Name: _____

Understanding Learning Disabilities

How Processing Affects Mathematics Learning

Companion Resource to the *Understanding Learning Disabilities* Waterfall Chart

This resource is designed to be used for starting points to think, plan, and support mathematics programming in response to a student's assessed areas of strength and/or need.

USING THIS RESOURCE

This resource is designed as a tool to begin thinking about how to plan and support programming in response to a student's assessed areas of strength and need. To understand the specific processing areas that are impacting an individual student's learning, access the psycho-educational assessment along with other valuable assessment information in the Ontario Student Record (OSR).

"Students are successful when they are:

- strong voices in their learning
- self-advocates for their learning
- knowledgeable about their own learning strengths and needs
- valued, supported and challenged with high expectations
- supported in the development of a growth mindset
- provided supports in an accessible learning environment
- provided timely, precise and personalized interventions
- provided necessary accommodations and/or modifications informed by their individual learning profile
- provided multiple entry points to access the curriculum"

-*YRDSB Learning Disabilities Strategic Plan*

Key Messages

- The interconnectedness of the environment, the learner and the learning within a *Comprehensive Math Program* is essential in developing students as mathematicians.
- Students with learning disabilities have average to above average thinking and reasoning abilities. With careful planning and instruction they can be successful. Giving them the support they need and helping them understand how they learn best teaches them skills for life.
- To ensure all students feel safe, valued, honoured and respected, educators must responsively integrate cultural ways of knowing, learning and teaching into their mathematics program. This allows students to make connections to prior knowledge and provides an entry point for them to make sense of mathematical thinking.
- The assessment and instructional strategies found in this resource are good for all students, necessary for some and essential for a few. The strategies are required for both instruction and assessment tasks. It is important to triangulate observations, conversations and products to assess student learning and inform instructional next steps.
- Accommodations and/or modifications must be individualized based on a student's strengths, needs and interests.
- Students who are English Language Learners (ELLs) and are identified with learning disabilities are entitled to supports for language acquisition alongside targeted strategies from this guide.

Important Resource Notes

- This resource is designed to be a companion tool to:
  - The *Understanding Learning Disabilities: How Processing Affects Learning* Module, Processing Chart (French, English), and Waterfall Chart (French, English)
  - A *Comprehensive Math Program*
    - BWW Math Page
    - A *Comprehensive Math Program* Infographic
    - Mathematical Processes
- Many more practical resources are available and are being developed on the BWW Student Services site.
- If the 'possible signs' are observed in a student who is learning English as an additional language (ELL), please refer to *Factors Influencing Language and Learning: A Tiered Model to Supporting English Language Learners* to support thinking, planning and instruction. Students who are learning English as an additional language may express some of the behaviours in the "possible signs" sections as part of the language acquisition process, particularly those in the early levels of proficiency, as evident by their *Steps to English Proficiency (STEP)*.
- The Mental Health and Addiction, Modern Learning and Math Strategies are important documents to support math learning for students with learning disabilities.
- This resource is research- and evidence-informed with input from a variety of educators and other professionals participating in collaborative inquiries across YRDSB.

Thank you to the educators and other professionals from across YRDSB who provided input into this resource based on work and learning in classrooms and collaborative inquiries.

COMPREHENSIVE MATH PROGRAM

"If we:

- build our knowledge and capacity;
- engage in deep learning, innovative teaching and sound assessment within a *Comprehensive Math Program*;
- provide early and ongoing interventions; and
- engage families and communities as partners in mathematics education,

then students will be confident problem solvers who use mathematical knowledge, skills and processes to be contributing members of a changing society." - *YRDSB Math Strategy*

To responsively plan, assess and teach students using a *Comprehensive Math Program*, educators:

- Create a safe, inclusive and responsive learning environment;
- Build on learners' interests and strengths to personalize learning experiences and respond to needs; and
- Use a variety of learning experiences to support problem solving.

The mathematical processes that support effective learning in mathematics are:

- Problem solving
- Reasoning and proving
- Reflecting
- Selecting tools and computational strategies
- Connecting
- Representing
- Communication

PHONOLOGICAL PROCESSING

Definition

Phonological processing refers to the use of phonological information, especially the sound structure of oral language, in processing written and oral information. Two key parts of phonological processing are phonological awareness and phonemic awareness. Phonological awareness is the awareness that spoken language can actually be broken down into smaller parts. Phonemic awareness is the knowledge that words can be broken into individual sounds (phonemes). This knowledge is critical to being able to make sense of how letters and sounds are combined in reading and writing.

Possible Signs

Students may have difficulty:

- Connecting sound awareness to sound-symbol knowledge for letters and numbers
- Recognizing the relationship between the word (e.g., ten) and the symbol (e.g., 10)
- Decoding/reading math text (e.g., instructions, word walls, problems, inquiry questions, labels on diagrams and graphs)
- With fluency (e.g., slower decoding speed)

What you may see: Students may have difficulty reading and writing, including letters and numbers (e.g., t-e-n, or 1-0), despite using a variety of instructional tools and strategies on multiple occasions.

Assessment/Instructional Strategies

- Provide foundational strategies for teaching reading and writing (e.g., clapping, rhymes, word patterns, combining sounds)
- Notice and name math vocabulary
- Make connections between like math terms
- Teach differences between math words that sound similar but have different meanings
- Make connections between spoken language and written format
- Pair math vocabulary with visuals
- Personalize math dictionary with written words, pictures/models/examples and/or first language
- Read text to student and support text with oral information
- Provide opportunities for students to paraphrase instructions
- Encourage students to create and discuss pictorial representations of their math thinking (e.g., mentally, digitally, with math manipulatives, on paper, using the outdoor environment)
- Display mathematical thinking in a variety of ways (e.g., illustrations, graphs, diagrams)
- Use multiple visual representations to support reading of numbers (e.g., t-w-o = 2 = two fingers = two on the math rack)
- Consider use of multi-sensory methods to develop sound/symbol association (e.g., writing numbers in sand to support kinesthetic-tactile senses)
- Co-create math learning walls (e.g., student generated strategies, ideas and models), anchor charts and multilingual word walls (e.g., visual cues to match numbers and symbols) to be used during instruction and assessment tasks
- Do not use spelling or reading as a criteria for mathematical assessment

Environmental Strategies

- Provide preferential seating away from sources of noise or distraction
- Post artifacts of student thinking on math learning walls (e.g., identifying big ideas, strategies and models), anchor charts and word walls to be used during instruction and assessment tasks
- Provide visual cues (e.g., desk chart to access representations of numbers, words and symbols)
- Create a safe, inclusive and equitable learning environment where students feel comfortable asking for help when they have difficulty processing oral and written language

Innovative Technologies

Provide access to innovative technology during both assessment and instruction. Tools to support Phonological Processing may include:

Digital Math Tools/Support:

- Mathies
- The Math Learning Centre Apps

Assistive Technology Tools:

- Dragon Naturally Speaking
- Kurzweil
- Read & Write for Google Chrome
- SpeakQ
- EquatIO (premium free for educators, lite version free for all)

Board Image Tools:

- Clicker
- OneNote (use non-web-based version on Board Image)
- Smart Notebook (Smart Recorder)
- WordQ

For Android and iOS apps, please refer to DTAP Apps

LANGUAGE

Definition

Language can be divided into comprehension and expression across all of its domains – oral, non-verbal, reading and writing – any of which can be affected in individuals with learning disabilities. Language is part of all aspects of our experience; it is essential for expressing ourselves, addressing our needs and connecting with others.

Possible Signs

Students may have difficulty:

- Following instructions and giving directions
- Recognizing math symbols and/or interpreting the meaning and use of them
- Naming numerals and symbols in the early years
- Connecting spoken number, written number and its quantity
- Expressing responses in oral and written format
- Connecting oral and written responses
- Expressing math vocabulary with accuracy
- Ordering numbers and quantity
- Learning number facts and formulas through memorization
- Mastering number facts and formulas for fluency
- Understanding mathematics conceptually and the use of math vocabulary (e.g., area, numerator, denominator, names of numbers, magnitude, negative, slope)
- Communicating ideas (e.g., verbally explaining how an answer was reached using appropriate math vocabulary)
- Comprehending word problems and extracting important ideas to begin solving
- Understanding the steps of a problem solving approach when the steps are presented
- Estimating the plausibility of their answer when relying on retrieval of math facts and/or formulas
- Describing and understanding patterns (e.g., linear growing patterns) using words
- Describing trends and making inferences from data
- Expressing mathematical thinking using multiple modalities (e.g., manipulatives, verbal explanation, visual representation)

What you may see: Students may appear as if they are not paying attention when they cannot understand the language of instruction or content of the lesson. They may appear disengaged or uninterested, look confused and respond with an implausible answer. Students may use brief, fragmented sentences and have difficulty verbally expressing/communicating their ideas. They may have a prolonged pause before responding.

Assessment/Instructional Strategies

- Activate and connect prior knowledge with new vocabulary and visual representations (e.g., draw and label an array or graph)
- Present instructions both orally and in written form with visual cues
- Keep oral and written instructions short and simple
- Accompany oral instructions with visuals when possible/appropriate
- Provide/model the use of sentence/question stems
- Reduce the grammatical complexity of word problems and instructions (oral and written)
- Have students paraphrase instructions to check for understanding
- Create an environment where students feel safe to take risks and ask questions for clarification
- Provide time to enable students to think through language
- Partner students with first language peers, consider using triads to foster the modeling of language
- Develop a math talk community to support understanding and communication (e.g., revoicing, paraphrasing, wait time, agree/disagree, prompt for participation) during the investigation and consolidation of learning
- Provide multiple ways for students to communicate their thinking (e.g., represent linear growing patterns on a graph and/or with tiles)
- Pair visual concepts and information with verbal explanations and instructions
- Use math models (e.g., number line, array, graphs) to make meaning of thinking
- Notice and name math vocabulary as it emerges through problem solving (e.g., "I notice you wrote 3n-1, that representation is an algebraic expression.")
- As students develop conceptual understandings, explicitly teach new math vocabulary and consistently use math labels and terminology over time
- Prompt students to use math vocabulary, strategies and models
- Use minilessons (e.g., dot plates, strings, quick images, number talks) as a way to introduce math models, representations and strategies
- Use visual and concrete manipulatives (e.g., math rack, geometric solids, number lines, base ten blocks, Desmos) to support language understanding
- Draw attention to patterns and relationships in numbers to build understanding
- Provide multiple opportunities for students to estimate quantity (e.g., Goldilocks Strategy--What number is too low? Too high? Just right?)
- Encourage students to create and discuss pictorial representations of their math thinking (e.g., mentally, digitally, with math manipulatives, on paper)
- Display mathematical thinking in a variety of ways (e.g., illustrations, graphs, diagrams)
- Create multilingual word banks, anchor charts (e.g., prompts to share math thinking, norms) and learning walls (e.g., strategies, ideas and models students have generated) with students to be used during instruction and assessment
- Group or categorize common vocabulary with visuals, strategies and math ideas
- Co-create personal math reference (e.g., procedures, formulas, visual dictionary, rules) to be used during instruction and assessment
- Give students opportunities to plan and practise with a student or teacher to prepare for consolidation (e.g., gallery walk, congress, bansho)
- Provide adequate visual representations and paraphrasing/revoicing during consolidation to personalize support for students who may struggle with language
- Do not use reading, writing and/or spelling as a criteria for mathematical assessment

Environmental Strategies

- Post multilingual word banks, anchor charts and learning walls with student work examples for reference
- Create a safe, inclusive and equitable learning environment where students feel comfortable asking for help when they do not understand the language of instruction or content
- Keep class/student created visual dictionaries accessible throughout the day

Innovative Technologies

Provide access to innovative technology during both assessment and instruction. Tools to support Language may include:

Digital Math Tools/Support:

- Harcourt Math Glossary
- Mathies
- The Math Learning Centre Apps
- Desmos

Assistive Technology Tools:

- Dragon Naturally Speaking
- Kurzweil
- Read & Write for Google Chrome
- SpeakQ

Board Image Tools:

- Clicker
- OneNote (use non-web-based version on Board Image)
- Smart Notebook (Smart Recorder)
- WordQ

For Android and iOS apps, please refer to DTAP Apps

VISUAL-MOTOR SKILLS

Definition

Visual-motor skills refers to the ability to co-ordinate the eyes and hands to produce/guide physical movements such as the production of written work. A deficit in this area can make it difficult to take notes or copy information by hand.

Possible Signs

Students may have difficulty:

- Copying information from the board or text accurately
- Gripping pencil
- Printing numbers (e.g., letter and number reversals)
- Lining up columns
- Handling manipulatives
- Composing and drawing figures and shapes
- Holding and using math tools (e.g., ruler, protractor)
- Wrapping string or elastics on a geoboard
- Cutting and gluing paper to make sense of math (e.g., transformational geometry)
- With hand-eye coordination (e.g., difficulty with mazes, puzzles)
- Writing for extended periods of time
- Organizing and making good use of space on paper

What you may see: Students may try to avoid written tasks even though they are able to understand what is expected and able to share information orally. Students may be too frustrated to record all of their thinking. Written work may be slow, difficult and laborious. Written work may appear crowded, crammed or disorganized.

Assessment/Instructional Strategies

- Provide multiple opportunities to capture mathematical thinking (e.g., taking photos, photocopies of notes, reflecting in math journal)
- Provide ample time and space for students to complete tasks during instruction and assessment opportunities
- Embed lined or graph paper within the task to support organization
- Limit the amount of cutting, tracing and colouring required
- Reduce the need for note taking and provide notes, photos and/or digital copies of the representations
- Do not require speed when copying
- Avoid large amounts of written work
- Provide adequate time and flexible structures during instruction and assessment tasks
- Provide access to digital tools to support students in organizing and representing mathematical thinking
- Never use neatness as part of the criteria for mathematical assessment
- Use math tools, manipulatives and models to develop understanding and show mathematical thinking during instruction and assessment tasks
- Use observations, conversations (e.g., interview, conference) and products (e.g., photo of how students have used manipulatives to explain their thinking) to assess student learning and inform instructional next steps
- Provide access to innovative technology during both assessment and instruction
- Consider reducing the number of questions that address the same skill or concept when visual-motor demands are high (e.g., paper and pencil work)
- Structure tasks to ensure question and answer spaces are displayed together on one side of a page

Environmental Strategies

- Provide instructional materials (e.g., detailed class notes) to reduce visual-motor demand
- Prepare student work space with materials required for task completion to reduce visual-motor demands (e.g., assistive technology, math manipulatives)
- Create a safe, inclusive and equitable learning environment where students feel comfortable asking for help when they have difficulty with written work

Innovative Technologies

Provide access to innovative technology during both assessment and instruction. Tools to support Visual-Motor Skills may include:

Digital Math Tools/Support:

- Desmos
- Dudamath
- Geogebra
- Gizmos
- Homework Help
- Mathies
- Meta-Chart
- The Math Learning Centre Apps
- WolframAlpha

Assistive Technology Tools:

- Dragon Naturally Speaking
- SpeakQ
- EquatIO (premium free for educators, lite version free for all)

Board Image Tools:

- Google Docs/Slides/Forms/Draw with comments
- OneNote (use non-web-based version on Board Image)
- Smart Notebook (Smart Recorder)

For Android and iOS apps, please refer to DTAP Apps

VISUAL-SPATIAL (PERCEPTUAL) SKILLS

Definition

Visual-spatial (perceptual) skills refers to the ability to organize visual information into meaningful patterns. Visual-spatial processing deficits can show up as problems understanding and making sense of visual information (e.g., figure-ground discrimination, perceiving constancy despite changes in context, or the perception of spatial relationships between objects).

Possible Signs

Students may have difficulty:

- Remembering and telling the difference between left and right (e.g., transformational geometry)
- Understanding visual patterns (e.g., linear growing patterns)
- Understanding how parts go together to make a whole (e.g., fractions)
- Estimating or comparing visual lengths and distances
- Picking out important visual details
- Understanding and recognizing the meaning of visuals presented (e.g., objects, diagrams, charts, graphs)
- Understanding number relationships and quantity (e.g., visualizing numbers, money, negative numbers)
- Understanding measurement relationships (e.g., distance, time, volume)
- Generalizing from visual patterns to mathematical rules
- Reasoning spatially (e.g., visualizing, scaling up and down, manipulating objects, mentally transforming objects)
- Estimating and/or comparing magnitude
- Lining up values to account for place value and decimal points
- Recognizing visual patterns
- Accessing excessive text and/or visuals on a page
- Including and aligning math symbols (e.g., dollar signs, units, operations)
- Interpreting and constructing graphs and tables
- Creating visual images in their mind and on paper
- Organizing space on a page

What you may see: Students may struggle to create visual images in their mind, misinterpret visual information based on the display (e.g., graph, chart) and miscalculate the space between objects.

Assessment/Instructional Strategies

- Pair visual concepts and information with verbal/written explanations and instructions
- Provide the support of clear verbal instructions with demonstrations, or visual cues, for tasks requiring spatial organization
- Encourage students to verbalize their thinking as they work through visual spatial tasks
- Model and allow opportunities for the use of mathematical models and different ways of knowing (e.g., placing objects on a 10-frame so the student can see a concrete representation of the quantity to support their conceptual understanding)
- Provide multiple and intentional opportunities to use manipulatives to support learning (e.g., nets and models so students can unfold, take apart and combine shapes and view shapes from different perspectives; relational rods to make explicit part/whole relationships)
- Practice visualization tasks, mental rotations and composing and decomposing shapes to develop spatial reasoning
- Provide manipulatives and models for support when practicing visualization and mental rotations
- Make use of concrete objects and dynamic geometry software to represent 3D figures
- Provide multiple opportunities for students to estimate quantity (e.g., Goldilocks Strategy--What number is too low? Too high? Just right?)
- Make connections between mathematical representations and objects at home, in the workplace, school and outdoors
- Label diagrams and provide explanations of the labels (e.g., label multiplier and constant in a linear growing pattern and explain how they impact the graph)
- Encourage students to ask questions if a tool, symbol, model or visual does not make sense
- Support students in identifying important information connected to symbols or visuals
- Provide multiple ways to learn about fractions, not solely relying on visual representations (i.e., set or group, area, measure, division, ratio, operator)
- Use a variety of models when exploring fractions to build conceptual understanding of abstract concepts (e.g., fraction circles, number lines, Cuisenaire rods, arrays, volume, money, clocks)
- Make connections between various representations of relationships (e.g., graphs, tables, equations, contexts, algebra tiles)
- Colour code signs and keywords (e.g., colour figures in transformations to highlight movement)
- Provide visual and verbal cues to support directionality (e.g., use hand gestures to model navigation or proportional relationships)
- Ensure all relevant information is together (e.g., all parts of a question are on one page with space to solve, slides display key information)
- Limit visual clutter on instructional and assessment tasks and ensure students have plenty of space to do their work
- Allow students to use digital tools to create graphs
- Encourage think-alouds to discuss generalizations (student and/or teacher)
- Encourage multiple ways to represent information
- Provide frequent checks for understanding
- Ensure the structure (e.g., decluttered work space), strategies (e.g., colour coding, verbalizing) and models (e.g., visuals, manipulatives) used during learning are mirrored in assessment tasks

Environmental Strategies

- Reduce visual clutter, keep student's space free of unnecessary materials
- Simplify visual displays and include explicit information
- Value the importance of asking questions to clarify, build understanding and/or confirm thinking
- Create a safe, inclusive and equitable learning environment where students feel comfortable asking for help when they do not understand the visual representation

Innovative Technologies

Provide access to innovative technology during both assessment and instruction. Tools to support Visual-Spatial (Perception) Skills may include:

Digital Math Tools/Support:

- Desmos
- Dudamath
- Geogebra
- Gizmos
- Mathies
- Meta-Chart
- The Math Learning Centre Apps
- WolframAlpha

Assistive Technology Tools:

- EquatIO (premium free for educators, lite version free for all)

Board Image Tools:

- Google Docs/Slides/Forms/Draw/GAPPS Suite/Google Apps
- OneNote (use non-web-based version on Board Image)
- Smart Notebook

For Android and iOS apps, please refer to DTAP Apps

MEMORY

Definition

Memory refers to the ability to retain information whether for the short-term or long-term.
Short-term memory – the storage of a small amount of information for a short period of time without rehearsal
Working memory – the ability to hold information in mind to work with it or apply it
Long-term memory – the storage of information for longer amounts of time
Retrieval – involves the use of strategies to quickly and efficiently access information; can be recall and/or recognition

Possible Signs

Students may have difficulty:

- Remembering information they have just seen and heard
- Remembering information long enough to use it and understand it
- Remembering information over longer periods of time (e.g., days and weeks)
- Remembering information without memory cues
- Remembering number facts and steps involved in computation
- Extracting information to be used in word problems
- Following multistep instructions
- Holding information in mind temporarily while simultaneously performing another problem solving task (e.g., regrouping, estimating, lining up math problems in appropriate columns)
- Recalling algorithms, formulas and/or a sequence of numbers with accuracy when shared orally
- Remembering mathematical procedures
- Solving multistep problems—losing track of steps or strategies
- Remembering what an operational sign means (e.g., greater than, less than)
- Retaining images, pictures or visualizations (e.g., dot plates, mental rotations, math rack flashes)

What you may see: Students may frequently ask for instructions to be repeated or look lost after instructions have been given and not remember what they are supposed to do. They may have difficulty consolidating information.

Assessment/Instructional Strategies

- Co-create a personal math reference resource (e.g., procedures, student examples, formulas, visual dictionary, rules) to be used during instruction and assessment
- Co-create multilingual word banks, anchor charts (e.g., prompts to share math thinking, steps to problem solving) and learning walls (e.g., strategies, ideas and models students have generated) with students to be used during instruction and assessment
- Keep oral instructions short and simple
- Provide frequent checks for understanding and opportunities to self-assess
- Provide multiple and intentional opportunities to use manipulatives and models to support learning (e.g., using fingers to compose and decompose numbers, number lines, arrays)
- Provide frequent opportunities for students to collaborate and to engage in math talk during each part of the learning
- Use mnemonic techniques (e.g., BEDMAS) to support concept recall
- Connect prior knowledge with new vocabulary and visual representations (e.g., draw and label an array or graph)
- Connect math concepts to meaningful contexts when possible (e.g., fractions in baking, measures of central tendency in sports)
- Encourage students to talk aloud through multistep or multi-sequential tasks to support limitations in working memory
- Prompt students to use memory aids (e.g., word walls, colour coding, math reference)
- Allow the use of calculator when the focus is not on computation
- Provide whiteboard or pen and paper for students to use during instruction (e.g., number talks, strings)
- Give students opportunities to plan and practise with a student or teacher to prepare for consolidation (e.g., gallery walk, congress, bansho)
- Revisit key understandings frequently and throughout the year
- Use student generated sample tasks with steps and written explanations as a reference tool
- Increase number sense and numeration through games (e.g., Rolling for Tens, Memory, Dominoes)
- Provide opportunities for purposeful practice
- Post or provide handouts of instructions
- Provide adequate time and flexible structures (e.g., student groupings, work space) during instruction and assessment tasks
- Chunk instructional and assessment tasks (e.g., more frequent assessments instead of a large unit test)
- Use multiple choice questions to assess application of knowledge and understanding
- Structure tasks to ensure question and answer spaces are displayed together

Environmental Strategies

- Post and make regular reference to artifacts of student thinking on math learning walls (identifying big ideas, strategies and models), anchor charts and word walls to cue memory during instruction and assessment tasks
- Provide visual cues (e.g., math talk prompts)
- Post math models on desk when appropriate (e.g., number line)
- Create a safe, inclusive and equitable learning environment to reduce anxiety

Innovative Technologies

Provide access to innovative technology during both assessment and instruction. Tools to support Memory may include:

Digital Math Tools/Support:

- Desmos
- Geogebra
- Homework Help
- Mathies
- The Math Learning Centre Apps

Assistive Technology Tools:

- Smart Ideas

Board Image Tools:

- Clicker
- Google Docs/Slides/Forms
- OneNote (Audio Recorder, use non-web-based version on Board Image)
- Smart Notebook (Smart Recorder)

For Android and iOS apps, please refer to DTAP Apps

PROCESSING SPEED

Definition

Processing speed refers to the ability to perform simple tasks quickly and efficiently. Delays in the ability to perform these small, simple tasks can interfere with the performance of more complex tasks. Speed and efficiency are impacted, not the ability to perform the tasks.
Be aware of what students need to process, find a focus and reduce the amount they need to process at once (e.g., a new context, what the task is asking for).

Possible Signs

Students may have difficulty:

- Rapidly naming numbers and symbols
- Quickly, fluently and efficiently retrieving consolidated math facts
- Reading math questions or problems fluently
- Quickly making comparisons between magnitude of numbers
- Fluently counting forwards or backwards
- Finishing work on time as output may be slow and laborious
- Completing sample problems during class time
- Performing basic arithmetic calculations in a timed format
- Recognizing simple visual patterns and scanning visual information quickly

What you may see: Students may take a long time to complete simple math tasks even though they understand how to do the task. They may take a long time to answer questions and/or have difficulty getting their responses down on paper in an efficient manner.

Assessment/Instructional Strategies

- Post or provide handouts of instructions
- Create word banks, anchor charts (e.g., prompts to share math thinking, steps to problem solving) and learning walls (e.g., strategies, ideas and models students have generated) with students to be used during instruction and assessment
- Allow the use of a calculator when the focus is not on computation
- Provide adequate and uninterrupted wait/think/work time
- Provide adequate time and flexible structures (e.g., student grouping, collaboration and/or independent work spaces) during instruction and assessment tasks
- Eliminate the use of speed based math activities (e.g., Around the World, Mad Minute)
- Reduce the number of questions that address the same skill or concept

Environmental Strategies

- Create a safe, inclusive and equitable learning environment where students and educators respect wait time and conceptual understanding rather than speed
- Create a classroom culture that values the access and use of tools (e.g., calculators, learning walls, manipulatives) to support learning
- Provide preferential seating
- Reduce distraction in the learning environment

Innovative Technologies

Provide access to innovative technology during both assessment and instruction. Tools to support Processing Speed may include:

Digital Math Tools/Support:

- Desmos
- Geogebra
- Mathies
- MetaChart
- The Math Learning Centre Apps

Assistive Technology Tools:

- EquatIO (premium free for educators, lite version free for all)
- Kurzweil
- Read & Write for Google Chrome

Board Image Tools:

- Clicker
- Google Docs/Slides/Forms/Classroom

For Android and iOS apps, please refer to DTAP Apps

"Learning environments are places where high expectations are held for all and students are viewed through an asset-based lens." - *Achieving Excellence: A Renewed Vision for Education in Ontario*. *A Frame for Effective Instruction in Mathematics*

ATTENTION

Definition

Attention refers to the ability to focus selectively on some activities while ignoring others, to sustain concentration for periods of time, to resist distraction and to shift attention among tasks. The Learning Disabilities Association of Ontario (LDAO) recognizes attention as an important process that significantly impacts learning.

Possible Signs

Students may have difficulty:

- With on-going attention to a task (e.g., appear distracted as if daydreaming)
- Maintaining consistent levels of attention (e.g., attention varies throughout the day, time and task)
- Paying attention for longer periods of time (e.g., may fatigue easily)
- Voluntarily controlling their attention in order to complete tasks (e.g., hyperfocused on some tasks and unable to enlist attention on a different task)
- Starting or finishing tasks
- Paying attention to details (e.g., operation signs, place value alignment)
- Maintaining attention while transcribing information from board to paper
- Regrouping place value during math operations
- Quickly retrieving math facts
- Solving multistep tasks
- Performing procedures with accuracy
- Sustaining attention in order to complete tasks/problems

What you may see: Students may have difficulty starting tasks and have a hard time sustaining their attention in order to finish their work.

Assessment/Instructional Strategies

- Structure and organize instructional and assessment tasks to support focus (e.g., more frequent assessments instead of a large unit test, split assessment task into separate days, colour code to highlight critical information, provide separate pages for each question, reduce the number of questions by selecting a representative sample, provide one or two instructions at a time)
- Supplement oral directions with written/visual instructions
- Support students to develop a plan and use the plan as a checklist for problem solving tasks
- Teach and support students' self-monitoring strategies (e.g., reflect in math journal, set reminders on digital devices, take photos of math representations)
- Personalize scheduled break times during instruction and assessment tasks
- Perform frequent checks for understanding and opportunities to self-assess against co-constructed criteria
- Provide visual/verbal/physical cues, prompts and focus questions to sustain and regain attention (e.g., "Look and listen for similarities between these two approaches")
- Use multiple modalities in learning (e.g., provide whiteboard to record their thoughts during congress/minilessons, provide manipulatives or digital tools during explorations, develop math learning wall with student work)
- Provide frequent opportunities for students to collaborate with peers and to engage in math talk during each part of the learning
- Provide meaningful and/or authentic contexts for learning
- Provide adequate time and flexible structures (e.g., student grouping, collaborative and independent work spaces, access to digital resources) during instruction and assessment tasks
- Focus feedback and consolidation to address learning goals and/or success criteria
- Document math ideas and student strategies as they emerge from students during investigation and consolidation (e.g., highlights and summary chart)
- Allow students opportunities to self-identify the need for a change in task or focus (e.g., brain break)

Environmental Strategies

- Structure math learning to involve movement and kinesthetic activities (e.g., human number line, quadratic aerobics, double clothesline)
- Provide a variety of flexible classroom spaces and structures for students to problem solve in (e.g., individual and collaborative spaces, vertical non-permanent surfaces, standing tables, floor space, stability ball)
- Minimize unrelated external distractions and visual clutter on walls (e.g., unnecessary posters, decorations)
- Reduce clutter, keep student space free of unnecessary materials
- Allow use of noise-reduction headphones
- Create a safe, inclusive and equitable learning environment where students feel comfortable asking for help when they have difficulty focusing, sustaining their concentration, resisting distraction and shifting attention among tasks

Innovative Technologies

Provide access to innovative technology during both assessment and instruction. Tools to support Attention may include:

Digital Math Tools/Support:

- Desmos
- Geogebra
- Gizmos
- Homework Help
- Mathies
- The Math Learning Centre Apps

Board Image Tools:

- Google Docs/Slides/Forms
- OneNote (Audio Recorder, use non-web-based version on Board Image)
- Smart Notebook (Smart Recorder)

For Android and iOS apps, please refer to DTAP Apps

Assistive Technology Tools:

- Kurzweil
- Read & Write for Google Chrome

"Students learn best when learning experiences and the learning environment align to their strengths, interests and needs." - *Learning For All*

EXECUTIVE FUNCTION

Definition

Executive function refers to the ability to plan, organize and monitor learning, behaviour and emotions. Just as a conductor coordinates the various parts of an orchestra, executive functioning coordinates the processes involved in learning. Executive function develops over time. It is crucial to developing learning skills that support ongoing success and independence.

Possible Signs

Students may have difficulty with one or more of the following executive function skills:

Skill	Possible Signs
Initiation	• Starting and continuing work/effort to complete tasks • Planning and setting goals to complete tasks • Managing multistep problem solving
Planning	• Estimating the time needed to complete a task • Determining important information in math problems • Using estimation skills • Selecting operational processes (e.g., BEDMAS, balancing equations, linear regression)
Organization	• Setting up problems • Representing mathematical thinking so that it can be followed by themselves and others • Lining up math equations consistently • Managing mistakes (e.g., frequently erasing work) • Showing or sharing how they solved a problem
Self-Monitoring	• Managing and regulating emotions (e.g., anxiety) • Knowing whether an answer is reasonable • Double-checking of work • Mentally representing, organizing and manipulating number relationships (e.g., 12x9 = (12x10) - 12)
Cognitive Flexibility	• Choosing the most appropriate strategy to solve a problem • Revising their strategy or plan in the face of feedback, challenges, mistakes or new information • Recognizing when a new strategy is necessary (e.g., recognizing when to try a new strategy to be more efficient, using other strategies to check work)
Working Memory	• Retrieving learned facts quickly • Recalling learned facts consistently and with accuracy
Sustained Attention	• Completing mathematical procedures with accuracy • Attending to math operational signs • Using procedures and algorithms • Aligning place value

What you may see: Students may find it difficult to get started on a task, work through multistep problems, and organize math tools to support problem solving. They may forget items needed to complete their work (e.g., protractors, markers) and forget to hand in assignments.

Assessment/Instructional Strategies

Skill	Assessment/Instructional Strategy
Initiation	• Support students to initiate task through questioning (e.g., Where might you begin? What materials might you need to get started?) • Anticipate student responses (e.g., math strategies they might use, misconceptions that may arise, big ideas that may emerge) and plan appropriate questions to guide learning • Give outline/notes of prior learning or necessary materials needed in advance • Post and follow a routine such as always starting with a review of the prior day's learning • Provide advance notice of changes in environment or routines
Planning	• Post problem solving process or checklists on desk and/or anchor chart • Support students in planning/scheduling for larger tasks • Support students in determining important information in math problems • Chunk instructional and assessment tasks (e.g., organize tasks into smaller parts with deadlines) • Model determining reasonableness in math problems • Post learning goals as they emerge through the investigation and consolidation of learning (e.g., math content, mathematical processes, learning skills)
Planning (cont'd)	• Co-construct success criteria within the math community • Provide multiple opportunities for students to estimate quantity (e.g., Goldilocks Strategy--What number is too low? Too high? Just right?)
Organization	• Provide course outlines and organizers in advance • Foster planning and organizational skills, monitor assignments closely, breakdown long-term assignments into smaller steps and check students' progress regularly • Explicitly teach problem solving processes (e.g., Polya's four-step model, STAR problem solving strategy, Jo Boaler's Mathematical Thinking Process) • Provide organizational structures (e.g., space to contain manipulatives, titles on chart paper)
Self-Monitoring	• Provide frequent descriptive feedback at critical points in the learning so students can self-monitor progress • Teach students to use self-regulation strategies (e.g., take a breath, think/pair/share, thumbs up/side/down) • Allow students individual, partner and/or small group 'think' and 'talk' time before responding to a large group • Develop math talk community to encourage discussion and collaboration • Monitor progress to reduce frustration • Teach students to self-reflect and monitor their own work (e.g., turn and talk partner share, reference posted success criteria)
Cognitive Flexibility	• Use minilessons (e.g., strings, quick images, number talks) as a way to introduce math models, representations and strategies • Provide opportunities for purposeful practice • Ask intentional open-ended questions that promote self-reflection • Provide additional and flexible time during instruction and assessment tasks • Highlight various ways to solve mathematical problems • Allow use of alternative models of thinking (e.g., mind maps, VENN diagrams)
Working Memory	• Alleviate sources of anxiety that impact working memory skills (e.g., provide ample notice and supports of upcoming assessment tasks) • Co-create personal math reference (e.g., procedures, formulas, visual dictionary, rules) to be used during instruction and assessment • Revisit key understandings frequently and throughout the year • Prompt students to use memory aids (e.g., word walls, colour coding, math reference) • Allow the use of calculators, when the focus is not on computation, to reduce cognitive load and allow room for thinking • Provide flexible assessment tasks (e.g., more frequent, smaller assessments instead of a large unit test) • Encourage students to talk through multistep problems
Sustained Attention	• Provide structure (e.g., 3-part lesson planning structure) with frequent breaks provided when fatigued • Frequent supportive check-ins to ensure the student is on task and engaged

Environmental Strategies

- Create a classroom culture that respects wait time and conceptual understanding rather than speed
- Provide preferential seating away from sources of noise or distraction when appropriate or when needed
- Post visual cues, mathematical processes, learning goals and success criteria (these may be on student desks, attached to work or posted on the wall depending on the student's profile)
- Provide access to required learning materials so time is not wasted in finding and gathering materials
- Post artifacts of student thinking on math learning walls (identifying big ideas, strategies and models), anchor charts and word walls to cue memory during instruction and assessment tasks
- Post math models on desk when appropriate (e.g., number line)
- Create a safe, inclusive and equitable learning environment where students feel comfortable asking for help when they have difficulty initiating, planning, organizing and monitoring their learning, behaviour and emotions

Innovative Technologies

Provide access to innovative technology during both assessment and instruction. Tools to support Executive Function may include:

Access digital math tools/support through:

- Desmos
- Dudamath
- Geogebra
- Gizmos
- Homework Help
- Mathies
- Meta-Chart
- The Math Learning Centre Apps
- WolframAlpha

Assistive Technology Tools:

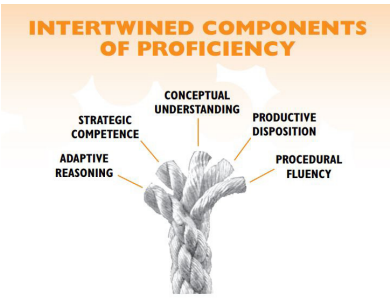
- Kurzweil
- Kurzweil calculator
- Read & Write for Google Chrome

Board Image Tools:

- Google Docs/Slides/Forms
- OneNote (use non-web-based version on Board Image)

For Android and iOS apps, please refer to DTAP Apps

GOOD FOR ALL MATH CONTENT STRATEGIES



Mathematical proficiency has five components. These components are not independent: they represent different aspects of a complex whole.

Conceptual Understanding - comprehension of mathematical concepts, operations, and relations
Procedural Fluency - skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
Strategic Competence - ability to formulate, represent, and solve mathematical problems
Adaptive Reasoning - capacity for logical thought, reflection, explanation, and justification
Productive Disposition - habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy

These five components are interwoven and interdependent in the development of proficiency in mathematics.
(National Research Council (2001). *Adding it up: Helping children learn mathematics*. Washington, DC. National Academy Press)

Automaticity is the quick, fluent and efficient retrieval and use of consolidated math facts. When facts are automatic, they reduce the cognitive load. In the early years and through the grades, it is important to build, develop and support the understanding of number sense by using math models (e.g., 5 rack, 10 rack, math rack, number line, array, relational rods, two-sided counters). Additionally, as students consolidate math concepts, it is essential to connect understanding to other mathematics such as functional, differential or geometric relationships. In different situations, we may choose to describe a relationship verbally, algebraically, graphically, pictorially, concretely or numerically. Math tools and models compensate for difficulty and allow equal access for all learners. In order to develop complex mathematics, students need to rely on foundational skills to support problem solving and reasoning. Without that, learners will need to access specific supports, tools, strategies and interventions to get to the same understanding.

The following strategies support students in developing automaticity.

Overall Number Sense and Numeration Strategies

- Estimate to make sense of the numbers
- Use mental math strategies to build number sense
- Look to the numbers to make connections and determine the most efficient strategy for the given task
- Build understanding of the idea that the properties of whole number operations are the same for rational number operations

Number Sense & Numeration: Addition and Subtraction

- Use a variety of manipulatives to represent place value (e.g., tens and little ones chart, five and ten frames, base ten blocks, counters, relational rods)
- Use a variety of math models (e.g., five frames, ten frames, math rack, number line)
- Support the development of finger discrimination and finger use (e.g., finger mazes, using fingers as a 10-frame)
- Recognize the relationship between addition and subtraction
- Use horizontal and vertical number lines, two-sided counters, constant difference to build understanding of integers
- Use the clock and money model to build conceptual understanding of fraction relationships (landmark fractions)
- Establish the importance of equivalence (e.g., the meaning of the equal sign, balance model, relationships between fractions-decimals-percents, zero principle)
- Identify relationships between numbers to support knowledge of the basic facts and families

Strategies for Addition

- Recognize patterns in numbers
- Compose and decompose numbers based on place value (i.e., splitting)
- Consider friendly numbers (e.g., give and take, adjust)
- Use combinations to make "10s"
- Use number lines to support skip counting, doubling and counting on
- Use lined or graph paper to set up problems
- Identify terms or phrases associated with addition (e.g., add, altogether, and, both, how many, how much, in all, increased by, plus, sum, together, total)

Strategies for Subtraction

- Draw visual representations
- Compose and decompose numbers based on place value (i.e., splitting, round to friendly number)
- Take leaps of 10 and adjust
- Use constant difference
- Identify terms or phrases associated with subtraction (e.g., are not, change, decreased by, difference, fewer, have left, how many did not have, how many more, how much more, less than, remain, subtract, take away, taller/shorter)

Multiplication and Division

- Use a variety of manipulatives to explore multiplication (e.g., grids, counters)
- Use a variety of math models (e.g., array, ratio table, number line)
- Identify relationships between numbers to support knowledge of the basic facts and families
- Recognize the relationship between multiplication and division
- Use the area, linear and set model to build conceptual understanding of fraction relationships
- Establish the importance of equivalence (e.g., the whole matters, ratios must remain content, relationships between fractions-decimals-percents)

Strategies for Multiplication

- Support students as they move from additive to multiplicative thinking by valuing strategies (e.g., repeated addition, skip counting, using 5 times and 10 times, using familiar facts)
- Unpack place value (e.g., 26 x 4 = (2 tens x 4 ones) + (6 ones x 4 ones))
- Use partial products to understand the distributive property (e.g., 24 x 6 = (20 x 6) + (4 x 6))
- Use doubling and halving and/or tripling and thirding to develop understanding of the associative property (e.g., 15 x 4 = 30 x 2 because 15 x (2 x 2) = (15 x 2) x 2)
- Use the array model to develop understanding of the commutative property (i.e., 4 x 7 = 7 x 4)
- Identify terms or phrases associated with multiplication (e.g., by-dimension, double, each group, multiplied by, of, product of, times, triple)

Strategies for Division

- Skip counting to help find equal groups
- Use repeated subtraction
- Use partial quotients and friendly multiples (e.g., flexible algorithm)
- Simplify (e.g., 100/25 = 4/1)
- Draw visual representations to understand partitive and quotitive relationships (e.g., showing sets, sharing through array model to make sense of long division algorithm)
- Identify terms or phrases associated with division (e.g., as much, cut up, divided by, each group has, half or other fractional parts, how many in each, parts, quotient of, separated, share something equally, split)

Strategies for Representing

- Sketch transformed functions to assist in modelling situations (e.g., know key features of $y = -(x-2)^3+4$)
- Use manipulatives (i.e., physical or virtual) to represent algebraic thinking (e.g., the difference between x and x^2)
- Use geometric properties as part of problem solving (e.g., slope of parallel lines, similar triangles in trigonometry)
- Represent a derivative numerically, graphically and algebraically
- Create polynomial, trigonometric or exponential models for problems within a given context (e.g., tidal patterns, population growth)

"In summary, the most important goal for any student in math is not necessarily to get the right answer but to gain a proper understanding of mathematics. Students who understand why an algorithm or method works will intuitively be in a better position to apply the concept in other settings instead of in isolation. By recognizing vocabulary and key phrases in word problems, students also gain a measure of confidence to solve a variety of problems given appropriate context clues. In order to assist students in building a strong foundation of number sense, teachers empower them to become fluent mathematicians. By using a broad repertoire of mental math strategies, decomposing numbers, and place value, students can attack any math problem efficiently, flexibly, and accurately. What better way to breed success than with confidence?" (Feifer & De Fina, 2005, p. 151)

THIS IS HOW I LEARN

How I learn best (strengths):

- _____
- _____
- _____
- _____
- _____
- _____

What I find difficult (needs):

- _____
- _____
- _____
- _____
- _____
- _____

This is what helps me:

- _____
- _____
- _____
- _____
- _____
- _____

If you have further questions or would like more information after you have completed this learning plan, contact the Special Education Resource Teacher (SERT) in your school.

"Every student has the right to engage in rich mathematical tasks and is capable of learning and doing mathematics." - *Dr. Christine Suurtamm*

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