Playing with Mathematical Ideas
preK-grade2

#NCTM100
June 29 2020

Janice Novakowski
@jnovakowski38
Playing with Mathematical Ideas in studio and outdoor spaces for all learners

JANICE NOVAKOWSKI
RICHMOND SCHOOL DISTRICT
BRITISH COLUMBIA, CANADA
NCTM CENTENNIAL MEETING 2020
Land Acknowledgement
Investigating Addition and Subtraction
Grades 1&2
How does knowing about 5 and 10 help you add numbers?
Make a number.
Roll a die.
Add or subtract.
What strategies did you use?
What stories live in these equations?

$8 + 4 + 6 = \_\_\_\_$
What different ways can you make 10?
How many different ways can you solve _______?
How are addition and subtraction connected?
What stories live in these equations?
Guiding Questions for The Studio

- What does it mean to belong in a space?
- How is math connected to you and the world around you?
“It’s a math sun!
It’s full of math!”

- Grauer Kindergarten student
Influences...

- Pedagogy of Play
  - Harvard Graduate School of Education
- Playful Inquiry
  - Opal School, Portland Oregon
- The Reggio Emilia Approach
  - Reggio Children, Reggio Emilia, Italy
What does it mean to play with ideas and concepts?
“Play is to mathematics what books are to reading.”

DAN FINKEL, MATHEMATICIAN, SEATTLE
MATHFORLOVE.COM
“the ball toss”

Loris Malaguzzi of Reggio Emilia, Italy often spoke of the ball toss or the back and forth of a ping pong game as a metaphor for the roles of adults and children in teaching and learning.
questions to nurture mathematical thinking, play and inquiry:

▶ How are these alike?
  ▶ How are these different?
▶ What do you notice?
  ▶ What do you wonder?
▶ What do you think?
▶ How do you know?
Some frames...

- What stories live within...?
- What do you notice? What do you wonder?
- What is the relationship between....?
- What are the connections between...?
- What happens when...?
- How many different...?
- How do these materials help you think about...?
- Where do we see...in the world?
Connections

- math to self
- math to world
- math to math
PLAY

- playing with materials
- playing with language
- playing with ideas
MIRRORS, WINDOWS & DOORS

Dr. Rudine Sims Bishop

Dr. Rochelle Gutierrez

- equity, access and
  re-humanizing mathematics

“How do the materials in our schools reflect the children within our community?

“This one is just like me!”

-Grauer Grade 2 student
Do students see themselves reflected in your classroom mathematical experiences?
Do students have opportunities to be exposed to new perspectives and worldviews?
Do students have openings to new opportunities and to reach their goals?
How do art materials inspire children to play with mathematical ideas?

“My Grandpa has one of those.”

What materials bring children together to learn with each other?

“THIS ONE IS JUST LIKE ME!”

-Grauer Grade 2 student
How are these shapes alike?
How are these shapes different?
What is math?
Everything finding patterns problem-solving powerful continuous life-changing awesome

What is math? Lines power

Clock-time counting (by 2s, 4s, 5s, 10s)

Adding, subtracting, dividing, multiplying

Building ten, hundred

Shapes puzzles patterns blocks

Estimating measuring size

Creative thinking working together

Fun epic creativity
What is math?
What is your relationship with math?
How does math make you feel?
Where is the math?
Investigating Cranberries
Where is the math?

how many will fill up the truck?

lots of water
how deep? how do they floating and sinking
A carpenter does math.
Who does math?

My Dad: Working on the Computer

He designs buildings, fixes heaters.
HELLO WORLD
Honey, I'm Home
The Proudest Blue
Boxitects
This Is How We Do It
RAINBOW WEAVER
Meet Viola Desmond
The Girl with a Mind for Math: The Story of Raya Montagne
What If...
The Colors of Us
The Boy Who Loved Math
Katherine
Nothing Stopped Sophie
A Book in Four Languages
My Numbers
One Eagle, Two Eagle
Vision for The Studio

- A space to re-imagine the teaching and learning of mathematics through an inclusive, flexible learning environment that offers choice of materials to consider mathematics through the aesthetic dimension.
for educators

• to disrupt thinking about mathematics teaching and learning
• to learn about the affordances of different materials
• to consider how the environment can support thinking and learning

• to learn more about instructional approaches that focus on deeper learning, inquiry and place-based and culturally responsive pedagogies
• to consider ways to teach mathematics more holistically, weaving together elements of our curriculum framework

for students

• to have opportunities to experience math to math, math to self and math to world connections
• to have choice in where they choose to learn, the materials they use and how they share their thinking and learning and what projects they might take up
Connecting Big Ideas/Concepts

- Identity
- Story
- Place
- Community
- Relationship
- Connection

- Decomposing
- Change
- Transformation
- Equivalence
- Shape
- Pattern
Teaching and Learning Through a Mathematical Big Idea/Concept: Decomposing
What is decomposing?

How might these materials help you think about decomposing quantities and shapes?
Numbers:

1. \(37 + 24 = 61\)
2. \(37 + 24 = 61\)
3. \(37 + 24\)
4. \(37 + 24\)
5. \(37 + 24\)
6. \(37 + 24\)
48 + 25
25 + 48 = 50
23 + 50 = 73

What is decomposing?

Why when how 48 361

40 + 20 = 60
8 + 5 = 13
40 + 10 = 70
70 + 3 = 73

48 + 25 =

48 25
40 8 20 5

48 25
40 8 20 5

48 25
40 8 20 5
40 + 20 = 60
2 3

8 + 5 = 13
40 + 10 = 70
70 + 3 = 73

356 + 89 =
Decomposing

1. Why do we use decomposing?
2. When we use decomposing?
3. When you find math too hard.
4. How do we use decomposing?

Breaking numbers a part.
Term 1
Big Idea: Number represents and describes quantity.
Grade 2 Big Idea: Numbers to 100 represent quantities that can be decomposed into tens and ones.
Grade 3 Big Idea: Numbers to 1000 represent quantities that can be decomposed into hundreds, tens and ones.

*What is decomposing? How does decomposing help us think about numbers?*

*How can shapes be decomposed? How can fractions be decomposed?*

*How does understanding 5 or 10 help us think about other numbers?*

<table>
<thead>
<tr>
<th>Grade 2</th>
<th>Decompose single digit numbers into parts in multiple ways</th>
<th>Decompose two-digit numbers into parts (tens and ones)</th>
<th>Represent decomposing of two-digit numbers in multiple forms (concrete, pictorial, symbolic) - using tens or other benchmark numbers</th>
<th>Develop mental math strategies by applying concept of decomposing to + &amp; - facts to 20</th>
<th>Develop and use multiple strategies to apply concept of decomposing to addition and subtraction to 100, including problem solving</th>
</tr>
</thead>
<tbody>
<tr>
<td>06.016</td>
<td>528</td>
<td>016</td>
<td>016</td>
<td>016</td>
<td>016</td>
</tr>
<tr>
<td>05.16</td>
<td>528</td>
<td>016</td>
<td>016</td>
<td>016</td>
<td>016</td>
</tr>
<tr>
<td>528.05</td>
<td>016</td>
<td>016</td>
<td>016</td>
<td>016</td>
<td>016</td>
</tr>
<tr>
<td>06.01</td>
<td>528</td>
<td>016</td>
<td>016</td>
<td>016</td>
<td>016</td>
</tr>
<tr>
<td>528.016</td>
<td>528.016</td>
<td>016</td>
<td>016</td>
<td>016</td>
<td>016</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 3</th>
<th>Decompose two-digit and three-digit numbers in multiple ways</th>
<th>Represent decomposing of three-digit numbers into parts by place value in multiple forms (concrete, pictorial, symbolic) - hundreds, tens &amp; ones and other benchmark numbers</th>
<th>Develop mental math strategies by applying concept of decomposing to + &amp; - facts to 20 - increasing</th>
<th>Develop and use multiple strategies to apply concept of decomposing to addition and subtraction to 1000 - including problem solving</th>
<th>Apply concept of decomposing to understanding of multiplication - grouping, arrays</th>
</tr>
</thead>
</table>

- apply concept of decomposing to understanding of multiplication - grouping, arrays
What is decomposing?
How do shapes come together to make new shapes?
How can shapes be decomposed?

How does this help us think about positional patterns?
Investigating Snowflakes

- playing with ideas of size, shape and symmetry
notice

- they are different
- the middles are not the same
- the lines go in different directions

6 sides
6 As
What math do you see?

- arrows
- lines
- circles
- hexagons
- shapes
- different sizes of shapes

- six arms
- same on both sides

- hexagon
Questions to support student inquiry around spatial reasoning:

- What stories live in these shapes?
- What is the relationship between 2D and 3D shapes?
- How can you combine shapes to make new shapes?
- What shapes live in this shape?
- How do shape and size help you make a map?
- How does visualizing help you make sense of the world?
Math to World Connections: Botany

connecting our thinking about size, shape and symmetry
shapes, sizes, grow in groups
• circle, star, triangle
• hanging down, different colours

count the petals

What connections are you making to your context?

- Think of a mathematical big idea or concept and consider materials or investigations that might support connection-making for your students.
- What kind of studio-like experience could you provide for your students?
Investigating Circles

Why are circles so important?
How are diameter and circumference related?
How can I draw circles with a compass?
How can we measure circles?
How can we use circles to create and build with?
Thinking about the Circle: Where does math live in Susan Point’s spindle whorl art?
Coast Salish Art
shape elements

- circles
- crescents
- curved triangles
- frog
- salmon
- symmetry
- environment
May 26, 2017

Dear Pupils of Ms. Partridge,

This year, Ms. Novakowski mailed me your letters and photographs and told me that she was introducing you to Coast Salish Art. Thank you for the kind letters and drawings.

Many people think that I use computers to create my artwork because my lines, crescents, and wedges are perfectly shaped. I want to tell you that I do not. All of my drawings are done by hand, with the help of what is called a flexible ruler.

Every one of my designs begins as a small sketch in one of my many sketchbooks. After I am happy with a small thumbnail sketch I begin to redraw it bigger so that...
Susan Point's striking pair of welcome columns stands near the bottom of the Susan Point stairs and extends a First Nations greeting to tourists and coastal travelers. The two totemic aspects of both figures are historical Coast Salish house pole bark panels. The artist's use of traditional images and motifs is depicted, including a beaver to signify her gender and high status. She also wears a ceremonial armband, buttons, and fish hooks. Members of the weaver family in Coast Salish sculpture are depicted with cleansing rites. The male figure is more shallowly carved and has scenes of sea serpents and of the weaving the eagles on Point's spindle whorl located on the other side of Pacific House. MUSQUEAM WELCOME Susan Point
What local artists or pieces of art might inspire mathematical thinking?
The Playground Project
- playing with ideas of shape and size and spatial reasoning
Help us build our dream playground!

Stay tuned for Phase 2

$60,000

$50,000

$40,000

$30,000

$20,000

$10,000
Where is the math?
Where is the math?

- plan
- balance
- math tools
- shapes
- hole-measure

tool math level/balance measuring
WHERE IS THE MATH?

Divisions 5 & 6 (grades 1 and 2) considered where, when and how mathematics was used to install Grauer’s new playground. We first had to think about “what is math?” and broaden our thinking beyond thinking math is only about numbers. Students began to connect the playground installation to other authentic experiences they have had in which they used mathematics following a plan, reading diagrams, labels and specifications.

- measuring distance
- using tools level and balance
- measuring depth
- shapes and design

Where, when and how do we use mathematics in our lives? September 2018
Divisions 5 & 6 (grades 1 and 2) have been inspired by the installation of the new playground at Grauer. They were invited to design and create their own playgrounds and consider the mathematics embedded in the process of design and creation. The students were introduced to the idea of creating math maps to consider where is the math? in their playgrounds.

"We keep checking to see if it’s level so it won’t fall down.”

What mathematics do we use when designing and creating?
What opportunities for measurement are there in your social studies, science, ADST, Arts or Physical Education curriculum?

- In exploratory play?
- Outdoors?

What tools or materials could be used to support and enhance students’ understanding of measurement?
playing with the idea of measuring
What does it mean to measure?
What do we do when we measure?
How do we communicate measurements?
When do we measure in our daily lives?
In discussing attributes of objects that we can measure, a grade one student wondered, **How do we measure colour?**
What is an interdisciplinary investigation that would connect and deepen understanding of a mathematical idea?
taking The Studio experience out in the community

- SD38 Math Play Space

- more info
  - NCTM Regional Boston 2019
taking The Studio outdoors
#100LeavesChallenge

Janice Novakowski @jnovakowski...
Beginning the #100LeavesChallenge with grades 1&2 at @Grauer_Phoenix - how will you know that you have 100 leaves? @RFJamesUK
#BCAMTreggio #sd38learn
What places and spaces might you find to play with mathematical ideas with your students?
considerations for remote learning

- weekly math plans
- outdoor math experiences
- at-home interdisciplinary projects
- Zoom math studio sessions
**Weekly Math Plans**

---

**SD 38 K-12 Mathematics & Numeracy**

**Kindergarten - Grade Two: Week Twelve**

**Big Ideas:** Number represents and describes quantity.
Computational fluency develops from a strong sense of number.

**Curricular Content:** Counting, decomposing and representing quantities, addition and subtraction facts to 20, addition and subtraction to 20, 100 (concept, process).

**Curricular Competencies:** Develop mental math strategies and abilities to make sense of quantities, develop, demonstrate, and apply mathematical understanding through play, inquiry and problem solving, engage in problem-solving experiences that are connected to place, story, community, and culture, communicate mathematical thinking in many ways, represent mathematical ideas in concrete, pictorial, and symbolic forms.

**Core Competencies focus:** Positive Personal and Cultural Identity

**Teachers and Families:** The following are five problems/tasks to choose from for this week, based on the above curricular areas of focus.

**Draw and write a math story for one of these questions:**
2 and _____ make 7 / 9 + ___ = 12 / 28 + ___ = 33 / ___ + 20 = 53 / 75 + ___ = 135

Choose numbers that stretch your thinking!
What problem will you pose as part of your math story?
Choose three of these numbers: 10, 25, 89, 100, 142
What different ways can you represent the numbers?
Consider using symbols, pictures, ten frames, tally marks, coins, etc.

Choose a number that stretches your thinking: 12, 25, 75, 99, 200
Find that quantity of items (rocks, seeds, books, blocks, toys).
What different ways can you count the items?
How can you show or record how you counted them?

Choose three questions that seem just right for you:
2 and 6, 8 and 4, 3 and 10, 9+8, 46+7, 52+9, 69+24, 98+37, 147+72
What different strategies can you use to solve these questions?
What strategy/method do you think is the strength of yours?

**Numeracy Task:**
There are 24 pieces of sidewalk chalk in a box. They need to be shared between four children. One child already has 3 pieces of chalk of their own. What are some different ways you could share the new box of sidewalk chalk?
Which way do you think is the most fair and why?
Use pictures, numbers and words to share your thinking.

---

**RICHMOND SCHOOL DISTRICT NO. 38**

*created by Janice Novakowski for the Richmond School District*
Outdoor Math Experiences

Outdoor Learning Experiences
for in-school and at-home learning
K-5 Mathematics & Numeracy
June 2020

Counting Collections
Find a collection of materials outside: leaves, rocks, twig cones. What different ways can you count them? How could you record your counts? Find plants, trees or flowers and think about how you could count them. For example, buttercups have five petals - find a patch of buttercups and count by 5s.

WODB
Using sidewalk chalk on concrete or twigs, create a 3x3 grid. Choose four numbers, shapes or natural items found outside and place one in each section. How are they the same? How are they different? If you had to choose one thing to not belong, which would it be and why? Leave your WODB out for others to think and talk about.

Math Walks
Go on a daily math walk, with a different focus each day. Take a notebook or clipboard with paper and pencil to record what you find. What shapes do you see? What numbers can you find? What could we count? What strategies can you use to estimate the number of leaves on the tree? What do you notice about the different patterns you find in plants and trees?

Patterns
Use materials found outside to create repeating patterns, growing patterns, patterns in circles or spirals. Create patterns on safe concrete areas with sidewalk chalk, leaving parts for others to think and talk about. What part of the pattern is missing? What could come next?

Measuring
What could you find outside to measure? Find 10 of something outside and put them in order from shortest to longest. Choose an area outside (garden, field, backyard). What different ways could you measure it? Length, width, area, perimeter. Record your measurements using pictures, numbers and words.

2D & 3D Shapes
Find twigs and use string to lash or tie them together to make nets/frames of 2D and 3D shapes. How do shapes come together to make new shapes? What shapes do you see within your shapes? What could you create with your shapes?

Tic Tac Toe
Gather materials outside to make a tic-tac-toe game or use chalk on a safe, clear concrete area. What strategies do you use when playing tic-tac-toe? What other games could you create with materials you can find outdoors?

Suggested materials to pack in a outdoors “go bag”:
- clipboard
- paper
- pencil
- eraser
- sidewalk chalk
- string or yarn
- scissors
- ruler
- measuring tape
- magnifying glass.
At-Home Interdisciplinary Projects

**At Home Project: SHADOWS**

Walk around your home or outside at a time when the sun is in the sky. What shadows do you notice? How do they change? What different surfaces do you notice shadows on?

Find some materials around your home and put them in front of a light source - from a window, flashlight, candle (with an adult) or a lamp. Can you create a shadow?

How can you play with shadows? How can you make them longer or shorter? Can you create a colored shadow? Can you create a shadow on top of another shadow? How can you make a longer or taller shadow?

Draw objects and the shadows they make. What shapes do you notice? How is the shape and size of the shadow the same as and different from the object?

On a sunny day, place an object outside and observe its shadow at three or four different times throughout the day. What do you notice? Record your measurements, including the unit you used to measure with.

Create a shadow story. Use your hands or cut out paper to make characters. What will your light source be? What sort of setting could you create? Share your story.

What else do shadows inspire you to think about or do?

**At Home Project: GROWING THINGS**

Look around your home, out your window or in your neighborhood for things that grow. What different plants or parts of plants can you find?

You can grow new plants from seeds or parts of plants. Where could you find seeds? Many fruits that you eat have seeds in them that you can try and grow. Many vegetables, such as carrots, celery and green beans can be cut and put in water to grow new plants. You can grow some plants in water but some seeds need soil to grow in. You can try growing seeds in wet paper towel. You can plant seeds in soil or soil in a jar, egg carton, egg shell cup or a small section of a paper towel.

What different ways can you measure and keep track of how your plants are growing? Dad! Calendaring!

What do you notice about the plants - size, shapes, growth patterns or symmetry? Draw your plants and label them with your observations.

Create a story about plants. A story about little creatures that live under and around the plants! A story about how plants are important in our lives! Share your story.

What else do plants inspire you to think about or do?
Zoom math studio sessions
student reflections on The Studio experience
I like weaving and decomposing, weaving, painting.

There are many ways of making math.

I really liked string.
I never realized how much I'd enjoy it!

I like working with all kinds of art.

There are so many ways of making math.

I really liked string art.

I enjoy looking at the shapes and patterns.

Fun and more!
Math is Really Fun!
creating a new narrative for mathematics

“Math is beautiful.”

“Math is fun.”

“There are many ways of making math.”

“Math is everywhere.”

“We all do math.”
What math lives here? uncovering mathematics in playful studio experiences

jnovakowski@sd38.bc.ca @jnovakowski38

Instagram: jnovakowski