



Investigating Patterns

a K-3 multi-lesson exploration

created by teachers in the
BC Reggio-Inspired Mathematics Project
for ShareEDBC
Summer 2020



created and compiled by teachers in the
BC Reggio-Inspired Mathematics Project

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Investigating Patterns – An Overview

Included in this collection are lessons that can be combined to create a focused unit of study or spread over the year to re-visit the concept of patterns.

This collection includes:

- an overview
- Reggio-Inspired principles and practices
- connections to the BC Mathematics Curriculum
- a collection of multi-grade lessons
- lessons include ideas for at-home, online and outdoor learning experiences and connections to grades 4&5 learning standards
- Appendix A: assessment tables
- Appendix B: recommended resources

As students investigate patterns, our goal is not only have students be able to describe, create, or extend different types of patterns, but to also be able to answer the question: *What is a pattern?*

Patterning is fundamental to the study of mathematics. Students will be looking for patterns throughout their years of education, and those experiences will become increasingly abstract. It is essential that students in the primary years have many experiences creating and describing patterns in the primary grades. In kindergarten & grade 1, students focus on repeating patterns with multiple elements, creating their own and building on and extending patterns created by others. They learn to “read” patterns and name the part of the pattern that repeats over and over. This is often called a stem or core of a repeating pattern and these are often labelled with letters such as ABB. The mathematical thinking students are doing is looking for regularities and beginning to make a generalization. In grades 2 & 3, students develop their understanding of increasing and decreasing patterns, using materials to create them and using numbers and words to describe them. In grades 4 & 5, students continue to create concrete increasing and decreasing patterns but also analyze pictorial representations of patterns and begin to use tables, charts and symbols to make connections between visual representations of patterns and the numbers that describe them.

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One way to develop an understanding of patterning is through investigations that are based on students' mathematical interests that honour where they are in their understanding. Inquiry-based learning experiences invite students to play with materials and ideas. These learning experiences are often named based on the intention of the experience – open questions, problems or tasks, explorations or invitations, provocation, and investigation or projects. Children need many opportunities over time to develop their understanding of patterns and to make connections across contexts, materials and representations.

The lessons included in this collection reflect an approach to the teaching and learning of mathematics that embeds inquiry and play elements that can be used across grades and provides a range of access and connection points.



BC Reggio-Inspired Mathematics Project

The BC Reggio-Inspired Mathematics Project is a collaborative professional inquiry involving teachers from several school districts in British Columbia. The project's goals are to bring teachers together from across districts, contexts and grades to think and learn together about how Reggio-Inspired principles and practices might enhance the teaching and learning of mathematics.

The Reggio Emilia Approach® is an approach to teaching and learning developed post-World War II in the northern Italy town of Reggio Emilia. It is an educational philosophy based on the image of a child with strong potentialities and competence, who learns through the hundred languages that is in all of us, and grows in community in relationship with others. In Reggio Emilia, this approach is enacted in infant, toddler and preschool and childcare centres as well as in one school-aged environment.

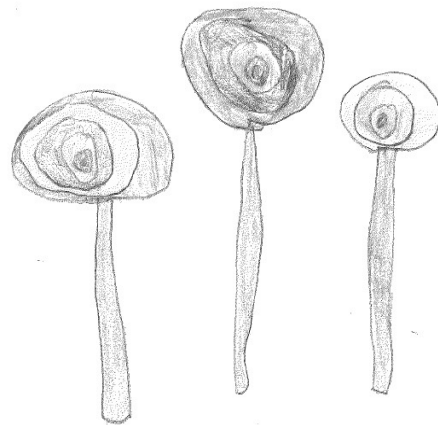
The following principles and practices inform and inspire our project:

Reggio Emilia education philosophy and principles:

- developed by Loris Malaguzzi and the parents and educators in the community
- viewing the child as capable, competent and having rights – that the child has a hundred or more languages to express ideas
- environment as third teacher, encounters with materials
- pedagogy of listening
- honours children's thinking
- responsive, emergent curriculum
- socially constructed learning, collaborative, in community
- importance of relationships

Reggio-inspired practices:

- the 100 languages of children
- connectedness
 - culture, community, environment
- the environment as third teacher
- emergent curriculum
- inquiry-based
- loose parts & natural materials
- interdisciplinary projects/investigations
- documentation
 - teacher as researcher
 - making learning visible



BC Mathematics Curriculum Connections

BC Mathematics Big Idea:

We use patterns to represent identified regularities and to make generalizations.

Questions to inspire student inquiry:

What makes a pattern a pattern?

What different patterns can you make with these materials?

How are these patterns alike? different?

Where do you see patterns in the world around you?

How could you make a pattern with just one colour of cube?

How are patterns and numbers connected?

BC Mathematics Curricular Content:

- repeating patterns with two or three elements (Kindergarten)
- repeating patterns with multiple elements and attributes (grade 1)
- repeating and increasing patterns (grade 2)
- increasing and decreasing patterns (grade 3)
- pattern rules using words and numbers, based on concrete experiences (grade 3)
- increasing and decreasing patterns using tables and charts (grade 4)
- rules for increasing and decreasing patterns using words, numbers, symbols and variables (grade 5)

BC Mathematics Curricular Competencies:

Although many mathematics curricular competencies will develop through these learning experiences, we have choose the following three curricular competencies to focus on:

- use reasoning to explore and make connections
- represent mathematical ideas in concrete, pictorial and symbolic forms
- connect mathematical concepts to each other and to other areas and personal interests

Core Competencies

Core competencies that will be focused on during these lessons include Communication, Collaboration and Creative Thinking.

First Peoples Principles of Learning

Many of these learning experiences aim to be holistic and interdisciplinary in nature. We have hoped to enact the following principle in our planning:

"Learning is holistic, reflexive, reflective, experiential, and relational (focused on connectedness, on reciprocal relationships, and a sense of place)."

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Exploring and Creating Patterns

The following experiences with pattern are opportunities to play with patterns and investigate the repeating part of a pattern. There are opportunities for the whole class, small groups, partners and individuals to explore patterns.

It is important to consider giving students time to play with materials and ideas before starting more focused explorations. This is especially important when materials are new and the ideas being explored are new. Children often naturally create patterns when working with materials. As you walk around observing student's explorations, notice and name the patterns you see. Ask questions to provoke their thinking about patterns.

Learning Intentions:

- Students will be able to explore and create repeating patterns with two or three elements.
- Students will be able to create patterns using a variety of materials.
- Students will be able to represent mathematical ideas in concrete, pictorial and symbolic forms.

Materials:

1. A variety of loose parts for making patterns – bread tags, rocks, buttons, keys.
2. Mats for students to work on – strips of paper, pieces of felt.
3. Paper, pencils and crayons.

Reggio-Inspired Principles and Practices:

- loose parts and natural materials
- emergent curriculum
- co-constructed learning

Lesson Flow:

The following parts of this lesson can be done on separate days to start explorations. To continue explorations of patterns, they can be done separately or in combination of 2 or 3 parts. Following your students' level of engagement, these pattern experiences can be from 20 to 45 minutes.

Part A

Gather on the carpet in a circle. Have a collection of loose parts separated into bowls, baskets or containers. Start creating a pattern in the middle of the carpet then pause.

What do you notice? What do you wonder?

What might come next? What could come before?

Cover a part of the pattern and ask: *What could be covered?*

Create a few patterns in this way.

Invite students to extend, copy and create patterns with materials of their choosing.

Part B

Invite students to work in partners to create patterns together – give each partner a mat and let them choose a collection of materials (such as a paper strip and a tea can full of loose parts). Students can trade their chosen material for another when they want to explore patterns with a different material.



Pause during explorations and walk around to look at each other's patterns. Provoke students' mathematical thinking with prompts such as: *What do you notice? What do you wonder? Can you find a pattern that is like yours? Can you find a pattern that inspires you to think of something new to try?*

Part C

Set out a variety of carefully chosen materials and invite children to explore and create patterns on their own. Choose materials to support learning intentions and nudge students' thinking.

For example:

- two or three colours of a material separated by colour in bowls/baskets – supporting creation of 2 and 3 part patterns
- loose parts of one colour – nudge thinking about patterns beyond colour patterns
- mats to work on – different shaped mats chosen to inspire different thinking about patterns (strips, circles, squares)
- lines drawn on paper to create patterns on top of – zig zag, spiral, grids
- provide different surfaces for explorations – table, floor, easel, magnetic white board
- change materials to sustain interest and provide new inspirations – seasonal children's rings and wooden spoons, scrabble letter trays to hold materials, beads and string/pipe cleaners



Bring the students together to share and reflect on their pattern explorations. Project a photo of a student's pattern or have them bring their pattern to the meeting area. Invite the students to share with the group about their pattern.

Can you read your pattern for us?

Can someone show us what the core of this pattern is?(What is the chunk that repeats?)

Did anyone make a pattern that is the same as this one? How is it the same?

Did anyone use these same materials to make a pattern that is different? How is it different?

To consolidate students' experiences and learning, ask students to turn and talk with a partner about this question:




What did you learn about patterns today?

After students have had many opportunities to explore patterns using concrete materials, invite them to record their pattern pictorially.



Grade 4/5 Connections:

Encourage students to demonstrate their understanding of repeating patterns by using words, numbers, and symbols. Have students create repeating patterns using polygons or create repeating patterns considering line symmetry.

At-Home Learning	<p>Can you find a pattern on something in your home? Have students go on a pattern hunt and bring something back to share with the class such as a pillow or tea towel.</p> <p>Have students use materials from home to create patterns. Students can use a collection of loose parts gathered for home learning such as blocks, lids, and materials gathered from their backyard.</p> <p>How can you share your patterns with others? (draw a picture, take a photo)</p> 
Online Learning	<p>Students can use virtual manipulatives such as these pattern blocks to create patterns. https://apps.mathlearningcenter.org/pattern-shapes/ Students can take a screen shot or draw a picture to share their pattern creations through email or posting to an e-portfolio.</p>
Outdoors Learning	<p>What patterns live outside? Go for a walk through your school yard or neighbourhood and look for patterns. Encourage students to look for both patterns in nature and human-made patterns. Take photos so that you are able to revisit the patterns found - create a class book, slideshow, use for provocations. You could look for patterns that live on your playground one day, patterns that live in your school garden another day.</p>   <p>Encourage students to gather found materials and create patterns – rocks, leaves, sticks, woodchips. You can bring a collection of found objects from nature back inside to continue explorations.</p>

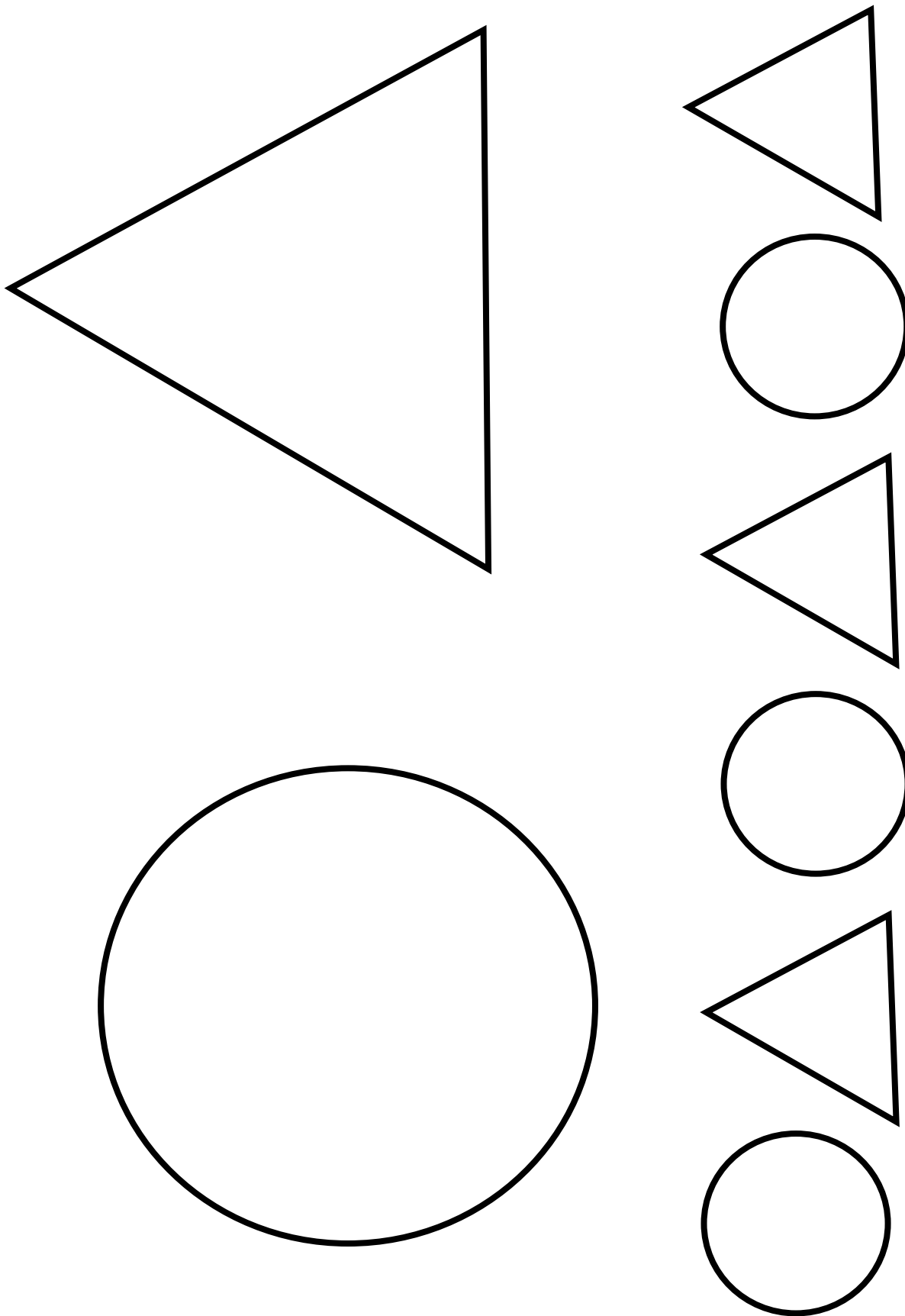
Resources:

- [A Pattern for Pepper](#) by Julie Krawlis

Assessment Questions:

- *Are students able to copy, extend and create patterns with two or three elements?*
- *Are students able to represent repeating patterns using a variety of materials?*

Place a set of objects in the large circle and a different set of objects in the large triangle.
Follow the circle and triangle guide to make an AB pattern.



Can you find the core?

Prior to this lesson, students will have had many opportunities to explore patterns with a variety of materials. They have explored copying, extending and creating patterns. Students have begun thinking about the core of the pattern (sometimes referred to as the stem or repeating unit) as the class has been composing and decomposing patterns together. What is the “chunk” of the pattern that repeats? Students will have had some experience in a group labeling the pattern core with letters such as, AB, ABC and ABB. This lesson will take about an hour if all parts of the lesson are done together or it can be broken into time periods for Parts A&B and then C&D.

Learning Intentions:

- Students will be able to create repeating patterns with two or three elements.
- Students will be able to identify the core of their repeating pattern.
- Students will be able to represent mathematical ideas in concrete, pictorial and symbolic forms.

Reggio-Inspired Principles and Practices:

- loose parts and natural materials
- honours children's thinking
- co-constructed learning

Materials:

- Digital photos of student made patterns showing pattern cores of 2 or 3 elements such as AB, ABC and ABB.
- A variety of loose parts for making patterns – bread tags, rocks, buttons, keys.
- Mats for students to work on – strips of paper, pieces of felt.
- Small cards with label of possible pattern cores such as AB, ABC and ABB. Blank cards for students to create their own labels.
- Paper, pencils and crayons.

Lesson Flow:

Part A

Project a digital photo of a student pattern. Provoke students' mathematical thinking with questions such as: What is the core of the pattern? How many parts/elements are in the core? How can we “read” this pattern using letters? Have students move so that the group is seated in a circle and place a collection of loose parts in the middle. Invite students to come to the middle of the circle, choose a label such as ABC and create an ABC pattern using loose parts.

Part B

Invite students to work together in partners. Have partners choose a label and a set of loose parts to create their pattern with.

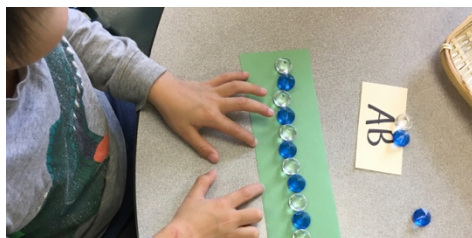
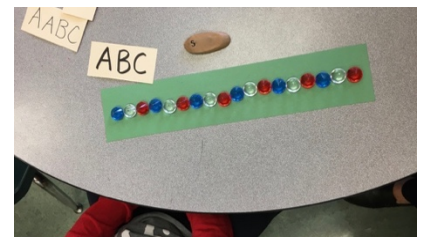
Students can trade in their label card and/or their set of loose parts to explore creating different kinds of patterns.



Pause during explorations and walk around to look at each other's patterns. Can you find a pattern with different materials that has the same label as yours?

Part C

Set out a variety of loose parts for students to choose from to create their own patterns. Invite students to label their pattern core with a pre-made label card or to make their own label card for their pattern core.



Some students may want to start by placing loose parts on top of the pattern core label before creating an extended repeating pattern with the materials.

Invite students to make a record of their patterns by taking a photo. Some students may be ready to draw a representation of their pattern. If students are able to take a photo of their pattern with an iPad, they can use the Markup option in edit photos to label their pattern.



Part D

Bring students together to share and reflect on their pattern core labeling explorations.

Project a photo of a student's pattern. (ABC)

Invite students to read the pattern using words to describe the 2 or 3 elements in the core of the pattern. (red, blue, yellow)

Invite students to turn and share with a partner another way that you could make an ABC pattern with these materials. (blue, red, yellow)

Grade 4/5 Connections:

Encourage students to demonstrate their understanding of repeating patterns by using words, numbers, and symbols. Have students create repeating patterns using polygons or create repeating patterns considering line symmetry. Students can make math-to-math connections by exploring concepts of area and perimeter through patterning (such a floor tiles, carpet design), with considering art elements and design.

At-Home Learning	This lesson can be done during home learning by having students create pattern core cards and using their collection of loose parts at home to make patterns. Students can make a record of their pattern by taking a photo or drawing a picture to represent their pattern.
Online Learning	Students can use virtual manipulatives such as these pattern blocks to create patterns. https://apps.mathlearningcenter.org/pattern-shapes/ Students can take a screen shot or draw a picture to share their patterns through email or posting to an e-portfolio.
Outdoors Learning	Students can gather found materials outside to make patterns. The label cards for pattern cores can be taken outside. Students can also label their patterns by creating their patterns on pavement and labeling their pattern using sidewalk chalk.

Resources:

1. [Beep Beep, Vroom Vroom](#) by Stuart J. Murphy
2. [Pattern Bugs](#) by Trudy Harris

Assessment Questions:

- Are students able to identify the core of a pattern they have created?
- Are students able to create a pattern following a given label for a pattern core such as AB, ABC or ABB?

Can you make an AB pattern?

Can you make an ABC pattern?

Can you make an AAB pattern?

Can you make an ABB pattern?

Growth Patterns

An increasing or growth pattern is when one of the elements in the core of the pattern increases with each iteration. After students have experienced multiple opportunities exploring and representing simple repeating patterns, they can begin experimenting with growth patterns. By using the picture book, *Swirl* by Joyce Sidman, students can discuss how patterns can increase and realize that there's regularity and predictability to growth patterns, just as there is with repeating patterns. This lesson can be done in a single day but can also be extended to allow for further inquiry and investigations.

Learning Intentions:

- Students will be able to demonstrate an understanding of increasing patterns using manipulatives, sounds, actions and numbers
- Students will use reasoning to explore with increasing patterns and make connections with other mathematical concepts, such as simple repeating patterns
- Students will be able to represent increasing patterns in concrete, pictorial and symbolic forms

Reggio-Inspired Principles and Practices:

- connectedness to environment
- facilitating explorations and co-constructing knowledge with students

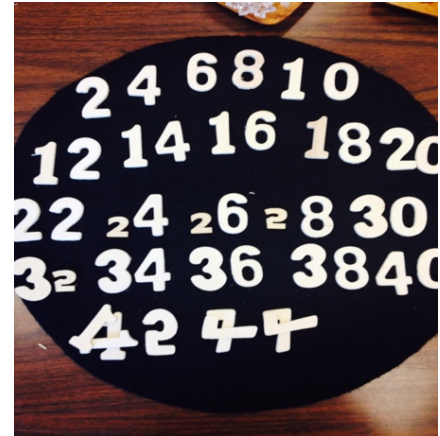
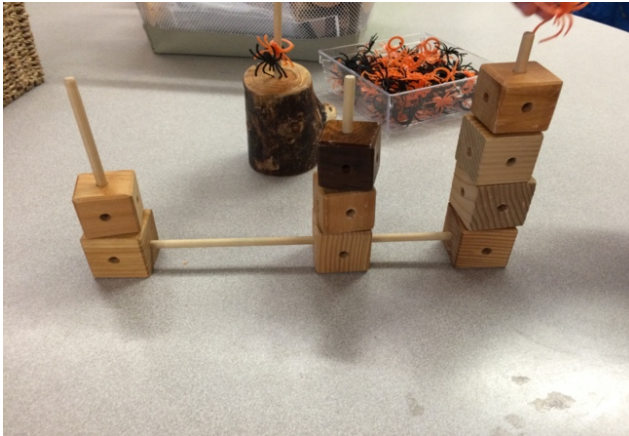
Materials:

- Loose parts could include number tiles, blocks, Cuisenaire rods, gems, rocks, other natural materials.
- Whiteboard or chalkboard and markers
- *Swirl by Swirl, Spirals in Nature*, by Joyce Sidman.
- Patterning recording sheets

Lesson Flow:

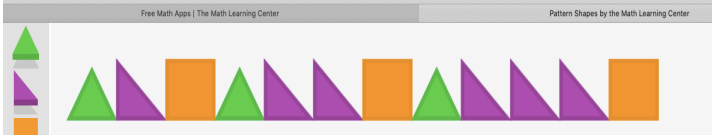

1. Introduce growth patterns with numbers by using the Choral Counting routine as a whole class. Orally chant a "skipcounting" pattern such as counting by 5s and record it in written form. After counting, ask students to notice and describe the patterns they see.
2. Read excerpts from *Swirl by Swirl* by Joyce Sidman. Discuss and brainstorm the many different ways that patterns can grow. Provide exploration time with a variety of loose parts at tables, carpet, or other designated learning areas.
3. Student discussion may be related to questions, such as: How do you know it's a growth pattern vs. repeating pattern? Can you show and/or explain the difference? Provide students with a patterning mat or recording sheet to organize the two types of patterns.

- Debrief the lesson by using the routine Same or Different with examples from the students' recording sheets. How is Student A's repeating pattern the same/different than their growth pattern? How is Student B's growth pattern the same/different from Student C's?



Grade 4/5 Ideas:

Encourage students to demonstrate their understanding of the rules for increasing patterns by using words, numbers, symbols, and variables.

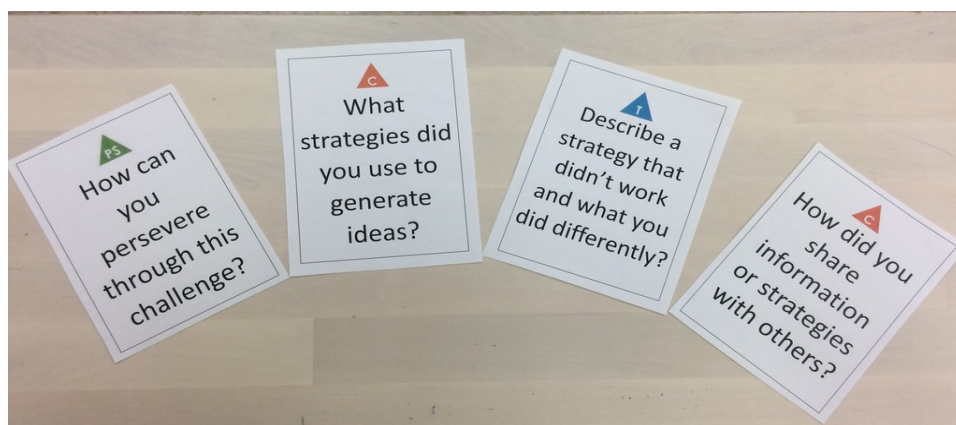
At-Home Learning	Through video conferencing or creating a video or audio file to share with their classmates and teacher, students can share their understanding of growing patterns by creating an example using sounds (e.g., their voice, an instrument at home, or using found materials such as a spoon and table).
Online Learning	<p>Students can use online manipulatives such as https://apps.mathlearningcenter.org/pattern-shapes/ to create a growth pattern.</p> 
Outdoors Learning	<p>Encourage students to discover growing patterns in nature such as snails, ferns, or flowers. Students can draw a picture in their nature journal or take a photo to share with peers and teacher.</p> 

Resources:

- 1) Choral Counting Routine (<https://tedd.org/choral-counting/>)
- 2) Same but Different Routine (<https://www.samebutdifferentmath.com/about>)

Assessment Questions:

- Are students able to successfully demonstrate an understanding of increasing patterns using manipulatives, sounds, actions and numbers?
- Can students effectively represent increasing patterns in concrete, pictorial and symbolic forms?



Students can use Core Competencies self-assessment prompts to reflect on their learning and set goals for what is next with their learning.

Growth Patterns

Can you show a repeating pattern?

Can you show a growth pattern?

How are they the same? different?

Where Do We See Patterns in the World?

Our world is full of patterns. There are patterns in the clothes we wear, the buildings we live in, the games we play and the music we listen to. This investigation could be used to conclude a patterning inquiry (after the children have had an opportunity to identify, extend, label and create different kinds of patterns). Over the course of a week, the students could choose different areas to investigate. They will be able to demonstrate their understanding while engaging with patterns they see all around them.

Learning Intentions:

- The students will be able to identify, create and extend different repeating, increasing and decreasing patterns that occur in the world around them.
- The students will be able to connect mathematical concepts to each other and to areas of personal interests.

Lesson Flow and Materials:

1. As a class, brainstorm different places we see patterns in the world. The teacher could record these ideas on chart paper.
2. In the following days, based on the responses from the students, the teacher could provide invitations and provocations that would allow children to explore, investigate, research, identify, create and engage with patterns they see in the world around them, choosing materials to further nudge their mathematical thinking.

Reggio-Inspired Principles and Practices:

- environment as the third teacher
- responsive, emergent curriculum, socially constructed
- connectedness to community and environment

Some examples of different invitations or provocations:

What patterns live in music?

- a selection of musical instruments
 - paper and pencils
 - sheet music
 - Google image of the value and symbols of different musical notes (whole notes, half notes, quarter notes)
- Online Tools: piano puppet, composer or music maker using the online tool at toytheater.com

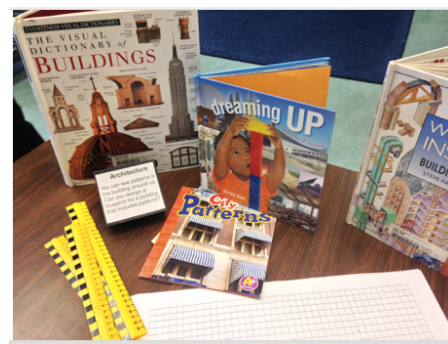


What patterns live in buildings and architecture?

- Google images of different tile or brick patterns
- books about different architecture or buildings
- graph paper and rulers
- blocks and building materials

Online Tools:

Students could draw or construct building designs using the different shapes on mathigon.org.



What patterns live in textile art and jewelry?

- Google images of different jewelry
- fabric
- yarn, thread, needles
- beads
- wire

What patterns live in the games and sports we play?

- books about different sports and games
- paper and pencils
- technology to use as a research tool



Grades 4&5 Connections:

The student could use words and numbers to describe their repeating, increasing and decreasing patterns. They could also record their patterns in charts or tables.

At-Home Learning	On an online platform, each day the teacher could share a different questions or area of investigation around patterns in the world (i.e. one day could be what patterns live in music). Together the students could brainstorm mini-projects or ways to explore the focus for each day.
Online Learning	<p><u>Here are some videos that will provide students with images of patterns that can be found in the world:</u></p> <p>https://www.youtube.com/watch?v=x7BwZpsdzYw</p> <p>https://www.youtube.com/watch?v=E1e6rovSgsM</p> <p>For exploring patterns in music: piano puppet, composer or music maker using the online tool toytheater.com.</p> <p>For exploring patterns in architecture: Students could construct building designs using the different shapes on mathigon.org.</p>
Outdoor Learning	Students could go outside and take photos of patterns they see in nature and in the man-made structures around them. Students could create photo collages, photo books or video of the patterns they find in the world.

Resources:

Spotty, Stripy, Swirly: What are Patterns? by Jane Brocket (picture book)
Flow, Spin, Grow: Looking for Patterns in Nature by Patchen Barss (picture book)
Growing Patterns: Fibonacci Numbers in Nature by Sarah Campbell (picture book)

Assessment:

- *Are the students able to successfully identify, create and extend different repeating, increasing or decreasing patterns that occur in the world around them?*
- *Are the students able to effectively communicate how different math concepts are connected?*

Patterns in the World

Using pictures, numbers, words, and/or symbols can you describe the different patterns you investigated in the world around you?

What Patterns Live in Mandalas?

A mandala is a circular geometric design that is important in many Asian cultures. Mandalas are created using different shapes and patterns around a single central point. This lesson focuses on providing the students with the opportunity to see patterns that live in the artwork of different cultures. Students will identify, explore and create different kinds of patterns in the creation of their own mandalas. This lesson could be completed in a single day.

Learning Intentions:

- Students will be able to represent mathematical ideas concretely, pictorially and symbolically.
- Students will be able to create repeating patterns or increasing/decreasing patterns.
- Students will be able to identify the core of their repeating pattern (e.g., the part of the pattern that repeats over and over) or the rule of their increasing/decreasing pattern.

Reggio-Inspired Principles and Practices:

- loose parts and natural materials
- connectedness
- honouring children's thinking

Materials:

1. Google images of mandalas
2. Different materials to create mandalas (i.e. pattern blocks, cuisenaire rods, buttons, shells, mirrors, gems etc.)
3. Art materials such as paint, pencil crayons, or chalk.

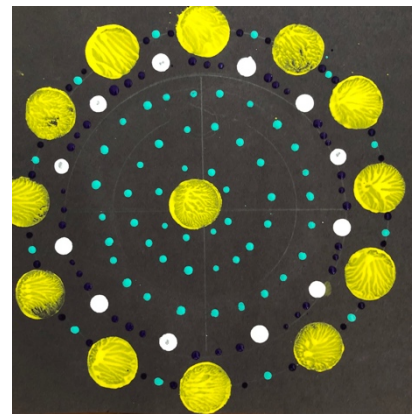
Lesson Flow:

1. Begin by sharing with the students different google images of mandalas. Ask the questions: What do you notice? What do you wonder? What shapes or patterns do you see? Depending on the grade of the students, invite them to look closely at the different patterns (repeating, circular, increasing, decreasing). Have the students label the patterns and their cores. Invite students to look closely for symmetry. Are the designs symmetrical? Where are the lines of symmetry?
2. Provide students with different materials (pattern blocks, Cuisenaire rods, buttons, shells, mirrors, gems etc.). Ask the questions: *How can you use these materials to create your own mandala? What shapes and patterns will you use? Will your design be symmetrical?*



3. Create a gallery in either a physical or virtual space, where students can share their creations. Have the students record and label the different patterns/cores they have created.

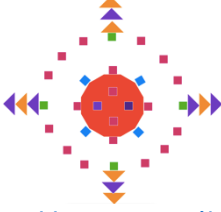
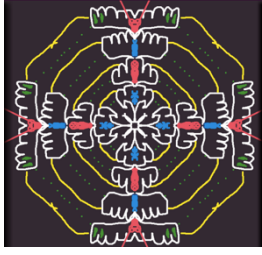

*As an extension, have the student use different art materials to create mandalas.



*As an extension, the class could investigate the artwork of Musqueam artist, Susan Point. *How are the spindle whorls similar to mandalas? How are they different?*

Grades 4/5 Connections:

After creating their mandalas, the student could use words and numbers to describe their increasing and decreasing patterns. They could also record their patterns in charts or tables.

At-Home Learning	<p>This lesson can be adapted to at home learning. On an online platform, the images and beginning discussion could take place or an email or blog post could be send to students with images and questions to think about. Invite the students to use materials found in their homes to create their mandalas (Lego, blocks, crayons, coins, cutlery or art materials).</p>
Online Learning	<p>Students could use virtual manipulatives to create their mandalas. https://mathigon.org/polypad</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p>https://community.gethopscotch.com/projects/xigxd7gv9</p>
Outdoor Learning	<p>Students could be invited to make mandalas outside using natural materials.</p> 

Resources:

The picture book, *Anywhere Artist*, by Nikki Slade Robinson could be used to inspire children to use natural objects to create math art.

Assessment Questions:

Are students able to successfully identify, create and label their patterns and cores?

Are students able to effectively communicate their understanding of patterns concretely, pictorially and symbolically?

Patterns in Mandalas

Using pictures, numbers, words, and/or symbols can you describe the different patterns you created in your mandala?

Pattern Talks

Pattern Talks build on the discourse agreements and thinking developed during similar instructional routines such as number talks and Which One Doesn't Belong. Pattern Talks, once established as an instructional routine, can be used as a short 5-10 minute introduction to a lesson, for small group instruction or as a full lesson with extensions to the pattern talk. An example of a full lesson (45-60 minutes) is included here.

Learning Intentions:

- Students will be able to describe, complete or extend repeating patterns or increasing/decreasing patterns.
- Students will be able to think about alternative solutions to a pattern problem.
- Students will be able to generalize the pattern "rule" found in a pattern and explain it orally, with materials or pictures.

Reggio-Inspired Principles and Practices:

- honouring children's thinking
- responsive
- use of materials

Materials:

- 1) Pattern Talk images: shared as a projected slide, printed and posted in large enough format for students to see, or created with magnets or drawn on a whiteboard/chalkboard
- 2) Markers to annotate Pattern Talk image
- 3) Concrete materials for students to create their own patterns with, such as gems, blocks, cubes, rocks, etc

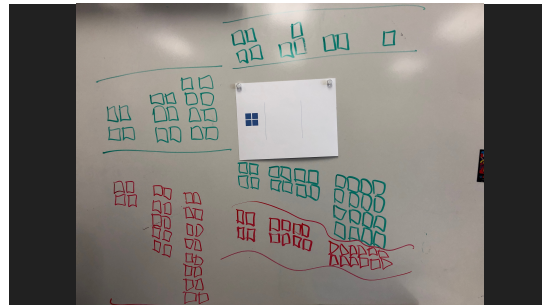
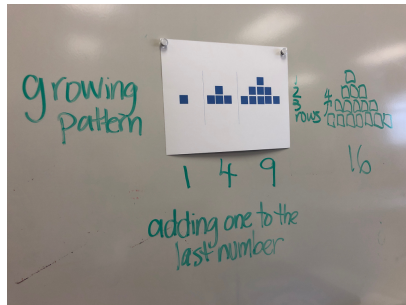
Lesson Flow:

Part A

- 1) Present a Pattern Talk image to the students. Ask them: What do you notice? and either have them turn and talk with a partner or share their ideas to the whole group, with the teacher recording their ideas to make them visible to others. This introduction to the pattern should focus on observable attributes – colours, shapes, quantity, change in quantity.
- 2) Ask students to consider:
 - a. What could come next?
 - b. What could come before?
 - c. What could come in-between?
(depending on image presented)
- 3) Have students share their ideas and their explanation/reasoning for their

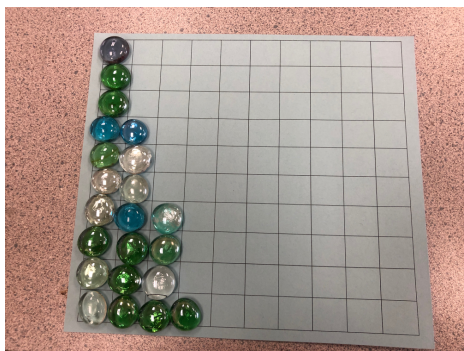
solution. What is the pattern “rule”? Continue to ask for more possibilities, asking: “What is a different idea someone has?”

- 4) Discuss the possibilities shared by the students. Is there one solution that is more likely? Are all the suggestions possible? How are they the same? How are they different?



Part B

- 1) Invite students to create a Pattern Talk image using materials or drawings. Students can choose to have a “missing part” after, before or in the middle of their pattern. An open grid can be provided as a structure to support mathematical thinking.
- 2) The patterns created can be shared by having the students do a gallery walk to see and think about each others' patterns.
- 3) Have students take photographs of their concrete patterns or represent them with pictorial images for use in future Pattern Talks.
- 4) Children may include number or word labels to their patterns using materials or whiteboards.



Grades 4&5 Ideas:

Focus on increasing and decreasing patterns, looking for the relationship or “pattern rule” within the pattern. For each Pattern Talk, co-construct a table or chart with the students to show the term number (ordered part of the pattern) and the quantity of elements in that term (for example, number of blocks used).

At-Home Learning	<p>Teachers can share a Pattern Talk image during small group or whole class online video conferencing for student to discuss.</p> <p>A Pattern Talk image can be posted to the class blog/website/portfolio for students to respond to or included in a weekly math plan or email.</p> <p>Printable recording sheets for students to draw, describe and label patterns are included here.</p>
Online Learning	<p>Create and share patterns using virtual manipulatives such as: https://www.mathlearningcenter.org/resources/apps or https://www.didax.com/math/virtual-manipulatives.html</p> <p>Students can post responses to a class blog or e-portfolios.</p>
Outdoors Learning	<p>Encourage children to find materials outdoors that they can create concrete representations of repeating, increasing or decreasing patterns with such as cones, rocks, shells, leaves, flowers, or sticks. Children can create a Pattern Talk image with materials to discuss with a partner or in small groups.</p> <p>Use sidewalk chalk on concrete surfaces outdoors to create Pattern Talks for students.</p>



Resources:

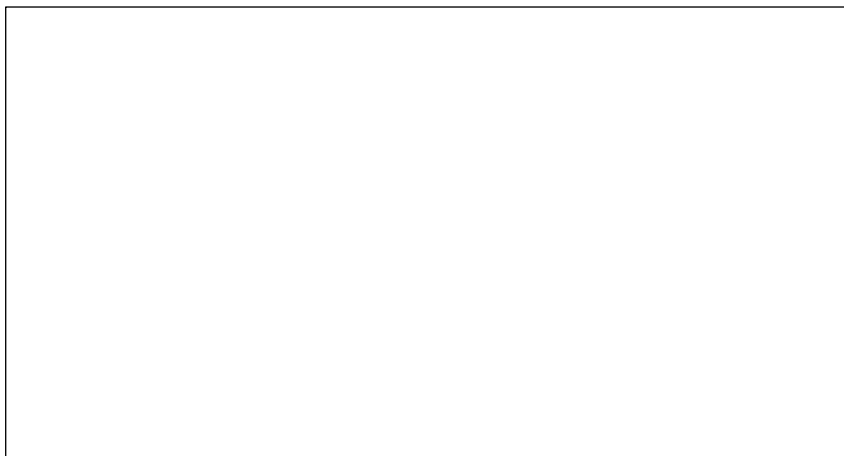
- 1) A collection of Pattern Talks images are included in Appendix C.
- 2) Fawn Nguyens' website: visualpatterns.org
- 3) The idea for Pattern Talks is inspired by Michael Fenton.

Assessment Questions:

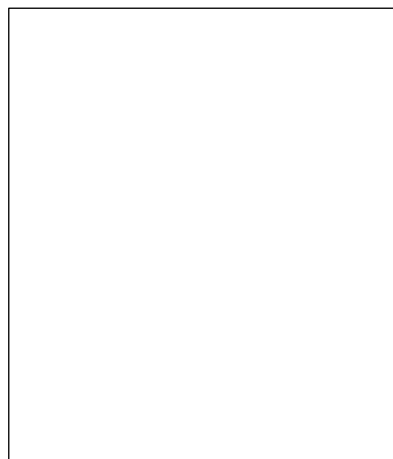
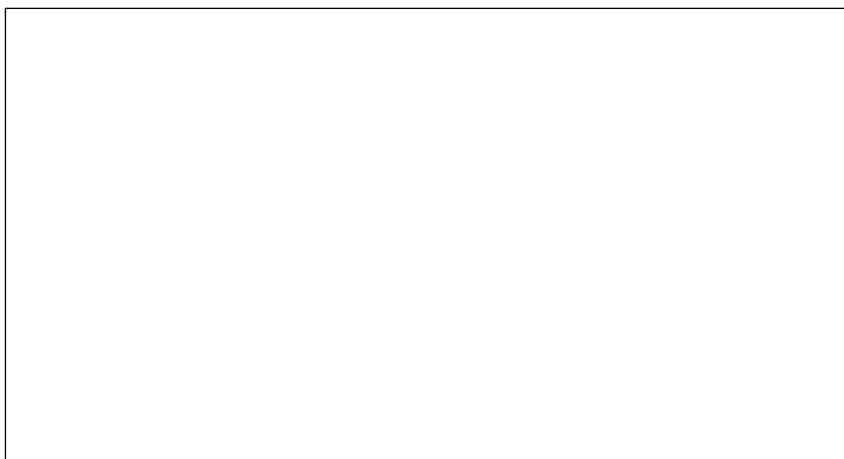
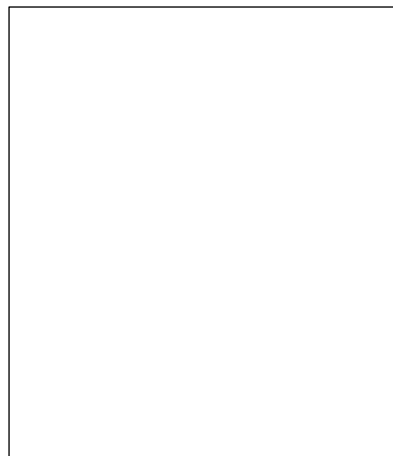
- Are students able to successfully demonstrate their understanding of grade-level mathematics content through concrete, pictorial or symbolic forms?
- Are students able to effectively use mathematical language and vocabulary to engage in mathematical discourse about patterns and share their reasoning and thinking?

Pattern Talks

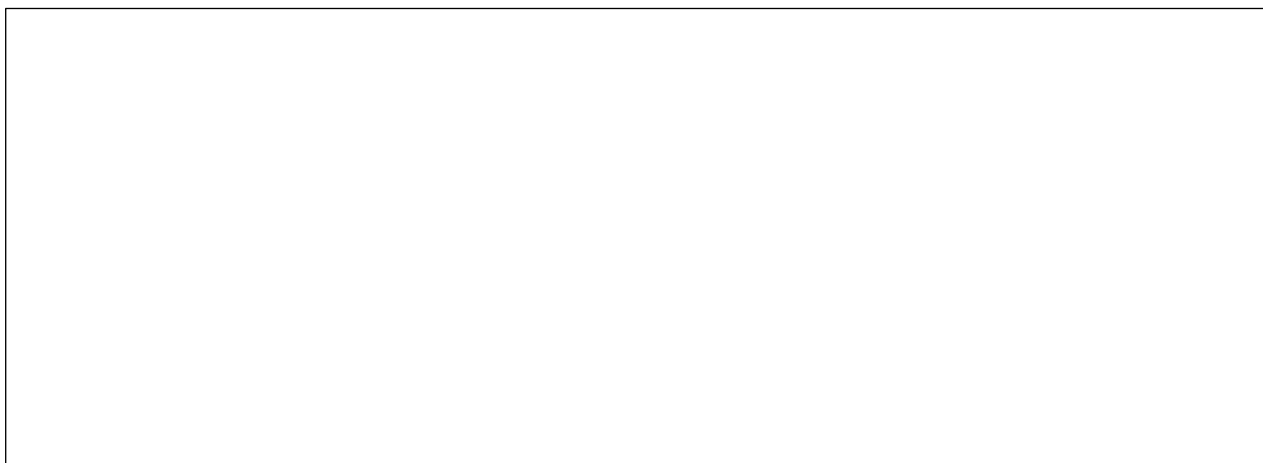
Draw a pattern:



What come next?



Draw a pattern with a missing part in the middle:



Pattern Talks

	<p>What do you notice?</p>
<p>What could come next?</p>	<p>What's another way to think about what could come next?</p>

	<p>What do you notice?</p>
<p>What could come in-between?</p>	<p>What's another way to think about what could come in-between?</p>

Create your own pattern:

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Positional Patterns

After many experiences with creating, extending and describing simple repeating patterns, encourage deepening students' understanding of patterning to include elements of spatial reasoning, like positioning and directionality. Invite students to consider: Is it possible to create a complex repeating pattern using only one type of material or manipulative? Gather materials and consider how to use rotation and positioning to create positional patterns.

Learning Intentions:

- Students will be able to describe, complete or extend complex repeating patterns, such as positional patterns, making connections to their understanding of simple repeating patterns.
- Students will be able to use manipulatives to create positional patterns and identify the core of the complex repeating patterns, representing their understanding in concrete, pictorial and symbolic forms.

Reggio-Inspired Principles and Practices:

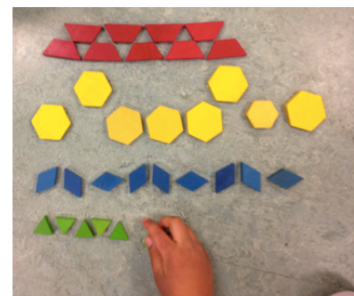
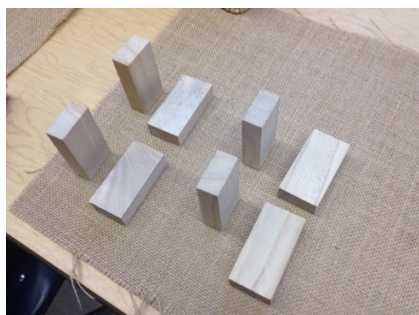
- choice
- connectedness to community
- environment as the third teacher

Materials:

- Positional pattern images drawn up on a whiteboard or chalkboard (e.g., using one colour marker to create a positional pattern)
- Writing utensils for students to label their patterns on paper or whiteboard
- Concrete materials for students to create their own patterns with, such as blocks, keys, collage / art materials, etc.

Lesson Flow:

1. Present students with materials that cannot be used to make a pattern that focuses on colour attributes. Examples of materials include a bowl of similarly sized wooden blocks or keys. Invite students to investigate how they can use these materials to create patterns. Allow enough time for students to explore with the materials. Encourage a gallery walk part way through the exploration time so that students can share ideas with one another (either by walking around the classroom, or the teacher can take photos and share them on a projector, smartboard, etc).
2. Invite students together to debrief to reflect on their experience using materials in different ways. Discussion may centre around questions such as: How has their understanding of patterning changed? or What other materials can we use to create positional patterns?



Grade 4/5 Ideas:

Encourage students to represent their positional patterns in a chart, table or graph, using words and numbers to describe their patterns.

At-Home Learning	Through video conferencing, blog or e-portfolio, teachers can have small group or large group discussion about using one material to create a positional pattern. Students can create their own patterns using materials they find at home and upload a picture or drawing onto an online platform to share with the teacher.
Online Learning	Create positional patterns using online tools such as: https://toytheater.com/category/teacher-tools/virtual-manipulatives/ Students can share with peers and teacher using their online platform, such as an e-portfolio.
Outdoors Learning	Allow time for students to collect natural materials found on the school grounds that they can use to create a positional pattern. Students can use sidewalk chalk or a clipboard to represent and describe their pattern.

Resources:

Fawn Nguyens' website: visualpatterns.org

Nature Patterning Video: <https://youtu.be/k4bp0YI5Df8>

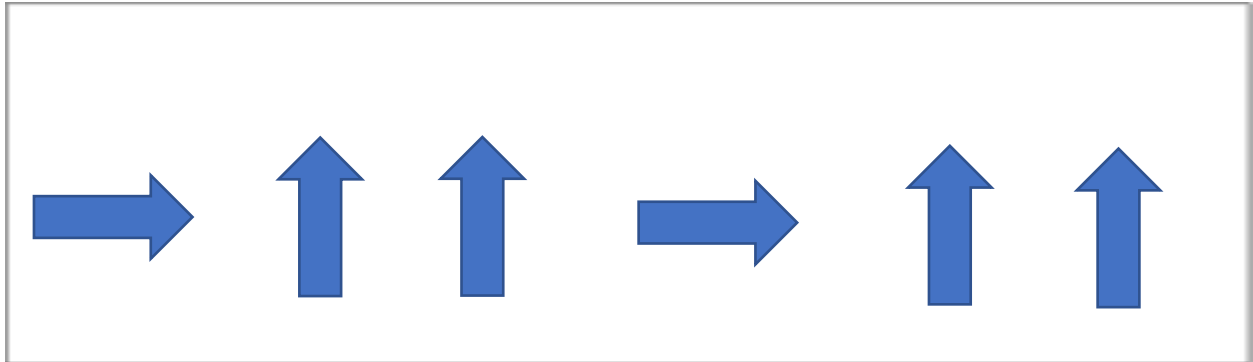
Positional Patterning Video: https://youtu.be/yFmlG_9Q0wc

Assessment Questions:

- Are students able to successfully describe, create and extend a positional pattern in concrete, symbolic and pictorial forms?
- Are students able to effectively use a variety of manipulatives to explore and make connections with complex patterns?

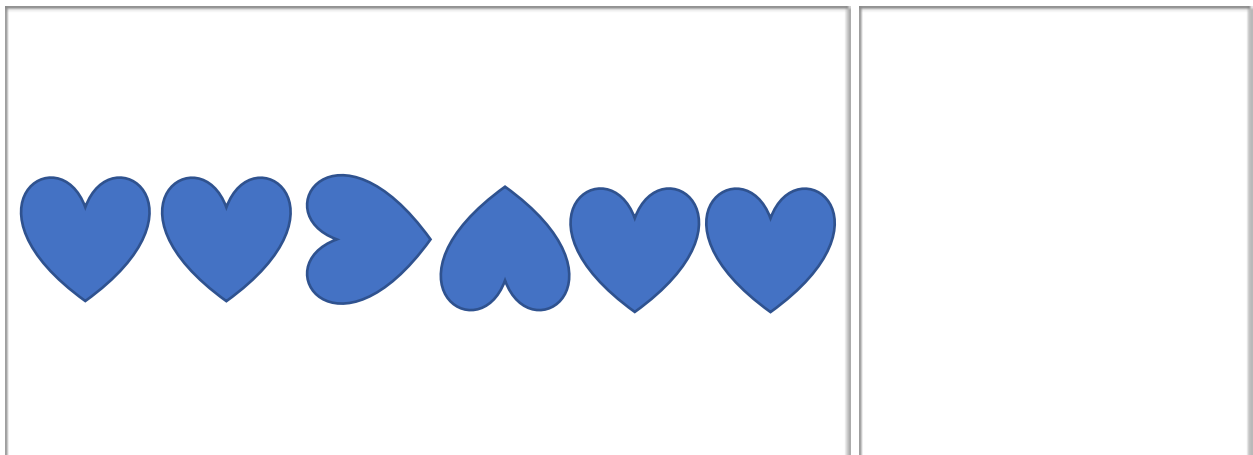
Positional Patterns

What do you notice?



What do you notice?

What comes next?



Draw a positional pattern:

Appendix A: Assessment of Student Learning

In each lesson on the previous pages of this collection, there are two to three formative assessment prompts for teachers to reflect on, to inform their planning.

In this Appendix, there is a proficiency assessment table for each grade level, specific to the areas of focus for this collection of lessons.

There are three parts to each proficiency assessment table:

- 1) In each table the grade level mathematics learning standards, both curricular content and curricular competencies, are included.
- 2) There are indicators of proficiency that include both content and competencies. Please note that all indicators may not apply to all lessons. These statements what a student is able to do if they are proficient in this area of mathematics for their grade level.
- 3) There is a student learning story which describes a learning engagement from one of the lessons, including some or all of the following: the students' observable actions, conversations the teacher had with the student and a product, drawing or creation from the student.

The purpose of the proficiency table is to be able to provide information for teachers to create a class profile of where their students are in their learning, in relation to the goal of reaching proficiency in regards to the learning standards. The indicators of proficiency can also be used to provide feedback to students and to support their engagement in setting learning goals.

Indicators of proficiency and learning stories were developed through observations, interviews and collection of work samples with students of teachers in our project.

Kindergarten

Kindergarten Learning Standards	Indicators of Proficiency
<p>Content:</p> <ul style="list-style-type: none"> repeating patterns with two or three elements <p>Competencies:</p> <ul style="list-style-type: none"> use reasoning to explore and make connections represent mathematical ideas in concrete, pictorial and symbolic forms connect mathematical concepts to each other and to other areas and personal interests 	<p>A student can create and describe a repeating pattern with two or three elements. A student may use AB labelling to “read” and describe the pattern.</p> <p>A student can create a repeating with concrete materials and draw a representation of the pattern.</p> <p>A student can demonstrate reasoning by successfully responding and explaining their response to the question: What comes next? when presented with a simple repeating pattern.</p> <p>A student can make connections by finding and describing patterns in the world around them.</p>

Student Learning Story:

A kindergarten student joins their class outside to find and choose materials to create patterns with. The student collects several materials and then lays them out on their classroom patio, creating a simple repeating pattern. The teacher visits the student and asks them to describe their pattern.

Student: “I used leaves and rocks and pinecones and berries. It’s an ABB pattern. See...ABB, ABB, ABB and more. It’s always two berries with other stuff.”


Teacher: “What would come next?”

Student: “Two more berries after the rock.”



After the teacher has taken a photo of the student’s pattern for their e-portfolio, the student then uses their clipboard and pencil to draw the pattern accurately.

Grade One

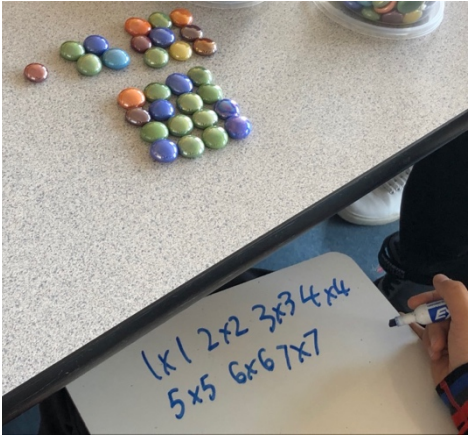
Grade One Learning Standards	Indicators of Proficiency
<p>Content:</p> <ul style="list-style-type: none"> repeating patterns with multiple elements and attributes <p>Competencies:</p> <ul style="list-style-type: none"> use reasoning to explore and make connections represent mathematical ideas in concrete, pictorial and symbolic forms connect mathematical concepts to each other and to other areas and personal interests 	<p>A student can create and describe a repeating pattern with two or more elements, considering different attributes such as colour, size, quantity, shape or position.</p> <p>A student can create a repeating with concrete materials and draw a representation of the pattern including symbolic labels. A student can use AB labelling to “read” and describe the pattern.</p> <p>A student can demonstrate reasoning by successfully responding and explaining their response to the question: What comes next? when presented with a repeating pattern.</p> <p>A student can make connections by finding and describing patterns in the world around them.</p>
<p>Student Learning Story:</p> <p><i>A grade one student chooses a set of loose parts from a collection of bowls and baskets in the classroom. Using a wicker picnic plate, the student plays with creating repeating patterns along the edge of the circular edge of the plate, having to consider the repeating unit of the pattern in order to keep the pattern going around the circle.</i></p> <p><i>Student: “This one is an AB pattern but it could either be red, white, red, white or big, small, big, small.”</i></p> <p><i>Teacher: “What are you going to do with the rest of the space you have?”</i></p> <p><i>Student: “More patterns into the middle. Can I do repeating patterns in each circle but also going out from the middle?”</i></p> <p><i>The student uses the class iPad to take a photo for their e-portfolio. The student captions their post with: Can you find all the repeating patterns?</i></p> 	

Grade Two

Grade Two Learning Standards	Indicators of Proficiency
<p>Content:</p> <ul style="list-style-type: none"> repeating and increasing patterns <p>Competencies:</p> <ul style="list-style-type: none"> use reasoning to explore and make connections represent mathematical ideas in concrete, pictorial and symbolic forms connect mathematical concepts to each other and to other areas and personal interests 	<p>A student can successfully create and describe a variety repeating patterns with multiple elements and attributes using concrete, pictorial and symbolic (ie. AB) representations.</p> <p>A student can successfully create an increasing pattern using concrete materials or pictorial representation and explain the number relationship in the pattern rule (ie. "it is an add 2 pattern")</p> <p>A student can demonstrate reasoning by successfully responding and explaining their response to the question: What comes next and why? when presented with a repeating or increasing pattern.</p> <p>A student can make math to math and math to world connections by finding and describing patterns in the world around them and connecting to other areas of math (number, shape, etc).</p>
<p>Student Learning Story:</p> <p>A grade two student chooses to investigate the question: Can a pattern grow and repeat at the same time? They choose and use loose parts to create the pattern and orally describe it to their teacher.</p> <p>Student: "It repeats because it goes big circles, small circles and on and on like that. But I also did it growing and each line has two more."</p> <p>Teacher: "How could you label this pattern with symbols?"</p> <p>Student: "Well, it's an AB pattern. It's also a 2, 4, 6, 8 pattern."</p> <p>Teacher: "What would come next and why?"</p> <p>Student: "I am going to use the small circle things because that comes next and there would be 12 because 12 is 2 more than 10."</p>	



Grade Three

Grade Three Learning Standards	Indicators of Proficiency
<p>Content:</p> <ul style="list-style-type: none"> increasing and decreasing patterns pattern rules using words and numbers, based on concrete experiences <p>Competencies:</p> <ul style="list-style-type: none"> use reasoning to explore and make connections represent mathematical ideas in concrete, pictorial and symbolic forms connect mathematical concepts to each other and to other areas and personal interests 	<p>A student can successfully create and describe increasing and decreasing patterns that have a one-step arithmetic pattern rule (adding 2, multiplying by 3, etc) using concrete, pictorial and numeric/symbolic representations.</p> <p>A student can demonstrate reasoning by successfully responding and explaining their response to the question: What comes next and why? when presented with an one-step increasing or decreasing pattern.</p> <p>A student can describe math to math and math to world connections by finding and explaining patterns in the world around them and connecting to other areas of math (number or geometric relationships).</p>
<p>Student Learning Story:</p> <p><i>The class was invited to investigate increasing patterns by thinking about addition or multiplication. A grade three student began creating "square" numbers with glass gems and then got up to get a whiteboard to record the pattern he was noticing.</i></p> <p><i>Student: "I thought it was going to be a doubling pattern with the squares but it's not."</i> <i>Teacher: "How could you describe the pattern?"</i> <i>Student: "The gems make square arrays so it's the same number on each side. So I wrote each down as a multiplication fact."</i> <i>Teacher: "I see you kept writing more down."</i> <i>Student: "I just continued the multiplication pattern."</i></p> 	

Appendix B: Suggested Resources

Teacher Resources:

Messy Maths by Juliet Robertson

Big Ideas from Dr. Small: Grades K-3, Patterns & Algebra chapter by Marian Small

Making Math Meaningful to Canadian Students, K-8 by Marian Small

Developing Number Concepts: Counting, Comparing and Pattern by Kathy Richardson

Is it a Pattern? by Lynn M. McGarvey, Teaching Children Mathematics, May 2013, Vol. 19, Issue 9, pages 564-571.

Online Resources and Websites:

BC Reggio-Inspired Mathematics Project

-blog posts, downloadables, planning guides, gallery, pedagogical content knowledge resources, patterning image gallery

<http://bit.ly/reggioinspiredmath>

Fawn Nguyen's Visual Patterns website

-pictorial representations of patterns involving arithmetic, algebraic or geometric relationships; can be used for pattern talks or inspiration for creating (concrete) patterns with materials

<http://www.visualpatterns.org>

Virtual Manipulatives

-various suites of virtual manipulatives can be used to create pictorial/visual representations of patterns

Math Learning Center: <https://www.mathlearningcenter.org/resources/apps>

Didax: <https://www.didax.com/math/virtual-manipulatives.html>

Toy Theatre: <https://toytheater.com/category/teacher-tools/virtual-manipulatives/>

Children's Books:

Spotty, Stripy, Swirly: What are Patterns? by Jane Brocket

Beep Beep, Vroom Vroom! by Stuart J. Murphy

Sorting through Spring by Lizann Flatt

Pattern Fish and Pattern Bugs by Trudy Harris

Growing Patterns: Fibonacci Numbers in Nature by Sarah C. Campbell

Flow, Spin, Grow: Looking for Patterns in Nature by Patchen Barss

Swirl by Swirl: Spirals in Nature by Joyce Sidman

A Pattern for Pepper by Julie Krawlis