SD38 K-2 Numeracy Assessment Support Document

RICHMOND
SCHOOL DISTRICT NO.38

November 2019

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on behalf of the SD38 Learning Services Numeracy Assessment Committee

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Overview

The following materials were developed in collaboration with the Learning Services Numeracy Assessment Committee from 2017-2019. From our work together, a SD38 K-2 Numeracy Assessment Tool was developed, drawing upon the BC Early Numeracy Project and current research regarding assessment of early numeracy. Thirty Richmond primary teachers piloted the assessment with their students in the fall of 2018 and their findings and feedback contributed to edits and revisions to the assessment tool. A further field test was done in the fall of 2019, again with thirty Richmond primary teachers using the assessment tool with their students.

As of November 2019, the assessment tool and recording sheets are approved to use in K-2 Richmond classrooms.

Further resources to support this assessment tool and related instruction were further developed in 2021 and are included in this updated resource. As the SD38 Numeracy Vision and Framework is being developed and we have received more information about provincial assessment using a proficiency scale, another update was made in June 2022.

Literacy and Numeracy Assessment in the Early Years

"Literacy is the ability to understand, critically analyze, and create a variety of forms of communication, including oral, written, visual, digital, and multimedia, in order to accomplish one's goals.

Numeracy ~~is~~ the ability to understand and apply mathematical concepts, processes, and skills to solve problems in a variety of contexts.

Literacy and numeracy are fundamental to all learning. While they are commonly associated with language learning and mathematics, literacy and numeracy are applied in all areas of learning."

https://curriculum.gov.bc.ca/curriculum/overview

The purpose of this section of this document is to outline the purposes of and provide guidelines and recommendations for Level A assessments in Richmond for Literacy and Numeracy.

What is assessment?

Assessment is the systematic process of gathering information about individual students which may assist in understanding their needs and learning profile so that necessary planning for learning and services can be provided. It begins with the classroom teacher and may expand to include other individuals both within and beyond the school system. While both formal and informal assessment procedures may be useful, assessment should generally begin with observation of the student by the teacher or others in the classroom context. Assessment may then proceed to more formal or clinical measures and contexts in an incremental manner as required to design effective programs and supports for the student.

Levels of Assessment

Since assessment includes more than formal testing, it is important to keep the various types of assessment in mind. The first source of support for all students is the classroom teacher, who has already obtained information through observation, work samples, student and parent interviews, screening tests, etc.. These can be described as **Level A** assessments. When a teacher has questions about a particular student's needs or abilities, the teacher can turn to members of the **School Based Team (SBT)** for further advice, support and assistance. Actions from the School Based Team meeting may result in collecting additional data to supplement the information the teacher has already collected. This is where **Level B** or **Level C** assessment tools may be of assistance. **Level B** tests require specific training for administration, scoring and interpretation. These tests are more complex than Level A assessments and should only be administrated by someone who is trained. **Level C** tests require advanced (graduate level) training for interpretation, and in the school setting are generally administered by the school psychologist. Level A and B assessment data should guide the School Based Team in determining whether additional Level C testing is required to answer questions about a student's learning profile and how to best support learning.

Please note that most Level B and C tests are not aligned to our BC mathematics curriculum. Bridging formal testing results and suggested instructional practices and supports for student learning need to take the BC mathematics curriculum learning standards in mind.

The SD 28 K-2 Numeracy Assessment Tool is a Level A assessment.

K-2 NUMERACY ASSESSMENT

Focus of project:

The focus of this district project was the development of district language and supports around early assessment in the area of numeracy. The range of grades of focus are K-2, but may also be supportive for educators working with older students with a beginning level of numeracy development. Whole class and individual student profiles maybe be created beginning at the end of Kindergarten.

What is numeracy?

Numeracy is the application and transfer of mathematical understanding to contextualized situations and problems. For our purposes, we are looking at one aspect of mathematical understanding – number sense.

From a cognitive science perspective, particularly in the area of early numeracy, numeracy is focused on awareness of quantity, numbers and operations and the relationship between concrete, pictorial and symbolic forms.

Numeracy is a student's number sense as demonstrated through cardinality, ordinality, meaning of symbols, being able to link symbols to sets and understanding arithmetic operations.

from Dr. Ansari, Number Cognition Lab, Western University

In mathematics education, and as defined in the BC Curriculum framework, numeracy is an application of mathematical understanding.

Numeracy is the willingness and ability to interpret and apply mathematical understanding to solve problems in complex situations, and the perseverance to analyze and communicate these solutions in ways that are relevant to the given context.

from Dr. Peter Liljedahl (SFU) from the BC curriculum website

In Kindergarten through grade 2, the focus is on developing young children's number sense. Numeracy development occurs with opportunities to connect, apply and transfer this number sense to contextual situations or problems.

Foundational concepts/skills connected to the development of number sense:

- Counting including one-to-one, cardinality and conservation
- Symbolic and Visual Magnitude
- Subitizing
- Linking sets to numerals
- Decomposition of quantities

Spatial Reasoning

It is important to note that spatial reasoning is foundational to overall mathematics development. When considering developing an understanding of number, concrete and visual materials and tools such as ten frames and dot patterns utilize spatial reasoning and understanding to support and enhance number sense. Concepts assessed in the included tasks such as comparing quantities and subitizing involve spatial reasoning.

What are indicators of numeracy development?

- Understanding of number (number sense, fluency, flexibility)
- Application and transfer of mathematical understanding to contextual situations (e.g. stories, problems, play, investigations)
- Making connections (math to self, math to world, math to math)
- Development of mathematical vocabulary and language (e.g. comparative language such as more/less, before/after, greater than/less than)

For Kindergarten-grade 2, here are some recommendations for assessments that can be used by school teams:

Suggestions for Assessments:

BC Based Assessments	Norm-Referenced Assessments
SD22 Grade One Screener https://sites.google.com/view/bc-numeracy-network/assessment/how-do-i-know-what-my-students-know-can-do-and-understand/grade-1?authuser=0	Numeracy Screener http://www.numeracyscreener.org
BC Early Numeracy Assessment https://www2.gov.bc.ca/gov/content/education-training/k-12/teach/teaching-tools/math Hardcopy available in schools	Number Sense Screener Maryland, Brookes Publishing
	Give a Number Task (Ansari)

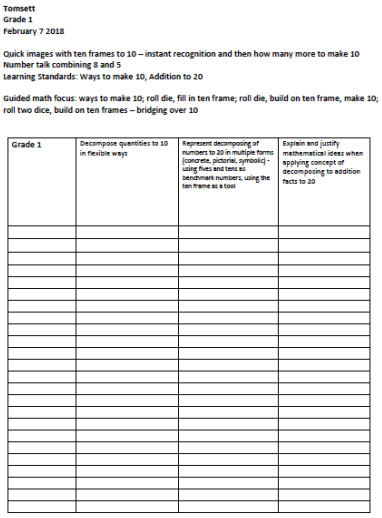
Compilation of resources to support assessment and interpret results can be found on the BC Numeracy Network website:
https://sites.google.com/view/bc-numeracy-network/assessment?authuser=0

The SD38 Numeracy Assessment Committee has developed a K-2 Assessment Tool and monitoring forms which are included in this package.

Two suggested numeracy tasks and a spatial reasoning task are also provided.

Progress Monitoring

Progress monitoring is used to assess students' growth in mathematics, and to evaluate the response to and effectiveness of instruction. Progress monitoring can be used with individual students or with an entire class. Some examples of ways to record and monitor progress over time include class lists, class profiles, and checklists connected to learning standards and foundational concepts and skills.



Tomsett
Grade 1
February 7 2018

Quick images with ten frames to 10 – instant recognition and then how many more to make 10
Number talk combining 8 and 5
Learning Standards: Ways to make 10, Addition to 20

Guided math focus: ways to make 10; roll die, fill in ten frame; roll die, build on ten frame, make 10; roll two dice, build on ten frames – bridging over 10

Grade 1	Decompose quantities to 10 in flexible ways	Represent decomposing of numbers to 20 in multiple forms (concrete, pictorial, symbolic) - using fives and tens as benchmark numbers, using the ten frame as a tool	Explain and justify mathematical ideas when applying concept of decomposing to addition facts to 20

What next?

In response to assessment and progress monitoring, use small group and whole class instruction to continue to develop foundational mathematical concepts and skills. Targeted intervention may also be necessary in addition to regular classroom instruction.

- the **BC ENP** (Early Numeracy Project) provides small group and whole class lesson idea booklets available in schools or in pdf format
- ***Number Sense Interventions*** by Nancy C. Jordan and Nancy Dyson (a book connected to *Number Sense Screener*)
- ***Do the Math*** kits (available through DRC)

Professional Learning

In order to assess students' mathematical understanding, educators may find it helpful to develop their own knowledge of the mathematics they are assessing. In mathematics, this is called pedagogical content knowledge – the mathematics you need to know to teach and assess the grade/s of students you are working with. Some professional resources that may support educators' mathematical understanding can be found in the list of references at the end of this document.

SD38 K-2 Numeracy Assessment Tool

The SD38 K-2 Numeracy Assessment Tool focuses on foundational concepts and skills that contribute to the development of number sense. The SD38 K-2 Numeracy Assessment Tool is intended to be used from the end of Kindergarten through grade 2 with a whole class of students to create a class profile and to reveal students that we might want to further assess for more information. It can also be used with students over time to monitor progress.

This assessment is focused on performance-based assessment with an interview aspect. No more than three students can be assessed at the same time, in order to get reliable information through observation and listening. Ideally, each student is assessed individually and this takes about 10-12 minutes a student.

Tasks One and Eight are marked with a * and this indicates these are core tasks and that indicators of proficiency are included.

Materials needed: counters that students can easily pick up/grab such as Unifix cubes (for some students having the cubes all one/same colour is helpful), numeral cards, a square of cardstock or cardboard (about 10x10cm), group/class or individual recording sheet

Recording sheets can be used to record dates, range or limit of quantities/numbers, Yes/No or your own coding system.

*Task 1: Place a collection of 10 counters on the table and ask student to count them: Please count all the cubes. After counting, ask: How many are there? Repeat with a set of 16 counters.
Observe and listen for: one-to-one correspondence, cardinality and sequence of number names. If count is incorrect, note where error is made.

For grade 2 students, first have them count 16 and then provide another collection of 34 to count to bridge over two decades.

Task 1 indicators of proficiency: The student can count with one-to-one correspondence and cardinality to 10 (kindergarten), 16 (grade one) and 34 (grade two); the student uses correct sequence of number names (kindergarten, grade one, grade two); the student shows beginning understanding of tens and ones through counting over decades (grade two)

Kindergarten

Proficient
-the student says the correct number sequence from 1-10 -the student demonstrates one-to-one correspondence while counting objects, by touching, moving or tracking each one -the student demonstrates cardinality by knowing that the last number they say when counting is how many are in the set (10)

Grade One

Proficient
-the student says the correct number sequence from 1-16 -the student demonstrates one-to-one correspondence while counting objects, by touching, moving or tracking each one -the student demonstrates cardinality by knowing that the last number they say when counting is how many are in the set (16)

Grade Two

Proficient
-the student says the correct number sequence from 1-34 -the student demonstrates one-to-one correspondence while counting objects, by touching, moving or tracking each one, or counting each and then grouping (in 2s, 5s or 10s for example) -the student demonstrates cardinality by knowing that the last number they say when counting is how many are in the set (16, 34)

Task 2: After the student has counted the 16 counters, rearrange them in another configuration and ask: How many are there? How do you know? (if they tell you 16). If student recounts counters, note this. If student says "I don't know" or responds with an incorrect answer, note this.
Observe and listen for: conservation ("It's still 16 because you didn't add any or take any away.")

Note: Tasks 1 and 2 can be "combined" and flow from one to another when focused on the quantity of 16.

Task 3: Place a small collection of counters in front of the child. Ask: Can you please grab three and show me? (Gesture a grab motion). If necessary, explain to student to grab the required amount without counting them. Put the cubes back in the collection and then repeat with quantities of 5 then 4.
Observe and listen for: counting vs subitizing and knowing small quantities

Task 4: Create a set of 8 counters and another set of 3 counters. Ask: Without touching or counting the counters, tell me which set has more. Repeat with 7 counters and 10 counters (opposite orientation from first part of task with smaller set first and greater set second).
Observe and listen for: visual magnitude comparison

Note: An additional task between Task 4 and Task 5 to bridge concrete to symbolic representations could be to compare quantities represented in a ten frame (pictorial representation).

Task 5: Place numeral cards for 9 and 2 on the table. Ask: Which is greater? (use larger, bigger, more if language seems to be a concern). Repeat with 6 and 8. *For Grade two students, start with 9 and 2 and then move to 14 and 28 and then 35 and 33.*
Observe and listen for: symbolic magnitude comparison

Task 6: Place 3 counters in a diagonal row on the table under a card. Lift the card for 1 second and then cover counters with a card. Ask: How many counters are there? How do you know?
Note: remind students not to try and count, to just say how many dots /counters they see.
Repeat with 4 counters in a regular dice pattern.
Repeat with 5 counters in regular dice pattern.
Repeat with 4 counters in irregular pattern.
Observe and listen for: instant recognition of dot patterns, connection to known dot patterns (dice, dominoes), conceptual subitizing ("I saw the five as a three and a two."), ability to subitize both regular and irregular dot patterns.

Task 7: Create separate sets of 3, 5 and 9 counters on the table. Lay out the numeral cards and ask: Can you match the numbers to the number of counters in each set? (rephrase as necessary for student understanding)
For grade 2 students, extend to 16 and 23 to see if they use the numeral cards as digits which suggests place value understanding.
Observe and listen for: ability to match symbol to quantity

***Task 8:** Give the student 5 counters and ask: What different ways can you make five? What parts make up five? How can you decompose five into parts? (use phrasing that is most familiar to your students). Can you think of any more ways? (if student seems to need prompting to continue with task) As an extension: Have you found all the ways to make five?
Note: If student seems to not understand what to do, model one way to make five such as showing the counters as 2 and 3.
Repeat for 10 if student demonstrates fluency with 5.
Note for grades 1 and 2 students: Begin with 10 using same process and if fluency is demonstrated, repeat with 16. Some students may connect this

task to thinking about addition and subtraction and use symbolic notation instead of using concrete materials.
Observe and listen for: ability to decompose into parts, random vs systematic approach, using more than two parts sometimes (ie. 2 and 2 and 1), oral explanation such as "3 and 2 make 5"

Task 8 indicators of proficiency: The student can decompose quantities of 5 (kindergarten), 10 (grade one) and 16 (grade two) in multiple ways (three or more different ways); the student demonstrates fluency and flexibility with the quantity provided and engages with thinking about different ways of decomposing including two, three or four parts (kindergarten, grade one, grade two); the student makes connections between decomposing and addition/subtraction and parts-whole thinking, either orally or recording in written/symbolic form (end of grade one, grade two)

Kindergarten

Proficient
-the student decomposes a quantity of 5 counters into parts in at least three different ways -the student names the parts orally such as (4 and 1, 3 and 1 and 1) -the student engages with the counters and moves them around to find different ways to decompose 5

Grade One

Proficient
-the student decomposes a quantity of 10 counters into parts in at least three different ways -the student names the parts orally such as (4 and 6, 3 and 2 and 5) -at end of grade 1, student can record corresponding equations (4+6=10) -the student engages with the counters and moves them around to find different ways to decompose 10, may build on another way they have decomposed or look for patterns or a system of organization

Grade Two

Proficient
-the student decomposes a quantity of 16 counters into parts in at least three different ways -the student names the parts orally such as (10 and 6, 5 and 5 and 5 and 1) -student can record corresponding equations (10+6=16, 8+2+6+16) -the student engages with the counters and moves them around to find different ways to decompose 16, considering patterns, building on ten or a system of organization

SD38 K-2 Assessment Tool
Task and Concept/Skill Correlation

Task	Concepts/Skills
one	one-to-one, counting sequence, cardinality
two	conservation
three	subitizing, "give me" showing three-ness, four-ness, five-ness
four	visual magnitude comparison
five	symbolic magnitude comparison
six	subitizing both regular and irregular dot patterns
seven	matching numeric symbol to quantity
eight	decomposing quantities

SD38 K-2 Numeracy Assessment Tool Class Profile Recording Sheet

	one-to-one	counting sequence	cardinality to _____	conservation Y/N	"give me" (ie three-ness)	visual magnitude	symbolic magnitude	subitizing	match symbol to quantity	decompose

0

1 4 7

2 5 8

3 6 9

SD38 K-2 Numeracy Assessment Tool
Individual Student Record

one-to-one correspondence	
counting sequence (correct order and stability)	
cardinality to _____	
conservation y/n (indicate quantity)	
"give me" task (ie having three-ness)	
visual magnitude	
symbolic magnitude	
subitizing (indicate quantity)	
match symbol to quantity	
decompose (indicate quantity and number of parts)	

_____
student name

_____
student birthdate, grade

_____
date of assessment

_____
completed by

notes

RICHMOND
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SD38 K-2 Numeracy Tasks

The SD38 K-2 Numeracy Assessment Tool focuses on early learners' number sense and the development of foundational number concepts.

The following numeracy tasks are provided to be used in parallel with the assessment tool, to assess the ability of students to connect, apply and transfer their understanding of number concepts. The tasks are inspired by the problem-solving tasks from the BC Early Numeracy Project and the K-3 Numeracy Tasks on Peter Liljedahl's website.

Sharing Cookies

"There are four plates and there are two cookies on each plate. What different ways could you and two friends share the cookies? Which way do you think is the most fair and why?"

Notes:
You may change to the context to two children instead of three.
You may choose to increase the quantity to 12 (four plates of three) or 24 (four plates of six) based on your knowledge of your students.
Have paper, pencils, crayons, small paper plates and Unifix cubes available for students to use if they choose.

Planning and Designing a Pet Habitat

"Design a habitat for a pet. What do you need to consider? What does this pet need? What size should it be? Make a plan and draw or build your habitat. Share your reasoning and thinking for your design."

Notes:
You may change the context to connect to your students' interests, for example, designing a pen for a farm animal.
Some students may choose to use standard units such as centimetres.
Have paper, pencils, crayons, rulers, blocks, popsicle sticks, Unifix cubes and other creating materials available for students to use if they choose.

GRADES K-2 SPATIAL REASONING TASK

The following task looks at the important mathematical thinking of spatial reasoning and connects to the big idea in the BC mathematics curriculum of "we can describe, measure and compare spatial relationships." For Grades K-2 the curricular focus in on describing and comparing attributes of two-dimensional shapes and three-dimensional objects.

Materials: a collection of three-dimensional objects (boxes, cans, paper cones, blocks, etc), paper and pencil or whiteboard and markers

Student Task:

1. Using three-dimensional blocks or objects build a structure or tower with at least three objects.
2. Describe the structure/tower focusing on position and attributes of objects (curved, flat, straight, quantity of sides, etc).
3. What shapes do you see in the objects? How could you describe them?
4. Draw your structure/tower.
    a. What do you notice about these two objects? How are they the same? How are they different?
5. Find something taller than and shorter than your structure.
    a. How could you describe your measuring? How else could you measure your structure/tower?

Observe and listen for: language used to describe shapes and objects and their attributes and position, choosing and orienting shapes to build with, measurement language (taller than, 5 cubes taller, 16 centimeters), comparative thinking

Indicators of proficiency: The student can build a structure using 3D objects. The student can use mathematical language and vocabulary to describe and compare shapes and their attributes and the objects' positions. The student can compare the size of their structure/tower to other objects or using measurement tools.

TASK	Task Concepts and Competencies
Spatial Reasoning	geometry, attributes of 2D shapes and 3D objects, position, comparative measurement, visualizing, using mathematical language, communicating mathematical thinking

Glossary

Assessment: Assessment is the systematic process of gathering information about individual students which may assist in understanding their needs and learning profile so that necessary planning for learning and services can be provided.

Cardinality: Cardinality is the understanding that the last number said while counting is the quantity counted.

Conservation: Conservation is an understanding is that a quantity stays the same whether they are in a line, spread out, re-arranged, etc.

Contextualized Situation: A task or problem embedded in a story, in play or an investigation.

Counting Sequence: The sequence of number names when counting is in a stable order.

Decomposing: Decomposing and composing quantities or numbers are related concepts. Decomposing is essentially "breaking" a quantity into parts, such as ten can be decomposed into five and four and one.

Magnitude: Magnitude looks at the relative size of a quantity in comparison to others and can be measured visually (with sets of objects or pictures) or symbolically (with number symbols).

Number Sense: A student with well-developed number sense is able to think fluently and flexibly about numbers and their relationships with each other.

Numeracy: Numeracy is the application and transfer of mathematical understanding to contextualized situations and problems.

One-to-One Correspondence: One-to-one correspondence involves saying one number name for each object counted, often accompanied by physically touching or visually tracking each object while counting.

Quantity: A quantity is an amount or number of a set, materials, objects, pictures, etc.

Spatial Reasoning: Spatial reasoning is based in dynamic processes with a focus on mental understanding and physical transformation.

Subitizing: Subitizing is the ability to see a small quantity of objects and know at a glance how many. There are two types of subitizing – perceptual and conceptual.

Symbol: The numeric symbol or number that represents the quantity/amount.

BC Mathematics Curriculum Connections

The assessment tasks focus on number with the numeracy tasks focusing on application of number, measurement and spatial reasoning.

A BC Mathematics Curriculum Big Idea that is the overall focus for this assessment support document is: ***Number represent and describes quantity.***

BC Mathematics Curriculum	Curricular Competencies Learning Standards *(focused on in the task design)*	Curricular Content Learning Standards
Kindergarten	• use reasoning to explore and make connections • develop mental math strategies and abilities to make sense of quantities • develop, demonstrate, and apply mathematical understanding through play, inquiry, and problem solving • visualize to explore mathematical concepts • develop and use multiple strategies to engage in problem solving • communicate mathematical thinking in many ways • explain and justify mathematical ideas and decisions • represent mathematical ideas in concrete, pictorial and symbolic forms • reflect on mathematical thinking	• number concepts to 10 • ways to make 5 • decomposition of numbers to 10
Grade One		• number concepts to 20 • ways to make 10 • addition and subtraction to 20
Grade Two		• number concepts to 100 • addition and subtraction facts to 20

SD38 K-2 Mathematics Instructional Ideas

connected to K-2 Numeracy Assessment Tool tasks

Task	Concepts/Skills	Follow-Up Instructional Ideas
1	**Counting set of cubes to 10/16/34** *one-to-one, counting sequence, cardinality*	Counting Collections routine How Many? and Number Talk Images routines
2	**Rearrange quantity from task 1 and ask how many?** *conservation*	Build this element into Counting Collections routine (have one partner re-arrange and then re-count to build confidence trust in the count)
3	**Grab and show task** *subitizing, "give me" showing three-ness, four-ness, five-ness*	In small groups, model or tell stories using puppets that "grab" quantities, have students check and count.
4	**Comparing two quantities of cubes** *visual magnitude comparison*	Soft start or centre task with different materials and more than/less than word, picture or symbol cards
5	**Comparing two number symbols** *symbolic magnitude comparison*	Placing number cards in order along a number line. Clothesline routine
6	**Subitizing patterns of cubes** *subitizing both regular and irregular dot patterns*	Use ten frames to subitize with, dot cards, number arrangement cards (Kathy Richardson) Quick Images routine
7	**Number Symbol to quantity of cubes** *matching numeric symbol to quantity*	Choose a number, have students find different ways to represent that number (concretely, pictorially, symbolically) with different materials, tallies, ten frames, different representations
8	**Ways to decompose set of 5 cubes (10, 16)** *decomposing quantities*	Number Talk routine – how many ways can you decompose ___? Soft start or centre task with different materials

Resources

Pedagogical Content Knowledge Resources

How Children Learn Number Concepts: A Guide to the Critical Learning Phases by Kathy Richardson (available through didax.com)
Making Math Meaningful to Canadian Students K-8 by Marian Small
Teaching Student-Centered Mathematics: Grades K-3 by John A. Van de Walle & LouAnn H. Lovin
Children's Mathematics: Cognitively Guided Instruction by Thomas Carpenter, Elizabeth Fennema et al
How Many? by Christopher Danielson (picture book & teacher guide)
Choral Counting and Counting Collections: Transforming the PreK-5 Math Classroom by Megan Franke, Elham Kazemi et al

BC Numeracy Network foundations page
https://bit.ly/BCNNfoundations

BC Reggio-Inspired Mathematics pedagogical content knowledge support documents
https://bit.ly/BCRIMsupportdocuments

Numeracy

BC Numeracy Network website
http://bit.ly/bcnumeracynetwork

Dr. Peter Liljedahl website
https://www.peterliljedahl.com/teachers/numeracy-tasks

SD38 Portal – Learn 38: Mathematics and Numeracy
https://portal.sd38.bc.ca/learn38/Pages/default.aspx#/=

SD38 District Mathematics Blog
https://blogs.sd38.bc.ca/sd38mathandscience/