**Playful Mathematical Inquiry With Patterns in Grades 3 - 5**

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| **UNDERSTAND: We use patterns to represent identified regularities and to form generalizations.**  *Identifying and extending patterns is an important process in algebraic thinking. The development of this process usually begins in Kindergarten… By third grade, students will have had numerous experiences with repeating patterns. Besides simply extending the patterns using materials or drawings, they should also have translated the patterns from one medium to another… It is common in early grades to “read” a repeating pattern using letter of the alphabet… If you find that your students have not had experiences with repeating patterns, it may be worthwhile to spend a few days exploring them* (John Van De Walle, Teaching Student Centered Mathematics: Grades 3 – 5, 2006 p. 291).  Important information on Patterning written by Janice Novakowski <http://janicenovkam.typepad.com/files/patterning.pdf> | |
| **KNOW:**  What is the learning trajectory for developing an understanding patterns? Although, we have used grade levels, we understand that learning is developmental and children learn at different rates and at different times; therefore, it was important to include grades below and above the current levels we are teaching. | |
| Grade Two   * Explore more complex repeating patterns (e.g., positional patterns, circular patterns) * Identify the core of repeating patterns (e.g., the smallest part of the pattern that repeats) * Increasing patterns using manipulatives, sounds, actions, and numbers (0-100) | **DO:**  What will my students DO to show me their knowledge and understanding?  What curricular competencies do we want to focus on?  Communicating and Representing   * Communicate their understanding of patterns in many ways including orally, concretely, pictorially, symbolically, in written text and/or using screencasting apps such as ShowMe. * Use mathematical vocabulary as it relates to patterns to contribute to mathematical discussions (e.g., pattern core, repeating pattern, increasing and decreasing patterns, elements, terms). * Explain and justify their pattern predictions * Represent patterns concretely, pictorially, and symbolically |
| Grade Three   * Creating increasing and decreasing patterns using concrete, pictorial, and numerical representations * Generalizing what makes a pattern increase or decrease (e.g, doubling, adding 2) |
| Grade Four   * Change in patterns can be represented in charts, graphs, and tables * Using words and numbers to describe increasing and decreasing patterns * Describing patterns rules using words and numbers from concrete and pictorial representations |
| Grade Five   * Using rules for increasing and decreasing patterns including words, numbers, symbols, and variables. * Number patterns can be expressed using variables in tables |
| Grade Six   * Creating and using rules for increasing and decreasing patterns, using expressions, tables, and graphs as functional relationships |

**How will I find out what my students already know? How will I activate their prior knowledge?**

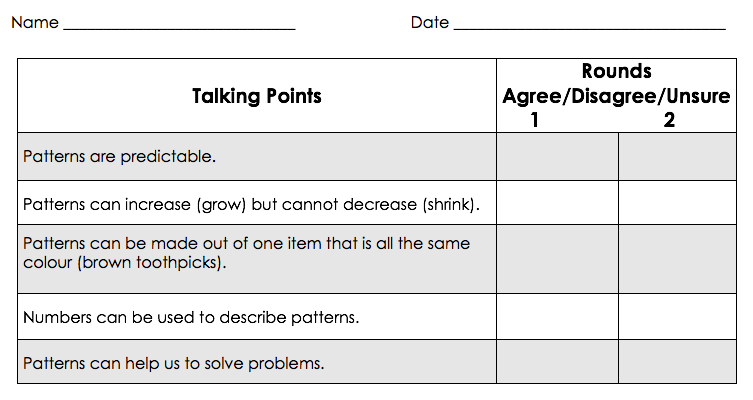
We will use Talking Points. As a class, together we will introduce and model how Talking Points work. Students will read the five statements and note whether they agree, disagree, or are unsure and glue this into their Math Journals. Then we will return to the carpet and form a circle. Students should bring their pencils and journals with them.

TALKING POINTS ACTIVITY – Activity adapted from <http://cheesemonkeysf.blogspot.ca/search?q=talking+points>

ROUND 1 – (15 – 20 min) Begin by reading aloud each talking point. Then ask the students to mark in Round One whether they AGREE / DISAGREE / or are UNSURE. Do this for all the Talking Points. Next, go around the group, and have each student say in turn whether they AGREE, DISAGREE, or are UNSURE about the statement AND WHY. Even if they are unsure, they should also state a reason WHY you are unsure (e.g., I don’t think it makes sense because…). All students are respectful of each other and do not add comments to another person’s explanation. Remind your students that they are free to change their mind during your turn in the next round.

Note: Typically, students do three rounds of talking points. In small groups this would work well, but since we are working with the whole class, we felt our students could not sit this long.

EXPLORATION TIME: Provide various materials (E.g., felt leaves, jewels, feather and beads, ribbons) and mats (circular, weaving wires, grids) around the room for the students to use to create patterns. Also provide books and images of real life items that have patterns. Let the students choose which materials they would like to use. Encourage them to create as many patterns as possible.   
  
ROUND 2 – After the students have had an opportunity to hear the thoughts of their peers, as well as engage in creating patterns, ask the students to return to each talk point and note whether they AGREE / DISAGREE / or are UNSURE.



Journal Prompts:

What talking point are you feeling confident about? Explain your reasoning.

Which talking point are you unsure about your answer? Why?

**What do my students know about patterns? And what misconceptions do they have?**

**What questions do my students have about patterns?**

**What opportunities are there for integrating aboriginal perspectives?**

* First Peoples local art and textiles, including beadwork and beading and frieze work in borders
* Metis finger weaving
* First Peoples head/armband patterning
* CHECK OUT OUR VERY OWN ABORIGINAL EDUCATION HELPING TEACHER’S SITE. THERE ARE TONS OF IDEAS THERE! I LOVE THIS SITE!

[**https://aboriginalresourcesforteachers.weebly.com/**](https://aboriginalresourcesforteachers.weebly.com/)

* Exploring Patterns through Coast Salish Weaving <https://aboriginalresourcesforteachers.weebly.com/uploads/3/0/3/5/30354089/exploring_patterns_through_coast_salish_weaving.pdf>

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| **Structured and Guided Inquiry Questions:** |
| **What makes a pattern a pattern? What patterns can you create?**  Depending on what is observed students may need several days with opportunities to explore repeating patterns.  Inviting and inspiring materials:   * jewels, glass beads, material leaves, sequins, wooden beads, toothpicks, cuisenaire rods, pattern blocks, unifix cubes, tiling squares * ribbons and wire racks for weaving * musical instruments or items that make sounds * square grid mats, zigzag and spiral mats, circular mats, black felt squares * Any of the children’s literature books with repeating patterns (see list below). Ask the students to create patterns similar to the story. Can they act out the patterns?   Guiding Questions:  What would come next?  Can you make the same pattern another way?  What is the core?  How might you label your pattern?  Other ideas:  Have students create a pattern and trade seats with a friend. Ask “Can you extend your friend’s pattern?  Turn to the person beside you. Can you guess each their pattern rule? |
| **Where do I see patterns in my world?**  A class walk around the school and/or neighborhood would allow children to document with iPads the patterns they see.  Inviting and inspiring materials:   * Images of patterns (animals), books with patterns   Guiding Questions:  How could you describe the patterns you found? How might you organize the patterns we found in our environment?  What connections are you making? |
| **Can a pattern be made from items that are all the same (e.g., colour and size such as brown toothpicks)?**  Inviting and inspiring materials:   * Any item that is the same colour and size (e.g., beige toothpicks, orange squares, red counters)   Guiding Questions:  How would you describe your pattern?  Can you represent you pattern on paper?  How is your pattern different that a repeating pattern with two elements (such as colours)?  Other ideas:  Have students create a pattern and trade seats with a friend. Ask “Can you extend your friend’s pattern?  Turn to the person beside you. Can you guess each their pattern rule? |
| **What patterns live in our lives? Or What patterns are related to time?**  Inviting and inspiring materials:  Read aloud Please, Please the Bees. While reading, pause at the point where Benedict the bear talks about how he does the same thing every day, day after day. Ask the students to turn and talk to a partner about some of their daily patterns. Brainstorm as a class. Have the students represent some of their daily patterns. This could be done on paper or in journals. Some way student could consider representing the patterns in their lives include dividing their paper into 7 sections for each day of the week, or labelling different places on a circle to represent a day.  Guiding Questions:  How are the patterns in yours and friend’s life similar or different (e.g., we both go to school M – F, but I have piano on Tuesdays)  How do your patterns change with the seasons? |
| **What patterns live in fabrics? Can you design a pattern? What patterns do you connect with?**  Inviting and inspiring materials:   * Pieces of fabric with patterns * A Pattern for Pepper by Julie Kraulis * Paints or pastels and paper * Pattern blocks   Guiding Questions:  How would you describe the pattern on this fabric?  How can you use transformations (e.g, slide/translation, flip/reflection, turn/rotation) to create patterns? |
| **Can a pattern also be a shape? Or 3-D?**  Inviting and inspiring materials:   * jewels, glass beads, material leaves, sequins, wooden beads, toothpicks, cuisenaire rods, pattern blocks, unifix cubes, tiling squares * square grid mats, circular mats, black felt squares * Read aloud a Circular Children’s Literature book and ask the students if they can represent the pattern in the book using concrete materials or through a pictorical representation   Guiding Questions:  Where does your pattern begin? Where does it end?  Will you pattern ever stop?  What did you need to consider when making your pattern?  Other ideas:  Have students create a pattern and trade seats with a friend. Ask “Can you extend your friend’s pattern?  Turn to the person beside you. Can you guess each their pattern rule? |
| **What patterns live in music and/or dances? Can you create a song or a dance with a pattern?**  Inviting and inspiring materials:   * iPod, iPad, laptop or anything that plays music or shows videos of songs with dancers (Teacher will need to preview and bookmark) * iPod or iPad or anything that can be used to digitally record * instruments * materials to make instruments * large area for body movements * blank paper and markers for recording   Guiding Questions:  What patterns do you hear in songs? What is this called? (e.g., chorus)  Can you describe the patterns you see/hear? |
| **What increasing patterns can you create?**  **OR Choose numbers for the blanks in this increasing pattern.**  **Start at \_\_\_\_\_\_ and add \_\_\_\_\_\_\_ each time. What would the 10th and 20th term be?**  Inviting and inspiring materials:   * Matryoshkaa dolls * Cookie cutters that are nested * Pattern blocks * Mini Cubes * Cuisenaire Rods * Geoboards and elastics * Dice * Dominoes * Square tiles * Wooden or plastic numbers * Unifix cubes * Children’s Literature books with increasing patterns (see list below). Read aloud a book and ask if students can represent a pattern similar to the book.   <http://www.visualpatterns.org/>  Guiding Questions:  Can you extend the pattern?  What comes next? What might this look like three terms from now?  How could you describe your pattern to a friend? How do numbers help us describe patterns?  How are growing patterns and repeating patterns alike and different?    Other ideas:  Have students create a pattern and trade seats with a friend. Ask “Can you extend your friend’s pattern?  Turn to the person beside you. Can you guess each their pattern rule? |
| **What decreasing patterns can you create?**  **OR Choose numbers for the blanks in this increasing pattern.**  **Start at \_\_\_\_\_\_ and subtract \_\_\_\_\_\_\_ each time. What would the 10th and 20th term be?**  Inviting and inspiring materials:   * Matryoshkaa dolls * Cookie cutters that are nested * Pattern blocks * Mini Cubes * Square tiles * Dice * Dominoes * Wooden or plastic numbers * Cuisenaire Rods * Unifix cubes * Read aloud Pete The Cat and The Missing Cupcakes – can you represent the pattern from the book?   <http://www.visualpatterns.org/>  Guiding Questions:  Can you extend the pattern?  What comes next? What might this look like three terms from now?  How could you describe your pattern to a friend? How do numbers help us describe patterns?  How are decreasing patterns and repeating patterns alike and different?  How are decreasing patterns and increasing patterns alike and different?    Other ideas:  Have students create a pattern and trade seats with a friend. Ask “Can you extend your friend’s pattern?  Turn to the person beside you. Can you guess each their pattern rule? |
| **What patterns can be found in charts?**  Inviting and inspiring materials:   * Grid paper with scissors for students to cut up into different sized rectangular shapes * 100’s charts * Addition Table * Multiplication Grid   Guiding Questions:  What patterns do you see?  How could you describe the patterns you see?  What is the pattern rule? |
| **How do tables and charts help us understand patterns?**  Inviting and inspiring materials:   * Unifix cube patterns or other pre-created patterns * Read aloud Patterns in Peru, Two Of Everything, or One Grain of Rice   Guiding Questions:  How can the tables and charts help you predict the pattern or the colour of the 25th cube? Or hundredth cube? |
| **How do graphs help us make sense of patterns?**  Inviting and inspiring materials:   * Graphing paper * Images of increasing or decreasing patterns * Contextual stories (e.g., Matthew and his friend play Minecraft on Sunday. Each day that week two more friends join the game.)   Guiding Questions:  How do graphs help you predict and make sense of the pattern? |
| **How are place value patterns repeated in numbers?**  Inviting and inspiring materials:   * Numbers (e.g., wooden, plastic, tiled numbers) * Place Value Tent Cards * Place Value Dice * Hundreds and Thousands charts   Guiding Questions:  How can your knowledge of the patterns in our place value system help you to make sense of numbers? |
| **How do tables help us see relationships and patterns?**  Inviting and inspiring materials:   * Increasing and decreasing patterns * Use children’s literature books such as: Patterns in Peru, Two Of Everything, One Grain of Rice – how can tables help us to make sense of these patterns?   Guiding Questions:  How can the tables and charts help you discover the pattern?  How do tables help us make sense of the patterns in the stories? |
| **Can you represent expressions? (e.g., 4*n* + 2)**  Inviting and inspiring materials:   * Paper and writing tools * Manipulatives to create patterns (e.g., unifix cubes, tiles, counters, etc.)   Guiding Questions:  How might a table help?  Can you build a model? |

**Journal Prompts:**

A pattern is… Today I learned…

A pattern I created today… Can you record one of the patterns you created in your math journal?

I’m proud of… I wonder…

I’m thinking now… I tried…

I know I noticed…

This reminds me of… A connection I have…

**Which children’s literature books could be used as provocations:**

**Patterns in the World**

* I See A Pattern by Bruce Goldstone – patterns in nature and tessellations
* Patterns by Samantha Berger – Scholastic – patterns in animals, nature, flags, piano
* Spotty, Stripy, Swirly: What Are Patterns? By Jane Brocket – LOVE this one!
* Bees, Snails, and Peacock Tails by Betsy Franco
* Swirl by Swirl: Spirals in Nature by Joyce Sidman
* Mysterious Patterns: Finding Fractals in Nature by Sarah C. Campbell
* Patterns In Peru by Cindy Neuschwander

**Repeating Patterns**

* Busy, Busy, Busy by Haneul Ddang – food, necklaces, sounds, paintings
* A Pair of Socks by Stuart J. Murphy
* Beep Beep, Vroom Vroom by Stuart J. Murphy – cars, sounds
* And Then Comes Halloween (series including And Then Comes Christmas, And Then Comes Summer) by Tom Brenner – repeating story pattern “when and then”
* Sorting Through Spring – repeating patterns with multiple elements
* Spotty, Stripy, Swirly: What Are Patterns? By Jane Brocket – circular patterns, spotty patterns, vertical patterns – A MUST US!
* If You Give A Mouse series by Laura Joffe Numeroff – circular patterns
* It’s A Pattern by M.W. Penn
* Please Please the Bees by Gerald Kelley – Benedict the Bear does the same things day after day – repeating pattern
* -B-A-B-A A Book of Pattern Play by Brian P Clearly – labeling
* Math Counts: Pattern by Henry Arthur Pluckrose
* Pattern Bugs by Trudy Harris
* Pattern Fish by Trudy Harris

**Growing and Decreasing Patterns**

* There Was An Old Lady Series - growing
* A Frog in the Bog by Karma Wilson and Joan Rankin – growing
* Growing Patterns: Fibonacci Numbers in Nature by Sarah C. Campbell
* Pet the Cat and the Missing Cupcakes by Kimberley and James Dean – decreasing by two

**Patterns - Charts and Tables and Expressions**

* Two of Everything by Lily Toy Hong
* One Grain of Rice by Demi
* Anno’s Magic Seeds by Mitsumasa Anno

**Formative Assessment:**

**How will I document and communicate the students’ learning?**

* Photos and videos
* Student journals
* Performance based assessment
* Checklists – based on observations
* Anecdotal notes
* Conferences with individual students
* Screencasting apps such as ShowMe or Explain Everything

**Summative Assessment:**

* Revisiting the “Talking Points” only this time the students will write down

**How will I continue to support my students’ growing understanding of patterns throughout the year?**

* Weaving patterning explorations (e.g., any of the questions above with inviting materials) into Daily Math Investigations
* Exploring a rich problem that involves patterning
* Read a story and explore the math using a book about patterning
* Weekly Patterning Routines including:
  + - * + Guess My Rule
        + Notice/Wonder
        + What would come next?
        + Predict down the line
        + Which One Doesn’t Belong