Good Spirit School Division

Mathematics 28

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Math 28 Introduction

(taken from the Grade 9 Math Saskatchewan Online Curriculum)

Broad Areas of Learning

There are three Broad Areas of Learning that reflect Saskatchewan's Goals of Education. K-12 mathematics contributes to the Goals of Education through helping students achieve knowledge, skills, and attitudes related to these Broad Areas of Learning.

Developing Lifelong Learners

Students who are engaged in constructing and applying mathematical knowledge naturally build a positive disposition towards learning. Throughout their study of mathematics, students should be learning the skills (including reasoning strategies) and developing the attitudes that will enable the successful use of mathematics in daily life. Moreover, students should be developing understandings of mathematics that will support their learning of new mathematical concepts and applications that may be encountered within both career and personal interest choices. Students who successfully complete their study of K-12 mathematics should feel confident about their mathematical abilities and have developed the knowledge, understandings, and abilities necessary to make future use and/ or studies of mathematics meaningful and attainable.

In order for mathematics to contribute to this Broad Area of Learning, students must actively learn the mathematical content in the outcomes through using and developing logical thinking, number sense, spatial sense, and understanding of mathematics as a human endeavour (the four goals of K-12 Mathematics). It is crucial that the students discover the mathematics outlined in the curriculum rather than the teacher covering it.

Developing a Sense of Self and Community

To learn mathematics with deep understanding, students not only need to interact with the mathematical content, but with each other as well. Mathematics needs to be taught in a dynamic environment where students work together to share and evaluate strategies and understandings. Students who are involved in a supportive mathematics learning environment that is rich in dialogue are exposed to a wide variety of perspectives and strategies from which to construct a sense of the mathematical content. In such an environment, students also learn and come to value how they, as individuals and as members of a group or community, can contribute to understanding and social well-being through a sense of accomplishment, confidence, and relevance. When encouraged to present ideas representing different perspectives and ways of

knowing, students in mathematics classrooms develop a deeper understanding of the mathematics. At the same time, students also learn to respect and value the contributions of others.

Mathematics provides many opportunities for students to enter into communities beyond the classroom by engaging with people in the neighbourhood or around the world. By working towards developing a deeper understanding of mathematics and its role in the world, students develop their personal and social identity, and learn healthy and positive ways of interacting and working together with others.

Developing Engaged Citizens

Mathematics brings a unique perspective and way of knowing to the analysis of social impact and interdependence. Doing mathematics requires students to "leave their emotions at the door" and to engage in different situations for the purpose of understanding what is really happening and what can be done. Mathematical analysis of topics that interest students such as trends in climate change, homelessness, health issues (hearing loss, carpal tunnel syndrome, diabetes), and discrimination can be used to engage the students in interacting and contributing positively to their classroom, school, community, and world. With the understandings that students derive through mathematical analysis, they become better informed and have a greater respect for and understanding of differing opinions and possible options. With these understandings, students can make better informed and more personalized decisions regarding roles within, and contributions to, the various communities in which students are members.

Cross-curricular Competencies

The Cross-curricular Competencies are four interrelated areas containing understandings, values, skills, and processes which are considered important for learning in all areas of study. These competencies reflect the Common Essential Learnings and are intended to be addressed in each area of study at each grade level.

Developing Thinking

It is important that, within their study of mathematics, students are engaged in personal construction and understanding of mathematical knowledge. This most effectively occurs through student engagement in inquiry and problem solving when students are challenged to think critically and creatively. Moreover, students need to experience mathematics in a variety of contexts – both real world applications and mathematical contexts – in which students are asked to consider questions such as "What would happen if …", "Could we find …", and "What does this tell us?" Students need to be engaged in the social construction of mathematics to develop an understanding and appreciation of mathematics as a tool which can be used to consider different perspectives, connections, and relationships. Mathematics is a subject that depends upon the effective incorporation of independent work and reflection with interactive contemplation, discussion, and resolution.

Developing Identity and Interdependence

Given an appropriate learning environment in mathematics, students can develop both their self-confidence and self-worth. An interactive mathematics classroom in which the ideas, strategies, and abilities of individual students are valued supports the development of personal and mathematical confidence. It can also help students take an active role in defining and maintaining the classroom environment and accept responsibility for the consequences of their choices, decisions, and actions. A positive learning environment combined with strong pedagogical choices that engage students in learning serves to support students in behaving respectfully towards themselves and others.

Developing Literacies

Through their mathematics learning experiences, students should be engaged in developing their understandings of the language of mathematics and their ability to use mathematics as a language and representation system. Students should be regularly engaged in exploring a variety of representations for mathematical concepts and should be expected to communicate in a variety of ways about the mathematics being learned. Important aspects of learning mathematical language is to make sense of mathematics, communicate one's own understandings, and develop strategies to explore what and how others know about mathematics. The study of mathematics should encourage the appropriate use of technology. Moreover, students should be aware of and able to make the appropriate use of technology in mathematics and mathematics learning. It is important to encourage students to use a variety of forms of representation (concrete manipulatives, physical movement, oral, written, visual, and symbolic) when exploring mathematical ideas, solving problems, and communicating understandings. All too often, it is assumed that symbolic representation is the only way to communicate mathematically. The more flexible students are in using a variety of representations to explain and work with the mathematics being learned, the deeper students' understanding becomes.

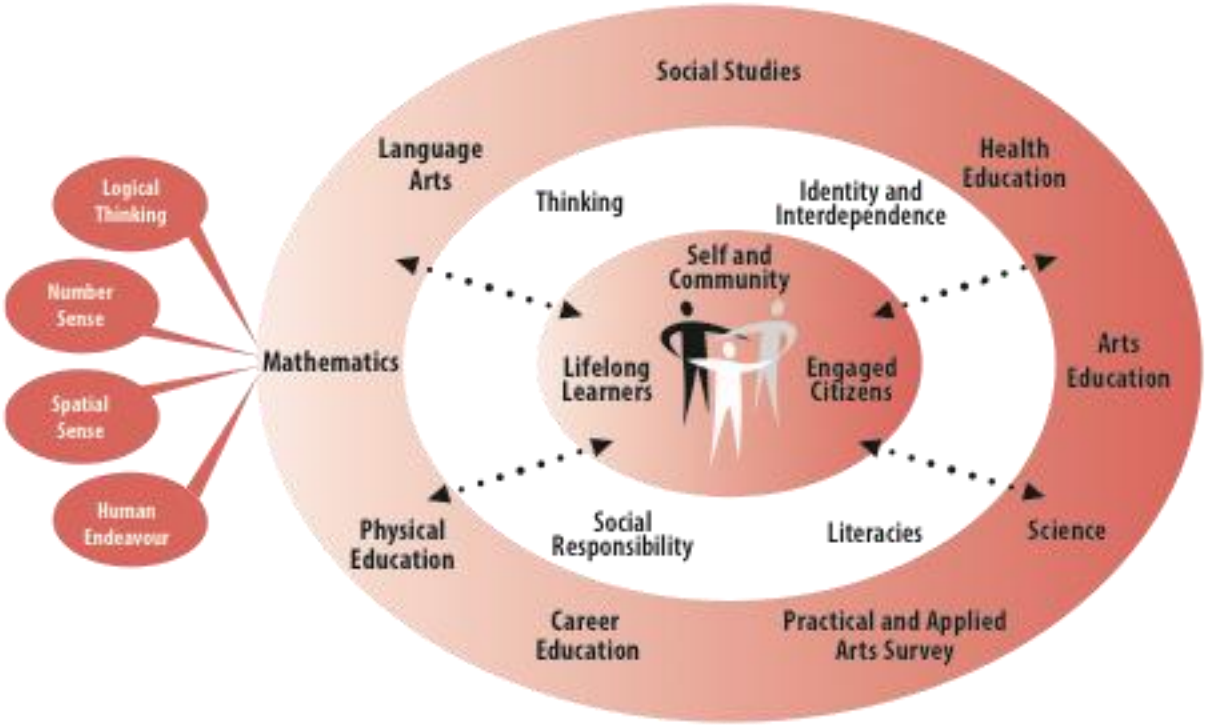
Developing Social Responsibility

As students progress in their mathematical learning, they need to experience opportunities to share and consider ideas, and resolve conflicts between themselves and others. This requires that the learning environment be constructed by the teacher and students to support respectful, independent, and interdependent behaviours. Every student should feel empowered to help others in developing their understanding, while finding respectful ways to seek help from others. By encouraging students to explore mathematics in social contexts, students can be engaged in understanding the situation, concern, or issue and then in planning for responsible reactions or responses. Mathematics is a subject dependent upon social interaction and, as a result, social construction of ideas. Through the study of mathematics, students learn to become reflective and positively contributing members of their communities. Mathematics also allows for different perspectives and approaches to be considered, assessed for situational validity, and strengthened.

Aims and Goals of K-12 Mathematics

The aim of Saskatchewan's K-12 mathematics program is to help students develop the understandings and abilities necessary to be confident and competent in thinking and working mathematically in their daily activities and ongoing learnings and work experiences. The mathematics program is intended to stimulate the spirit of inquiry within the context of mathematical thinking and reasoning. Defined below are four goals for K-12 mathematics in Saskatchewan. The goals are broad statements that identify the characteristics of thinking and working mathematically.

At every grade level, students' learning should be building towards their attainment of these goals. Within each grade level, outcomes are directly related to the development of one or more of these goals. The instructional approaches used to promote student achievement of the grade level outcomes must, therefore, also promote student achievement with respect to the goals.



Logical Thinking

Through their learning of K-12 Mathematics, students will **develop and be able to apply mathematical reasoning processes, skills, and strategies to new situations and problems.**

This goal encompasses processes and strategies that are foundational to understanding mathematics as a discipline. These processes and strategies include:

- observation
- inductive and deductive thinking
- proportional reasoning
- abstracting and generalizing
- exploring, identifying, and describing patterns
- verifying and proving
- exploring, identifying, and describing relationships
- modeling and representing (including concrete, oral, physical, pictorial, and symbolic representations)
- conjecturing and asking "what if" (mathematical play).

In order to develop logical thinking, students need to be actively involved in constructing their mathematical knowledge using the above strategies and processes. Inherent in each of these strategies and processes is student communication and the use of, and connections between, multiple representations.

Number Sense

Through their learning of K-12 mathematics, students will **develop an understanding of the meaning of, relationships between, properties of, roles of, and representations (including symbolic) of numbers and apply this understanding to new situations and problems.**

Foundational to students developing number sense is having ongoing experiences with:

- decomposing and composing of numbers
- relating different operations to each other
- modeling and representing numbers and operations (including concrete, oral, physical, pictorial, and symbolic representations)
- understanding the origins and need for different types of numbers
- recognizing operations on different number types as being the same operations
- understanding equality and inequality
- recognizing the variety of roles for numbers
- developing and understanding algebraic representations and manipulations as an extension of numbers
- looking for patterns and ways to describe those patterns numerically and algebraically.

Number sense goes well beyond being able to carry out calculations. In fact, in order for students to become flexible and confident in their calculation abilities, and to transfer those abilities to more abstract contexts, students must first develop a strong understanding of numbers in general. A deep understanding of the meaning, roles, comparison, and relationship between numbers is critical to the development of students' number sense and their computational fluency.

Spatial Sense

Through their learning of K-12 mathematics, students will **develop an understanding of 2-D shapes and 3-D objects, and the relationships between geometrical shapes and objects and numbers, and apply this understanding to new situations and problems.**

Development of a strong spatial sense requires students to have ongoing experiences with:

- construction and deconstruction of 2-D shapes and 3-D objects
- investigations and generalizations about relationships between 2-D shapes and 3-D objects
- explorations and abstractions related to how numbers (and algebra) can be used to describe 2-D shapes and 3-D objects
- explorations and generalizations about the movement of 2-D shapes and 3-D objects
- explorations and generalizations regarding the dimensions of 2-D shapes and 3-D objects
- explorations, generalizations, and abstractions about different forms of measurement and their meaning.

Being able to communicate about 2-D shapes and 3-D objects is foundational to students' geometrical and measurement understandings and abilities. Hands-on exploration of 3-D objects and the creation of conjectures based upon patterns that are discovered and tested should drive the students' development of spatial sense, with formulas and definitions resulting from the students' mathematical learnings.

Mathematics as a Human Endeavour

Through their learning of K-12 mathematics, students will **develop an understanding of mathematics as a way of knowing the world that all humans are capable of with respect to their personal experiences and needs.**

Developing an understanding of mathematics as a human endeavour requires students to engage in experiences that:

- value place-based knowledge and learning
- value learning from and with community
- encourage and value varying perspectives and approaches to mathematics
- recognize and value one's evolving strengths and knowledge in learning and doing mathematics
- recognize and value the strengths and knowledge of others in doing mathematics
- value and honour reflection and sharing in the construction of mathematical understanding
- recognize errors as stepping stones towards further learning in mathematics
- require self-assessment and goal setting for mathematical learning
- support risk taking (mathematically and personally)
- build self-confidence related to mathematical insights and abilities
- encourage enjoyment, curiosity, and perseverance when encountering new problems
- create appreciation for the many layers, nuances, perspectives, and value of mathematics.

Students should be encouraged to challenge the boundaries of their experiences, and to view mathematics as a set of tools and ways of thinking that every society develops to meet their particular needs. This means that mathematics is a dynamic discipline in which logical thinking, number sense, and spatial sense form the backbone of all developments and those developments are determined by the contexts and needs of the time, place, and people.

The content found within the grade level outcomes for the K-12 mathematics program, and its applications, is first and foremost the vehicle through which students can achieve the four goals of K-12 mathematics. Attainment of these four goals will result in students with the mathematical confidence and tools necessary to succeed in future mathematical endeavours.

Teaching Mathematics

At the National Council of Teachers of Mathematics (NCTM) Canadian Regional Conference in Halifax (2000), Marilyn Burns said in her keynote address, “When it comes to mathematics curricula there is very little to cover, but an awful lot to uncover [discover].” This statement captures the essence of the ongoing call for change in the teaching of mathematics. Mathematics is a dynamic and logic-based language that students need to explore and make sense of for themselves. For many teachers, parents, and former students, this is a marked change from the way mathematics was taught to them. Research and experience indicate there is a complex, interrelated set of characteristics that teachers need to be aware of in order to provide an effective mathematics program.

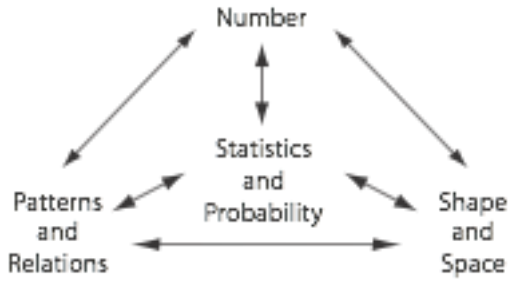
Critical Characteristics of Mathematics Education

The following sections in this curriculum highlight some of the different facets for teachers to consider in the process of changing from covering to supporting students in discovering mathematical concepts. These facets include:

- organization of the outcomes into strands
- seven mathematical processes
- the difference between covering and discovering mathematics
- development of mathematical terminology
- First Nations and Métis learners and mathematics
- critiqueing statements
- continuum of understanding from concrete to abstract
- modelling and making connections
- role of homework
- importance of ongoing feedback and reflection.

Strands

The content of K-12 mathematics can be organized in a variety of ways. In this curriculum, the outcomes and indicators are grouped according to four strands: **Number, Patterns and Relations, Shape and Space, and Statistics and Probability.** Although this organization implies a relatedness among the outcomes identified in each of the strands, it should be noted the mathematical concepts are interrelated across the strands as well as within strands. Teachers are encouraged to design learning activities that integrate outcomes both within a strand and across the strands so that students develop a comprehensive and connected view of mathematics rather than viewing mathematics as a set of compartmentalized ideas and separate strands.



Mathematical Processes

This Grade 9 Mathematics curriculum recognizes seven processes inherent in the teaching, learning, and doing of mathematics. These processes focus on: communicating, making connections, mental mathematics and estimating, problem solving, reasoning, and visualizing along with using technology to integrate these processes into the mathematics classroom to help students learn mathematics with deeper understanding. The outcomes in K-12 mathematics should be addressed through the appropriate mathematical processes as indicated by the bracketed letters following each outcome. Teachers should consider carefully in their planning those processes indicated as being important to supporting student achievement of the respective outcomes.

Communication [C]

Students need opportunities to read about, represent, view, write about, listen to, and discuss mathematical ideas using both personal and mathematical language and symbols. These opportunities allow students to create links among their own language, ideas, and prior knowledge, the formal language and symbols of mathematics, and new learnings.

Communication is important in clarifying, reinforcing, and adjusting ideas, attitudes, and beliefs about mathematics. Students should be encouraged to use a variety of forms of communication while learning mathematics. Students also need to communicate their learning using mathematical terminology, but only when they have had sufficient experience to develop an understanding for that terminology.

Concrete, pictorial, symbolic, physical, verbal, written, and mental representations of mathematical ideas should be encouraged and used to help students make connections and strengthen their understandings.

Connections [CN]

Contextualization and making connections to the experiences of learners are powerful processes in developing mathematical understanding. When mathematical ideas are connected to each other or to other real-world phenomena, students begin to view mathematics as useful, relevant, and integrated.

The brain is constantly looking for and making connections. Learning mathematics within contexts and making connections relevant to learners can validate past experiences and prior knowledge, and increase student willingness to participate and be actively engaged.

Mental Mathematics and Estimation [ME]

Mental mathematics is a combination of cognitive strategies that enhance flexible thinking and number sense. It is calculating mentally and reasoning about the relative size of quantities without the use of external memory aids. Mental mathematics enables students to determine answers and propose strategies without paper and pencil. It improves computational fluency and problem solving by developing efficiency, accuracy, and flexibility.

Estimation is a strategy for determining approximate values of quantities, usually by referring to benchmarks or using referents, or for determining the reasonableness of calculated values. Students need to know how, when, and what strategy to use when estimating. Estimation is used to make mathematical judgements and develop useful, efficient strategies for dealing with situations in daily life.

Problem Solving [PS]

Learning through problem solving should be the focus of mathematics at all grade levels. When students encounter new situations and respond to questions of the type, “How would you …?”, “Can you …?”, or “What if …?”, the problem-solving approach is being modelled. Students develop their own problem-solving strategies by being open to listening, discussing, and trying different strategies.

In order for an activity to be problem-solving based, it must ask students to determine a way to get from what is known to what is sought. If students have already been given ways to solve the problem, it is not problem solving but practice. A true problem requires students to use prior learnings in new ways and contexts. Problem solving requires and builds depth of conceptual understanding and student engagement.

Problem solving is a powerful teaching tool that fosters multiple and creative solutions. Creating an environment where students actively look for, and engage in finding, a variety of strategies for solving problems empowers students to explore alternatives and develops confidence, reasoning, and mathematical creativity.

Reasoning [R]

Mathematical reasoning helps students think logically and make sense of mathematics. Students need to develop confidence in their abilities to reason and explain their mathematical thinking. High-order inquiry challenges students to think and develop a sense of wonder about mathematics.

Mathematical experiences in and out of the classroom should provide opportunities for students to engage in inductive and deductive reasoning. Inductive reasoning occurs when students explore and record results, analyze observations, make generalizations from patterns, and test these generalizations. Deductive reasoning occurs when students reach new conclusions based upon what is already known or assumed to be true.

Visualization [V]

The use of visualization in the study of mathematics provides students with opportunities to understand mathematical concepts and make connections among them. Visual images and visual reasoning are important components of number sense, spatial sense, and logical thinking. Number visualization occurs when students create mental representations of numbers and visual ways to compare those numbers.

Being able to create, interpret, and describe a visual representation is part of spatial sense and spatial reasoning. Spatial visualization and reasoning enable students to describe the relationships among and between 3-D objects and 2-D shapes including aspects such as dimensions and measurements.

Visualization is also important in the students' development of abstraction and abstract thinking and reasoning. Visualization provides a connection between the concrete, physical, and pictorial to the abstract symbolic. Visualization is fostered through the use of concrete materials, technology, and a variety of visual representations as well as the use of communication to develop connections among different contexts, content, and representations.

Technology [T]

Technology tools contribute to student achievement of a wide range of mathematical outcomes, and enable students to explore and create patterns, examine relationships, test conjectures, and solve problems. Calculators, computers, and other forms of technology can be used to:

- explore and demonstrate mathematical relationships and patterns
- organize and display data
- extrapolate and interpolate
- assist with calculation procedures as part of solving problems
- decrease the time spent on computations when other mathematical learning is the focus
- reinforce the learning of basic facts and test properties
- develop personal procedures for mathematical operations
- create geometric displays
- simulate situations

- develop number sense
- develop spatial sense
- develop and test conjectures.

Technology contributes to a learning environment in which the growing curiosity of students can lead to rich mathematical discoveries at all grade levels. It is important for students to understand and appreciate the appropriate use of technology in a mathematics classroom. It is also important that students learn to distinguish between when technology is being used appropriately and when it is being used inappropriately. Technology should never replace understanding, but should be used to enhance it.

Discovering versus Covering

Teaching mathematics for deep understanding involves two processes: teachers covering content and students discovering content. Knowing what needs to be covered and what can be discovered is crucial in planning for mathematical instruction and learning. The content that needs to be covered (what the teacher needs to explicitly tell the students) is the social conventions or customs of mathematics. This content includes things such as what the symbol for an operation looks like, mathematical terminology, and conventions regarding recording of symbols.

The content that can and should be discovered by students is the content that can be constructed by students based on their prior mathematical knowledge. This content includes things such as strategies and procedures, rules, and problem solving. Any learning in mathematics that is a result of the logical structure of mathematics can and should be constructed by students.

For example, in Grade 9, the students encounter similarity of 2-D shapes for the first time in outcome SS9.3 :

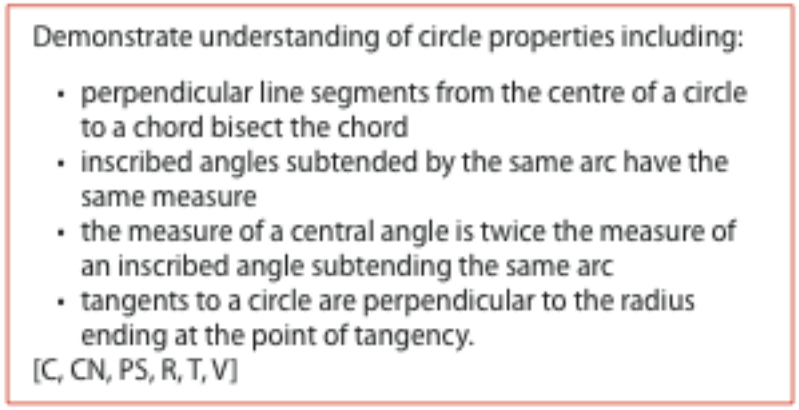
> Demonstrate understanding of similarity of 2-D shapes.
>
> [C, CN, PS, R, V]

In this outcome, the term “similarity” and the symbol “~” are both social conventions of the mathematics the students are learning and, as such, both are something that the teacher must tell the student. Identifying and describing patterns of proportionality between the side lengths of 2-D shapes as well as the relationship between interior angles is the foundation of the students’ construction of understanding. This type of learning requires students to work concretely, pictorially, orally, in writing, and symbolically. It also requires that students share their ideas with classmates and reflect upon how the ideas and understandings of others relate to, inform, and clarify what students individually understand. In this type of learning, the teacher does not tell the students how to do the mathematics but, rather, invites the students to explore and develop an understanding of the logical structures inherent in the mathematics in increasing patterns. Thus, the teacher’s role is to create inviting and rich inquiring tasks and to use questioning to effectively probe and further students’ learning.

Development of Mathematical Terminology

Part of learning mathematics is learning how to speak mathematically. Teaching students mathematical terminology when they are learning for deep understanding requires that the students connect the new terminology with their developing mathematical understanding. As a result, it is important that students first linguistically engage with new mathematical concepts using words that students already know or that make sense to them.

For example, in outcome SS9.1:



Demonstrate understanding of circle properties including:

- perpendicular line segments from the centre of a circle to a chord bisect the chord
- inscribed angles subtended by the same arc have the same measure
- the measure of a central angle is twice the measure of an inscribed angle subtending the same arc
- tangents to a circle are perpendicular to the radius ending at the point of tangency.

[C, CN, PS, R, T, V]

the terminology of “chord”, “subtended”, “inscribed angles”, “arc”, “central angle”, and “point of tangency” will likely be new. Before being formally introduced to this terminology, it is important that students be concretely and pictorially, including through the use of technology, representing and analyzing different relationships involving lines, angles, and circles. As the students discover different relationships, their need for specific terminology emerges and it is at that time the specific terms should be introduced. Students should be encouraged to use their own personal vocabulary as they develop their understandings and to then demonstrate the new terminology as they summarize their discoveries and learnings for themselves and for others in the classroom.

In helping students develop their working mathematical language, it is also important for the teacher to recognize that for many students, including First Nations and Métis, that just because a student doesn’t recognize a specific term or procedure, the student may in fact have a deep understanding of the overall mathematical topic. Many perceived learning difficulties in mathematics are the result of students’ cultural and personal ways of knowing not being connected to the mathematical language.

In addition, the English language often allows for multiple interpretations of the same sentence, depending upon where the emphasis is placed. For example, consider the sentence “The shooting of the hunters was terrible” (Paulos, 1980, p. 65). Were the hunters that bad of a shot, was it

terrible that the hunters got shot, was it terrible that they were shooting, or is this all about the photographs that were taken of the hunters? It is important that students be engaged in dialogue through which they explore possible meanings and interpretations of mathematical statements and problems.

First Nations and Métis Learners and Mathematics

It is important for teachers to realize that First Nations and Métis students, like all students, come to mathematics classes with a wealth of mathematical understandings. Within these mathematics classes, some First Nations and Métis students may develop a negative sense of their ability in mathematics and, in turn, do poorly on mathematics assessments. Such students may become alienated from mathematics because it is not taught to their schema, cultural and environmental content, or real life experiences. A first step in actualization of mathematics from First Nations and Métis perspectives is to empower teachers to understand that mathematics is not acultural. As a result, teachers then realize that the traditional ways of teaching the mathematics are also culturally-biased. These understandings will support the teacher in developing First Nations and Metis students' personal mathematical understandings and mathematical self-confidence and ability through a more holistic and constructivist approach to learning. Teachers need to consider factors that impact the success of First Nations and Métis students in mathematics: cultural contexts and pedagogy.

It is important for teachers to recognize the influence of cultural contexts on mathematical learning. Educators need to be sensitive to the cultures of others, as well as to how their own cultural background influences their current perspective and practice. Mathematics instruction focuses on the individual parts of the whole understanding and, as a result, the contexts presented tend to be compartmentalized and treated discretely. This focus on parts may be challenging for students who rely on whole contexts to support understanding.

Mathematical ideas are valued, viewed, contextualized, and expressed differently by cultures and communities. Translation of these mathematical ideas between cultural groups cannot be assumed to be a direct link. Consider, for example, the concept of "equal", which is a key understanding in this curriculum. The Western understanding of "equal" is 'the same'. In many First Nations and Métis communities, however, "equal" is understood as meaning 'for the good of the community'. Teachers need to support students in uncovering these differences in ways of knowing and understanding within the mathematic classroom. Various ways of knowing need to be celebrated to support the learning of all students.

Along with an awareness of students' cultural context, pedagogical practices also influence the success of First Nations and Métis students in the mathematics classroom. Mathematical learning opportunities need to be holistic, occurring within social and cultural interactions through dialogue, language, and the negotiation of meanings. Constructivism, ethnomathematics, and teaching through an inquiry approach are supportive of a holistic perspective to learning. Constructivism, inquiry learning, and ethnomathematics allow students to enter the learning process according to their ways of knowing, prior knowledge, and learning styles. Ethnomathematics also shows the relationship between mathematics and cultural anthropology. It is used to translate earlier forms of thinking into modern-day understandings. Individually, and as a class, teachers and students need to explore the big ideas that are foundational to this curriculum and investigate how those ideas relate to them personally and as a learning community. Mathematics learned within contexts that focus on the day-to-day activities found in students' communities support learning by providing a holistic focus.

Mathematics needs to be taught using the expertise of elders and the local environment as educational resources. The variety of interactions that occur among students, teachers, and the community strengthen the learning experiences for all.

Critiquing Statements

One way to assess students' depth of understanding of an outcome is to have the students critique a general statement which, on first reading, may seem to be true or false. By having students critique such statements, the teacher is able to identify strengths and deficiencies in their understanding. Some indicators in this curriculum are examples of statements that students can analyze for accuracy. For example, for outcome P9.3, one of the indicators reads:

Critique the statement: "For any linear equality, there are two related linear inequalities".

The purpose of this indicator is for teachers to assess the depth of understanding students have about the relationship between equality and inequality in a mathematical, and more specifically variable, context. Although it may be true that one quantity can always be described as being equal to, less than, or greater than another quantity, the same is not true of variable expressions. In such cases, two additional possibilities exist in the relationship, that of being less than or equal to and greater than or equal to. Students often find this conceptually difficult if they have not grasped the relationship, and also the fundamental difference between quantities and variable expressions. Asking students to critique statements like the one given above will give teachers insight into the students' understandings, and also provide guidance regarding further experiences that the student may need to have.

Critiquing statements is an effective way to assess students individually or as a small or large group. When engaged as a group, the discussion and strategies that emerge not only inform the teacher, but also engage all of the students in a deeper understanding of the topic.

The Concrete to Abstract Continuum

It is important that, in learning mathematics, students be allowed to explore and develop understandings by moving along a concrete to abstract continuum. As understanding develops, this movement along the continuum is not necessarily linear. Students may at one point be working abstractly but when a new idea or context arises, they need to return to a concrete starting point. Therefore, the teacher must be prepared to engage students at different points along the continuum.

In addition, what is concrete and what is abstract is not always obvious and can vary according to the thinking processes of the individual. For example, when considering a problem about the total number of pencils, some students might find it more concrete to use pictures of pencils as a means of representing the situation. Other students might find coins more concrete because they directly associate money with the purchasing or having of a pencil.

As well, teachers need to be aware that different aspects of a task might involve different levels of concreteness or abstractness. Consider the following situational question involving surface area:

What is the surface area of your computer?

Depending upon how the question is expected to be solved (or if there is any specific expectation), this question can be approached abstractly (using symbolic number statements), concretely (e.g., using manipulatives, pictures), or both.

Models and Connections

New mathematics is continuously developed by creating new models as well as combining and expanding existing models. Although the final products of mathematics are most frequently represented by symbolic models, their meaning and purpose is often found in the concrete, physical, pictorial, and oral models and the connections between them.

To develop a deep and meaningful understanding of mathematical concepts, students need to represent their ideas and strategies using a variety of models (concrete, physical, pictorial, oral, and symbolic). In addition, students need to make connections between the different representations. These connections are made by having the students try to move from one type of representation to another (how could you write what you've done here using mathematical symbols?) or by having students compare their representations with others in the class.

In making these connections, students should be asked to reflect upon the mathematical ideas and concepts that are being used in their new models (e.g., I know that addition means to put things together into a group, so I'm going to move the two sets of alge-tiles together to determine the sum of the polynomials).

Making connections also involves looking for patterns. For example, in outcome P9.1:

Demonstrate understanding of linear relations including:

- graphing
- analyzing
- interpolating and extrapolating
- solving situational questions.

[C, CN, PS, R, T, V]

the students' exploration and recognition of patterns and relationships between graphs and equations of linear relations is key to the development of a deep understanding of linear relations. Students need to build strong connections between the characteristics and properties of the graphs and the characteristics of the equations.

Role of Homework

The role of homework in teaching for deep understanding is important. Students should be given unique problems and tasks that help students to consolidate new learnings with prior knowledge, explore possible solutions, and apply learnings to new situations. Although drill and practice does serve a purpose in learning for deep understanding, the amount and timing of the drill will vary among different learners. In addition, when used as homework, drill and practice frequently serves to cause frustration, misconceptions, and boredom to arise in students.

As an example of the type or style of homework that can be used to help students develop deep understanding of Grade 9 Mathematics, consider outcome SP9.3:

> SP9.3 Demonstrate an understanding of the role of probability in society.
>
> [C, CN, R, T]

As a homework task, students might be asked to collect examples from their homes, interests, and personal lives that involve or include statements of probability. From there, those examples could be shared in class and would provide the foundation for the students' learning about the impact of probability theory on their everyday lives. Some of the questions that students might discuss related to their examples include:

- Would you make the same decision as the person/people in your example? Why or why not?
- Are there factors other than the known probability that you would consider before making such a decision?
- Is an 80% chance of an event happening equally influential in different contexts?

By first engaging the students in contexts that are personally relevant, students can explore and bring to light different factors to consider when making a decision regarding known probability. From these personal contexts, students can expand into community and socially relevant contexts and bring a better understanding of the role of emotions, values, and probability in decision making.

Ongoing Feedback and Reflection

Ongoing feedback and reflection, both for students and teachers, are crucial in classrooms when learning for deep understanding. Deep understanding requires that both the teacher and students need to be aware of their own thinking as well as the thinking of others.

Feedback from peers and the teacher helps students rethink and solidify their understandings. Feedback from students to the teacher gives much needed information in the teacher's planning for further and future learnings.

Self-reflection, both shared and private, is foundational to students developing a deep understanding of mathematics. Through reflection tasks, students and teachers come to know what it is that students do and do not know. It is through such reflections that not only can a teacher make better informed instructional decisions, but also that a student can set personal goals and make plans to reach those goals.

Teaching for Deep Understanding

For deep understanding, it is vital that students learn by constructing knowledge, with very few ideas being relayed directly by the teacher. As an example, the addition sign (+) is something which the teacher must introduce and ensure that students know. It is the symbol used to show the combination or addition of two quantities. The process of adding, however, and the development of addition and subtraction facts should be discovered through the students' investigation of patterns, relationships, abstractions, and generalizations.

It is important for teachers to analyze the outcomes to identify what students need to know, understand, and be able to do. Teachers also need to consider opportunities they can provide for students to explain, apply, and transfer understanding to new situations. This reflection supports professional decision making and planning effective strategies to promote students' deeper understanding of mathematical ideas.

It is important that a mathematics learning environment include effective interplay of:

- reflection
- exploration of patterns and relationships
- sharing of ideas and problems
- consideration of different perspectives
- decision making
- generalizing
- verifying and proving
- modeling and representing.

Mathematics is learned when students are engaged in strategic play with mathematical concepts and differing perspectives. When students learn mathematics by being told what to do, how to do it, and when to do it, they cannot make the strong connections necessary for learning to be meaningful, easily accessible, and transferable. The learning environment must be respectful of individuals and groups, fostering discussion and self-reflection, the asking of questions, the seeking of multiple answers, and the construction of meaning.

Inquiry

Inquiry learning provides students with opportunities to build knowledge, abilities, and inquiring habits of mind that lead to deeper understanding of their world and human experience. The inquiry process focuses on the development of compelling questions, formulated by teachers and students, to motivate and guide inquiries into topics, problems, and issues related to curriculum content and outcomes.

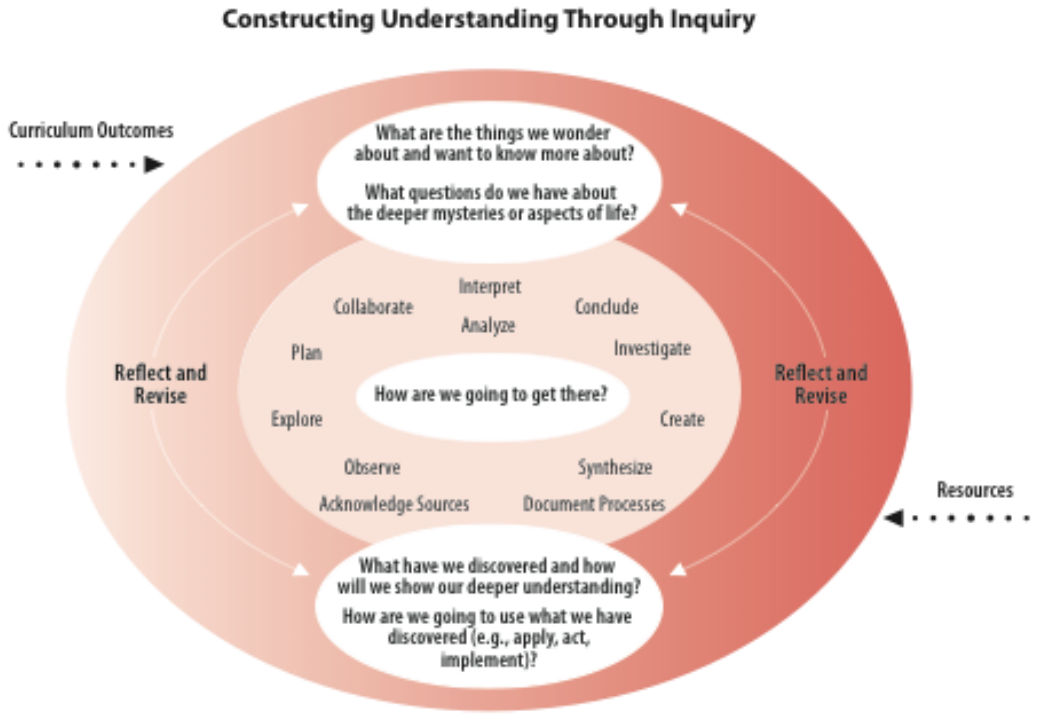
Inquiry is more than a simple instructional method. It is a philosophical approach to teaching and learning, grounded in constructivist research and methods, which engages students in investigations that lead to disciplinary and transdisciplinary understanding.

Inquiry builds on students' inherent sense of curiosity and wonder, drawing on their diverse backgrounds, interests, and experiences. The process provides opportunities for students to become active participants in a collaborative search for meaning and understanding. Students who are engaged in inquiry:

- construct deep knowledge and deep understanding rather than passively receiving it
- are directly involved and engaged in the discovery of new knowledge
- encounter alternative perspectives and conflicting ideas that transform prior knowledge and experience into deep understanding
- transfer new knowledge and skills to new circumstances
- take ownership and responsibility for their ongoing learning and mastery of curriculum content and skills.

(Adapted from Kuhlthau & Todd, 2008, p. 1)

Inquiry learning is not a step-by-step process, but rather a cyclical process, with various phases of the process being revisited and rethought as a result of students' discoveries, insights, and construction of new knowledge. The following graphic shows the cyclical inquiry process.



Inquiry prompts and motivates students to investigate topics within meaningful contexts. The inquiry process is not linear or lock-step, but is flexible and recursive. Experienced inquirers move back and forth through the cyclical process as new questions arise and as students become more comfortable with the process.

Well-formulated inquiry questions are broad in scope and rich in possibilities. They encourage students to explore, gather information, plan, analyze, interpret, synthesize, problem solve, take risks, create, conclude, document, reflect on learning, and develop new questions for further inquiry.

In mathematics, inquiry encompasses problem solving. Problem solving includes processes to get from what is known to discover what is unknown. When teachers show students how to solve a problem and then assign additional problems that are similar, the students are not problem solving but practising. Both are necessary in mathematics, but one should not be confused with the other. If the path for getting to the end situation has already been determined, it is no longer problem solving. Students too must understand this difference.

Creating Questions for Inquiry in Mathematics

Teachers and students can begin their inquiry at one or more curriculum entry points; however, the process may evolve into trans-disciplinary integrated learning opportunities, as reflective of the holistic nature of our lives and interdependent global environment. It is essential to develop questions that are evoked by students' interests and have potential for rich and deep learning. Compelling questions are used to initiate and guide the inquiry and give students direction for discovering deep understandings about a topic or issue under study.

The process of constructing inquiry questions can help students to grasp the important disciplinary or trans-disciplinary ideas that are situated at the core of a particular curricular focus or context. These broad questions will lead to more specific questions that can provide a framework, purpose, and direction for the learning activities in a lesson, or series of lessons, and help students connect what they are learning to their experiences and life beyond school.

Effective questions in mathematics are the key to initiating and guiding students' investigations, critical thinking, problem solving, and reflection on their own learning. Questions such as:

- "When would you want to add two numbers less than 100?"
- "How do you know you have an answer?"
- "Will this work with every number? Every similar situation?"
- "How does your representation compare to that of your partner?"

are examples of questions that will move students' inquiry towards deeper understanding. Effective questioning is essential for teaching and student learning, and should be an integral part of planning in mathematics. Questioning should also be used to encourage students to reflect on the inquiry process and the documentation and assessment of their own learning.

Questions should invite students to explore mathematical concepts within a variety of contexts and for a variety of purposes. When questioning students, teachers should choose questions that:

- *help students make sense of the mathematics.*
- *are open-ended, whether in answer or approach. There may be multiple answers or multiple approaches.*
- *empower students to unravel their misconceptions.*
- *not only require the application of facts and procedures but encourage students to make connections and generalizations.*
- *are accessible to all students in their language and offer an entry point for all students.*
- *lead students to wonder more about a topic and to perhaps construct new questions themselves as they investigate this newly found interest.*

(Schuster & Canavan Anderson, 2005, p. 3)

Reflection and Documentation of Inquiry

An important part of any inquiry process is student reflection on their learning and the documentation needed to assess the learning and make it visible. Student documentation of the inquiry process in mathematics may take the form of reflective journals, notes, drafts, models, and works of art, photographs, or video footage. This documentation should illustrate the students' strategies and thinking processes that led to new insights and conclusions. Inquiry-based documentation can be a source of rich assessment materials through which teachers can gain a more in-depth look into their students' mathematical understandings.

It is important that students are required to engage in the communication and representation of their progress within a mathematical inquiry. A wide variety of forms of communication and representation should be encouraged and, most importantly, have links made between them. In this way, student inquiry into mathematical concepts and contexts can develop and strengthen student understanding.

Overview of Math 18 and 28 Outcomes and Indicators

NUMBER	
Math 18	**Math 28**
N18.1 Demonstrate an understanding of whole numbers to 1 000. a. Represent numbers to 1 000. b. Describe numbers to 1 000. c. Compare two numbers up to 1 000. d. Order three or more numbers up to three digits. e. Hear a number up to three digits and write down the numeral. f. Skip count forward by 2's, 5's, 10's, and 100's. g. Skip count backward by 2's, 5's, 10's, and 100's.	**N28.1 Demonstrate an understanding of whole numbers to 1 000 000.** a. Represent numbers to 1 000 000. b. Describe numbers to 1 000 000. c. Compare two numbers up to 1 000 000. d. Order three or more numbers with up to six digits. e. Hear a number up to six digits and write down the numeral. f. Skip count forward by 2's, 3's, 4's, 5's, 10's, 25's, and 100's using any starting point. g. Skip count backward by 2's, 3's, 4's, 5's, 10's, 25's, and 100's using any starting point.
N18.2 Represent, compare and describe whole numbers to 1 000 within the contexts of place value and the base ten system. a. Write and say the numeral for a quantity using proper spacing. b. Identify the position of a digit in a given numeral. c. Pose and solve problems that explore the quantity of whole numbers. d. Express a number in expanded notation.	
	N28.2 Develop and apply personal strategies for estimation and computation. a. Front-end rounding. b. Compensation. c. Compatible numbers.

N18.3 Demonstrate an understanding of addition of whole numbers (up to 3 digits). a. Use personal strategies (including hundreds chart, ruler, manipulatives, calculator, etc.) for adding whole numbers. b. Estimate sums. c. Solve problems involving addition. d. Create problems involving addition. e. Relate subtraction to addition.	**N28.3 Extend understanding of addition, subtraction, multiplication, and division of whole numbers by solving single variable problems with whole numbers.** a. Identify aspects from daily life that could be represented by a variable (e.g., temperature, cost of an iPad, performance of a pitcher, etc.). b. Describe a situation for which a given equation could apply and identify what the variable would be. c. Solve single variable equations. d. Explain the strategies used to solve an equation. e. Verify the results of an equation.
N18.4 Demonstrate an understanding of subtraction of whole numbers (up to 3 digits). a. Use personal strategies (including hundreds chart, ruler, manipulatives, calculator, etc.) for subtracting whole numbers. b. Estimate differences. c. Solve problems involving subtraction. d. Create problems involving subtraction.	
N18.5 Demonstrate an understanding of multiplication of whole numbers (up to 3 digits x 1 digit multipliers). a. Use personal strategies (including a calculator, manipulatives, multiplication chart, etc.) to multiply whole numbers. b. Use arrays to represent multiplication. c. Estimate products. d. Solve problems involving multiplication. e. Create problems involving multiplication. f. Relate multiplication to division.	

N18.6 Demonstrate an understanding of division of whole numbers (up to 3 digits divided by 1 digit divisors). a. Use personal strategies (including a calculator, manipulatives, multiplication chart, etc.) to divide whole numbers. b. Estimate quotients. c. Solve problems involving division. d. Create problems involving division.	
N18.7 Demonstrate an understanding of fractions less than or equal to one. a. Represent a fraction using concrete materials. b. Name and record fractions for the parts of a whole or a set. c. Compare and order fractions with similar denominators. d. Create sets of equivalent fractions. e. Provide examples of fractions used in daily life. f. Provide examples of when two identical fractions may not represent the same quantity.	**N28.4 Extend understanding of fractions to improper fractions and mixed numerals.** a. Identity equivalent fractions. b. Convert a mixed number to a fraction and a fraction to a mixed number. c. Add and subtract proper and improper fractions with like denominators. d. Provide examples of improper fractions and mixed numerals in daily life.
N18.8 Demonstrate an understanding of decimals to the hundredths. a. Describe and represent decimal numbers to the hundredths. b. Add and subtract decimal numbers to the hundredths. c. Estimate sums and differences of decimal numbers to the hundredths. d. Solve problems with decimals to the hundredths. e. Relate decimal numbers to fractions.	**N28.5 Extend understanding of decimals to the hundredths.** a. Multiply and divide decimal numbers to the hundredths (with one-digit whole number multipliers or divisors). b. Estimate products and quotients of decimal numbers to the hundredths. c. Solve problems with decimals to the hundredths. d. Express a fraction as a decimal and a decimal as a fraction.
	N28.6 Demonstrate an understanding of percent. a. Describe examples of percents in daily life. b. Describe situations in which 0% or 100% may be used. c. Write percent as a decimal or fraction. d. Write a decimal as a percent. e. Write a fraction as a percent.

	N28.7 Operate a calculator accurately. a. Accurately calculate an operation involving the addition, subtraction, multiplication, or division of whole numbers. b. Accurately calculate an operation involving the addition, subtraction, multiplication, or division of fractions and/or mixed numbers. c. Accurately calculate an operation involving the addition, subtraction, multiplication, or division of decimals. d. Find the percent of a number using a calculator. e. Calculate sales tax. f. Calculate discounts.
PATTERNS AND RELATIONS	
Math 18	**Math 28**
PR18.1 Demonstrate an understanding of patterns and relations in tables, charts, diagrams and graphs. a. Identify and describe patterns on a multiplication chart. b. Describe and extend patterns found in a table or chart. c. Identify the sorting rule for a Venn diagram. d. Describe the relationship shown in a given Venn diagram where the circles intersect, when one circle is contained in the other, and when the circles are separate. e. Determine where new data should be placed in a Venn diagram. f. Compare graphs in which the same data has been displayed using one-to-one correspondences.	**PR28.1 Extend understanding of patterns and relations in tables, charts, diagrams and graphs.** a. Create a chart or table based on provided information. b. Solve problems using charts, tables, or diagrams to identify mathematical relationships. c. Compare graphs in which the same data has been displayed using one-to-one correspondence and many-to-one correspondence and explain how they are similar and different. d. Compare graphs in which different correspondences are used and explain why the correspondences may have been used. e. Research a current or past topic of interest relevant to First Nations and Métis peoples and present the data as a table or graph.
Shape and Space	
Math 18	**Math 28**

SS18.1 Demonstrate an understanding of time. a. Use standard and non-standard units of measure to mark the passage of time. b. Understand the concept of time using years, months, weeks, days, hours, and minutes. c. Describe activities related to daily life that involve the measurement of time. d. Identify today's date, day of the week, month of the year, and year. e. Locate a specific date on the calendar and identify strategy used to locate date. f. Order events according to time. g. Read and record time using 12-hour digital and analog clocks.	**SS28.1 Extend understanding of time.** a. Express time orally on both a 12-hour and 24-hour analog and digital clock. b. Write down time shown on both a 12-hour and 24-hour analog and digital clock. c. Express time as "minutes to" or "minutes after" the hour. d. Explain the meaning of AM and PM and provide examples of activities that occur in the AM and PM. e. Read and record calendar dates in a variety of formats.
SS18.2 Demonstrate an understanding of symmetry. a. Sort 2-D shapes into symmetrical and non-symmetrical categories. b. Identify lines of symmetry and explain why each shape is symmetrical. c. Determine whether or not a 2-D shape is symmetrical by folding or super-imposing.	
SS18.3 Demonstrate an understanding of regular and irregular 2-D shapes. a. Identify examples of 2-D shapes in the classroom, home, and community. b. Identify circles, squares, triangles, rectangles, semicircles, hexagons, octagons, pentagons, trapezoids, parallelograms, and rhombuses. c. Create and describe a concrete representation of a personally relevant 2-D shape. d. Sort quadrilaterals into rectangles, squares, trapezoids, parallelograms, and rhombuses.	**SS28.2 Extend understanding of regular and irregular 2-D shapes.** a. Calculate the perimeter of a variety of 2-D shapes. b. Calculate the area of a variety of 2-D shapes using the area formula.

SS18.4 Demonstrate an understanding of 3-D objects. a. Identify examples of 3-D objects in the classroom, home, and community. b. Identify pyramids, cubes, spheres, cones, and cylinders. c. Create and describe a concrete representation of a personally relevant 3-D object. d. Sort 3-D objects according to an attribute and describe the rule.	**SS28.3 Demonstrate an understanding of rectangular and triangular prisms.** a. Sort a set of rectangular and triangular prisms using the shape of the base. b. Identify examples of rectangular and triangular prisms in the environment. c. Construct rectangular and triangular prisms.
SS18.5 Demonstrate an understanding of mass (g and kg). a. Describe the relationship between g and kg. b. Estimate mass using g and kg. c. Measure and record mass using g and kg.	
SS18.6 Demonstrate an understanding of linear measurement (mm, cm, and m). a. Describe the relationship between mm, cm, and m. b. Estimate length and perimeter. c. Measure and record length, width, height, and perimeter. d. Calculate the perimeter of various shapes. e. Demonstrate an understanding of circles, including circumference. f. Demonstrate an understanding of area of a square, rectangle, triangle, and circle.	**SS28.4 Extend understanding of linear measurement (mm, cm, and m).** a. Sketch a line segment of an estimated length and describe the strategy used. b. Draw a 2-D shape given the measurements and/or perimeter of the shape.
SS18.7 Demonstrate an understanding of capacity (ml and l). a. Describe the relationship between ml and l. b. Estimate capacity using ml and l. c. Measure and record capacity using ml and l.	**SS28.5 Extend understanding of capacity to daily life.** a. Identify the unit of measure in a recipe. b. Measure the correct amount of ingredients with measuring utensils.
	SS28.6 Demonstrate an understanding of angles. a. Estimate the measure. b. Determine the angle measure in degrees. c. Draw angles.

	SS28.7 Demonstrate an understanding of temperature and how it relates to daily life. a. Accurately read a thermometer in degrees Celsius. b. Determine how temperature relates to daily life. c. Apply temperature to daily decisions (cooking, dressing, etc.).
Statistics and Probability	
Math 18	**Math 28**
SP18.1 Demonstrate an understanding of graphs. a. Formulate a question relevant to one's self, family, or community that can be answered by gathering information from people. b. Pose questions related to gathered data and explain how data can be used to answer those questions. c. Create a graph to display collected data.	**SP28.1 Extend an understanding of graphs.** a. Find examples of graphs in which a many-to-one correspondence is used in print and electronic media, such as newspapers, magazines, and the internet, and describe the correspondence used. b. Create and label (with categories, title, and legend) a pictograph to display a set of data using a many-to-one correspondence, and justify the choice of correspondence used. c. Create and label (with axes and title) a bar graph to display a set of data using a many-to-one correspondence, and justify the choice of correspondence used. d. Answer a question using a graph in which data is displayed using a many-to-one correspondence.
SP18.2 Demonstrate an understanding of first-hand data using tally marks, charts, lists, bar graphs, and line plots. a. Observe and describe situations relevant to self, family, or community in which a particular type of data recording or organizational strategy might be used, including tally marks, charts, lists, and knots on a sash. b. Create a line plot from a pictograph. c. Answer questions related to the data presented in a bar graph or line plot. d. Collect and represent data using bar graphs or line plots.	**SP28.2 Extend understanding of data analysis.** a. Create graphs from given data. b. Collect data through questionnaires. c. Collect data through experiments. d. Draw conclusions from data collected. e. Report conclusions.

Consumer Math	
Math 18	**Math 28**
CM18.1 Demonstrate an understanding of coins and bills up to $100.00. a. Identify names and values of coins and bills up to $100.00. b. Count bills and coins up to $100.00. c. Make change by using subtraction and counting back.	
	CM28.1 Demonstrate an understanding of income. a. Calculate daily and weekly wages involving regular pay. b. Determine the difference between gross and net pay by calculating deductions using CPP, income tax, and EI charts.
CM18.2 Apply understanding of money. a. Calculate the unit price of items sold in multiples. b. Compare prices between products based on equivalent number and sizes.	**CM28.2 Demonstrate an understanding of budget.** a. Define and explain the purpose of a budget. b. Determine fixed and variable expenses for the month. c. Plan a budget based on percentages allotted to various categories as suggested by financial institutions. d. Stay within a budget and adjust a budget as necessary. e. Estimate the cost of groceries and decide if you can make the purchase. f. Calculate the cost of a purchase.
	CM28.3 Demonstrate an understanding of credit. a. Define credit and determine its appropriate use. b. Determine why a good credit rating is important. c. Describe how to get a good credit rating. d. Describe how to use credit wisely. e. Find the monthly interest charges and service charges on unpaid credit balance.

	CM28.4 Demonstrate an understanding of banking. a. Know the definitions for banking terms (interest, deposit overdraft, withdrawal, service charges, safety deposit box, travelers' cheques, balance, debit, credit, NSF cheques, bonds, bounced cheques). b. Know the difference between a chequing account and a savings account. c. Write a cheque and know how to cash it. d. Know how to use an ATM machine and a debit card. e. Calculate simple interest with the use of a calculator or chart.
	CM28.5 Demonstrate a basic understanding of loans. a. Identify reasons for getting a loan. b. Complete a loan application. c. Determine the cost of the loan and how it fits within a budget.

Outcomes and Indicators

Number

N28.1 Demonstrate an understanding of whole numbers to 1 000 000.

a. Represent numbers to 1 000 000.
b. Describe numbers to 1 000 000.
c. Compare two numbers up to 1 000 000.
d. Order three or more numbers with up to six digits.
e. Hear a number up to six digits and write down the numeral.
f. Skip count forward by 2's, 3's, 4's, 5's, 10's, 25's, and 100's using any starting point.
g. Skip count backward by 2's, 3's, 4's, 5's, 10's, 25's, and 100's using any starting point.

N28.2 Develop and apply personal strategies for estimation and computation.

a. Front-end rounding.
b. Compensation.
c. Compatible numbers.

N28.3 Extend understanding of addition, subtraction, multiplication, and division of whole numbers by solving single variable problems with whole numbers.

a. Identify aspects from daily life that could be represented by a variable (e.g., temperature, cost of an iPad, performance of a pitcher, etc.).
b. Describe a situation for which a given equation could apply and identify what the variable would be.
c. Solve single variable equations.
d. Explain the strategies used to solve an equation.
e. Verify the results of an equation.

N28.4 Extend understanding of fractions to improper fractions and mixed numerals.

a. Identity equivalent fractions.
b. Convert a mixed number to a fraction and a fraction to a mixed number.
c. Add and subtract proper and improper fractions with like denominators.
d. Provide examples of improper fractions and mixed numerals in daily life.

N28.5 Extend understanding of decimals to the hundredths.

a. Multiply and divide decimal numbers to the hundredths (with one-digit whole number multipliers or divisors).
b. Estimate products and quotients of decimals numbers to the hundredths.
c. Solve problems with decimals to the hundredths.
d. Express a fraction as a decimal and a decimal as a fraction.

N28.6 Demonstrate an understanding of percent.

a. Describe examples of percents in daily life.
b. Describe situations in which 0% or 100% may be used.
c. Write percent as a decimal or fraction.
d. Write a decimal as a percent.
e. Write a fraction as a percent.

N28.7 Operate a calculator accurately.

a. Accurately calculate an operation involving the addition, subtraction, multiplication, or division of whole numbers.

b. Accurately calculate an operation involving the addition, subtraction, multiplication, or division of fractions and/or mixed numbers.
c. Accurately calculate an operation involving the addition, subtraction, multiplication, or division of decimals.
d. Find the percent of a number using a calculator.
e. Calculate sales tax.
f. Calculate discounts.

Patterns and Relations

PR28.1 Extend understanding of patterns and relations in tables, charts, diagrams and graphs.

a. Create a chart or table based on provided information.
b. Solve problems using charts, tables, or diagrams to identify mathematical relationships.
c. Compare graphs in which the same data has been displayed using one-to-one correspondence and many-to-one correspondence and explain how they are similar and different.
d. Compare graphs in which different correspondences are used and explain why the correspondences may have been used.

Shape and Space

SS28.1 Extend understanding of time.

a. Express time orally on both a 12-hour and 24-hour analog and digital clock.
b. Write down time shown on both a 12-hour and 24-hour analog and digital clock.
c. Express time as “minutes to” or “minutes after” the hour.
d. Explain the meaning of AM and PM and provide examples of activities that occur in the AM and PM.
e. Read and record calendar dates in a variety of formats.

SS28.2 Extend understanding of regular and irregular 2-D shapes.

a. Calculate the perimeter of a variety of 2-D shapes.
b. Calculate area of a variety of 2-D shapes using the area formula.

SS28.3 Demonstrate an understanding of rectangular and triangular prisms.

a. Sort a set of rectangular and triangular prisms using the shape of the base.

b. Identify examples of rectangular and triangular prisms in the environment.
c. Construct rectangular and triangular prisms.

SS28.4 Extend understanding of linear measurement (mm, cm, and m).

a. Sketch a line segment of an estimated length and describe the strategy used.
b. Draw a 2-D shape given the measurements and/or perimeter of the shape.

SS28.5 Extend understanding of capacity to daily life.

a. Identify the unit of measure in a recipe.
b. Measure the correct amount of ingredients with measuring utensils.

SS28.6 Demonstrate an understanding of angles.

a. Estimate the measure.
b. Determine the angle measure in degrees.
c. Draw angles.

SS28.7 Demonstrate an understanding of temperature and how it relates to daily life.

a. Accurately read a thermometer in degrees Celsius.
b. Determine how temperature relates to daily life.
c. Apply temperature to daily decisions (cooking, dressing, etc.).

Statistics and Probability

SP28.1 Extend an understanding of graphs.

a. Find examples of graphs in which a many-to-one correspondence is used in print and electronic media, such as newspapers, magazines, and the internet, and describe the correspondence used.
b. Create and label (with categories, title, and legend) a pictograph to display a set of data using a many-to-one correspondence, and justify the choice of correspondence used.
c. Create and label (with axes and title) a bar graph to display a set of data using a many-to-one correspondence, and justify the choice of correspondence used.
d. Answer a question using a graph in which data are displayed using a many-to-one correspondence.

SP28.2 Extend understanding of data analysis.

a. Create graphs from given data.
b. Collect data through questionnaires.
c. Collect data through experiments.
d. Draw conclusions from data collected.
e. Report conclusions.

Consumer Math

CM28.1 Demonstrate an understanding of income.

a. Calculate daily and weekly wages involving regular pay.
b. Determine the difference between gross and net pay by calculating deductions using CPP, income tax, and EI charts.

CM28.2 Demonstrate an understanding of budget.

a. Define and explain the purpose of a budget.
b. Determine fixed and variable expenses for the month.
c. Plan a budget based on percentages allotted to various categories as suggested by financial institutions.
d. Stay within a budget and adjust a budget as necessary.
e. Estimate the cost of groceries and decide if you can make the purchase.
f. Calculate the cost of a purchase.

CM28.3 Demonstrate an understanding of credit.

a. Define credit and determine its appropriate use.
b. Determine why a good credit rating is important.
c. Describe how to get a good credit rating.
d. Describe how to use credit wisely.
e. Find the monthly interest charges and service charges on unpaid credit balance.

CM28.4 Demonstrate an understanding of banking.

a. Know the definitions for banking terms (interest, deposit overdraft, withdrawal, service charges, safety deposit box, travelers' cheques, balance, debit, credit, NSF cheques, bonds, bounced cheques).
b. Know the difference between a chequing account and a savings account.
c. Write a cheque and know how to cash it.
d. Know how to use an ATM machine and a debit card.
e. Calculate simple interest with the use of a calculator or chart.

CM28.5 Demonstrate a basic understanding of loans.

a. Identify reasons for getting a loan.
b. Complete a loan application.
c. Determine the cost of the loan and how it fits within a budget.

Number

UbD Planning Document

Good Spirit School Division UbD Unit Plan		
Teacher:	**Subject: Math**	**Grade: Eleven – Level 28**
Unit Title: Number		
Context (ELA only):	**Type of Unit (ELA only):**	
Time Frame:		
STAGE ONE: IDENTIFY THE DESIRED RESULTS		
Outcomes Addressed in the Unit **SK curriculum outcomes can be copied and pasted, focuses highlighted.**		

N28.1 Demonstrate an understanding of whole numbers to 1 000 000.
N28.2 Develop and apply personal strategies for estimation and computation.
N28.3 Extend understanding of addition, subtraction, multiplication, and division of whole numbers by solving single variable problems with whole numbers.
N28.4 Extend understanding of fractions to improper fractions and mixed numerals.
N28.5 Extend understanding of decimals to the hundredths.
N28.6 Demonstrate an understanding of percent.
N28.7 Operate a calculator accurately.

Big Ideas/Enduring Understandings **What do you want students to understand and be able to use several years from now?** **What are the BIG ideas?**	**Essential Questions** **Open-ended questions that stimulate thought and inquiry linked to the content of the enduring understandings.**
- Numbers are an important part of our daily lives. - There are different ways to solve problems. - Different people use different strategies to solve problems. - Fractions and decimals are all around us.	- Why are numbers important in our daily lives? - How are adding larger numbers like adding smaller numbers? - When is it best to estimate a product? - What strategy should I use to estimate? - What strategy should I use to solve a problem? - Why did I choose that strategy?

Knowledge and Skills (Students will know and do…) **What key knowledge and skills will students acquire as a result of this unit?** **(These may be indicators from the curriculum)**	
Knowledge (Students will know…) **What key knowledge will students acquire as a result of this unit?**	**Skills (Students will know how to…)** **What key skills will students acquire as a result of this unit?**

- the importance of place value when adding, subtracting, multiplying, and dividing whole numbers. - adding and subtracting larger numbers is similar to adding and subtracting smaller numbers (e.x., finding the total, how much larger is one number from the other, etc.). - problems can be solved by using different operations depending on the approach taken. - when to use estimation. - the definitions for a fraction, a decimal, a mixed fraction, an improper fraction, etc. - the meaning of the % sign. - the purpose of using a calculator.	- use different strategies to solve a problem. - explain the strategies they used to solve problems involving whole numbers. - determine the correct answer to addition, subtraction, multiplication and division questions. - choose numbers for estimation and be able to explain why they chose those numbers. - create and solve different problems involving whole numbers to 1 000 000. - convert fractions to decimals and decimals to fractions. - add and subtract fractions. - add, subtract, multiply and divide decimals to the hundredths. - write decimals as fractions and fractions as decimals. - operate a calculator accurately. - calculate sales tax and discounts.

STAGE TWO: DESIGN ASSESSMENT EVIDENCE

Assessment Evidence

Summative Assessments/Performance Tasks

Assessments of what students know and can do aligned to the outcomes. They are a snapshot in time used for reporting and evaluating.

Outcomes/Objectives	Co-construct criteria and/or rubrics with students whenever possible. Examples of Summative Assessments/Performance Tasks include:
N28.1, N28.2, N28.3, N28.4, N28.5, N28.6, N28.7	**News Reporters -** Students are news reporters and are to write an article about key discoveries they make during the numbers unit.
	Design a Game - Provide students with a list of concepts and skills they developed during the numbers unit. Students choose one or two concepts/skills and design a game that uses these concepts/skills. Have a games afternoon and let students play the games they create and those made by their classmates.
	Math Fair - Co-construct a set of criteria with your students for projects at a math fair. Give students time in class to prepare their projects and have them present their projects to another class or at a parent's evening.

Formative Assessments

Through what multiple sources of evidence will students demonstrate their understanding on a continual basis?
These help guide instruction and provide feedback to students.

Examples of possible formative assessments include:

Personal Connections Journal - At regular intervals, provide students with time to write in their math journals. Encourage students to make personal connections to their learning. Students write about what they are learning and how it connects to their daily lives and to the world around them.

Three Facts and a Fib - Use a version of the three facts and a fib strategy with your numbers unit. Ask students to write four questions and answers that relate to a current topic such as estimation or two digit multiplication. Tell students to include the correct answers for three of the question and to include one wrong answer. Students can share their questions and answers with classmates. The students try to discover the question that was answered incorrectly.

Exit Cards - Provide students with exit cards at the end of class. Students demonstrate their understanding of concepts/skills they practiced during math class by completing one or two questions related to the topic being studied.

Pre-Assessments

Pre-assessments are used to determine what students know and their readiness level to inform instruction.

Examples of possible pre-assessments include:

What I Know - Provide students with a piece of paper and encourage them to write what they know about numbers. Return these sheets to students throughout the unit and have them add further information they learn about the topic. Encourage students to date their entries to provide a visual of student learning.

ABCD Response Cards - Give each student a set of four cards. Each set of cards will include an 'A' card, a 'B' card, a 'C' card and a 'D' card. Ask students a question and give them four possible responses. Students hold up the card that matches their response.

Fist to Five - To get a read on what your students know about numbers, present a number of questions or statements to your students and have them hold up the correct number of fingers for their understanding. If they fully understand, they hold up 5 fingers. If they sort of understand but need more instruction, they hold up three fingers. If they know nothing about the topic, they hold up their fist.

STAGE THREE: CREATE THE LEARNING PLAN

Instructional Plan

The Instructional Plan should include a sequence of lessons, teaching strategies, and information on First Nation, Inuit and Metis Content integration and technology integration.

The instructional plan will depend on the unique learning needs of the students in each Math 28 class. Through pre- and formative assessments, plan activities and learning opportunities that target your students' unique learning needs. Possible activities and strategies may include:

N28.1 Demonstrate an understanding of whole numbers to 1 000 000.

- Have students draw a card that has a three to six digit number on it. Ensure that one of the numerals is highlighted. Students identify the place value of the highlighted numeral and then they read the number that is on the card.
- Set up math centres that include activities students must complete that focus on their understanding of whole numbers (e.g., skip counting, ordering numbers, greater than or less than, etc.).

N28.2 Develop and apply personal strategies for estimation and computation.

- Walk through the process of front-end rounding with students.
- Provide students with a visual, or have them create a visual, that focuses on estimating and its process.

N28.3 Extend understanding of addition, subtraction, multiplication, and division of whole numbers by solving single variable problems with whole numbers.

- Discuss different examples in the students' lives when an understanding of the four basic operations will be useful to them (e.g., buying a new bike, getting groceries, packing for a trip, etc.).
- Have students write their own problems and then ask their classmates solve them.

N28.4 Extend understanding of fractions to improper fractions and mixed numerals.

- Discuss with students how they can identify equivalent fractions. Provide students with practice in developing this skill.
- Talk about cooking and why it is important to understand fractions when reading a recipe.

N28.5 Extend understanding of decimals to the hundredths.

- Give students the opportunity to practice adding, subtracting, multiplying and dividing numbers to the hundredths.
- Explicitly teach the connection between numbers to the hundredths and money.

N28.6 Demonstrate an understanding of percent.

- Brainstorm a list of percents that are seen or used in daily life. Discuss what 0% and 100% mean and when they are used.
- Practice converting a decimal and a fraction to a percent.

N28.7 Operate a calculator accurately.

- Calculators are useful tools that enable us to perform calculations that we are unable to manually or that would take too long to compute. Explain the need to operate a calculator accurately to ensure people can make informed decisions (e.g., interest on a loan, having enough money to buy groceries, etc.).
- Teach students how to calculate sales tax or discounts on products.

Key Resources

Support Materials: Math Makes Sense Math Strategies that Multiply: The Best of Times by Greg Tang Children Are Mathematical Problem Solvers by Lynae Sakshaug, Melfriend Olson, and Judith Olson Extending the Challenge in Mathematics: Developing Mathematical Promise in K-8 Schools Good Questions for Math Teaching: Why Ask Them and What to Ask Grades 5-8 It All Adds Up: Engaging 8 to 12 Year Olds in Math Investigations

Patterns and Relations

UbD Planning Document

Good Spirit School Division UbD Unit Plan		
Teacher:	**Subject: Math**	**Grade: Eleven – Level 28**
Unit Title: Patterns and Relations		
Context (ELA only):	**Type of Unit (ELA only):**	
Time Frame:		
STAGE ONE: IDENTIFY THE DESIRED RESULTS		
Outcomes Addressed in the Unit **SK curriculum outcomes can be copied and pasted, focuses highlighted.**		
PR 28.1 Extend understanding of patterns and relations in tables, charts, diagrams, and graphs.		
Big Ideas/Enduring Understandings **What do you want students to understand and be able to use several years from now?** **What are the BIG ideas?**	**Essential Questions** **Open-ended questions that stimulate thought and inquiry linked to the content of the enduring understandings.**	
- Tables, charts, diagrams, and graphs provide us with useful information. - Data is used by the media. - Different people can interpret data in different ways.	- What are the different forms of data? - How can we use charts and graphs in our daily lives?	

Knowledge and Skills (Students will know and do…)

What key knowledge and skills will students acquire as a result of this unit?
(These may be indicators from the curriculum)

Knowledge (Students will know…) What key knowledge will students acquire as a result of this unit?	Skills (Students will know how to…) What key skills will students acquire as a result of this unit?
- the definition of first-hand data. - what a table, graph, chart, and diagram are used for.	- identify the similarities and differences between graphs using one-to-one and many-to-one correspondences. - use tables, charts, diagrams, and graphs to solve problems.

STAGE TWO: DESIGN ASSESSMENT EVIDENCE

Assessment Evidence

Summative Assessments/Performance Tasks

Assessments of what students know and can do aligned to the outcomes. They are a snapshot in time used for reporting and evaluating.

Outcomes/Objectives	Co-construct criteria and/or rubrics with students whenever possible. Examples of Summative Assessments/Performance Tasks include:
PR28.1	**Graph Comparison** - Provide students with two different graphs and have them identify the similarities and differences between the graphs.
	Problem Solving - Students solve problems using charts, diagrams, and tables. Ask students to explain the strategies they used to solve the problems.
	Graph Scrapbook - Provide each student with a scrapbook. Have students collect different types of graphs throughout the unit. Encourage students to talk or write about the data in each graph.

Formative Assessments

Through what multiple sources of evidence will students demonstrate their understanding on a continual basis?
These help guide instruction and provide feedback to students.

Examples of possible formative assessments include:

Personal Connections Journal - At regular intervals, provide students with time to write in their math journals. Encourage students to make personal connections to their learning. Students write about what they are learning and how it connects to their daily lives and to the world around them.

Four Corners - Use the four corners strategy to quickly assess what your students know about a concept you are studying in class. Place four responses in each corner of the classroom and have students move toward the response they believe to be correct. Encourage students to share their reasons for choosing their response.

Two Stars and a Wish - Use a version of the two stars and a wish strategy. At different points during the unit, have students identify two things they have learned during the unit. Ask them to identify one question or "wish" they have about the patterns and relations unit.

Pre-Assessments **Pre-assessments are used to determine what students know and their readiness level to inform instruction.**
Examples of possible pre-assessments include: **Class Discussion** - Before beginning your unit on patterns and relations, compose a few key questions that will target student knowledge. Discuss these questions with the students to gain an understanding of their current level of knowledge surrounding the topic of study. **Chart, Table or Graph** - Provide students with a chart, table, or graph and no further information. Ask students to identify two or three things about the visual. Their responses will provide you with information about their knowledge and experiences with these types of materials. **Turn and Talk** - Give students target words and phrases that you want them to "turn and talk" to their neighbour about. Circulate through the class during these discussions and listen to the responses of the students.
STAGE THREE: CREATE THE LEARNING PLAN
Instructional Plan **The Instructional Plan should include a sequence of lessons, teaching strategies, and information on First Nation, Inuit and Metis Content integration and technology integration.**
The instructional plan will depend on the unique learning needs of the students in each Math 28 class. Through pre- and formative assessments, plan activities and learning opportunities that target your students' unique learning needs. Possible activities and strategies may include: **PR 28.1 Extend understanding of patterns and relations in tables, charts, diagrams, and graphs.** - Provide students with data and have them create a chart or table with the information. - Present students with different problems and give them copies of charts, tables, or graphs that will help them solve the problems.
Key Resources
Support Materials: Math Makes Sense Extending the Challenge in Mathematics: Developing Mathematical Promise in K-8 Schools Good Questions for Math Teaching: Why Ask Them and What to Ask Grades 5-8

Shape and Space

UbD Planning Document

Good Spirit School Division UbD Unit Plan		
Teacher:	**Subject: Math**	**Grade: Eleven - Level 28**

Unit Title: Shape and Space	
Context (ELA only):	**Type of Unit (ELA only):**
Time Frame:	

STAGE ONE: IDENTIFY THE DESIRED RESULTS

Outcomes Addressed in the Unit

SK curriculum outcomes can be copied and pasted, focuses highlighted.

SS28.1 Extend understanding of time.
SS28.2 Extend understanding of regular and irregular 2-D shapes.
SS28.3 Demonstrate an understanding of rectangular and triangular prisms.
SS28.4 Extend understanding of linear measurement (mm, cm, and m).
SS28.5 Extend understanding of capacity to daily life.
SS28.6 Demonstrate an understanding of angles.
SS28.7 Demonstrate an understanding of temperature and how it relates to daily life.

Big Ideas/Enduring Understandings **What do you want students to understand and be able to use several years from now?** **What are the BIG ideas?**	**Essential Questions** **Open-ended questions that stimulate thought and inquiry linked to the content of the enduring understandings**.
- Time can be represented in a variety of ways. - We need standardized measures of time (seconds, minutes, hours, etc.). - Time helps us to organize our lives. - There are rectangular and triangular prisms in our world. - Knowing how to measure the length of an object has many real-life applications. - Temperature affects the way we live.	- How can time be represented? - When and why do we tell time on an analog clock? … on a digital clock? - What are the advantages and disadvantages of analog clocks and digital clocks? - When is it important to know the area of an object or space? - How are rectangular and triangular prisms the same and different? - When is knowing the length of an object important? - What is the best strategy for determining the capacity of a container? - What role do angles play in daily life?

Knowledge and Skills (Students will know and do…)

What key knowledge and skills will students acquire as a result of this unit?
(These may be indicators from the curriculum)

Knowledge (Students will know…) **What key knowledge will students acquire as a result of this unit?**	**Skills (Students will know how to…)** **What key skills will students acquire as a result of this unit?**

- there are different ways to record time. - there are different ways to write today's date. - how area and multiplication are related to each other. - that different shapes can have the same area. - when to use different units for area measurements. - the definition of an attribute and a prism. - there are different units of measurement. - the definition of capacity. - what an angle is.	- write and read time on a 12-hour and 24-hour clock. - estimate the area of a 2-D shape using square units of measure. - use grid paper to determine the area of a shape. - construct different 2-D shapes using manipulatives or grid paper. - determine the exact area of a shape and explain strategy used to determine area. - sort prisms. - determine what is common between prisms and what is different. - identify rectangular and triangular prisms found within school, home, and community. - draw and construct rectangular and triangular prisms. - express the same length using different units. - use length in different real life situations. - use a ruler properly. - explain why a unit of measurement was chosen. - solve problems involving measurement. - determine the capacity of a container. - construct an angle. - measure an angle. - read a thermometer. - use knowledge of temperature to make decisions in daily life.

STAGE TWO: DESIGN ASSESSMENT EVIDENCE

Assessment Evidence

Summative Assessments/Performance Tasks

Assessments of what students know and can do aligned to the outcomes. They are a snapshot in time used for reporting and evaluating.

Outcomes/Objectives	Co-construct criteria and/or rubrics with students whenever possible. Examples of Summative Assessments/Performance Tasks include:
SS28.1, SS28.2, SS28.3, SS28.4, SS28.5, SS28.6, SS28.7	**Power Point Presentation -** Students create a power point presentation that focuses on the information they have learned about 2-D shapes, 3-D objects, and measurement. When completed, have students present their power points to the rest of the class.
	Dictionary - Have students create a dictionary of all terms used throughout the space and shape unit. Encourage students to include details in their definitions. Students could also include pictures and diagrams when appropriate.
	Demonstration - To gain an understanding of student learning, ask students to demonstrate different tasks - how to read a thermometer, how to construct a given angle, how to determine the area of an object, etc.

Formative Assessments

Through what multiple sources of evidence will students demonstrate their understanding on a continual basis? These help guide instruction and provide feedback to students.

Examples of possible formative assessments include:

Personal Connections Journal - At regular intervals, provide students with time to write in their math journals. Encourage students to make personal connections to their learning. Students write about what they are learning and how it connects to their daily lives and to the world around them.

Thumbs Up, Thumbs Down - Periodically throughout the unit, ask students to rate their understanding of the material you are presenting. Students give a thumbs up if they understand and a thumbs down if they don't understand. If they are on their way to understanding but need further instruction, they can hold their thumb sideways.

Problem Solving - Present students with a number of different problems that involve measurement and have them solve the problems using the information they are learning during the unit.

Pre-Assessments

Pre-assessments are used to determine what students know and their readiness level to inform instruction.

Examples of possible pre-assessments include:

Sticky Notes - Provide students with a sticky note. Ask students to draw and/or write down everything they know about shape and space on the sticky note.

Entrance Tickets - At the start of class, give students an entrance ticket that they must complete. Have students answer questions or solve problems related to the day's lesson. A quick glance through the entrance tickets will provide you with information on how to target your instruction.

Three Questions - Give students the topic of "shapes and space." Explain that the class will be beginning a new unit of study. Ask students to come up with three questions they have about this topic. You can either have students write these questions down or brainstorm a list and record the questions on the Smart Board or chart paper. Continue to add questions asked by the students throughout the unit.

STAGE THREE: CREATE THE LEARNING PLAN

Instructional Plan

The Instructional Plan should include a sequence of lessons, teaching strategies, and information on First Nation, Inuit and Metis Content integration and technology integration.

The instructional plan will depend on the unique learning needs of the students in each Science 28 class. Through pre- and formative assessments, plan activities and learning opportunities that target your students' unique learning needs. Possible activities and strategies may include:

SS28.1 Extend understanding of time.
- Explain the connection between the 12-hour and 24-hour clock. Give students the opportunity to practice using both types of clocks.
- Ensure students understand the concepts of AM and PM.

SS28.2 Extend understanding of regular and irregular 2-D shapes.
- Discuss the difference between area and perimeter and allow students time to practice calculating each.
- Make visuals of the steps needed to calculate area and perimeter.

SS28.3 Demonstrate an understanding of rectangular and triangular prisms.
- Bring in different examples of rectangular and triangular prisms and have students sort these objects based on set criteria.
- Let students create concrete examples of the different types of prisms.

SS28.4 Extend understanding of linear measurement (mm, cm, and m).
- We use measurement on a daily basis. Brainstorm a list of the different uses we encounter during the day. Keep this list throughout the unit so students can add new ideas.
- Provide opportunities for students to apply their knowledge of linear measurement in practical ways (e.g., in sewing, woodworking, etc.).

SS28.5 Extend understanding of capacity to daily life.
- Bake cookies or follow a simple recipe. Students can apply what they have learned about capacity as they follow the recipe.
- Have students create a recipe book and make connections between the list of ingredients and their measurements and the knowledge they have about fractions. Students can convert mixed fractions to irregular and irregular fractions to mixed to get an idea about what the amounts of ingredients in the recipe mean.

SS28.6 Demonstrate an understanding of angles.
- Create cards with different angles and have students measure and record the each angle's measurement.
- Provide students with angle measurements and have students draw the angles.

SS28.7 Demonstrate an understanding of temperature and how it relates to daily life.
- Keep a daily log of the outside temperature and record how the temperature affects daily life (e.g., need to wear a winter coat, bring an umbrella to school, etc.).
- Provide opportunities for students to read and record temperatures on a thermometer.

Key Resources

Support Materials: Math Makes Sense Extending the Challenge in Mathematics: Developing Mathematical Promise in K-8 Schools Geometry: Seeing, Doing, Understanding Good Questions for Math Teaching: Why Ask Them and What to Ask Grades 5-8

Statistics and Probability

UbD Planning Document

Good Spirit School Division UbD Unit Plan		
Teacher:	**Subject: Math**	**Grade: Eleven – Level 28**
Unit Title: Statistics and Probability		
Context (ELA only):	**Type of Unit (ELA only):**	
Time Frame:		
STAGE ONE: IDENTIFY THE DESIRED RESULTS		
Outcomes Addressed in the Unit **SK curriculum outcomes can be copied and pasted, focuses highlighted.**		
SP28.1 Extend an understanding of graphs. SP28.2 Extend understanding of data analysis.		
Big Ideas/Enduring Understandings **What do you want students to understand and be able to use several years from now?** **What are the BIG ideas?**	**Essential Questions** **Open-ended questions that stimulate thought and inquiry linked to the content of the enduring understandings.**	
- There are different ways we can organize data and report our findings. - We use data for many things.	- How can I gather information to answer my questions? - When is it appropriate to conduct a survey? - How can survey results be displayed? - Why do we create graphs? - What information can we gather from graphs?	

<table>
<tr><td colspan="2"><u>Knowledge and Skills (Students will know and do…)</u>
What key knowledge and skills will students acquire as a result of this unit?
(These <u>may</u> be indicators from the curriculum)</td></tr>
<tr><td>Knowledge (Students will know…)
What key <u>knowledge</u> will students acquire as a result of this unit?</td><td>Skills (Students will know how to…)
What key <u>skills</u> will students acquire as a result of this unit?</td></tr>
<tr><td>- the steps to conducting a survey.
- the meaning of data, attribute, purpose, and interpret.
- the purpose of using a graph.</td><td>- formulate a survey question.
- gather survey data.
- interpret meaningful data.
- create a graph.
- report findings.
- draw conclusions from findings.</td></tr>
<tr><td colspan="2">STAGE TWO: DESIGN ASSESSMENT EVIDENCE</td></tr>
<tr><td colspan="2">Assessment Evidence</td></tr>
<tr><td colspan="2"><u>Summative Assessments/Performance Tasks</u>
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<tr><td>Outcomes/Objectives</td><td>Co-construct criteria and/or rubrics with students whenever possible. Examples of Summative Assessments/Performance Tasks include:</td></tr>
<tr><td rowspan="3">SP28.1, SP28.2</td><td>Survey Results - Present students with a set of survey results. Ask students to display the information in a number of different ways and explain the reasons for their choices.</td></tr>
<tr><td>Visual Presentations - Challenge students to visually represent what they have learned during the unit on statistics and probability.</td></tr>
<tr><td>Draw Conclusions - Provide students with a copy of a graph and have them draw conclusions based on the information displayed on the graph.</td></tr>
<tr><td colspan="2"><u>Formative Assessments</u>
Through what multiple sources of evidence will students demonstrate their understanding on a continual basis?
These help guide instruction and provide feedback to students.</td></tr>
</table>

Examples of possible formative assessments include:

Personal Connections Journal - At regular intervals, provide students with time to write in their math journals. Encourage students to make personal connections to their learning. Students write about what they are learning and how it connects to their daily lives and to the world around them.

Web - Provide students with a word or phrase that represents an area of study. For example, you may want to give students the word "survey" or "data analysis." Ask students to create a web, using words, phrases, or illustrations.

One Sentence Summary - Give students a template or a scrap piece of paper. Have students write a one sentence summary about what they learned in a lesson or up to a given point in the unit.

Pre-Assessments

Pre-assessments are used to determine what students know and their readiness level to inform instruction.

Examples of possible pre-assessments include:

Give One, Get One - Provide students with a give one, get one graphic organizer. Students list 3 to 5 things they know about statistics and probability in the 'give' column of the template. Students then circulate around the classroom and have conversations with their classmates. They "give" an idea and then "get" an idea and write the new idea in the 'get' column.

White Board Brainstorm - Similar to the graffiti wall, place a word, phrase, or question at the top of your white board. As students come into the classroom, have them add their understandings to the white board. They can either write or draw their responses or ask someone to scribe their ideas for them.

Doodle It - Provide students with a topic and a piece of blank paper. Ask students to doodle about the topic.

STAGE THREE: CREATE THE LEARNING PLAN

Instructional Plan

The Instructional Plan should include a sequence of lessons, teaching strategies, and information on First Nation, Inuit and Metis Content integration and technology integration.

The instructional plan will depend on the unique learning needs of the students in each Science 28 class. Through pre- and formative assessments, plan activities and learning opportunities that target your students' unique learning needs. Possible activities and strategies may include:

SP28.1 Extend an understanding of graphs.

- Practice creating graphs for given data. Discuss the importance of labels on graphs and why they need to be included.
- Have students answer questions based on the information from the graphs.

SP28.2 Extend understanding of data analysis.

- Ask students to work through the survey process and then analyze the data they collected to draw conclusions from their findings.

Key Resources

Support Materials: Math Makes Sense Extending the Challenge in Mathematics: Developing Mathematical Promise in K-8 Schools Good Questions for Math Teaching: Why Ask Them and What to Ask Grades 5-8

Consumer Math

UbD Planning Document

Good Spirit School Division UbD Unit Plan		
Teacher:	**Subject: Math**	**Grade: Eleven - Level 28**
Unit Title: Consumer Math		
Context (ELA only):	**Type of Unit (ELA only):**	
Time Frame:		
STAGE ONE: IDENTIFY THE DESIRED RESULTS		
Outcomes Addressed in the Unit **SK curriculum outcomes can be copied and pasted, focuses highlighted.**		
CM28.1 Demonstrate an understanding of income. CM28.2 Demonstrate an understanding of budget. CM28.3 Demonstrate an understanding of credit. CM28.4 Demonstrate an understanding of banking. CM28.5 Demonstrate a basic understanding of loans.		
Big Ideas/Enduring Understandings **What do you want students to understand and be able to use several years from now?** **What are the BIG ideas?**	**Essential Questions** **Open-ended questions that stimulate thought and inquiry linked to the content of the enduring understandings.**	
- People earn money to pay for their needs and wants. - Different people earn different amounts of money.	- Why don't people get paid the same amount of money? - Why do we need to pay taxes? - How do I set up a budget? - When and how do I need to make payments?	

Knowledge and Skills (Students will know and do…)

What key knowledge and skills will students acquire as a result of this unit?
(These may be indicators from the curriculum)

Knowledge (Students will know…) **What key knowledge will students acquire as a result of this unit?**	**Skills (Students will know how to…)** **What key skills will students acquire as a result of this unit?**
- the meaning of gross and net pay. - the purpose of credit and when it is appropriate to use. - the purpose of banking. - reasons for getting a loan.	- calculate wages involving regular pay. - determine deductions on a pay cheque. - use a CPP, income tax, and EI chart. - plan a budget. - estimate monthly costs for rent, groceries, etc. - figure out monthly payments on a loan. - make a deposit or withdraw money at a bank or ATM. - fill out a loan application. - describe how to get a good credit rating.

STAGE TWO: DESIGN ASSESSMENT EVIDENCE

Assessment Evidence

Summative Assessments/Performance Tasks

Assessments of what students know and can do aligned to the outcomes. They are a snapshot in time used for reporting and evaluating.

Outcomes/Objectives	Co-construct criteria and/or rubrics with students whenever possible. Examples of Summative Assessments/Performance Tasks include:
CM28.1, CM28.2, CM28.3, CM28.4, CM28.5	**On My Own Book** - Co-construct a list of criteria or provide a teacher-created list for students to create an "On My Own Book." Encourage students to record information and provide step-by-step directions for processes they will need when they are finished school and needing to do things "on their own."
	Compose What Am I? Riddles - There are many different terms associated with consumer math. Have students compose what am I? riddles for the various vocabulary terms. Study the riddles to determine the depth of student understanding.
	Future Budget - Have students set up a budget based on a career they would like to have, where they would like to do, what their interests are, etc. Students can then present their budgets to the class and explain how they would ensure the budget was maintained.

Formative Assessments

Through what multiple sources of evidence will students demonstrate their understanding on a continual basis?
These help guide instruction and provide feedback to students.

Examples of possible formative assessments include:

Personal Connections Journal - At regular intervals, provide students with time to write in their math journals. Encourage students to make personal connections to their learning. Students write about what they are learning and how it connects to their daily lives and to the world around them.

Maintain a Budget - Students can maintain a budget in their personal lives or track a budget in their life in the classroom. If focusing on a classroom budget, provide students with a set amount of money at the start of each month. Charge them desk rental, cost of books, etc. Students track their spending and turn in records at the end of each month on their income and their expenses.

Exit Cards - At the end of your lessons, provide students with an exit card. Have students answer a question or solve a problem related to the day's lesson.

Pre-Assessments

Pre-assessments are used to determine what students know and their readiness level to inform instruction.

Examples of possible pre-assessments include:

Vocabulary Match - Pass out word and definition cards to the students. Students with the word cards walk around the classroom and find the classmate that has the definition that matches their word card.

True/False, Yes/No, or Red/Green Cards - Before beginning your consumer math unit or a lesson on a specific topic, prepare a number of statements. Read the statements to the students and have them hold up a card that matches their responses. Encourage students to share the reasons for their response.

Text the Answer - If using technology in your classroom and all students have access to an iPod or phone, ask students questions and have them text the answer to you.

STAGE THREE: CREATE THE LEARNING PLAN

Instructional Plan

The Instructional Plan should include a sequence of lessons, teaching strategies, and information on First Nation, Inuit and Metis Content integration and technology integration.

The instructional plan will depend on the unique learning needs of the students in each Science 28 class. Through pre- and formative assessments, plan activities and learning opportunities that target your students' unique learning needs. Possible activities and strategies may include:

CM 28.1 Demonstrate an understanding of income.
- Play board games or apps, such as Life and Monopoly, that encourage students to develop an understanding of wages and living expenses.
- Provide students with a set income and a list of expenses (CPP, EI, rent, groceries, etc.). Students calculate how their income will be spent, what money (if any) is left over, and what they will do with the extra money. For students who are ready, and if appropriate, include items such as car loans, travel, etc.

CM28.2 Demonstrate an understanding of budget.
- Practice constructing budgets for different scenarios. Discuss the different items and possible unexpected expenses.
- Solve word problems related to making a purchase. Calculate the total cost and figure out possible financing.

CM28.3 Demonstrate an understanding of credit.
- Discuss the concept of credit and why it is important to have a good credit rating. Stress the importance of paying down a credit card on a monthly basis if used.
- Determine monthly costs of items bought on credit.

CM28.4 Demonstrate an understanding of banking.
- Walk through how to use an ATM card and how to make a deposit and withdrawal at the bank.
- Practice writing cheques and discuss when it is appropriate to write a cheque.

CM28.5 Demonstrate a basic understanding of loans.
- Discuss when it is appropriate to get a loan.
- Practice filling out loan applications.

Key Resources

Support Materials:

Life Skills, Grades 5-8: Preparing Students for the Future

Math Makes Sense

Extending the Challenge in Mathematics: Developing Mathematical Promise in K-8 Schools

Good Questions for Math Teaching: Why Ask Them and What to Ask Grades 5-8

Learning Math With Calculators

Glossary

(taken from the Saskatchewan Online Curriculums)

Addend
Any quantity being added to another quantity (e.g., in the expression 32 + 57, both 32 and 57 are addends).

Angle
When two lines meet each other, angles are formed. The size of the angle is the amount of turn needed to take one line and place it on top of the other line. Angles can be classified by their measurement in degrees. Angles less than 90° are called acute angles. Angles that measure 90° are called right angles. Angles that measure between 90° and 180° are called obtuse angles. Angles that measure 180° are called straight angles.

Array
A visual, concrete, or pictorial pattern arranged in a grid formation. For example, seating in an auditorium could be represented by an array.

Attributes
Characteristics of 2-D shapes and 3-D objects that can be used to compare and sort sets of 2-D shapes and 3-D objects (e.g., colour, relative size, number of corners, number of lines of symmetry).

Bar Graph
A graph in which data are represented by horizontal or vertical bars. Each bar represents the quantity of data of a certain type or category (e.g., red, blue, green, or yellow; 1998, 1999, 2000, 2001; or car, truck, bus, bike, walk).

Benchmarks
Numeric quantities used to compare and order other numeric quantities. For example, 0, 5, 10, and 20 are often used as benchmarks when placing whole numbers on a number line.

Chart
“Chart” is a general word for various kinds of pictures and diagrams which are used to represent data - often frequency data (e.g., a bar graph can be referred to as a bar chart).

Correspondence

A correspondence is a description of how one set of numbers (or objects) is mapped to a second set of objects. For example, a correspondence might describe how individual students are matched to their shoes. If each child in the class has a different type of shoe, then the correspondence between the shoes and the students would be one-to-one (for every child, there is exactly one type of shoe). If some children have the same type of shoe, then the correspondence is said to be many-to-one (many children to one type of shoe).

Denominator
The bottom number in a fraction that defines how many equal parts are in a whole.

Dividend
In a division statement, the dividend is the quantity that is being divided into equal groups. For example, in the expression 38 ÷ 4, 38 is the dividend (which is being divided into groups of 4 items or being divided into 4 equal groups).

Divisor
In a division statement, the divisor is the number of groups to be created, or the number of items to be within a group. For example, in the expression 38 ÷ 4, 4 is the divisor.

Double Bar Graph
A bar graph which compares two different sets of data according to the same criteria. For example, in a double bar graph, internet usage of boys and girls at a particular school could be compared over a number of years (the criteria).

Equality as a Balance and Inequality as Imbalance
The equal sign represents the idea of equivalence. For many students, it means “do the question”. For some students, the equal sign in an expression such as 2 + 5 = means to add. When exploring equality and inequality, by using objects on a balance scale, students discover the relationships between and among the mass of the objects. The equal sign in an equation is like a scale: both sides, left and right, must be the same in order for the scale to stay in balance and the equation to be true. When the scale is imbalanced, the equation is not true. Using 2 + 5 = □, rather than simply 2 + 5 = helps students understand that the equal sign (=) represents equality rather than “do the work” or “do the question”.

Equation
An equation is a statement which says that one expression or quantity is equal to another.

First-hand Data
Data that has been directly collected by the person using it (e.g., questionnaire data).

Fraction
A description of quantity as part of a whole.

Interdisciplinary
Disciplines connected by common concepts and skills embedded in disciplinary outcomes.

Line Graphs
A graph that results from connecting consecutive ordered pairs in a relation using straight lines.

Line Plot
A stylized version of a pictograph where the symbol * is used in place of one picture.

Line Symmetry
A property of some 2-D shapes in which a line can be used to divide the 2-D shape in half. Although there are many types of symmetry, in grade four the students are focussing on symmetry that can be defined as a reflection through the line of symmetry (i.e, no rotation or translation involved).

Minuend
In a subtraction sentence, the quantity that is being decreased (e.g., in the subtraction sentence 84 – 55, 84 is the minuend).

Multidisciplinary
Discipline outcomes organized around a theme and learned through the structure of the disciplines.

Multiple
A multiple of a number is exactly divisible by that number with no remainder.

Multiplier
Any quantity that another quantity is being multiplied by.

Number, Numeral, Digit
A number is the name that we give to quantities. For example, there are seven days in a week, or I have three brothers – both seven and three are numbers in these situations because they are defining a quantity. The symbolic representation of a number, such as 287, is called the numeral. If 287 is not being used to define a quantity, we call it a numeral.

Numerals, as the symbolic representation of numbers, are made up of a series of digits. The Hindu- Arabic number system that we use has ten digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. (Note: sometimes students are confused between these digits and their finger digits – this is because they count their fingers starting at one and get to ten rather than zero to nine.) These digits are also numerals and can be numbers (representing a quantity), but all numbers and all numerals are combinations of digits. The placement of a digit in a number or numeral affects the place value of the digit and, hence, how much of the quantity that it represents. For example, in 326, the 2 is contributing 20 to the total, while in 236 the 2 contributes 200 to the total quantity.

Numerator
The top number in a fraction. The numerator tells how many (the quantity) parts are present or being considered. The number of parts making up the whole is defined by the denominator of the fractions.

Object
Object is used to refer to a three-dimensional geometrical figure. To distinguish this meaning from that of shape, the word "object" is preceded by the descriptor "3-D".

Pattern Rule
A description of how consecutive terms or elements in a pattern are determined.

Percent
Percent means out of a hundred, being part of a hundred. The symbol for percent is %.

Personal Strategies
Personal strategies are strategies that the students have constructed and understand. Outcomes and indicators that specify the use of personal strategies convey the message that there is not a single procedure that is correct. Students should be encouraged to explore, share, and make decisions about what strategies to use in different contexts. Development of personal strategies is an indicator of the attainment of deeper understanding.

Pictograph
A graph which uses pictures or symbols to show how often something occurs.

Polygon
2-D shapes that have straight line edges that only intersect at the endpoints of the line segments and that form a closed shape.

Problem
A situation or context in which a solution strategy is not immediately known, but requires being sought after.

Quadrilaterals
Four-sided polygons.

Referents
A concrete representation of a unit of measure.

Regular/Irregular 2-D Shapes
Regular 2-D shapes are those shapes whose side lengths are equal and angle measures are also equal. Irregular 2-D shapes do not have all equal side lengths and/or all equal angle measures. For example, a square is a regular 2-D shape, while not all rectangles are regular 2-D shapes.

Relation
A statement that explains how the terms in a pattern relate to each other or how one unknown value is related to another.

Representations
Mathematical ideas can be represented and manipulated in a variety of forms including concrete manipulatives, visual designs, sounds and speech, physical movements, and symbolic notations (such as numerals and operation signs). Students need to have experiences in working with many different types of representations, and in transferring and translating knowledge between the different forms of representations.

Subtrahend

In a subtraction statement, the quantity that is being subtracted (e.g., in the subtraction statement 90 – 26, 26 is the subtrahend).

Superimposing
This term refers to the covering of one 2-D shape by one or more other 2-D shapes by placing the new shapes on top of the original.

Table
A set of data specially laid out in rows and columns, so that given one value, another separate value can be read out which is connected to the first one in some way (e. g., multiplication table).

Tally Marks
One way to collect and organize data. Each tally mark (often shown as a downward stroke |) represents one time that value appears in the data . Frequently, tally marks are grouped into sets of fives (four downward strokes and one cross-stroke) for ease of counting.

Trans-disciplinary
All knowledge interconnected and interdependent; real-life contexts emphasized and investigated through student questions.

References

Grade Three Saskatchewan Online Curriculum

Grade Four Saskatchewan Online Curriculum

Grade Five Saskatchewan Online Curriculum

Grade Six Saskatchewan Online Curriculum

Grade Seven Saskatchewan Online Curriculum

Grade Eight Saskatchewan Online Curriculum

Grade Nine Saskatchewan Online Curriculum