Area of Learning: Mathematics	**Workplace Mathematics 11**
Big Ideas	Elaborations

• **Proportional reasoning** is used to make sense of **multiplicative** relationships.	• **Proportional reasoning:**
	  ○ reasoning about comparisons of relative size or scale instead of numerical difference
	• **multiplicative:**
	  ○ the multiplicative relationship between two numbers or measures is a relationship of scale rather than an additive difference (e.g., “12 is three times the size of 4” is a multiplicative relationship; “12 is 8 more than 4” is an additive relationship)
	• *Sample questions to support inquiry with students:*
	  ○ How are proportions used to describe changes in size?
	  ○ How are proportions used to solve problems in different contexts?
	  ○ How can proportions be used to represent and analyze rates of change?
	  ○ As the proportions of a shape change, what happens to the angles?

• Mathematics informs financial **decision making**.	• **decision making:**
	• *Sample questions to support inquiry with students:*
	  ○ How do we make informed financial decisions?
	  ○ What factors should be considered when making a large purchase?
	  ○ What are the benefits of making responsible financial decisions?

• **3D objects** are often represented and described in 2D space.	• **3D objects:**
	• *Sample questions to support inquiry with students:*
	  ○ Why is it important to represent 3D objects on a 2D plane?
	  ○ Where are representations of 3D objects used outside the classroom?
	  ○ Why is accuracy of measurement important when looking at scale diagrams?
	  ○ Can all 3D objects be described using 2D representations?
	  ○ What do we notice about angles in scale diagrams?

• Flexibility with number builds meaning, **understanding**, and confidence.	• **understanding:**
	• *Sample questions to support inquiry with students:*
	  ○ How does solving puzzles and playing games relate to mathematics?
	  ○ How does experiential learning facilitate deeper understanding?

• Representing and analyzing data allows us to **notice and wonder** about relationships.	• **notice and wonder:** • *Sample questions to support inquiry with students:*

		○ How can statistical analysis help us make inferences about the future? ○ How can a trend be determined from a set of given data? ○ How can mathematics be used to influence our decisions around positive changes in society?	
Learning Standards			
Curricular Competencies	Elaborations	Content	Elaborations

Students are expected to do the following:		*Students are expected to know the following:*	

Reasoning and modelling
• Develop **thinking strategies** to solve puzzles and play games
• Explore, **analyze**, and apply mathematical ideas using **reason**, **technology**, and **other tools**
• **Estimate reasonably** and demonstrate **fluent, flexible, and strategic thinking** about number
• **Model** with mathematics in **situational context**s
• **Think creatively** and with **curiosity and wonder** when exploring problems
 	
Understanding and solving
• Develop, demonstrate, and apply conceptual understanding of mathematical ideas through play, story, **inquiry**, and problem solving
• **Visualize** to explore and illustrate mathematical concepts and relationships
• Apply **flexible and strategic approaches** to **solve problems**
• Solve problems with **persistence and a positive disposition**
• Engage in problem-solving experiences **connected** with place, story, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and other cultures
	• **thinking strategies**
	  ○ using reason to determine winning strategies
	  ○ generalizing and extending
	• **analyze:**
	  ○ examine the structure of and connections between mathematical ideas (e.g., rate of change, trigonometry calculations)
	• **reason**:
	  ○ inductive and deductive reasoning
	  ○ predictions, generalizations, conclusions drawn from experiences (e.g., with puzzles, games, coding)
	• **technology:**
	  ○ graphing technology, dynamic geometry, calculators, virtual manipulatives, concept-based apps
	  ○ can be used for a wide variety of purposes, including:
	  – generating and testing inductive conjectures
	  – mathematical modelling
	• **other tools:**
	  ○ manipulatives such as algebra tiles and other concrete materials
	• **Estimate reasonably:**
	  ○ be able to defend the reasonableness of an estimated value or a solution to a problem or equation (e.g., trigonometric angle/side relations and rate of change calculations)
		• **financial literacy:** personal investments, loans, and budgeting
		• **rate of change**
		• how probability and statistics are used in different **contexts**
		• **interpreting graphs** in society
		• **3D objects:** angles, views, and scale diagrams
			• **financial literacy:**
			  ○ personal investments, loans (lease versus buy), credit cards, mortgages, graphical representations of financial growth
			  ○ to purchase, own, or lease and to operate and maintain a vehicle
			  ○ banking services
			  ○ other significant purchases
			• **rate of change:**
			  ○ slope of 3D objects, angle of elevation
			  ○ interest rates
			• **contexts:**
			  ○ exploring games of chance and insurance payout likelihood
			  ○ reading about and interpreting surveys and information in the media to make informed decisions
			  ○ understanding statistical vocabulary
			• **interpreting graphs:**
			  ○ investigating graphs in the media (e.g., news articles, blogs, social media, websites, advertisements)
			  ○ how data and media influence social justice issues and personal decisions
			• **3D objects:**
			  ○ creating and interpreting exploded diagrams and perspective diagrams
			  ○ drawing and constructing 3D objects

Communicating and representing
• **Explain and justify** mathematical ideas and **decisions** in **many ways**
• **Represent** mathematical ideas in concrete, pictorial, and symbolic forms
• Use mathematical vocabulary and language to contribute to **discussions** in the classroom
• Take risks when offering ideas in classroom **discourse**
 	
Connecting and reflecting
• **Reflect** on mathematical thinking
• **Connect mathematical concepts** with each other, other areas, and personal interests
•
• Use **mistakes** as **opportunities to advance learning**
• **Incorporate** First Peoples worldviews, perspectives, **knowledge**, and **practices** to make connections with mathematical concepts
	• **fluent, flexible, and strategic thinking:**
	  ○ includes:
	  – using known facts and benchmarks and partitioning (e.g., creating and interpreting 3D diagrams and making financial decisions based on evidence)
	  – choosing from different ways to think of a number or operation (e.g., Which will be the most strategic or efficient?)
	• **Model:**
	  ○ use mathematical concepts and tools to solve problems and make decisions (e.g., in real-life and/or abstract scenarios)
	  ○ take a complex, essentially non-mathematical scenario and figure out what mathematical concepts and tools are needed to make sense of it
	• **situational contexts:**
	  ○ including real-life scenarios and open-ended challenges that connect mathematics with everyday life
	• **Think creatively:**
	  ○ by being open to trying different strategies
	  ○ refers to creative and innovative mathematical thinking rather than to representing math in a creative way, such as through art or music
	• **curiosity and wonder:**		

	○ asking questions to further understanding or to open other avenues of investigation • **inquiry:** ○ includes structured, guided, and open inquiry ○ noticing and wondering ○ determining what is needed to make sense of and solve problems • **Visualize:** ○ create and use mental images to support understanding ○ Visualization can be supported using dynamic materials (e.g., graphical relationships and simulations), concrete materials, drawings, and diagrams. • **flexible and strategic approaches:** ○ deciding which mathematical tools to use to solve a problem ○ choosing an effective strategy to solve a problem (e.g., guess and check, model, solve a simpler problem, use a chart, use diagrams, role-play) • **solve problems:** ○ interpret a situation to identify a problem ○ apply mathematics to solve the problem ○ analyze and evaluate the solution in terms of the initial context ○ repeat this cycle until a solution		

	makes sense • **persistence and a positive disposition:** o not giving up when facing a challenge o problem solving with vigour and determination • **connected:** o through daily activities, local and traditional practices, popular media and news events, cross-curricular integration o by posing and solving problems or asking questions about place, stories, and cultural practices • **Explain and justify:** o use mathematical arguments to convince o includes anticipating consequences • **decisions:** o Have students explore which of two scenarios they would choose and then defend their choice. • **many ways:** o including oral, written, visual, use of technology o communicating effectively according to what is being communicated and to whom • **Represent:** o using models, tables, graphs, words, numbers, symbols o connecting meanings among various representations		

	• **discussions:**
	  ○ partner talks, small-group discussions, teacher-student conferences
	• **discourse:**
	  ○ is valuable for deepening understanding of concepts
	  ○ can help clarify students' thinking, even if they are not sure about an idea or have misconceptions
	• **Reflect:**
	  ○ share the mathematical thinking of self and others, including evaluating strategies and solutions, extending, posing new problems and questions
	• **Connect mathematical concepts:**
	  ○ to develop a sense of how mathematics helps us understand ourselves and the world around us (e.g., daily activities, local and traditional practices, popular media and news events, social justice, cross-curricular integration)
	• **mistakes:**
	  ○ range from calculation errors to misconceptions
	• **opportunities to advance learning:**
	  ○ by:
	  – analyzing errors to discover misunderstandings
	  – making adjustments in further attempts		

	– identifying not only mistakes but also parts of a solution that are correct • **Incorporate:** ○ by: – collaborating with Elders and knowledge keepers among local First Peoples – exploring the First Peoples Principles of Learning (http://www.fnesc.ca/wp/wp-content/uploads/2015/09/PUB-LFP-POSTER-Principles-of-Learning-First-Peoples-poster-11x17.pdf; e.g., Learning is holistic, reflexive, reflective, experimental, and relational [focused on connectedness, on reciprocal relationships, and a sense of place]; Learning involves patience and time) – making explicit connections with learning mathematics – exploring cultural practices and knowledge of local First Peoples and identifying mathematical connections • **knowledge:** ○ local knowledge and cultural practices that are appropriate to share and that are non-appropriated		

Comment [mw1]: Carpe Diem: Possible to embed link in "First Peoples Principles of Learning" rather than showing the URL?

	• **practices:**
	  ○ Bishop's cultural practices: counting, measuring, locating, designing, playing, explaining (http://www.csus.edu/indiv/o/oreyd/ACP.htm_files/abishop.htm)
	  ○ Aboriginal Education Resources: (www.aboriginaleducation.ca)
	  ○ *Teaching Mathematics in a First Nations Context,* FNESC (http://www.fnesc.ca/resources/math-first-peoples/)		