PATTERNS AND RELATIONS

GRADE 3

Western and Northern Canadian Protocol (WNCP) Edition

hands-on mathematics

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PORTAGE & MAIN PRESS

Winnipeg • Manitoba • Canada

From ***Hands-On Mathematics***: *Grade 3*, second edition
First edition, 2005

Portage & Main Press acknowledges the financial support of the Government of Canada through the Book Publishing Industry Development Program (BPIDP) for our publishing activities.

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Patterns and Relations
Grade 3
Revised Manitoba Edition

ISBN 978-1-55379-137-9

Printed and bound in Canada by Prolific Group

PORTAGE & MAIN PRESS

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Portage & Main Press

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Introduction

Mathematics is the study of patterns and relations. When students begin to recognize and explore the patterns that are inherent in mathematics, it becomes easier for them to understand the relationships among different mathematical concepts. Students need opportunities to discover and explore both patterns that occur in everyday life as well as those revealed through calculators and computers.

In this module, students learn to recognize, describe, extend, and create patterns using real objects, mathematical materials, and numbers. Students first learn about patterns by identifying similarities and differences as they sort. Students explore various sorting activities at the beginning of the module, learning to identify, describe, and classify objects by their attributes. As they start to understand the relationships between objects, students can begin making predictions about patterns. They then proceed to the recognition of visual patterns, auditory patterns, and patterns involving the sense of touch. From recognition, students progress to pattern extension, translation of patterns to other modes, and finally to the creation of their own patterns.

Students learn to create various forms of patterns in this module including patterns using objects, geometric shapes, pictures, numbers, sounds, "touch" actions (for example, tapping), and physical actions (clapping, jumping, and so on). Students should be exposed to all different forms of patterning and should develop skills in transferring patterns from one form to another.

Teachers should also expose students to a wide variety of activities and play with patterns of all kinds including those from different cultures such as the patterns in ancient number systems like Roman numerals. These should consist of linear patterns, symmetrical patterns, repeating patterns, and increasing/decreasing patterns.

Mathematics Vocabulary

Students must learn to recognize and understand the mathematical vocabulary related to the patterns and relations module. A "mathematics word wall" is a valuable reference for students for displaying new vocabulary. Dedicate a classroom bulletin board to your word wall, and display the letters of the alphabet along the top of the bulletin board. Use index cards to record math vocabulary introduced in each lesson, and place these on the board under the appropriate letter of the alphabet. Encourage students to refer to the math word wall during activities and while doing written tasks.

Throughout this module, teachers should use, and encourage students to use, vocabulary such as: *attribute, less, more, fewer, shape, pattern, element, term, repeat, increasing, decreasing, compare, extend, vertical, horizontal, row, column, diagonal,* and *core*.

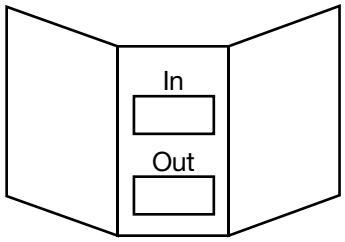
5 Patterns in Addition and Subtraction

Background Information for Teachers

Grade three students should already have a good foundation in addition and subtraction facts to 20. The activities in this lesson are designed to build on these skills to develop problem-solving and predicting skills. The lesson begins with a review of the use of patterns to solve addition and subtraction equations. Students observe number patterns in addition and subtraction grids by examining rows, columns, and diagonals, and then describe the pattern rule.

Materials

- overhead projector
- overhead transparency film
- overhead markers
- addition grid (included. Photocopy onto overhead transparency.) (1.5.1)
- pencils
- graph paper
- magic number generator (Fold a long piece of cardboard into three sections. Cut out "in" and "out" slots from the middle section, as in the diagram below. The slot must be large enough to receive an index card. You will need one magic number generator for each small group of students.)



- index cards
- markers
- chart paper

Activity: Part One: Review of Patterns in Addition and Subtraction Strategies

Doubles

On the overhead, begin a chart showing doubles addition facts, such as the one below, and ask students to tell you the answers to fill in:

1 + 1	2 + 2	3 + 3	4 + 4	5 + 5	6 + 6	7 + 7	8 + 8	9 + 9
2	4	6						

Remind students that doubles are addition facts where both addends are the same. Ask:

- What number patterns do you see?

Doubles plus one

Explain to students that doubles facts can be used to learn other facts. On the overhead, record the facts 5 + 5 = 10 and 5 + 6 = ___. Ask:

- What is the same about these two number sentences?
- What is different?
- What is the sum of 5 + 6?
- How do you know? (The second addend is 1 more than the second addend in the fact 5 + 5, so the sum should also be 1 more.)

Repeat with other doubles-plus-one facts.

Fact families

Record 6 + 5 = ___ on the overhead. Ask:

- What is the sum?
- Is the sum different from the sum of 5 + 6 (used in the doubles-plus-one example)?
- Why or why not? (Although the addends have been reversed, the numbers are the same, so the sum is the same).

Now, ask students to make a subtraction fact using the same numbers (11 – 5 = 6). Ask students for the related fact. List all of the facts in the fact family for these three numbers.

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Ask:

- How many facts are in this fact family? (four)

Repeat with other doubles-plus-one fact families.

Now, record 7 + 7 = 14 on the overhead. Ask:

- Does this addition fact have a related addition fact? (No, because reversing the addends does not change the fact.)
- What is the related subtraction fact?
- What do you know about doubles-fact families? (They have only one addition fact and one subtraction fact.)

Expand this activity to include all doubles facts to 20, as well as doubles facts beyond 20.

Activity: Part Two: Addition Grids

Distribute Activity Sheet A (1.5.2), and have students complete the addition grid by finding the sum of each pair of horizontal and vertical numbers. Then, ask students to record the number patterns they observe.

Activity Sheet A

Note: Before having students complete this activity sheet, review definitions for the words *horizontal* and *vertical*.

Directions to students:

Complete the addition grid by finding the sum of each pair of horizontal and vertical numbers. Then, record any number patterns you observe (1.5.2).

On the overhead, display the transparency of the addition grid (1.5.1). Ask students to share the patterns they discovered on their own addition grids (1.5.2), guiding them to:

- describe the patterns they observe in the rows
- describe the patterns they observe in the columns
- describe the patterns they observe in the diagonals

Now, distribute pencils, and ask students to draw an outline around any 2 x 2 square on their addition grid. Ask:

- How is your 2 x 2 square like other 2 x 2 squares? How is it different?
- Do all 3 x 3 squares have the same pattern? (Have students draw 3 x 3 boxes and share their discoveries.)

Tell students to draw a box around any three numbers in a row or column. Ask:

- What do you notice about the middle number? Does this pattern work for any five numbers in a row or column?

Have students record in their math journals all the discoveries they made from observing their addition grids.

Now, distribute graph paper to students, and have them make their own subtraction grids, numbering the top row 9 to 18 and numbering the left column 0 to 9. Ask students to complete their subtraction grids and then describe the patterns they see. Compare the addition and subtraction grids.

Activity: Part Three: Magic Number Generator

Show students one of the "magic number generators" (see "Materials" list, page 74). Stand behind it, and explain that you are going to record a rule on an index card. When a number goes into the magic number generator, a different number will come out that fits the rule.

Record an addition rule (for example, "+ 5") on an index card, but do not show it to students. Ask a volunteer to record a number on another index card and insert the card into the "in" slot. If a student inserts a 3, record an 8 on a blank

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card, and send it through the "out" slot. If a student inserts a 9, send out a 14, and so on. On the overhead, record the numbers going in and coming out. Repeat until students guess your rule. Then, review the numbers on the overhead showing numbers in and out to verify the rule.

In	3	9	5		
Out	8	14	10		

Repeat the activity, this time with a subtraction rule. Once students understand how the magic number generator works, have them work in small groups to create their own number generator rules. Provide each group with a magic number generator, index cards, a piece of chart paper, and a marker. Have students in each group take turns making up the rule while the others guess. Encourage students to keep track of the rules on chart paper.

Note: Have students alternate between making vertical charts and horizontal charts:

In	Out

In					
Out					

Problem Solving

If you cut a piece of string fifty times, how many pieces of string will you have? Make a chart to explain your answer.

Note: A reproducible master for this problem can be found on page 107.

Activity Centres

- Include four sets of cards numbered 1 through 6 at an activity centre along with scrap paper and pencils, and have pairs of students play Race to 365. Tell students to shuffle the four sets of cards together before they begin and place the deck facedown in the centre of the playing space.

  Have each player begin with a score of 300. Tell students to take turns drawing a card and adding its value to their running total on scrap paper. A player may choose to pass on a card drawn and not add its value to his/her total, thereby missing a turn. The first person to reach 365 without going over wins.

  Variations:

  - Have students play the game with other sets of numbers (for example, 1 through 9).
  - Change the target number to different numbers, to 1000.
  - Start with a large number, and subtract to a target number.

- Place calculators at an activity centre. Starting with the number 50, have pairs of students take turns subtracting any one-digit number (except 0) from the difference. The first player to reach 0 wins. As a follow-up, ask students:

  - Can you find a strategy to win?
  - Does it matter who goes first?

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- How would you change your strategy if the rule changed and the first person to reach 0 lost the game?

- At an activity centre, place a set of cards numbered 0 to 9, and include an extra 9 card. Also include scrap paper and a pencil. Have pairs of students play Minus 9. Tell the pair to place one of the 9 cards face up in front of them, shuffle the rest of the cards, and put them facedown beside the 9. Ask players to take turns drawing two cards from the deck, placing them above the 9, and subtracting 9 from the two-digit number created. If they subtract correctly, they gain a point. Once students have played for a while, have them describe the patterns they observe. Vary the game by having students add 9 to the two-digit number created rather than subtracting 9.

Extensions

Note: The following activity has students using the constant feature on a calculator. A common way for activating this feature is presented here, but different calculators prompt the feature in different ways. Be sure to experiment with the calculators students will be using before doing this activity.

- Distribute calculators, and show students how to use the constant feature for repeated addition or subtraction. Have students enter 500 on their calculators and then press "+, 1, =, =, =…" to count-on by 1s. Tell students to continue pressing "=" until the display reaches 530. Next, have students use the constant feature to skip count by 2s, starting at 500 (enter 500, then press "+, 2, =, =, =...").

  Have students predict how long it will take them to use the constant feature to count from 500 to 600 by 1s, stopping exactly at 600. Ask students to enter "500, +, 1" and then wait for you to say "Go!" to begin pressing the "=." Time students, and record the best time.

  Now, have students estimate how long it will take them to use the constant feature to count from 500 to 600 by 2s. Time students, and discuss the difference between the amount of time it took to count by 1s and the amount of time it took to count by 2s. Have students predict how long it would take them to skip count from 500 to 600 by 3s, 4s and 5s. Encourage students to consider whether they could reach 600 exactly for each of these skip counting numbers.

  Repeat the previous activities with students, this time skip counting backward ("600, –, 1, =, =, =…"). Have students say the numbers aloud as they count back by 1s, 2s, 3s, 4s, and 5s. Other variations include:

  - Have students predict how long it would take them to count from 500 to 1000 by 1s or by 10s.
  - Have students skip count forward or backward beginning at random numbers. For example, have students enter "18, +, 5, =, =, =…" on their calculators. Ask students to record the numbers displayed on their calculators and describe the number patterns they see.

- To extend the magic number generator activities from Activity: Part Three, have students try The Shodor Education Foundation site's interactive "Number Cruncher" at http://www.shodor.org/interactivate/activities/numbercruncher/index.html.

Addition Grid

+	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9	10
2	2	3	4	5	6	7	8	9	10	11
3	3	4	5	6	7	8	9	10	11	12
4	4	5	6	7	8	9	10	11	12	13
5	5	6	7	8	9	10	11	12	13	14
6	6	7	8	9	10	11	12	13	14	15
7	7	8	9	10	11	12	13	14	15	16
8	8	9	10	11	12	13	14	15	16	17
9	9	10	11	12	13	14	15	16	17	18

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