Patterning

What is it?
Patterning involves being able to recognize, describe, create and extend patterns that have an identified regularity. Patterning involves big mathematical ideas of order and regularity. Students are able to generalize and explain a pattern "rule" for concrete and pictorial patterns.

- Repeating patterns: In repeating patterns, the identified regularity is a "core" or the part of the pattern that repeats over and over. For example, a student might create a long linear pattern using coloured gems alternating blue and green. The child identifies that it is the blue and green part that repeats.

- Increasing and decreasing patterns: In increasing and decreasing patterns, the identified regularity is the constant amount that affects each term in a predictable way. For example, a student creates a staircase pattern using wooden cubes explaining that each stair increase by two cubes.

Why is it important?

Patterning is often considered the foundation of mathematical thinking. Mathematics is often referred to as the science of patterns (Devlin, 2001). The ability to see, describe, compare and generalize patterns is essential for mathematical thinking in algebra and other mathematical topics. Patterning is important because it allows students to seek connections and see relationships, particularly visual-spatial and additive or multiplicative relationships.

What to think about?

- Begin by providing students with a collection of materials to sort and describe (eg. buttons or coloured cubes). Students need to be able to pay attention to and describe the attributes of the materials such as colour, size, postion, etc.
- Provide students with examples of multiple concrete and visual patterns, ranging from simple and complex. During class discussions or small group work, elicit descriptions of patterns, using mathematical vocabulary to support students' thinking. For example, terms like "core", "term", "label", "attribute", "repeat", "increase" and "decrease" should be infused into the math talk in the classroom.
- A variety of both mathematically structured materials such as Unifix cubes and patterns blocks as well as other materials such as rocks, shells and buttons offer different possibilities for patterning and mathematical thinking.
- Look for opportunities when students are working with materials to introduce different ways to describe and label patterns such as using letter coding (ABABAB) or seeking numerical relationships.

What to do?

Gather students together to share a concrete model of a pattern or a photograph of a pattern found in the "real world" and ask students: *What do you notice?* Listen for the language the students are using and weave in mathematical vocabulary as applicable.

Ask students to consider: *What is a pattern? What makes a pattern a pattern?*

After this opening, students could move to investigating materials with the focus on thinking about patterns with the prompt: *What can you find out about patterns?* Different types of materials could be presented on different tables, including both mathematically structured materials and other natural or found materials. By adding numeral or letter cards, an opportunity for labeling patterns is provided. Likewise, a collection of mats such as spirals or open grids could be presented in a provocation for students to continue their exploration of patterning.

Some examples of patterning provocations include:

What different patterns can you make?
What patterns are inspired by these materials?
Can patterns be repeating and increasing at the same time?
What happens when circles and patterns meet?
Where do you see patterns in your world?

What to look for?

Provide students with a small collection of materials such as buttons or coloured cubes.

> *Are students able to sort and describe the attributes of the materials? Do they see how the materials are the same and how they are different?*

Prompt students to create a pattern with the materials.

> *What kind of patterns do students create? Do they only create the same pattern (ie. AB) but with different materials? Are students able to identify the core of the pattern? Are students able to extend the pattern in either direction/at either end?*

After an extended time working with the materials and patterns, look for developing understanding of the big ideas in patterning.

> *Are students creating patterns with increasing complexity over time? Are they able to compare patterns – how are these two patterns the same and different? How could you change this pattern to make a different pattern?*

What next?

1) If a student is having difficulty identifying the core of a repeating pattern (eg. AB or ABBC) or the constant change of an increasing or decreasing pattern (eg. add 3 or doubling), increase the focus of this aspect in class or small group discussions. For example, with linear repeating patterns drawn out on a chart, have students identify and come up to draw a box around the

part that repeats over and over. With concrete representations have students use their hands to frame the core of the pattern.
1) If a student is having difficulty creating patterns other then a typical AB pattern in a line, focused only the attribute of colour, intentionally provide three colours of material and ask student to create a pattern using all three colours, providing support as necessary. Also try providing different materials (ie. all yellow cubes) to help the student consider position or orientation or provide different mats such as spiral, circle or grid to help the students think about patterns in different ways.

What next?

2) If a student is fluent and confident creating and describing patterns, provide opportunities to investigate different type of geometric patterns such as mosaics and mandalas or patterns in other areas of interest such as sports or music. Extend students thinking about patterns by asking them to make connections to and seek numerical relationships within the patterns.

References

Big Ideas from Dr. Small: Grades K-3, Chapter 1-Patterns and Algebra 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.
Sorting and Patterning in Kindergarten: From Activities and to Assessment by Elizabeth J. Ziemba and Jo Hoffman, Teaching Children Mathematics, January 2006, pages 236-241.

Real World Connections

Patterns are evident in a child's everyday surroundings – in the tiling of a floor, artistic representations and the number patterns found within street addresses. There is a predictable nature to patterns that transfers to many real world applications such as music, weather and language.

Children's Literature

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