiring tedious calculations or those beyond their capabilities.

GCO B: Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.

Suggestions for Assessment

Performance

B13.1 Ask the student to show how he/she would use a calculator to find 4234 + 187.

Pencil and Paper

B12.1 Present calculations, such as the following, orally (or on an overhead), and ask the student to write only the answer. Allow only a few seconds for each question. (e.g., 300 + 600, 200 - 40, 200 + 80 + 30, 220 - 40)

Resources