

PATTERNING AND ALGEBRA

GRADE 3

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hands-on **mathematics**

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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.

Note: Although the Data Management and Probability strand of the *Ontario Curriculum for Mathematics (2005)* addresses sorting and classifying, most sorting skills are prerequisites for patterning. Accordingly, sorting activities are included in this module on patterning and algebra. As well, the learning expectations that focus on “Expressions and Equality” (Patterning and Algebra strand) are addressed in the module *Number Operations*, because of the connection between these expectations and number operations skills and concepts.

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 unit, 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 unit 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 this 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, sort, classify, set, similarities, differences, less, more, fewer, shape, pattern, element, term, repeat, increasing, decreasing, Venn diagram, Carroll diagram, intersection, compare, extend, vertical, horizontal, row, column, diagonal, and core.*

2 Describing Attributes

Background Information for Teachers

An *attribute* is a characteristic or quality of something or someone that can be used for sorting purposes. In order to sort into complex groupings, grade three students will need to review what an attribute is. The activities in this lesson encourage students to use language to describe buttons, attribute blocks, and other objects. Students review sets, attributes, sorting rules, and discriminating similarities and differences.

As noted previously, sorting activities are included in this module, rather than in the *Data Management and Probability* module, to help develop in students the skills that are prerequisite for patterning.

Materials

- *Sorting (Math Counts)*, a book by Henry Pluckrose
- variety of sets of objects (beans, shells, keys, school supplies, small toys, attribute blocks, and so on)
- “Button Fun,” a poem by Dakshana Bascaramurty (included. Print the poem onto chart paper. Be sure to print large, and leave space between each line of the poem.) (1.2.1)
- collection of buttons (be sure there is variation in size, colour, shape, number of holes, and material from which buttons are made. You will need twenty to thirty buttons for each working group of students.)
- clear tape
- attribute blocks (you will need several blocks for each pair of students)

Activity: Part One: Describing Attributes

Read the book, *Sorting (Math Counts)* together with students. While reading, be sure to stop

frequently, asking students to describe in detail the objects on each page. Discuss the similarities and the differences in the sorted sets, and review the questions asked in the book. Make a list of sorting rules to keep track of the attributes used in the book (colour, size, shape, function, length, type, location).

Have students sit in a circle. Place a variety of objects (beans, shells, keys, school supplies, small toys, attribute blocks, and so on) in the centre of the circle, and play “I Spy” with students. Provide three or four clues (both positive and negative) about one of the objects, and have students determine which object you are describing. For example, referring to a toy car, you might say:

- I spy an object that is red.
- It is not used for drawing.
- It has wheels.
- What object am I thinking of?

Pause after each clue, allowing one or two guesses from students before providing another clue. When a student guesses correctly, ask him/her:

- How did you know you were naming the correct object?
- Which other objects are red, are not used for drawing, or have wheels?
- How else could I describe my object? (small, a toy, a type of transportation)

Repeat the activity, but have a student give the clues. Remind the student to describe the object in as many different ways as possible using both positive and negative clues.

When students become familiar with the game, have them play it in small groups. After each round, the student who guessed correctly gives clues about a new object in the next round.

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Activity: Part Two: Attribute Poems

Display for students the poem “Button Fun” (1.2.1), which you have printed on chart paper. Read through the poem together as a class, and have students identify and highlight all the words that are used to describe buttons.

Divide the class into working groups, and provide each group with some clear tape as well as twenty to thirty buttons to use in an attribute hunt. Have students in each group search for a button in their collection that has one of the attributes mentioned in the poem. When they find a button with a matching attribute, have one student from the group tape their button just above or below that attribute on the poem. Have students continue the attribute hunt until each group has found six buttons to match six different attributes listed in the poem.

Divide the class into pairs of students, and distribute a copy of Activity Sheet A (1.2.2) to each student. Present sets of objects (beans, shells, keys, school supplies, small toys, and so on) to students, and have each pair choose a set and make a list of all the attributes they can think of to describe the objects in their set. For example, attributes to describe the set of keys could include: big, small, silver, gold, coloured, shiny, dull, new, old.

Once pairs have completed their lists, have each pair use their list to create their own attribute poem. Later, have each pair share their attribute poem with the rest of the class. Or, display the poems throughout the classroom, or bind them into a class attribute poem book.

Note: Save the attribute lists from Activity Sheet A (1.2.2) for use in an upcoming lesson.

Activity Sheet A

Directions to students:

Note: This is a two-page activity sheet.

Make a list of all the different attributes you can think of to describe your set of objects. Record one attribute in each box. Record the title of your set of objects in the blank at the top of the sheet. Once you have completed your list, use it to create your own attribute poem (1.2.2).

Activity: Part Three: Similarities and Differences

Have students sit in a circle. Hold up an attribute block for students to see. Ask students to describe as many of the block’s attributes as they can including number of sides, thickness, colour, and size. For example:

- The block is yellow.
- It has six sides.
- It is thin.
- It is large.

Place the attribute block in the centre of the circle. Give each student his/her own attribute block, and tell students they will now build a “one-difference train.” Ask students to look carefully at their blocks. Ask:

- Does anyone have a block that is different from my block by (because of) only one attribute?

Have any student who replies positively explain how his/her block is the same as yours and describe the one attribute that is different. For example:

- My block and your block are both yellow.
- They both have six sides.
- They are both large.
- My block is thick and your block is thin.

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If the student's block differs from yours by only one attribute, have the student place it next to your block in the centre of the circle. Then, ask:

- Does anyone have a block that is different from (student)'s block by only one attribute?

Repeat the process three or four more times until students understand the concept.

Once the one-difference train is five or six attribute blocks long, remove all blocks except the original one from the centre of the circle. Redistribute one attribute block to each student who had added his/her block to the one-difference train. Tell students they will now build a "two-difference train." Ask:

- Who has an attribute block that is different from my block in exactly two ways?

Repeat the same process as before with students describing similarities and differences to ensure that the block fits onto the train.

Divide the class into pairs of students, and distribute several attribute blocks to each pair. Have the pairs create their own two-difference trains, with each block different from the one next to it in two ways.

Distribute Activity Sheet B (1.2.3) to students. Using the two-difference trains they created with attribute blocks, have students record all four attributes for each block by printing them in the boxes. Ensure that they record the attributes for each block in the same order: colour, sides (number of sides), size, and thick/thin. Once they have recorded attributes for each block, have students draw lines between corresponding attributes from one box to the next. If the attribute is the same (blue, blue) the line should be solid. If the attribute is different the line should be dotted, as in the following example:

colour	blue - - - - - red	- - - - - red	- - - - - red
sides	3 sides - - - - - 3 sides	- - - - - 4 sides	- - - - - 4 sides
size	big - - - - - big	- - - - - small	- - - - - small
thick/thin	thin - - - - - thick	- - - - - thick	- - - - - thick

Then, challenge students to use attribute blocks to make three-difference trains, with each block different from the one next to it in three ways. Again, ask students to record all four attributes for each block by printing them in the boxes on the activity sheet and then drawing solid lines between similar attributes and dotted lines between different attributes.

Activity Sheet B

Directions to students:

Using the two-difference train you created with attribute blocks, record all four attributes for each block by printing them in the boxes. Be sure you record the attributes for each block in the same order: colour, sides (number of sides), size, and thick/thin. Draw solid lines between similar attributes from one box to the next, and draw dotted lines between different attributes from one box to the next. Then, try using attribute blocks to make a three-difference train, with each block different from the one beside it in three ways. Record all four attributes for each block by printing them in the boxes. Draw solid lines between similar attributes and dotted lines between different attributes (1.2.3).

Problem Solving

Carl went shopping to buy a present for his sister. He considered a doll, a stuffed puppy, some coloured blocks, and a music box. The gift Carl chose does not make noise. It is soft. You cannot build with it. It has four legs. What did Carl buy for his sister?

Note: A reproducible master for this problem can be found on page 163.

2

Activity Centres

- Place a bag filled with small objects (beans, shells, keys, buttons, school supplies, small toys, plastic animals, and so on) at an activity centre along with scrap paper and pencils. Have students choose two objects from the bag and record three similarities and three differences between the objects. As a variation, have two or more students compete to see who can list the most similarities/differences between the two objects.
- Have groups of two or more students play Mattel's TriBond Junior. The object of this game is to find the commonality between three objects. For example, what do a turtle, a nut, and an egg all have in common? (They all have shells.) Or, what do a shark, a comb, and a saw all have in common? (They all have teeth.)

Or, make up your own questions that are related to other units of study. For example:

- What do stamens, pistils, and petals have in common? (They are all parts of a flower.)
- What do beams, braces, and joints all have in common? (They all help to support structures.)

After a little practice, students can try making up their own clues.

- Have groups of two to four students play Ravensburger's Guess My Name Game. One player gives clues to describe an object, while the other players try to be the first to guess what the object is. For example:
 - I live in the water.
 - I am covered with feathers.
 - I say "quack."
 - What am I?

Extensions

- Add the word *attribute* to your math word wall.
- Divide the class into pairs of students, and provide each pair with a set of twelve to sixteen small objects as well as scrap paper and pencils. Have each pair place their set of objects between them and play What Is My Object? Ask player *A* to select one of the objects and record which one he/she has chosen without player *B* seeing. Then, have player *B* try to guess which object player *A* chose by asking "yes or no" attribute questions. For example, a set of sixteen buttons with different attributes is placed between the partners, so that both partners can see all of the buttons. Player *A* selects a red, plastic, square button with four holes. He records his choice to show player *B* at the end of the game. Player *B* asks:
 - Is your button round?
 - Is your button blue?
 - Is your button made of plastic?

Examples of questions that are not suitable (because they do not elicit "yes" or "no" answers) include:

- What colour is your button?
- How many holes does your button have?

Tell students to keep a tally of the number of questions asked. Have students play several times so they can begin to develop strategies to guess the object in as few questions as possible.

- Read with students *Hannah's Collections*, a book by Marthe Jocelyn. Have each student bring a collection of his/her own to school and describe it to the class.

2

- Have students play Fripplle Place (available through the Winnipeg School Division freeware suite). Players examine the clues and use deductive reasoning to sort the Fripplles by their attributes and then place them into the correct rooms.
- Have students play one of two interactive logic games found at the Learner.Org Teacher's Lab Patterns in Mathematics website (Annenberg/CPB) at <http://www.learner.org/teacherslab/math/patterns/logic.html>:
 - In Guess My Button, the computer secretly chooses a button, and players must figure out which one it is.
 - In People Patterns, players must figure out who should come next in a sequence of people.

Assessment Suggestion

Observe students as they participate in the attribute activities. Assess each student's ability to:

- use a variety of attributes (size, colour, function, material, and so on) to describe objects
- distinguish similarities and differences between objects
- use attribute blocks to complete a two-difference train
- use attribute blocks to complete a three-difference train

List these criteria on the Rubric sheet, found on page 18, and record your observations.

Button Fun

By Dakshana Bascaramurty

I have fun with buttons
That have fallen off my clothes,
I sort them into columns
And I sort them into rows.

Metallic, dull or shiny,
Circular or square,
Buttons come in fours or threes
And sometimes just in pairs.

Brown, black, or white buttons
Silver, brass, or gold,
Big buttons, little buttons,
Buttons – new or old.

I like to put them into sets
By colour, shape, or size,
In a button-sorting contest
I would surely win first prize!

Sample Pages

Date: _____

Names: _____

Using Attributes to Write a Poem

Attribute List for _____

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Date: _____

Name: _____

Two- and Three-Difference Trains

