CONTENTS

Getting Ready to Read: Previewing a Text

MATHEMATICS Grades 10 - 12

A well designed textbook, website, or other print resource has a variety of elements or features that are applied consistently to help the reader locate and use the material. Some texts have more of these features, and clearer cues, than others do. Previewing a course text can help students to identify the text features and use them efficiently.

Purpose

- Learn how to navigate subject-specific textbooks and resources.
- Examine the layout and features of a particular text, and how to use it.

Payoff

Students will:

- become familiar with different course texts and resources (print and electronic).
- use strategies for effectively previewing and locating information in different texts, using the table of contents, indices and/or navigation bar.

Tips and Resources

- Most informational texts use a variety of visual, graphic, and text features to organize information, highlight important ideas, illustrate key concepts, and provide additional information. Features may include headings, subheadings, table of contents, index, glossary, preface, paragraphs separated by spacing, bulleted lists, sidebars, footnotes, illustrations, pictures, diagrams, charts, graphs, captions, italicized words or passages, boldface words or sections, colour, symbols, and icons.
- In a mathematics textbook, the lesson title tells the reader the learning focus of the lesson. Subheadings are often used to identify the parts of the lesson that are for learning and the parts that are for practising. Accompanying diagrams, calculations, and tables are alternate forms of mathematical information that is integral to the meaning of the whole mathematical text.
  For an alternate approach: see ***Analyzing the Features of a Text,*** page 8.

  Teaching Reading in Social Studies, Science, and Math, pp. 266-269.
  Beyond Monet, pp. 94, 105.
  Cross-Curricular Literacy: Strategies for Improving Secondary Students' Reading & Writing Skills, pp. 20-21.

Further Support

- Provide the students who are having difficulties with the regular text, with alternate resources that use simpler language.
- Encourage students to use text features to assist them with future mathematics reading tasks.

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Getting Ready to Read: Previewing a Text

Mathematics Grades 10 - 12

What teachers do	What students do
Before • Select a mathematics textbook, website, print, or electronic resource. • Create a book walk hand-out with ten or twelve questions to guide students to particular features of the text. See Teacher Resource, *Suggested Prompts for a Text-Features Search*. • Read the prompts out loud, if needed.	• Read or listen to the task prompts and ask clarifying questions.
During • Have pairs of students work to complete the text search task within a specific time frame. • Choose a cooperative learning strategy for student sharing of responses. (See *Beyond Monet*.)	• Read and respond to the prompts. Record responses on the text search recording sheet.
After • Discuss the text search items that were challenging to identify. • Ask students which text features were helpful in completing the book walk.	• Identify text search items that were challenging to complete. • Identify the text features they used to complete the book walk.

Notes

Suggested Prompts for a Text-Features Search

1. Using the Table of Contents, find the chapter number for the topic ____________ (e.g., solving systems of 2 linear equations; developing the formula for volume of a cone).

2. In the Index at the back of the text, find and list all the pages that deal with ______ (e.g., quadratic relation and graph of a parabola; properties of similar triangles).

3. On page _____, what is the purpose of the coloured box (e.g., highlights the key ideas of the section)?

4. On page _____, what is the purpose of the icon beside question _____ (e.g., indicates that the use of a graphing calculator or spreadsheet is required)?

5. Where would you go in the textbook to quickly find a definition for ___________?

6. On what page would you find the answer to question __________?

7. In Chapter Four, which page(s) reviews the skills needed for the mathematics in this chapter?

8. Turn to page _____. How does the textbook review the concepts of the chapter?

9. Which page has the “Review Test” for Chapter Two?

10. Open the text to page _____. What does the word “cumulative” mean in the expression “cumulative review” ________?

11. On page _____, what is the purpose of the **boldface** type?

12. Name the topic for the Chapter Problem in Chapter Eight _____________.

13. Where would you go in the textbook to quickly find information on __________ (e.g., Geometer’s Sketchpad®, graphing calculators, spreadsheets, Tinker Plots®)?

Suggested Prompts for a Text-Features Search

1. Using the Table of Contents, find the chapter number for the topic ____________ (e.g., experimental and theoretical probability, metric and imperial measurements, area).

2. In the Index at the back of the text, find and list all the pages that deal with ______ (e.g., surface area, volume of 3-D objects, rotations, dilatations, decimals, fractions).

3. On page _____, what is the purpose of the coloured box?

4. On page _____, what is the purpose of the icon beside question _____ (e.g., indicates that the use of a graphing calculator or spreadsheet is required)?

5. Where would you go in the textbook to quickly find a definition for ___________?

6. Where would you find the answer to question _____ on page _____?

7. In Chapter One which page(s) reviews the skills needed for the mathematics in this chapter?

8. Turn to page _____. How does the textbook review the concepts of the chapter?

9. Which page has the “Review Test” for Chapter Two?

10. Open the text to page _____. What does the word “cumulative” mean in the expression “cumulative review?

11. On page _____, what is the purpose of the **boldface** type?

12. Name the topic for the Chapter Problem in Chapter Three.

13. Where would you go in the textbook to quickly find information on __________ (e.g., Geometer’s Sketchpad®, graphing calculators, spreadsheets)?

Suggested Prompts for a Text-Features Search

1. Using the Table of Contents, find the chapter number for the topic ____________ (e.g., experimental and theoretical probability, metric and imperial measurements, area).

2. In the Index at the back of the text, find and list all the pages that deal with ______ (e.g., surface area, volume of 3-D objects, rotations, dilatations, decimals, fractions).

3. On page _____, what is the purpose of the coloured box (e.g., highlights the key ideas of the section)?

4. On page _____, what is the purpose of the icon beside question _____ (e.g., indicates that the use of a graphing calculator or spreadsheet is required)?

5. Where would you go in the textbook to quickly find a definition for ___________?

6. Where would you find the answer to question __________?

7. In Chapter One which page(s) reviews skills needed for the mathematics in this chapter?

8. Turn to page _____. How does the textbook review the concepts of the chapter?

9. Which page has the "Review Test" for Chapter Two?

10. Open the text to page _____. What does the word "cumulative" mean in the expression "cumulative review?

11. On page _____, what is the purpose of the **boldface** type?

12. Name the topic for the Chapter Problem in Chapter Three.

13. Where would you go in the textbook to quickly find information on __________ (e.g., Geometer's Sketchpad®, graphing calculators, spreadsheets)?

Getting Ready to Read: Analyzing the Features of a Text

MATHEMATICS Grades 10-12

There's more to a good book or website than the words. A well-designed textbook uses a variety of graphical and text features to organize the main ideas, illustrate key concepts, highlight important details, and point to supporting information. When features recur in predictable patterns, they help the reader to find information and make connections. Readers who understand how to use these features spend less time unlocking the text, and have more energy to concentrate on making sense of the mathematics content.

In this strategy, students go beyond previewing to examine and analyze a textbook and determine how the features will help them to find and use the information for learning. You can use the same strategy to examine other types of text (e.g., magazines, e-zines, newspapers, e-learning modules).

Purpose

- Familiarize students with the main features of the texts they will be using in the classroom, so that they can find and use information more efficiently.
- Identify patterns in longer texts.

Payoff

Students will:

- develop strategies for effectively locating information in texts.
- become familiar with the main features of the texts they will be using.

Tips and Resources

- Create a template that describes the main features of the texts, and post it in the classroom so that students can refer to it.
- Text features may include headings, subheadings, table of contents, index, glossary, preface, paragraphs separated by spacing, bulleted lists, chapters, answers, sidebars, footnotes, illustrations, captions, italics, colour, and icons.
- See Student/Teacher Resource, *Features of a Mathematics Textbook – Sample.*

  Cross-Curricular Literacy: Strategies for Improving Secondary Students' Reading & Writing Skills, pp. 20-21.
  Teaching Reading in the Content Areas: If Not Me, Then Who? , pp. 16-18.
  For an alternate approach: see ***Previewing a Text*** page 2.

Further Support

- Provide students with one or more reading organizers to guide them as they read a particular text.
- Ask students to investigate similar and different features of computer software (e.g., File, Edit,) and Internet websites (e.g., URLs and pop-up menus) to help them navigate and read the program or site.

Getting Ready to Read: Analyzing the Features of a Text

MATHEMATICS Grades 10-12

What teachers do	What students do
Before • Ask students to recall a magazine or informational book they have recently read, or a website they have recently viewed. Ask them to describe how the text looked and how they found information. Ask students what they remember about the content, and have them suggest possible reasons for how they were able to locate and/or remember information. • Note similarities and differences among the responses and have the students make connections among the features of the different mathematical materials. • Provide students in small groups with two different reading samples (e.g., sequential textbook chapters, a textbook lesson and an EQAO assessment task, a textbook lesson and a news article). • Remind students that different sources have many different elements or features that are designed to help the reader understand the material being presented. Some material, like a textbook, has a greater variety of features than others.	• Recall something recently read or viewed and identify some features of that particular text. • Share findings with other groups.
During ▪ Have groups scan the assigned materials and note features that are similar and those that are unique to the reading samples (e.g., chapter previews, tables of contents, charts and graphs, typography [italics, bold], questions, chapter reviews/summaries, timelines, and headings). ▪ Have groups record their findings on chart paper (e.g., point-form notes, Venn diagram, compare/contrast chart). • Ask each group to send an "ambassador" to the other groups to share one idea the group noted and to obtain one idea that the other group noted. The ambassadors return to their original groups and report. • Have each group report on the features of its samples (e.g., some textbooks contain an annotated overview of the textbook layout). • Create a textbook or chapter template on chart paper, indicating common features and noting unique features. (See Student/Teacher Resource, *Features of a Mathematics Textbook– Sample.*)	• Scan materials, and note the different features. • Contribute to the group discussion and chart-paper notes. • Share the groups' observations. • Contribute to a class template, itemizing features of a mathematics textbook.
After • Assign a relevant reading task to small groups of students so that they can practise using the features of the text to locate information and help them understand and remember what they read. • Extend this strategy to electronic media.	• Use the features of text to complete the assigned mathematics reading task. • Discuss experiences finding information from electronic media.

Notes

Features of a Mathematics Textbook – Sample

Textbook Title:

Table of Contents:	This is an ordered list with page references to the topics and subtopics for the lessons in each chapter.
Chapters:	These are used to group and organize important mathematical ideas.
Chapter Introduction:	This gives a brief overview of the important mathematics in the chapter and lists the learning goals. The Chapter Introduction might also pose a problem that can be solved by applying the mathematical concepts and/or skills presented in the chapter.
Skill(s) Review:	This provides review material of mathematical skills learned earlier that are necessary for doing the mathematics in this chapter.
Chapter Review:	This is a summary of the mathematics in the chapter. It includes additional examples and extra practice questions that are connected to the mathematics in the chapter.
Chapter Review Test:	This is a sample chapter test on the mathematics and its applications covered in the chapter.
Cumulative Review Test:	This is a sample test on the mathematics and its applications covered in several consecutive chapters.
Technology Appendix:	This section has specific instructions about technological tools such as: calculators, CBRs, spreadsheets, Fathom, and The Geometer's Sketchpad. Technology icons are often used to identify specific technologies.
Icons:	A textbook has a variety of icons. These visuals help locate related text.
Answers:	These are answers to exercise questions and are provided at the back of the textbook.
Glossary:	This text feature is an alphabetical listing of the mathematical terms used throughout the textbook. Some textbooks have a list of instructional words as well.
Index:	This text feature provides page references for specific information or concepts.

Getting Ready to Read: Extending Vocabulary – Creating a Word Wall

MATHEMATICS Grades 10-12

Secondary students benefit from clues and cues as they encounter new mathematical concepts and vocabulary. A word wall displays key vocabulary words for a unit of study, on a bulletin board or chalk board.

Purpose

- To provide visual clues and cues for the students when learning or reviewing mathematics vocabulary for a unit of study.

Payoff

Students will:

- have a visual reference for vocabulary in the unit.
- be able to review the words each day.
- improve their comprehension and spelling of key words.

Tips and Resources

- Consider posting certain words for longer periods (e.g., words that occur frequently in the unit, words that are difficult to spell, and words like 'justify' that are used in all strands of mathematics).
- Have students refer to the word wall to check their spelling and understanding of words.
- Include symbols on the word wall.

(See Student/Teacher Resource, *The Frayer Model*).

Further Support

- Adding pictures can be particularly beneficial for English Language Learners and struggling readers.
- Provide each student with a place to record a copy of the word wall. It could be a special section in a notebook, or on recipe cards.

Getting Ready to Read: Extending Vocabulary – Creating a Word Wall

MATHEMATICS Grades 10-12

What teachers do	What students do
Before • Preview a unit for key symbols and words. • Make a list of words/symbols you anticipate students will identify as being unfamiliar. • Plan a place in the classroom to house the word wall: it will grow as the semester progresses and should not be moved once established. • Prepare strips of card stock or recipe cards for your word wall items. • Help students to skim and scan sections of the text that are to be studied.	• Scan the section of text for unfamiliar words and symbols.
During • Have students independently skim and scan sections for unfamiliar words and symbols. • Have students record their words one per recipe card. • Have students share their findings with the rest of the class. • Have students work in small groups to compare recipe cards and compile a master collection. • Have students post the collection somewhere in the room.	• Scan the text for symbols and words that are unfamiliar. • Compare lists. • Make a master list. • Post list.
After • Discuss the meaning of the words with the students. • Have students copy out the collection into their books. • Have students look up the unfamiliar words. • Students will add words as the learning progresses.	• Record their personal lists and look up words that are unfamiliar.

Notes

Getting Ready to Read: Extending Vocabulary – Creating a Word Wall

MATHEMATICS Grades 10 Applied

Quadratic Functions

Curve of best fit

Parabola

Differences

Arch

Axis of symmetry

Possible Word Wall Vocabulary:

Functions:
Capacity, ordered pair of co-ordinates, dependent variable, independent variable, table of values, function, slope y-intercept form, diameter, graphical model, coordinates, x-axis, y-axis, linear function, slope, y-intercept, x-intercept, first differences, point slope form of an equation, piecewise linear functions.

Linear Systems:
Intercept, solving by substitution, solving by graphing, solving by elimination.

Proportional Reasoning:
Proportional relationship, unit price, ratio, proportion, scale diagram, drawing size, actual size, stretched vertically, stretched horizontally.

Similar Triangles and Trigonometry:
Inaccessible Heights, triangle, acute triangle, obtuse triangle, Isosceles triangle, equilateral triangle, right triangle, similar triangles, sss, sas, asa, congruent, sine ratio, cosine ratio, tangent ratio.

Quadratic Functions:
Parabola, quadratic function, curve of best fit, arch, differences, axis of symmetry, zeros of a function.

From Algebra to Quadratics:
Like terms, distributive law, simplify, expand, collect like terms, evaluate, monomial, binomial, trinomial, polynomial, factoring, common factors, difference of squares, trinomial where a equals 1.

Analysing Quadratic Functions:
Transformations, vertex, direction of opening, congruent, standard form, vertex form, roots.

Getting Ready to Read: Extending Vocabulary – Concept Circles

MATHEMATICS Grades 10 - 12

A Concept Circle is an organizer that is divided into sections for holding words or symbols that are related.

Purpose

- Create a visual connection between concepts and vocabulary.

Payoff

Students will:

- develop an understanding of key concepts and vocabulary.
- draw on prior knowledge to make connections among concepts and vocabulary.

Tips and Resources

- Draw from the classroom word wall. See Extending Vocabulary – **Creating a word wall.**
- Develop organizers using different strategies such as a **Graffiti strategy**.
- Use organizers for words that have multiple meanings depending on contexts (e.g., rational, root, similar and radical).
- Use organizers to help the understanding of symbols as well as words (e.g., π, $\in$, $\geq$).
- See Student/Teacher Resources: *Concept Circles – Samples.*
- See Student/Teacher Resource: *Concept Circles – Templates.*

Further Support

- Encourage students to use the organizers as references.
- Consider allowing students to use organizers during assessments.

Getting Ready to Read: Extending Vocabulary – Concept Circles

MATHEMATICS Grades 10 - 12

What teachers do	What students do
Before • Identify key concepts and vocabulary that students will need. • Ask students to generate a list of key words and concepts. • Reduce the list to essential concepts that are critical to the unit of study. • Model the creation of a concept circle by placing 3 to 6 words into a concept circle. Ask for student input to suggest possible titles for each circle.	• Check their notes for underlined vocabulary words and key concepts. • Work in small groups or alone to identify relationships among the concepts. • Ask questions to clarify understanding.
During • Choose an Oral Communication strategy such as Think/Pair/Share. • Direct students to determine the relationship among the words/symbols. • Have them create concept circles using the relationships found. • Have students share their concept circles with other groups.	• Make the concept circles. • Discuss the meaning of the words, seeking help from the teacher if necessary. • Contribute to group discussions.
After • Ask students for other words or symbols that could go on their concept circles if they were given more parts to the circle. • Decide the best way to have the concept circles stored for future reference and study (e.g., putting them on a bulletin board, keeping them in the students' books, or taping them to the wall).	• Generate other words or symbols that could have been used in the concept circle.

Notes

Getting Ready to Read: Extending Vocabulary – Concept Circles – Samples

MATHEMATICS Grade 12 Workplace

Sample Concept Circle

Concept: ______________________

the Metric System	estimating distances
estimating capacities	measuring lengths

Sample Concept Circle

Concept: ______________________

feet	cm
km	yards

Sample Concept Circle

Concept: ______________________

monthly budget	affordable housing
components of a house-hold budget	changing one item in a budget

Sample Concept Circle

Concept: ______________________

sampling techniques	statistics in the media
conducting a survey	interpreting data

Possible Answers: Measuring and Estimating, Metric and Imperial Measurements, Household Budgets, Collecting and Organizing Data.

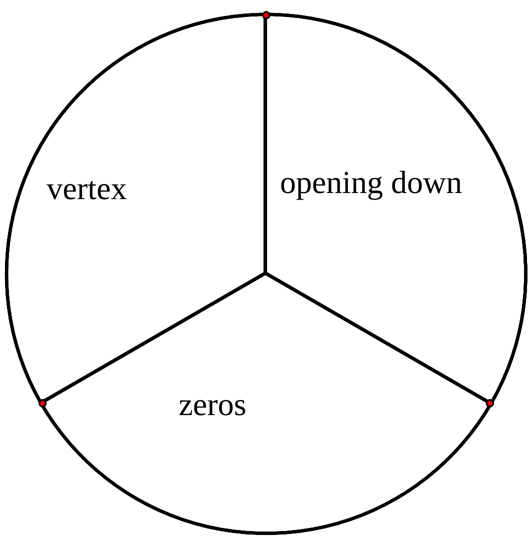
Getting Ready to Read: Extending Vocabulary – Concept Circles – Samples

MATHEMATICS (MPM 2D, MBF 3C, MCB 4U)

Concept Circles – Samples (MPM 2D, MBF 3C, MCB 4U)

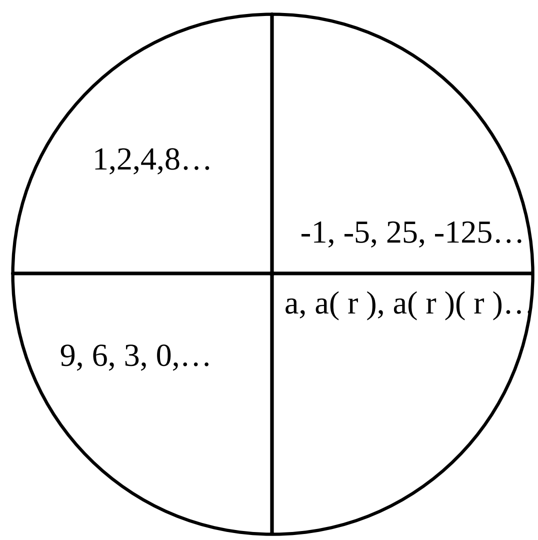
1. Put related concepts (e.g., units, shapes, words, phrases, symbols) into each section. Then direct students to identify the relationship among the contents of the sections and write in the title.
2. Modify the strategy by:
   a. leaving one section empty to be filled by students.
   b. including one non-example and asking students to find which item does not belong, and justify their answer.

Concept 1: ______________________________



Example of 2b

Concept 2: ______________________________



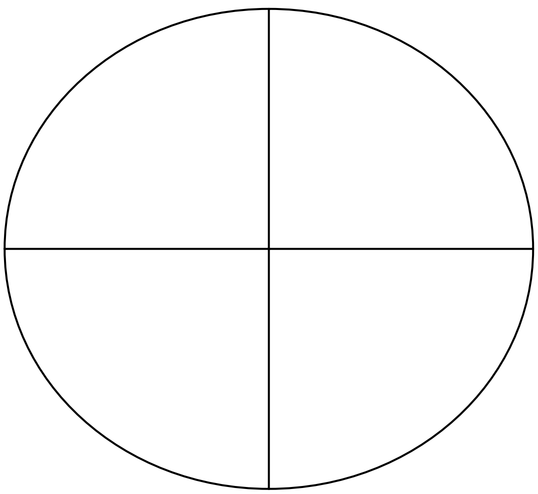
Possible Answers:
Characteristics of some Quadratic Function

The bottom left quadrant is not a geometric sequence

Getting Ready to Read: Extending Vocabulary – Concept Circles – Templates

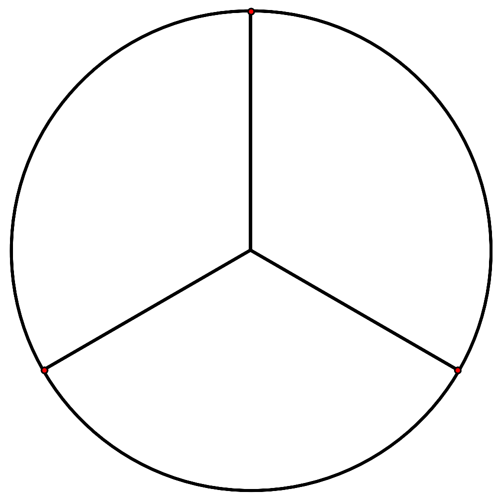
Sample Concept Circle

Concept: ______________________________



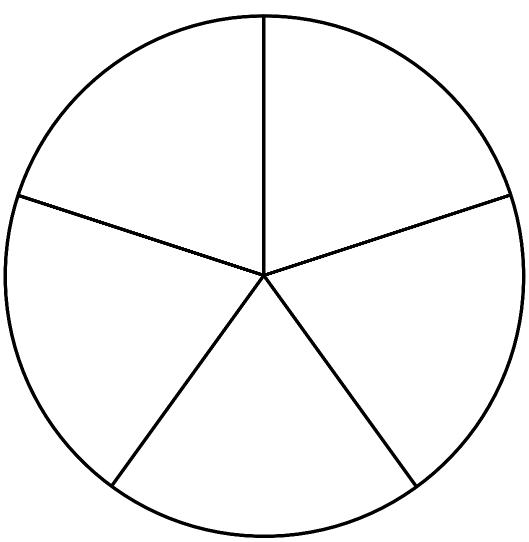
Sample Concept Circle

Concept: ______________________________



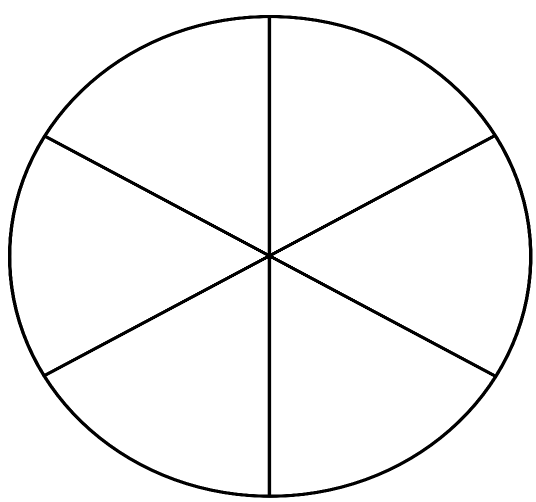
Sample Concept Circle

Concept: ______________________________



Sample Concept Circle

Concept: ______________________________



Getting Ready to Read: Extending Vocabulary: The Frayer Model

MATHEMATICS Grades 10-12

The Frayer Model is a visual organizer that helps students understand key words and concepts. It is a chart with four sections that can hold a definition, some characteristics/facts, examples, and non-examples of the word/concept.

Purpose

- To give students a visual reference for what the word/concept is and is not.

Payoff

Students will:

- draw on prior knowledge to make connections among concepts.
- develop an understanding of key concepts and vocabulary.
- think critically to create examples and non-examples of the concept.

Tips and Resources

- Preview by scanning text. See *Skimming and Scanning To Preview Text*, pg. 32, *Think Literacy: Cross-Curricular Approaches, Grades 7-12.*
- Include targeted vocabulary/concepts on a word wall. See Extending Vocabulary – *Creating a word Wall*.
- Consider using the back of a word wall card for the Frayer Model.
- At the beginning of a unit give the students the vocabulary/concept and have a Home Activity that has them consider examples and non-examples of the concept. If appropriate ask them to bring in pictures of an example and a counter example.
- The Home Activity could help with the 'Minds On' for the lesson on the Frayer Model.
- See Student/Teacher Resource: *The Frayer Model – Samples*.
- See Student/Teacher Resource: *The Frayer Model – Templates for Two Versions*.

Further Support

- Have students use the organizer as a reference tool.
- Consider allowing students to use organizers during assessments.

R

Getting Ready to Read: Extending Vocabulary: The Frayer Model

MATHEMATICS Grades 10-12

What teachers do	What students do
Before • Identify in advance the key concepts and vocabulary that the students will work with. • Ask for student input to generate a list of key words and concepts. • Reduce the list to the critical concepts. • Have students generate definitions in their own words. Have them state some characteristics that the concept has, and some it does not have. Have them give some examples and non-examples of the concept. • Have them identify the concept/term that is displayed on a completed Frayer model.	• Check their notes for underlined vocabulary words and key concepts. • Work in small groups or alone to generate definitions in their own words, give some characteristics that it has and does not have and give some examples and non-examples. • Determine the concept name.
During • Choose an Oral Communication strategy. • Direct students to determine the relationships among the words/symbols they generated at the beginning of the lesson. • Have groups create their own Frayer Models. • Circulate and pose questions to refine understanding of the relationships. • Encourage students to share their Frayer Models with other groups.	• Create the Frayer Models. • Contribute to group discussions. • Actively listen and reflect and respond on learning during sharing.
After • Discuss how a concept is better understood when a Frayer Model is used. • Decide the best way to have the Frayer models stored for future reference and study. Ideas include putting them on a bulletin board, keeping them in the students' books, or taping them to the wall. • Later in the lesson or unit, use a different color pen to add new knowledge to the Frayer Model.	• Decide if a personal copy is needed. • Decide if additional notes or pictures could be added as learning expands.

Notes

The Frayer Model - Samples

Determine the unknown words in the given Frayer Models.
How does thinking about non-examples clarify your understanding of the word?

Definition:

Something we can solve to find the value of a given variable.

Rules/Method

- Whatever you do to one side you have to do to the other side.
- Simplify (e.g., get x by itself).
- Isolate x terms on one side of the equation.
- Divide both sides by the coefficient of x.
- Check if required.

?

Example:
Solve for x: $4x + 3 = 27$
$4x + 3 – 3 = 27 – 3$
$4x = 24$
$4x/4 = 24/4$
$x = 6$ Therefore $x = 6$

Non-examples:

$4x < 40$

$x + 4$

Definitions:
A monomial has one term (e.g., $3x$ or $4y^2$).
A binomial has two terms (e.g., $x + 7$).
A trinomial has three terms.
(e.g., $x + y – 4z$).

Facts:
1) You can add like terms.
2) Name the polynomial once you have combined the terms.

?

Example:
$3x + 2x$ is a binomial expression that can be simplified to $5x$ which is a monomial.

Non-example:

$3x + 7 = 13$
This is an equation to be solved.

Answers: linear equations, polynomials expressions

Getting Ready to Read: Extending Vocabulary: The Frayer Model

Two Templates

Choose the version whose headings best suit the concept/word. Print the template on card stock. Direct students to complete the template, individually, in small groups or as a whole class. Print the vocabulary word on the reverse side then place the card on a word wall for future reference.

Definition:	**Rules/Method:**
Example:	**Non-examples:**

Definition:	**Facts/Characteristics:**
Examples:	**Non-examples:**

Reacting to Reading: Responding to Text (Graffiti)

MATHEMATICS Grades 10 - 12

Graffiti is a strategy of free expression on posters located around the classroom. Each Graffiti chart begins with a teacher-selected mathematical statement and/or question based upon text reading.

Purpose

- Give students the opportunity to read, reflect, and draw/write about topics in mathematics.
- Allow for free expression on a given topic.
- Provide students with an opportunity to consolidate learning or make connections to prior learning.

Payoff

Students will:

- connect prior learning to this topic.
- expand their understanding of the topic by reading.

Tips and Resources

- Use playing cards to randomly assign groups. (If you have 28 students then the teacher has the aces through sevens in hand from the deck.) The students randomly pick a card upon entry to the classroom.
- For sample role descriptions designed to promote small-group discussion, see the Group Roles strategy in the Oral Communication section of *Think Literacy Approaches, Grades 7-12*.
- Have each group use a different coloured marker to distinguish the groups.
- The entire process should take about 20 minutes. If students are given too much time at any one station they will lose focus.
- This is a good strategy for consolidation at the end of a unit.

Beyond Monet, pp. 174 – 177.

Further Support

- Assign two students to the role of reporter, to ensure that struggling or English Language Learners are supported if they are chosen as the reporter.

Reacting to Reading: Responding to Text (Graffiti)

MATHEMATICS Grades 10 - 12

What teachers do	What students do
Before • Select the correct number of playing cards in order to randomly assign groups. • Record individual focus questions and/or statements that reflect information from the course/unit or topic on to sheets of chart paper and post them around the room. • Provide different colour markers so that each group has a different colour. • Ask students for their definition of graffiti (e.g., "scribbling thoughts or feelings on walls in public places"). • Instruct the students on how they will rotate through the stations. • Remind students that they will be assessed on communication skills as well as group dynamics.	• Contribute to the discussion about graffiti.
During • After a given time signal for the students to move to another station (taking their coloured marker with them). • Monitor the activity and make anecdotal notes as necessary about the students' understanding of the concepts as well as group and individual communication skills.	• Actively listen when others are talking. • Be respectful of each other's input. • As a group rotates on the teacher's signal through the stations; take the coloured marker with you. • The role of recorder should rotate. • Take turns contributing ideas to the chart paper.
After • Assign students within each group to summarize the information on their last chart. • Have each group report to the rest of the class on the summary of that chart. • Encourage students to respond to each report as it is given. • Invite students to reread the charts and jot down the top three ideas for each chart topic in order to prepare some study notes.	• Summarize the chart page. • Choose a reporter who then presents the summary to the class. • Respond with clarifying questions or comments. • Look at all the chart pages and take notes to build study notes for the topic/unit.

Notes

Reacting to Reading: Responding to Text (Graffiti)

MATHEMATICS Grades 10 - 12

**Topics for: Advanced Functions and Introductory Calculus;
Geometry and Discrete Mathematics;
Grade 12 Workplace Mathematics.**

Advanced Functions and Introductory Calculus Questions: (end of year review)

1. What do you think of a graphical approach to develop a visual understanding of a derivative?
2. The derivative is a limit.
3. What do you know about Differentiation in Calculus?
4. What do functions have to do with math anyway?
5. Where's the Math in Calculus?

Geometry and Discrete Mathematics Questions: (end of year review)

1. What is a proof? Explain and give examples.
2. What do you know about Cartesian and Geometric Vectors?
3. What do you know about Equations of Lines and Planes?
4. What is the difference between a Permutation and a Combination?
5. How can Pascal's Triangle help you count outcomes?

Grade 12 Workplace Mathematics Questions: (end of year review)

1. How are graphs used in real life situations?
2. Where's the Math in buying a home?
3. What's a budget? Why might you have one?
4. How is the Pythagorean Theorem used in real life?
5. What's the same and what's different between the Metric and Imperial systems of measurement?

Organizing Ideas: Webbing, Mapping and More

MATHEMATICS Grades 10 - 12

When putting ideas together, people use different strategies to sort their information. An initial organization allows them to make connections, identify relationships, and determine possible directions and forms for their thinking and writing. This strategy gives students the opportunity to reorganize, regroup, sort, categorize, classify, and cluster their notes.

Purpose

- To identify relationships and make connections among ideas and information.

Payoff

Students will:

- use a variety of strategies to organize information that can be used throughout the course and identify connecting ideas.

Tips and Resources

Strategies for webbing and mapping include:

- *Clustering* – looking for similarities among ideas, information or things, and grouping them according to characteristics.
- *Comparing* – identifying similarities among ideas, information, or things.
- *Contrasting* – identifying differences among ideas, information, or things.
- *Generalizing* – describing the big picture by using the clusters and information presented.
- *Outlining* – providing a framework for what has been accomplished based on the information presented.
- *Relating* – showing how events, situations and ideas are connected.
- *Sorting* – arranging information into clusters.
- *Trend spotting* – identifying things that seem to follow a pattern.

Also see Student/Teacher Resource, *Webbing, Mapping and More*.

Further Support

- Provide students with sample graphic organizers that guide them in sorting and organizing information and notes [e.g., cluster (webs), sequence (flowcharts), compare (Venn diagram)].
- Collect student samples of graphic organizers that they have successfully used earlier in their studies and create a class collection for student reference and use.
- Select a familiar topic (e.g., a topic for review). Have students form discussion groups. Taking turns, students record one idea or question on a post-it note and place it in the middle of the table. Encourage students to build on the ideas of others. After students have contributed everything they can recall about the topic, groups sort and organize their post-it notes into appropriate clusters on chart paper. Ask students to discuss connections and relationships, and identify possible category labels for the clusters. Provide groups with markers or highlighters to make links between the post-it notes. Display the charts.

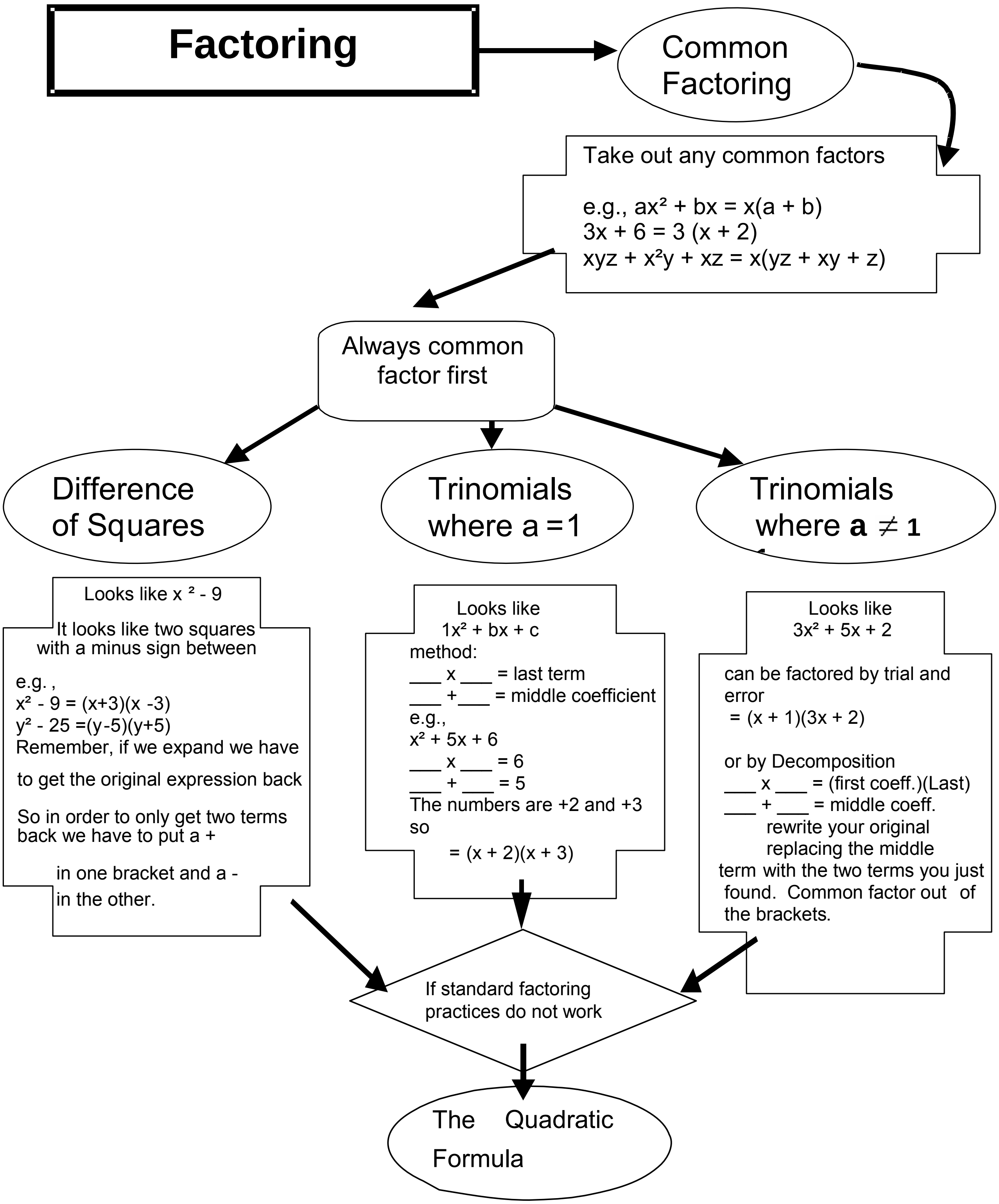
Organizing Ideas: Webbing, Mapping and More

MATHEMATICS Grade 10 - 12

Notes

What teachers do	What students do
Before • Select a unit or topic for review. • Have the students read from their class notes to identify major topics in the unit. • Show various examples of how connections are made among ideas.	• Bring notes from the topic under review to class. • Recall what they already know about the topic.
During • Ask the students for key ideas and list these on the board. • Ask students to identify possible groupings, relationships, and connections. • Ask students to organize the material using visual representation strategies.	• Contribute to key ideas. • Identify groupings and connections. • Organize the material using visual representation strategies.
After • Ask students to create a visual organizer for a different topic. • Discuss how students can use this organizer as a study tool.	• Create a visual organizer. • Share and compare. • Use visual organizers for review.

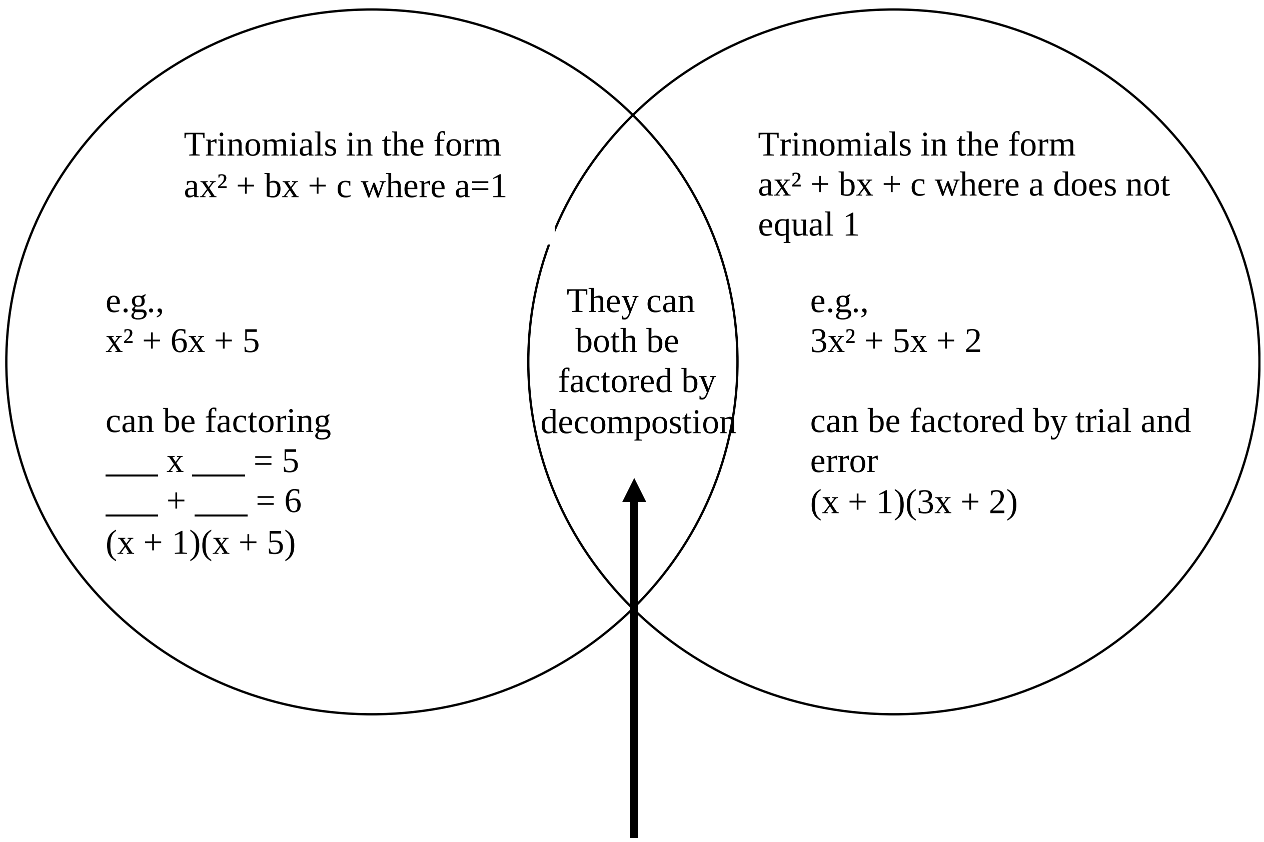
Mind Mapping – Sample (Grade 10 Academic – From a student's perspective)



Organizing Ideas: Webbing, Mapping and More

MATHEMATICS Grade 12 (MCT 4C)

Comparing Using a Venn Diagram



$x^2 + 6x + 5$	$3x^2+5x+2$
_____ x ___ = last term	___ x ____ = (first)(last)
_____ + ___ = middle term	___ + ____ = middle term

rewrite original using factors found in above

$x^2 + 5x + 1x + 5$	$3x^2 + 2x + 3x + 2$

put brackets around the two sets of parts

$(x^2 + 5x) + (1x + 5)$	$(3x^2 + 2x) + (3x + 2)$

common factor out of each set of brackets

$x(x + 5) + 1(x + 5)$	$x(3x + 2) + 1(3x + 2)$

common factor to the front

$(x + 5)(x + 1)$	$(3x + 2)(x + 1)$

Writing for a Purpose: Journal Writing

MATHEMATICS Grades 10-12

Journal writing in mathematics is a tool that can positively affect attitudes toward the subject, promote skill development, and aid concept mastery. Journals allow teachers to see into student reasoning, rather than simply testing output. Journal writing in mathematics offers students not only a growth opportunity but also the opportunity to receive better-focused teaching strategies. A journal is both a learning tool and a coaching tool.

Purpose

- Provide students with a supportive learning environment in which they are able to test ideas (i.e., to be able to express ideas and be willing to be wrong).
- Provide a vehicle for feedback to students which supports, encourages, and challenges, rather than judges.
- Inform and focus instruction.

Payoff

Students will:

- become better thinkers and writers.
- learn mathematical content and improve problem solving skills.
- overcome math anxiety.

Tips and Resources

- There are three developmental stages in journal writing: the class journal, the group journal, and the personal journal. As the students pass through each stage their role and the role of their teacher will change. However, the strategies they use in the writing process remain the same. As students become familiar with the various strategies, they may pick and chose the methods that work best for them. The teacher will help students identify useful strategies if more than one strategy is introduced.
- Recognize that journals gradually become vehicles for communication for students. Initial writings may be brief and meaningless to the teacher. (This disappears when writing in math becomes part of the culture of the school.)
- Always use very specific prompts that direct student writing – prompts such as, “What did you learn today?” invite the reply, “Nothing.”
- Persistence is required when first introducing writing in the math class: “I am glad that the students are starting to show progress with their math journals.” (A teacher from DDSB after 6 weeks of implementing journals.) Many, however, see much quicker progress.
- Do not give in to the temptation to minimize the time spent on modeling (i.e., Class Journals) and practice (i.e., Group Journals).
- Each developmental stage must be reintroduced when the journal form changes.
- As the writing process moves from the first stage to the final stage, the teacher’s role evolves from that of a leader to that of a respondent.
- See Teacher Resource: *Journal Writing – Developmental Stages.*
- See Teacher Resource: *Journal Writing – Forms and Writing Prompts.*
- See Teacher Resource: *Journal Writing – Linking Process, Strategies and Developmental Stages.*

Further Support

- Give struggling learners organizers or word lists that will help them with their tasks.

W

Writing for a Purpose: Journal Writing

MATHEMATICS Grades 10 - 12

What teachers do	What students do
Before • Develop a journal writing prompt (see Teacher Resource: *Journal Writing – Forms and Writing Prompts*). • Model the form of writing to be used if it has not been modeled before. (See Teacher Resource: *Journal Writing – Developmental Stages* and Teacher Resource: *Journal Writing – Forms and Writing Prompts*).	• Learn the journal form and the response style.
During • Assign the journal entry in one of three formats: class, group, or personal journal. (See Teacher Resource: *Journal Writing – Developmental Stages.*)	• Respond to the journal prompt: as a class to a class journal; as a group (3 or 4 students) in a group journal; or individually in a personal journal.
After • Respond to the journal entry. This **must** initially be done after each journal assignment until such time that the students are confident that the teacher is an interested reader; then journal entries may be responded to after two or three journal assignments: - respond as a comment; marking/grading will often stop students from responding freely; - start the response with a positive comment (on effort, honesty, style, use of terminology …. *something*); - comment on the central concept; - ask a question to help clarify or to further the student's thinking; - do not grade grammar and spelling; this is the students' opportunity to express themselves freely, on their terms, not the teacher's; - comment on grammar and spelling in a 'coaching' mode, and <u>only after</u> a supportive learning environment has been established; - assess the journal entry for student understanding and for indicators to the teacher that an alternate instruction is required.	• Read/listen to the response and respond to it if a return question is asked.

Notes

Writing for a Purpose: Journal Writing

MATHEMATICS

Journal Writing – Developmental Stages

There are three developmental stages in journal writing: the class journal, the group journal, and the personal journal. As the students pass through each stage their role and the role of their teacher will change. However, the strategies they use in the writing process remain the same. As students become familiar with the various strategies, they may pick and choose the methods that work best for them. The teacher will help students identify useful strategies if more than one strategy is introduced.

The writing process and possible strategies are outlined in the Teacher Resource, *Journal Writing – Linking Process, Strategies and Developmental Stages*. Not every strategy listed can be found in this resource. The omitted strategies are marked with * and can be found in *Think Literacy: Cross Curricular Approaches, Grades 7 – 12.*

Journal Writing – Forms and Writing Prompts

In the context of journal writing the word 'form' and the expression 'writing prompt' take on very specific meanings. These are outlined on the next pages

Forms	Sample Starts, Ideas
Personal Writing reflecting on feelings, attitudes, successes, challenges	- I think I'm good/weak in working with technology because … - When I'm asked a question in class I …
Summaries explaining what they learned	- Create a poster that displays data in various ways. - Brainstorm everything you know about probability.
Definitions defining math terms in their own words	- Define the words that are associated with series and sequences. - Define difference of squares, completing the square, and perfect squares.
Translations taking information from one source and having the students put it in their own words	- What does, "The population is modeled by a quadratic relation" mean? - Explain the additive principle.
Reports bringing a series of lessons together to show understanding of how they are related	- We have looked at ways to measure distances through modeling. Report on how these methods are similar/different. - How are annuities and loans the same/different?
Instructions writing a series of steps in a procedure	- How do you expand the product of two binomials? - How do you create a histogram?
Lists a written collection of items, objects, ideas, etc.	- List all of the things that need to be done to complete your independent study unit. - List different forms of a linear function.

Forms	Journal Prompts
Self-assessments giving feedback or comments about math work, learning experiences	- The hardest problem was … - I think I could do better if …
Descriptions describing procedures, conversation, group work…	- Our group had trouble agreeing on … - The two different solutions that we got were …
Arguments/Justifications persuading others to accept your point of view, refuting someone's point of view, justifying a choice…	-The most efficient way to solve this problem is … - I found the roots of the equation in order to …
Explanations reasoning, findings, attempts, strategies, patterns, suggestions	- I tried to solve the word problem by … -We find the x intercept in order to …
Applications where this math/lesson could be used	- How would an astronomer use the sine law? -How would a biologist use probability?
Problem Design creating a problem that has to incorporate specific criteria	- Create a problem using similar triangles. - Create a problem using the body mass index.

Journal Writing – Linking Process, Strategies and Developmental Stages

Process	Strategies	Class Journal	Group Journal	Personal Journal
Generate and Record	• Rapid Writing* • Setting the Context *	Teacher's Role: • select the form and writing prompt • model the strategy Student's Role: • make notes • provide ideas • ask questions	Teacher's Role: • select the form and writing prompt • assign groups • monitor progress Student's Role: • select a strategy as a group • decide on their role • provide ideas • ask questions	Teacher's Role: • select the form and journal prompt • monitor progress Student's Role: • select and carry out the strategy
Develop and Organize	• Webbing and Mapping * • Supporting the Main Idea • Adding Details	Teacher's Role: • model the strategy Student's Role: • make notes • provide ideas • ask questions	Teacher's Role: • monitor progress • provide feedback Student's Role: • select a strategy as a group • lead in designated role • provide ideas • ask questions	Teacher's Role: • monitor progress • provide feedback Student's Role: • select and carry out the strategy
Revise and Edit	• Reorganizing Ideas * • Asking Questions to Revise Writing • Peer Editing* • Proofreading Without Partners*	Teacher's Role: • model the strategy Student's Role: • make notes • provide ideas	Teacher's Role: • monitor progress • provide feedback Student's Role: • select a strategy as a group • lead in designated role • provide ideas • ask questions	Teacher's Role: • monitor progress • provide feedback Student's Role: • select and carry out the strategy

* Refer to *Think Literacy Approaches Grades 7-12* (2003).

Writing for a Purpose: Journal Writing – Adding Details

MATHEMATICS Grade 10-12

In a first attempt at a journal, often important information or connections are overlooked. In this strategy, students are given a paragraph from a sample journal. By asking critical questions they determine how the paragraph can be improved, thus fine tuning their journal writing skills.

Purpose

- Provide additional specific and supportive detail in the writing.

Payoff

Students will:

- add depth and breadth to their writing by including appropriate details.

Tips and Resources

- Provide the students with copies of the various journal forms. Examples of summary, explanation, and problem design journal forms are included as Samples A – C respectively. For other journal forms see Teacher Resource: *Journal Writing – Forms and Writing Prompts.*
- Use coloured paper when copying journal material. This will help students find the appropriate handouts quickly.
- Make sure the paragraph composed for this activity is "bare-bones," leaving out most details and including many unanswered questions. (See Teacher Resource: *Adding Details – Samples A - C.*)
- Be sure that the topic is familiar to all of your students so that everyone is engaged. Leave the newer and less familiar topics for group and personal journal writing.
- Encourage students to use anecdotes and examples, as well as facts.
- For annotated samples, see Teacher Resource, *Writing for a Purpose: Journal Writing – Adding Details - Samples A - C.*
  As a next step in the writing process, please see ***Revising Editing: Asking Questions to Revise Writing*** in *Think Literacy Approaches Grades 7-12 (2003).*

Further Support

- The following lesson plan has been organized to introduce class journal writing. To use this strategy for group journals and personal journals please see Teacher Resource, *Journal Writing – Linking Process, Strategies and Developmental Stages.*

Writing for a Purpose: Journal Writing – Adding Details

MATHEMATICS Grade 10-12

What teachers do	What students do
Before ▪ Select a journal prompt. ▪ Compose a brief paragraph that explains or describes something that the students have studied before. (See Teacher Resource, *Adding Details*: Samples A – C.) ▪ Copy the paragraph for the class and make a transparency for yourself. ▪ Copy a class set of the Student/Teacher Resource: *Stretching Ideas* located in *Think Literacy Cross-Curricular Approaches Grades 7-12*, page 122.	▪ Bring a copy of the journal prompts to class.
During ▪ Identify the journal prompt being used. ▪ Distribute the *Stretching Ideas* handout and read it with the class. ▪ Read the paragraph to the class. ▪ Model how to apply the *Stretching Ideas* handout to the first few sentences in the paragraph. ▪ Ask students to reread the paragraph and then to identify all the places where more information is needed. ▪ Respond to student questions by adding more details, examples, or anecdotes. ▪ Guide students in a discussion to see how additional supporting detail improves the quality of the writing.	▪ Read the paragraph and the *Stretching Ideas* handout. ▪ Ask questions about the missing detail using the *Stretching Ideas* handout as a guide. Record these questions. ▪ Share these questions with the class. ▪ Record questions and make notes on how to answer these questions.
After ▪ Model how to answer a few of the questions within the context of the paragraph. ▪ Assign revision of the paragraph for homework. ▪ (Optional) Have students work with the handout and their revised draft to identify further areas for revision.	▪ Complete revision of the first draft for homework. ▪ Use the handout and the revised draft (individually or in pairs) to identify further areas for revision.

Notes

Teacher Resource

Writing for a Purpose: Journal Writing – Adding Details

MATHEMATICS Grade 10-12

Sample A – MCF 3M

Questions to help stretch ideas.	Journal Response
How is a proportion applied to baking?	Proportional relationships occur in every part of our lives. You can apply proportions to purchases, wages, baking, currency exchange, and simple interest. Just remember that proportions are fractions in disguise.
Why is the statement "A fraction is an example of a proportion" wrong?	A fraction is an example of a proportion. By using that idea you can solve lots of proportion questions. Just set up your proportion like a fraction and cross multiply. As long as both numbers on the top represent the same thing, your answer should be correct. You can keep making up new proportions and record them in a table of values. If you plot them you will get a line. So proportions are represented by linear relations as well.
What does a proportion look like if it is not in fraction form?	Keep your proportion organized and cross multiply to get the answer. That's the way to use proportions in your daily life.

Student Editorial Notes:

How is a proportion applied to baking? It can be used to increase or decrease the quantity baked.

A fraction is a ratio, but a proportion is an equality of two ratios. Realizing this idea the rest of the paragraph must be fixed.

Writing for a Purpose: Journal Writing – Adding Details

MATHEMATICS Grade 10-12

Sample A – MCF 3M

Questions to help stretch ideas	Journal Response
	Proportional relationships occur in every part of our lives. You can apply proportions to purchases, wages, baking, currency exchange, and simple interest. Just remember that proportions are fractions in disguise. A fraction is an example of a proportion. By using that idea you can solve lots of proportion questions. Just set up your proportion like a fraction and cross multiply. As long as both numbers on the top represent the same thing, your answer should be correct. You can keep making up new proportions and record them in a table of values. If you plot them you will get a line. So proportions are represented by linear relations as well. Keep your proportion organized and cross multiply to get the answer. That's the way to use proportions in your daily life.

Writing for a Purpose: Journal Writing – Adding Details

MATHEMATICS Grade 10-12

Sample B – MCF 3M

Questions to help Stretch Ideas	Journal Response
What are the important parts of a compound interest question? What is an example of a compound interest question? What is the compound interest formula?	Finding the value of an investment can be difficult if you do not understand the terminology in the question. By first highlighting the important words, the steps are easy to follow. First, you need to read that the interest rate is "compounded". Then, using the frequency of the compounding period, apply that to finding i and n. For example, the term "monthly' means 12, "quarterly" means 4 and "semi-annually" means 2. "Annually" is easy, that means 1. Using that fact you divide the i and multiply the n by 12, 4, 2 or 1. In case you forget to "divide the i" just say the phrase by emphasizing the i in the word divide. Substitute the values for n and i into the compound interest formula and find the answer using your calculator. You will be surprised at how easy compound interest questions will be if you follow those three steps.
Student Editorial Notes: One sample note: the interest rate, the period, and the principal.	

W

Writing for a Purpose: Journal Writing – Adding Details

MATHEMATICS Grade 10-12

Sample C - **MAP 4C**

<table>
<tr><th>Questions to help stretch Ideas</th><th>Journal Response</th></tr>
<tr><td>What is time and height measured in?

Why do we set t greater than or equal to zero?

Why did you remove t = -5 as a solution?

How do we know that the ball is in the air at t = 0?

Where is your conclusion? What details should your conclusion include?</td><td>Sample C: MAP 4C
There are many situations that can be modeled using the quadratic function. In many situations, the path of a ball, profit, the area of a swimming pool, and a city's population growth can be represented using the form $y = ax^2 + bx + c$.

Let $h = -t^2 - t + 20$, where h is the height of the ball and t is the time after it was first tossed; t is greater than or equal to 0. Since the coefficient of the t^2 is negative, we also know that the graph opens downward and has a maximum value. To learn more about the graph we can investigate the x intercepts. By setting h = 0, we find the t intercepts -5 and 4. We remove t = -5 as a solution. Height cannot be negative so we also remove values of t > 4. We also know that the ball is already in the air at t = 0.

Now that we have a picture of the parabola in our mind, we can make up a question. Using the equation $h = -t^2 - t + 20$, what is the height of the ball when t = 0? How high does the ball travel? How far has the ball traveled when it finally hits the ground?</td></tr>
<tr><td colspan="2">Student Editorial Notes:

Sample note:

We would remove t=-5 as a solution because we set t = 0 in the question.</td></tr>
</table>

Developing and Organizing Ideas: Supporting the Main Idea

MATHEMATICS Grades 10 - 12

In this strategy, students learn how to select the better of two possible main ideas to use as a topic sentence in an information paragraph, and then learn how to choose details to support it.

Purpose

- Distinguish main ideas and supporting details for a paragraph.

Payoff

Students will:

- write organized paragraphs on mathematical topics using supporting details.
- demonstrate a clear understanding of the topic.
- improve reading comprehension by spotting main ideas and supporting details.

Tips and Resources

- Select a journal form before beginning to write the sample paragraph. See Teacher Resource: *Journal Writing – Forms and Writing Prompts.*
- Definition, list, and instruction journal forms are included. Please see Student/Teacher Resource: *Finding and Supporting the Main Idea: Samples A – C.*
- An answer key to each sample is provided. Please see Student/Teacher Resource: *Finding and Supporting the Main Idea – Answer Key for Samples A – C*.
- Define new terms when introducing the strategy (e.g., "Main Idea": a broad statement that includes a topic that can be expanded). It usually begins a paragraph (e.g., "Studying mathematics organizes the mind").
- Ask students how they know which statement is the best-supported generalization. Point out that if students have more sentences crossed out than they have left to work with, they have probably selected the wrong generalization. See Student Resource: *Finding and Supporting the Main Idea.*
- Demonstrate how to write a concluding sentence. The basic style is to reword the first sentence/generalization.
- This strategy can help students to understand how to do the task on information paragraphs in the Ontario Secondary School Literacy Test.

Further Support

- The accompanying lesson plan is organized for practicing the group journal. For modification ideas please see Teacher Resource: *Journal Writing – Linking Process, Strategies and Developmental Stages*.

Developing and Organizing Ideas: Supporting the Main Idea

MATHEMATICS Grades 10 - 12

<table>
<tr><th>What teachers do</th><th>What students do</th></tr>
<tr><td>Before
Select a journal form and two topics. (See Teacher Resource: Journal Writing – Forms and Journal Prompts.)
Create one set of sentences that can be copied, cut up, and inserted into labeled envelopes for each group of students. (See Teacher Resource: Finding and Supporting the Main Idea: Samples A – C.)
Copy the second set of sentences for each student.
Copy the Student Resource: Finding and Supporting the Main Idea.</td><td>Identify the methods they already use to select the main idea and supporting details in reports, journals, and articles.</td></tr>
<tr><td>During
Divide the class into groups of three or four and give each group one set of statements.
Model the strategy on the board or overhead using the first set of sentences that were given to the students.
Teach how to find the main ideas in the statements (see Tips and Resources).
Model how to use the sentences to write a paragraph and a conclusion. See Tips and Resources.
Hand out copies of a second set of sentences to each group member.
Have the students individually organize the sentences on their paper copy.
Have the group members discuss the individual results.
Circulate through the class (see Tips and Resources).</td><td>Read through the set of statements with the teacher.
Annotate statements while the teacher models.
Read the second set of sentences.
Use the handout Finding and Supporting the Main Idea to organize the sentences.
Alternatively, use scissors to cut up the paragraph.
Join a group to compare solutions.</td></tr>
<tr><td>After
Review and discuss the second set of sentences. If needed, have students move on to a third set of sentences.
Assign a written paragraph using the second set of sentences for homework.</td><td>Compare their work with the correct answers.
For homework write sentences into a paragraph, including a conclusion.</td></tr>
</table>

Notes

Student Resource

Finding and Supporting the Main Idea

1. Look at the scrambled statements in the sample paragraph.

2. Identify two main ideas in the sample paragraph.

3. Choose which main idea is best supported by the other statements given – this will be the main idea for your paragraph.

4. Cross off or remove the statements that do not belong in the paragraph (i.e., do not support the main idea).

5. Order the statements in the paragraph.

6. Share and compare your ideas with others.

7. Write your final paragraph.

Teacher Resource

Finding and Supporting the Main Idea: Samples A and B

Sample A: MPM 2D

Perpendicular lines will have slope angles that are separated by 90 degrees.
When a line lies below a horizontal line, the angle is referred to as the angle of depression.
Architects, engineers, and carpenters refer to slope using rise over run, delta y over delta x, and some use the word "pitch".
Slope angle is the angle that the line makes with any horizontal line.
Slope is studied in many professions and described by many terms.
Two parallel lines will have the same slope angle.
If the line lies below the horizontal line, the slope angle will be negative.
No matter how slope is described, slope will always have a slope angle.

Sample B: MBF 3C

Other expenses include recreation and education which may also be tied to savings.
Lastly, you may want to include donations in your budget.
When finances are accounted for, more money can be saved.
Your long term goals will determine the amount you budget for savings.
Although people have different priorities, there are some large expenses that should be budgeted for first.
Take the amounts in your budget and convert them to a percent.
The largest expense is housing, followed by food, which does not include eating at restaurants.
There is also the cost of transportation and health care coverage.
Everyone should have a budget.

Finding and Supporting the Main Idea – Sample C

Sample C: MCB 4U

But before that, you need to know that any logarithm can be written in exponential form.

Since 81 can be written as 3 to the power of 4, you can write $3^{-x} = 3^4$.

Therefore, use the fact that $x = b^y$ is equivalent to $y = \log_b x$.

Remember that the logarithmic form of $y = \log_b x$ is read "y equals the log of x to the base b".

So, b represents the base.

Using a simple example like $\log_{10} 100 = y$, you would write 10 to the power of y equals 100.

Finally, solve for x to get x = -4.

To find the value of a logarithm it is important to have some examples in mind.

Once you rewrite 100 as 10 to the power of 2, you will see that y = 2.

A more challenging example could look like $\log_{\frac{1}{3}} 81 = y$.

That will give you –x = 4.

John Napier was the first person to use logarithms.

Remember to rewrite the equation in exponential form.

That will give you $\left(\frac{1}{3}\right)^y = 81$ or $\left(3^{-1}\right)^y = 3^{-y} = 81$.

The bases are the same so you can compare the exponents.

Finding and Supporting the Main Idea – Answer Key for Samples A, B and C

Legend

→ main idea
√ statement belongs in the paragraph
x statement does not belong in the paragraph

Sample A: MPM 2D

→ Slope is studied in many professions and described by many terms.
√ Architects, engineers, and carpenters refer to slope using rise over run, delta y over delta x, and some use the word “pitch”.
√ No matter how slope is described, however, slope will always have a slope angle.
√ Slope angle is the angle that the line makes with any horizontal line.
√ Two parallel lines will have the same slope angle.
√ Perpendicular lines will have slope angles that are separated by 90 degrees.
√ If the line lies below the horizontal line, the slope angle will be negative.
x When a line lies below a horizontal line, the angle is referred to as the angle of depression.

Sample B: MBF 3C

→ Everyone should have a budget.
√ When finances are accounted for, more money can be saved.
√ Although people have different priorities, there are some large expenses that should be budgeted for first.
√ The largest expense is housing, followed by food, which does not include eating at restaurants.
√ There is also the cost of transportation and health care coverage.
√ Other expenses include recreation and education which also may be tied to savings.
√ Your long term goals will determine the amount you budget for savings.
√ Lastly, you may want to include donations in your budget.
X Take the amounts in your budget and convert them to a percent.

Sample C: MCB 4U

→To find the value of a logarithm it is important to have some examples in mind.
√ But before that, you need to know that any logarithm can be written in exponential form.
√ Therefore, use the fact that $x = b^y$ is equivalent to $y = \log_b x$.
√ Remember that the logarithmic form of $y = \log_b x$ is read “y equals the log of x to the base b”.
√ So, b represents the base.
√ Using a simple example like $\log_{10} 100 = y$, you would write 10 to the power of y equals 100.
√ Once you rewrite 100 as 10 to the power of 2, you will see that y = 2.
√ A more challenging example could look like $\log_{\frac{1}{3}} 81 = y$.
√ Remember to rewrite the equation in exponential form.
√ That will give you $\left(\frac{1}{3}\right)^y = 81$ or $\left(3^{-1}\right)^y = 3^{-y} = 81$.
√ Since 81 can be written as 3 to the power of 4, you can write $3^{-x} = 3^4$.
√ The bases are the same so you can compare the exponents.
√ That will give you –x = 4.
√ Finally, solve for x to get x = -4.
X John Napier was the first person to use logarithms.

Revising: KWL Chart (I Know, I Wonder, I Learned)

MATHEMATICS Grades 10 - 12

"I Know, I Wonder and I Learned" is a strategy that is used at the beginning of a lesson to activate prior knowledge and the end of a lesson to consolidate and debrief.

Purpose

- To give students the opportunity to activate prior knowledge, ask questions about a topic, and then consolidate and debrief once the lesson has been taught.

Payoff

Students will:

- connect to prior learning on this topic.
- ponder mathematics, and then have a chance to have their questions answered.

Tips and Resources

- Be certain to collect the student papers once the first two thirds have been completed. Cut the last third off and only hand it back at the end of the class for consolidation. A template is not needed if students divide their papers into thirds.
- A good idea is to do a consolidation and debriefing with the entire class before you ask the students to individually write the "I learned" third of their paper.
- Remind students that their communications and reflections will be assessed.

Reference: *Beyond Monet – Reading in Mathematics* by Mary Lee Barton.

Further Support

- Tell the students the night before the lesson, what the topic is going to be as this will give them time to look over previous course grade notes for the topic.
- The topics for this activity could be used for a word wall.

W

Revising: KWL Chart
(I Know, I Wonder, I Learned)

MATHEMATICS Grades 10 - 12

What teachers do	What students do
Before • Decide on a template, or uniform way for the students to fold their papers. • Remind students that this will be used as an assessment piece. • Give students a template or ask them to label the sheet that they have folded to divide into thirds with the headings "I Know, I Wonder, and I Learned".	• Actively listen to the instructions.
During • Ask students to complete the "I know and I wonder sections" of their sheet individually.	• Read the text, pausing to record whatever they know about subject. • Record whatever they wonder about the subject (e.g., what they would like to know about).
After • Collect and keep some of the samples to use in other classes. • Review the information gathered in the first two columns of the student work to gage their knowledge of the lesson/topic to be studied. As well, look at their "I Wonder" third of the page to get an idea of their line of thinking (and interest) on the topic.	• Draw conclusions about their understanding of the lesson based on the debriefing given. • Compare their own conclusions with those of others.

Notes

Revising: KWL Chart
(I Know, I Wonder, I Learned)

MATHEMATICS Grade 10 Applied

Template :

I Know…	I Wonder…	I Learned…

Topics include :

What I Know about Functions….

What I Know about the Equation of a Line ….

What I Know about the Midpoint of a Line….

What I Know about Linear Systems….

What I Know about Factoring….

What I Know about Quadratic Functions….

What I Know about Similarity….

What I Know about Congruence….

What I Know about Trigonometry….

Mathematical Literacy: Literacy Tool Kits

MATHEMATICS Grade 10-12

Most of us have Math tool kits in our classrooms that have calculators and graphing technology in them. In order to reach all of the students in our classrooms we need to have literacy tool kits available for all of our students.

A literacy tool kit should include:

Dictionaries
Thesauruses
Math Dictionaries
Post-it-notes
Writing utensils (pens and pencils)
Crayons
Pencil crayons
Markers
Scissors
Manipulatives
Chart Paper
Graph Paper

Writing for a Purpose: Journal Writing - Asking Questions to Revise Writing

MATHEMATICS Grades 10 - 12

Students ask other students questions and provide specific feedback about other students' writing. Students gain a sense of taking personal responsibility for their writing.

Purpose

- Discuss the ideas in a piece of writing in order to refine and revise the ideas.

Payoff

Students will:

- engage in meaningful discussion and deepen understanding of mathematics.
- develop over time into supportive writing partners with peers.
- recognize that the writer owns the writing and that the collaboration helps other students to recognize unintended omissions and inconsistencies.

Tips and Resources

- There are examples of journals using the Report and Application writing forms. (See Teacher Resource: *Writing for a Purpose – Journal Writing.)*
- This specific resource is written to help edit a personal journal. To modify this resource for class journal and group journal writing, please see the Teacher Resource: *Journal Writing – Linking Process, Strategies and Developmental Stages.*
- The writer should be the first to amend or add ideas rather than having another person suggest a solution. When other students ask questions or provide open-ended prompts, they give the writer an opportunity to think deeply about a piece of writing and to gain a better sense of how to tailor it to make it both a more formal piece of communication and a better solution.
- Revising and editing a solution to a mathematics problem differs from revising and editing a literary piece in at least two ways. The first difference is that it is not the power of words, expressions, or style that convinces the reader but rather the logic and the reasoning must be clear. The second difference is that mathematical communication has its own syntax and conventions which must be adhered to if correctness as well as clarity is to be presented.
- See the Mathematics exemplars (*The Ontario Curriculum – Mathematics Exemplars*) for samples of student work at levels 1, 2, 3 and 4 to use as examples of both good solutions and of solutions needing revision. These are available both on-line at http://www.edu.gov.on.ca and in hard-copy form from The Queen's Printer.
- See also EQAO Release Materials from the Grade 9 testing for other examples. These are available on-line at http://www.eqao.com/06ede/ed6_1e.asp
- To view the prompts and questions see Student Resource: *Asking Questions to Revise Writing.*

Writing for a Purpose: Journal Writing - Asking Questions to Revise Writing

MATHEMATICS Grades 10- 12

What teachers do	What students do
Before ▪ Decide on a journal form. ▪ Prepare a writing sample using the journal form. ▪ Read the sample aloud, asking students to listen carefully (to hear "how it sounds") while following with their eyes. ▪ Ask students to identify areas of concern or confusion. ▪ Model the use of questions and prompts, asking students to consider the purpose of these questions and prompts.	▪ Look and listen for areas of confusion or concern in the writing sample. ▪ Offer suggestions for areas of concern or confusion. ▪ Suggest the purposes or effects of the questions and prompts.
During ▪ Distribute the Student Resource, *Asking Questions to Revise Writing*, and read it the class. ▪ Put students in conferencing groups of three or four to read each other's writing. ▪ Ask students to share their piece of writing with at least two people in their group. ▪ Encourage students to use one or two of the prompts or questions. ▪ Provide 20 to 30 minutes for this exercise.	▪ Exchange writing drafts with another group member. Take turns reading the writing aloud to each other and asking questions or providing prompts. ▪ Exchange writing drafts with a different group member. Take turns reading the writing aloud to each other and asking questions or providing prompts.
After ▪ Engage students in a whole-class discussion about the process. How did they feel about using the questions or prompts? How helpful was the process in setting a direction for revising their writing draft? ▪ Direct students to revise their writing draft.	▪ Participate in a class discussion. ▪ Revise own writing drafts based on the prompts and questions from their partners.

Notes

Asking Questions to Revise Writing – Sample Questions

Your job as a revising partner is a very important one. You can help the writer by:
- giving the writer a sense of how completely the task has been accomplished;
- praising proper form, use of required convention and/or reasoning;
- identifying poor form;
- identifying areas of confusion;
- targeting statements that are not relevant;
- targeting conclusions that do not address the question;
- targeting conclusions that are not supported with evidence.

The writer owns the writing, and should not feel that your suggestions or ideas are being imposed as THE solution. The best way to help your revising partner is to phrase your comments as open-ended prompts, as questions, or as a combination of an observation and a question. Some suggestions are below.

- Begin by using any "praise" statements when you can.
- If you can't use the "praise" suggestions, you should use the "questions."

Asking Questions to Revise Writing: Samples A, B and C

Sample A: MFM 2P

We have been studying functions in many ways. Functions can be written as an equation, a table of values, or as a graph. There are also different ways to determine if each description is linear.

A table of values records the points of a function. Subtract pairs of y values to record first differences. A linear function will always have the same difference for every pair of y values. A graph will be straight if it is linear. An equation will have the degree of one if it is linear.

Sample B: MCR 3U

Many situations can be modeled using a quadratic formula. For instance, a shopkeeper may use an equation to determine the store's profit. If that were the case, the clerk would need to understand some characteristics of a quadratic function.

When writing the equation, the clerk would have to pick an independent variable like t, for time, and a dependent variable like profit, represented by p(t). Using that equation the manager could determine when the store made the most profit (vertex) and what the sales would be at a specific time. The store owner could also see when the sales are the lowest in an attempt to discover the reason.

Using a quadratic function to model store profit would be a good idea. It provides the store owner and manager with valuable information that they could use to change the way they run the store.

Sample C: MDM 4U

A scatter plot is used by social scientists to understand large amounts of data. Once the data is visually displayed, many interest groups can benefit from knowing if the data shows any patterns. Once patterns are established, any predictions made using the data will affect the behavior of different groups of people.

For example, a study of moderate wine consumption and deaths from heart disease would attract the attention of advertisers, the medical community, governments and entrepreneurs. One such study out of the University of California has data to show a steady decline of heart disease deaths as the consumption of alcohol increases. This strong negative trend is evident on the scatter plot with data forming a fairly linear pattern.

With such a strong negative correlation, there is a temptation to make predictions relating wine consumption and heart disease deaths. A causal relationship however has not been clearly established. Therefore, the study simply informs doctors that drinking wine in moderation is not a health risk and entrepreneurs along with advertisers can market wine to an older age group. Governments may then want to study the effects of wine consumption on workplace absenteeism and the demands for addiction services.

As with all studies, a correlation between two variables is always intertwined with other uncontrolled variables. More research must be done on this subject but a scatter plot has helped clarify some of the study's conclusions

Praise	Questions
• Your solution is complete.	• Your solution doesn't seem to be complete: • Have you defined the variable? • Have you included a concluding statement? • Is your conclusion connected to the numerical values that you worked out? • Have you shown all of your steps?
• Your solution uses proper form.	• How could you improve the 'form' of your solution? • Do you have more than one = sign on a line? • Have you carried all of the expression from line to line? • Have you used the appropriate units?
• Your conclusion is consistent with the question being asked.	• What conclusion would better connect to the question being asked? • Should the numerical answer you calculated be rounded? If yes, up or down?
• Your work is clearly laid out with your steps outlined.	• What comments could you add to clearly identify the steps you took? • How could you organize/space your solution to help the reader follow your thinking? • Could you include a diagram, chart or graph to support your thinking?
• You have used all the necessary conventions.	• What conventions have to be paid attention to in your solution (e.g., units, = sign position, rounding, labels, and scales on graphs / diagrams, symbols)?
• You have made good use of mathematical terminology.	• What mathematical terminology and symbols can you use in your solution?
• Your strategy is reasonable.	• Does your strategy produce an answer to the question being asked? • Does your diagram/graph reflect the information given in the problem? • Did you choose appropriate values from the given chart/graph? • Did you choose an appropriate formula?
• You were able to consider more than one possible solution.	• Can this problem have more than one solution?

Pair Work: Think/Pair/Share

MATHEMATICS Grades 10 - 12

In this strategy, students individually consider an issue or problem and then discuss their ideas with a partner.

Purpose

- Encourage students to think about a question, issue, or reading, and then refine their understanding through discussion with a partner.

Payoff

Students will:

- reflect on subject content.
- deepen understanding of an issue or topic through clarification and rehearsal with a partner.
- develop skills for small group discussion, such as listening actively, disagreeing respectfully, and rephrasing ideas for clarity.

Tips and Resources

- Use Think/Pair/Share in all math strands for any topic.
- Use it to help students read and understand a problem [e.g., direct students to complete a KMWC (*Know/Model/Words/Cross out*) chart (see *Most/Least Important Idea(s) or Information*) then share their work with a partner].
- Once a problem has been understood, this strategy can be used to help in the problem solving process (see Student/Teacher Resource, *Think/Pair/Share – Sample Starters*).
- This strategy can be used for relatively simple questions and for ones that require more sophisticated thinking skills, such as hypothesizing. Use it at any point during a lesson, for very brief intervals or in a longer time frame.
- Use it to activate prior knowledge, understand a problem, or consolidate learning.
- Take time to ensure that all students understand the stages of the process and what is expected of them.
- Review the skills that students need to participate effectively in *Think/Pair/Share*, such as good listening, turn-taking, respectful consideration of different points of view, asking for clarification, and rephrasing ideas.
- After students share in pairs, consider switching partners and continuing the exchange of ideas.
- See Student/Teacher Resource, *Think/Pair/Share – Possible Starters.*
- See other strategies, including *Take Five* and *Discussion Web* (Oral Communication strategies in *Think Literacy: Cross-Curricular Approaches, Grades 7-12, 2003*) for ways to build on this strategy.

Teaching Reading in Social Studies, Science, and Math, pp. 266-269.
Beyond Monet, pp.94, 105.

Further Support

- Some students may benefit from a discussion with the teacher to articulate their ideas before moving on to share with a partner. Interview those students who require additional support to scaffold their thinking so that they are prepared to pair share.
- Provide criteria for what effective thinking, pair sharing, and small group or additional pairing look, sound, and feel like. Such criteria includes details about active listening (e.g., one voice at a time, eyes looking at the speaker, nodding to show that you heard what they said); taking turns (e.g., first one person shares and the other listens, and then reverse roles); monitoring sharing time (e.g., 2 minutes, identifying start and stop time).

Pair Work: Think/Pair/Share

MATHEMATICS Grades 10 - 12

What teachers do	What students do
Before • Think about the different purposes of the *Think/Pair/Share* activity: to activate prior knowledge; to think about ideas first and then share with other students for feedback; to pace student thinking and discussion; to include all students in developing a plan for solving a problem; to share a solution to a math problem; to analyze and compare solutions to a math problem. • Consider the social and academic goals for the *Think/Pair/Share* activity, and plan for pairing of particular learners who would further those goals. • Demonstrate with students the actions and time frame that students use during a *Think/Pair/Share*.	• Follow the actions of Think (think and write individually) Pair (share ideas with a partner) Share (share what you heard from your partner with another pair of students or a small group). • Use *Think/Pair/Share* for any of these purposes at the 'Before' part of a lesson, given the teacher's prompts: to solve a problem from the previous day's lesson; to describe a mathematical concept, skill, or strategy used in the previous day's lesson or homework; to preview and identify key features and ideas from the text to be used in the lesson.
During • Ask students to spend several minutes thinking about and writing down ideas (e.g., as a review of previous learning; to describe a mathematical concept; to brainstorm ideas for making a plan to solve a problem). • Identify expectations regarding the mathematical focus of the student thinking (e.g., criteria for active listening, taking turns, and monitoring time for sharing). • Organize students in pairs to share, clarify their ideas and understanding, and ask questions. • Monitor the focus, quality, and amount of student dialogue through observation and interview.	• Use *Think/Pair/Share* to formulate thoughts and ideas about: the key concepts, skills, and/or strategies learned from a previous lesson; the making of a plan for solving a math problem; a solution to a math problem; analysis and comparison of solutions for a math problem. • Record thoughts and ideas in written form (e.g., phrases, diagrams, charts, mathematical symbols) as preparation for sharing with a partner. • Practise effective active listening, taking turns, and monitoring time skills when learning in pairs and small groups, using techniques such as paraphrasing what the other has said, asking for clarification, revising and restating own ideas, waiting for others to stop sharing, watching clock for equitable sharing time.
After • Call upon some pairs to share their learning and ideas with the whole class. • Possibly extend the *Think/Pair/Share* with a further partner trade, where students swap partners and exchange ideas again. • Consider adding a journal writing activity as a productive follow-up to a *Think/Pair/Share* activity.	• Pinpoint any information that is still unclear after the pair discussion, and ask the class and teacher for clarification.

Notes

Pair Work: Think/Pair/Share

MATHEMATICS   Grades 10 - 12

- Take about 5 minutes to jot down things you remember about ___ (e.g., Pythagorean Theorem, graphing a line, slope, using a graphing calculator, the properties of similar triangles).
- Describe ___   including a worked example. [e.g., the relationship for calculating the surface area of a pyramid; trigonometric ratios (i.e., sine, cosine, tangent)].
- What is the difference between ___ and ___ (e.g., the instructions *describe* and *justify*)?
- What is the same and what is different between ___ and ___ (e.g., 1st degree and 2nd degree equations)?
- Think about different ways that you can ___ (e.g., model a first-degree equation with one variable using algebra tiles, paper and pencil, a balance scale).
- You are going to look at a diagram on the overhead for a few moments. Then I will cover the diagram and ask you to individually write things that you remember about the diagram.
- Look at the table of values and the graph of a parabola. Identify the key features of a graph of a parabola.
- How are scatter plot data on a line graph different than on a parabola?
- Think about the math problems we solved over the last few days. Summarize the relationship between two linear relations when there is a point of intersection. Show your ideas using an algebraic and graphic method.

Sample Think/Pair/Share Process for Problem Solving:

Step 1: Think 	Individually think about the following (3-5 minutes): • What information do you need to solve the problem? • What information do you already know? • What tools and strategies could you use? • What questions do you need to ask your group?
Step 2: Pair 	With a partner, jot down ideas to help you get started with the problem (2-3 minutes). You may use any of the tools provided in the classroom, including calculators to help with estimating.
Step 3: Share 	Take turns sharing ideas in a larger group (3-4 minutes).
Step 4:	Decide on the first strategy your group would like to apply to solve the problem. Record other possible strategies. You may want to revise your plan as you work through the problem.
Step 5:	The person with _______________________________________ shares your favoured strategy with the whole class.

Pair Work: Think/Pair/Share

MATHEMATICS   Grades 10 - 12

Sample Starters for Individual Thinking before Pairing:

- Think of three things you know about ___ (e.g., forms of taxation, using a spreadsheet to determine the value of investments, calculating interest for a loan, difference between fixed and variable costs).
- Take about 5 minutes to jot down things you remember about ___ (e.g., owning or leasing a vehicle, simple and compound interest, features and conditions of short-term loans for cars, line of credit).
- Describe ___ including a worked example (e.g., discounts, simple interest, gross and net pay, payroll deductions – pension plan, employment insurance, union dues, income tax).
- What is the difference between ___ and ___ (e.g., the instructions *identify* and *calculate*)?
- What is the same and what is different between ___ and ___ (e.g., salary and commission pay)?
- Think about different ways that you can ___ (e.g., make a decision about the purchase of an item).
- You are going to look at a diagram on the overhead for a few moments. Then I will cover the diagram and ask you to individually write things that you remember about the diagram.
- Read the text about risk tolerance and highlight any words or phrases that require clarification and further explanation.
- Think about the "making change" problems we solved in class over the last few days. Summarize some mental math strategies you learned to calculate change.

Sample Think/Pair/Share Process for Problem Solving:

Step 1: Think 	Individually think about the following (3-5 minutes): • What information do you need to solve the problem? • What information do you already know? • What tools and strategies could you use? • What questions do you need to ask your group?
Step 2: Pair 	With a partner, jot down ideas to help you get started with the problem (2-3 minutes). You may use any of the tools provided in the classroom, including calculators to help with estimating.
Step 3: Share 	Take turns sharing ideas in a larger group (3-4 minutes).
Step 4:	Decide on the first strategy your group would like to apply to solve the problem. Record other possible strategies. You may want to revise your plan as you work through the problem.
Step 5:	The person with ____ shares your favoured strategy with the whole class.

Pair Work: Think/Pair/Share

MATHEMATICS Grades 10 - 12

Sample Starters for Individual Thinking before Pairing:

- Think of three things you know about ___ (e.g., simple iterative processes, permutation and combination problems, databases, network problems, factorials, use of Fathom® software).
- Take about 5 minutes to jot down things you remember about ___ (e.g., binomial distribution, sampling bias and variability, difference between cause-effect relationships and correlation).
- Describe ___ (e.g., situations that give rise to U-shaped, exponential, skewed, bimodal situations). What is the difference between ___ and ___ (e.g., the instructions *solve* and *simplify*)?
- What is the same and what is different between ___ and ___ (e.g., measures of central tendency)?
- Think about different ways that you can ___ (e.g., simulate a situation for which the calculation of the theoretical probability is difficult or impossible).
- You are going to look at a diagram of Pascal's triangle on the overhead for a few moments. Then I will cover the diagram and ask you to individually write things that you remember about the diagram.
- Read the set of instructions and highlight any that you don't understand.
- Think about the permutation problems we did in class over the last few days. Summarize the additive and multiplicative counting techniques. Explain the advantages of using these techniques for particular situations.

Sample Think/Pair/Share Process for Problem Solving:

Step 1: Think 	Individually think about the following (3-5 minutes): • What information do you need to solve the problem? • What information do you already know? • What tools and strategies could you use? • What questions do you need to ask your group?
Step 2: Pair 	With a partner, jot down ideas to help you get started with the problem (2-3 minutes). You may use any of the tools provided in the classroom, including calculators to help with estimating.
Step 3: Share 	Take turns sharing ideas in a larger group (3-4 minutes).
Step 4:	Decide on the first strategy your group would like to apply to solve the problem. Record other possible strategies. You may want to revise your plan as you work through the problem.
Step 5:	The person with ____ shares your favoured strategy with the whole class.

Adapted from TIPS: Section 4 – TIPS for Teachers, page 8

Small-Group Discussions: Place Mat

MATHEMATICS Grades 10-12

In this strategy, students are divided into small groups of 4 to 6 students and gathered around a piece of chart paper. The chart paper is organized with sections for each student to record their ideas and a central section for students to summarize their individual ideas. First, students individually think about a question and write down their ideas on their own section of the chart paper. Then students share ideas to discover common elements, which can be written in the centre of the chart paper.

Purpose

- Provide all students with an opportunity to share ideas and learn from each other in a cooperative small-group discussion.

Payoff

Students will:

- have an opportunity to reflect and participate.
- feel that their ideas are valued, enjoy interacting with others, and extend their learning by listening to the ideas of others and accomplish a small group task.

Tips and Resources

- The strategy can be used with a wide variety of questions and prompts.
- Use the *Place Mat* strategy for a wide range of learning goals, for example:
    - to encourage students to share ideas and come to a consensus about a concept/topic;
    - to activate the sharing of prior knowledge among students;
    - to help students share problem-solving techniques;
    - to facilitate peer review and coaching on a particular type of problem or skill;
    - to take group notes during a video or oral presentation;
    - to summarize learning after the lesson and be used as an opening review for the subsequent lesson.
- Groups of 4 students are ideal for placemat, but it can also work with up to 6 students in a group.
- You may choose several questions or issues for simultaneous consideration in a *Pace Mat* strategy. To start, each group receives a different question or issue to work on. Once they have completed their discussion, the groups rotate through the various questions or issues until all have been explored.
- *Place Mat* also works well as an icebreaker when students are just getting to know each other.
- See Teacher Resource, *Placemat - Template and Sample*.
  Beyond Monet, pp.172-173
  TIPS: Section 4 – TIPS for Teachers

http://www.curriculum.org/occ/tips/index.shtml

Further Support

- Discuss, record, and post a labeled diagram of the *Place Mat* on the board, so that students always have a visual reference of the organization and required actions.
- Consider the composition of the small groups, and vary the membership according to the students' styles of learning and interaction, subject-matter proficiency, and other characteristics. However, note that some groups will require more teacher support in carrying out the task than other groups.
- Some students may benefit from being able to "pass" during group sharing. Students should know that they can pass once, but they need to prepare themselves for the next round of sharing.
- Use the placemats as a record of collective student thinking and post their ideas for other groups to see.

Small Group Discussions: Place Mat

MATHEMATICS Grades 10 - 12

What teachers do	What students do
Before • Divide students into small groups of 4 or 5. • Decide on a question (or concept or problem) for the centre of the placemat. • Distribute chart paper and markers to each group. • Ask the students to divide the chart paper into sections equal to the number of students in the group, leaving a circle/oval/rectangle in the centre of the chart for the recording of the group consensus.	• Organize the placemat according to the number of students in their small group, so that there are sufficient sections for the students and a center rectangle for recording their group consensus ideas.
During • Direct each group member to think about, then silently write ideas/information that relate to the question in their personal area of the chart paper. Give students a pre-determined amount of time.	• Gather their thoughts about the chosen question and write silently in their own area of the paper, respecting the space and silence of all members of the group.
After • Give a signal for students in each group to discuss their ideas and information and to agree upon a response to be shared with the entire class. • Call on one member from each placemat group to share their group's response with the whole class. • Assess *for* understanding by listening to student responses. • Use information gained throughout the activity to inform instructional decisions. • Have students post the charts to further share their group's thinking with the class.	• Take turns sharing ideas with the group. • Engage in discussion with all group members to reach consensus on a group response. • Use communication skills, such as active listening and requesting clarification. • Record the group response in the center of the placemat. • Actively listen as each group's placemat is presented. • Post the chart for further sharing with the class and as a record of mathematics learned so that the students and teacher can make reference to it in subsequent lessons.

Adapted from: TIPS: Section 4 – TIPS for Teachers
http://www.curriculum.org/occ/tips/index.shtml

Notes

Template:

Write quietly on your own in your section of the border for several minutes.

Through group sharing, summarize the key ideas and information for the question or concept.

Sample:

Take a few minutes to think about and then individually write down what you know about **measuring and calculating the area of a rectangle** (reviewing/summarizing concepts).

Measure in square units by seeing how many square units cover the rectangle.
Calculate – 6 cm x 8 cm rectangle = 48 cm^2 -

Measure - Multiply the number of rows by the number of columns in a rectangle on square grid paper.
Calculate – length x width of a rectangle = area of a rectangle in square measurement units.

Measuring and Calculating the Area of Rectangles

Can measure by counting the number of square units. Can calculate the area by multiplying the 2 linear dimensions of the rectangle.

Measure – the number of square tiles that cover the floor in a room.
Calculate – multiply the length of one side by the length of the other side of the rectangle.

Measure the area by counting the number of square tiles that cover the rectangle.
Calculate area by multiplying length and width and get square units.

Template:

Write quietly on your own in your section of the border for several minutes.

Through group sharing, summarize the key ideas and information for the question or concept.

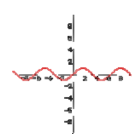
Sample:

Take a few minutes to think about and then individually write down what you know about the **sinusoidal function** (reviewing/summarizing concepts).

graph of y = sin (2x) from x = 0 to x = 2 π. have to compress the graph of y = sin x by one-half horizontally. This changes the period from 2 π to 2 π / 2. So this sinusoidal function has a period of π. To draw the graph from x = 0 to x = 2 π you'll have to draw two complete cycles of the graph.

Sinusoidal functions have period lengths that are multiples of 360° or 2Π which stretches or compresses the sine function

Sinsusoidal Function



A sinusoidal function is a function that is like a sine function and can be produced by shifting, stretching or compressing the sine function

*The graphs of **y = sin x** are called sinusoidal waves. The graph repeats itself as it moves along the x-axis in cycles called periods. For y = sin (1)x is changed to y = sin 2x. There are two periods in the space where there was one. That means periods occur twice as often or we say they are one-half as long.*

The period of each base sinusoidal curve, $y=\sin\theta$ or $y=\cos\theta$, is 360° or 2Π. The period is $360^\circ/|k|$ or $2\Pi/|k|$ for $y=\sin k\theta$ or $y=\cos k\theta$

Template:

Write quietly on your own in your section of the border for several minutes.

Through group sharing, summarize the key ideas and information for the question or concept.

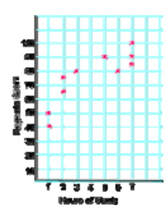
Sample:

Take a few minutes to think about and then individually write down what you know about **scatter plots** (reviewing/summarizing concepts).

Points on a graph
Label axes, write title
Line of best fit
Extend line
Curve of best fit

Ordered pairs on a graph
Shows trends
Interpolate
Extrapolate

Scatter Plots



Graphical model used to determine if a relationship exists between two variables. It is also used to make predictions based on the given data.

Points
2 variables
Used to show data
Can make predictions
Compares 2 sets of data

Graph points
Put line of best fit through points
Make predictions
Strong or weak correlation
Positive or negative correlation

Whole-Class Discussions: Four Corners

MATHEMATICS Grades 10-12

In this strategy, students individually choose a response to a question or prompt and move to an area in the room where they join others who share their ideas and responses. This strategy is flexible and can be used for many topics, questions, and problems in mathematics.

Purpose

- Allow students to make their own response to a question, prompt, or problem; encourage critical thinking.
- Encourage an exchange of student-generated ideas and solutions to problems in small groups.
- Facilitate a class discussion and analysis of student-generated ideas and responses.

Payoff

Students will:

- make up their own minds on the validity of an idea and/or solution to a mathematics problem.
- speak freely in a relaxed environment.

Tips and Resources

- Consider using more than four areas for response.
- Vary the approach by creating a value line. Ask students to rank themselves by lining up in a single line of a continuum; from 'strongly agree' to 'strongly disagree'. This will make student exchanges a necessity so that students can discover exactly where they fit on the line.
- This strategy would work well as a forum in which students could share a product they have created. In this case students would take their work to one of the corners to share, compare, and discuss with other students. This is a very helpful option for students prior to submitting work for teacher assessment.
- Provide a simple protocol for students to discuss the key ideas that prompted them to be in one of the four corners (e.g., What are your responses? How are your responses similar? Explain how your corner responses are different than the other 3 corners?)
- **Opposite Sides** Variation:
  - This is used when there are only two responses. Divide the room in two and ask students to take one side, depending on their decision.
  - If the class is large, use smaller groups to allow all students a chance to speak. Arguments could be written on chart paper. After a specified time, the groups would share their arguments with the whole class.
- See Teacher Resource, *Opposite Sides - Examples*.
- See Teacher Resource, *Four Corners – Examples.*

Further Support

- Keep a diagram of the class and the four corners and use it to record the possible responses for questions, so that students know where to stand in the classroom.
- Post the protocol for sharing ideas at the four corners, so that students generate details that support their choice of one of the four corners.
- The teacher may need to encourage some students to develop a response and make a decision.
- Think about how the four corners also is a concrete graphic representation of students' collective responses to a question.

Whole Class Discussions: Four Corners

MATHEMATICS Grades 10 - 12

What teachers do	What students do
Before • Create a statement or question for students to ponder that has the potential for varying degrees of agreement or preference. • Organize the room into four areas (corners) and label with: strongly agree, agree, disagree, and strongly disagree; four descriptors/categories; four solutions to a homework or class problem. • Give students ample time (2 to 5 minutes) to think about the question, develop a response, and take a stance. Students need to be encouraged to make their own choices. • Questions posed should not require extensive mathematical work.	• Discuss the details of the question posed. • Develop and record an individual response to the question. • Carefully ponder the question, making a personal decision as to the position each will take. • Develop a brief rationale for their choice of one of the four corners.
During • Ask students to move to one of the four corners that best represents their response to a question. • Direct students to get into groups of three (if possible) to discuss the reasons for their choices. In cases where the groups are not large enough, pairs may be formed. In cases where only one student is in a group, the teacher could act as the other member of the pair.	• Move to the corner that best describes their response to a question. • Engage in an exchange of ideas with other members of their group, remaining open and communicative. • Ensure that everyone is heard and that everyone in the group shares equally. • Prepare to speak to the class about the group's discussion, noting common reasons and differing opinions.
After • Call upon various groups to share information gathered in small group discussions with the whole class.	• Highlight their group's main points with the class, pointing out commonalities and discrepancies. • Prompt each member of the group to contribute something to the ideas discussed in the corner group with the class.

Notes

Four Corners - Examples

Example 1:

1
Strongly agree

2
Agree

Explaining your solution to a problem shows that you understand the mathematics used.

Disagree
3

Strongly disagree
4

Example 2:

State a relationship that can be modeled in at least three of the different ways listed. Ask students to choose which model they would use and to be prepared to justify why their chosen model is the best choice. Consider directing students to create the model in which case technology or appropriate manipulatives should be placed in corner 4. Other models (e.g., algebraic) may be used instead of those listed below.

1
Pictorial Model

2
Graphical Model

The sum of the co-interior angles formed by a transversal of parallel lines is 180^{o}.

Numerical Model
3

Dynamic Model
4

Four Corners - Examples

Example 1:

1 Strongly agree		2 Agree
	Clear and precise mathematical communication includes the use of mathematical terms and symbols in an organized manner.	
Disagree 3		Strongly disagree 4

Example 2:

Have the students analyze this set of numbers and decide which concept is represented: simple interest, arithmetic sequence, linear growth, geometric sequence.

1 simple interest A = P × (1 + rt) I = A - P I = P × rt		2 arithmetic sequence $a_n = a_1 + (n - 1)d$
	2, 6, 18, 54, 162 … has a <u>constant</u> <u>ratio</u> between its <u>terms</u>. The first term is a_1, the <u>common ratio</u> is r, and the number of terms is n. This is an example of …	
geometric sequence $a_n = a_1r^{n-1}$ 3		linear growth 4

Four Corners - Examples

Example 1:

1 Strongly agree		2 Agree
	Probability can be expressed as a fraction, decimal, percent, and ratio.	
Disagree 3		Strongly disagree 4

Example 2:

State a relationship that can be modeled in at least three of the different ways listed. Ask students to choose which model they would use and to be prepared to justify why their chosen model is the best choice. Consider directing students to create the model in which case technology or appropriate manipulatives should be placed in corner 4.

1 Pictorial Model		2 Graphical Model
	Is doubling the area of a triangle the same as doubling each side of the triangle?	
Numerical Model 3		Dynamic Model 4

Whole-class Discussions: Four Corners Variation – Opposite Sides

MATHEMATICS Grades 10 - 12

In this strategy, students individually choose an "agree" or "disagree" response to a question or prompt and move to an area in the room where they join others who share their ideas and response. This strategy is flexible and can be used for many topics, questions, and problems in mathematics.

Purpose

- Allow students to make their own response to a question, prompt, or problem; encourage critical thinking.
- Encourage an exchange of student-generated ideas and solutions to problems in small groups.
- Facilitate a class discussion and analysis of student-generated ideas and responses.

Payoff

Students will:
- make up their own minds on the validity of an idea and/or solution to a mathematics problem.
- speak freely in a relaxed environment.
- think creatively and critically.

Tips and Resources

- Encourage students to make up their own mind concerning the validity of a response to a question, prompt, or a solution to a mathematics problem.
- Provide a simple protocol for students to discuss the key ideas that prompted them to be on one side or the other (e.g., What are your responses? How are your responses similar? Explain how are your responses are different than the other side).
- See Teacher Resource: *Opposite Sides - Examples*.
- See Teacher Resource: *Four Corners – Examples.*

Further Support

- Post the protocol for sharing ideas, so that students generate details that support their choice.
- The teacher may need to encourage some students to develop a response and make a decision.

Whole-class Discussions: Four Corners Variation - Opposite Sides

MATHEMATICS Grades 10 - 12

What teachers do	What students do
Before • Create a true/false statement or question for students to ponder. Choose a statement that requires critical thinking. • Assign one side of the room as the "Agree" side, and the opposite side of the room as the "Disagree" side. • Give students a minute or two of quiet time to individually think about the question and take a stance. • A minute or two should be ample time; ensure that this time is spent quietly so that students make their own choices.	▪ Carefully ponder the statement, making a personal decision as to the position they will take. • Respect other students' quiet thinking time.
During • Ask students to move to the side of the room that represents their stance on the question. • Have some students justify their choice of sides to the whole class. • Allow students to change sides after another student's explanation. However, when a student chooses to change sides, ask the student to give reasons for the change. • Be prepared to contribute to the "debate" by asking "what if ..." questions.	• Move to the side of the room that describes their stance on the statement. • Actively listen to other students' justifications. • Be prepared to justify their own choice. • If sufficiently swayed by a justification from the other side, be prepared to justify a move to the other side of the room.
After • Debrief the activity by leading a discussion to summarize the justifications and clarify concepts in order to dispel misconceptions.	• Participate in summarizing the justifications.

Notes

Whole-class Discussions: Opposite Sides – Examples

"Agree" Side

Mathematical Statement,   ***A Solution to a Problem***

"Disagree" Side

Sample Statements
Grade 10 Applied
1. Similar triangles have equivalent corresponding angles and sides.
2. sinA = opp/adjacent; cosA= adjacent/hypotenuse; tanA= hypoteneuse/adj.
3. Surface area (pyramid) = area of square base + area of 4 similar triangles.
4. $x/3+5 = 4x-2$.
5. $2x^2-128 = (2x-8)(x+8)$.
6. A parabola is represented as $y = -ax^2 + bx + c$ is an upwards parabola.
Grade 11 Workplace
1. An employee can be paid a salary and a commission.
2. The least amount of coins for $28.45 is 1 quarter and 2 dimes.
3. $1 414.78 is the value of $1 000 compounded semi-annually, 10 yrs at 3.5%.
4. For a simple interest loan, you only pay interest on the original principal.
5. Variable costs for operating a vehicle includes repairs, price of vehicle, license.
6. It is always cheaper to travel by train than bus.
Grade 12 University
1. The behaviour of a polynomial function, $f(x) = a_nx^n + a_{n-1}x^{n-1} + \cdots a_1x + a_0$ is essentially the same as that of the monomial, a_nx^n .
2. The logarithmic function is defined as the inverse of the exponential function. These are examples of a logarithmic function: $f(x) = \ln x$; $g(x) = \log_4 x$; $h(x) = \log_{0.5} x$.
3. The current rate of change in the Canadian population can be determined by calculating the average rate of change (i.e., slope of the tangent to a curve at a point).
4. A discontinuous function can be determined if there are undefined points or zeros in the denominator, for those functions composed entirely of products and quotients of polynomials. A simple example of this is $f(x)=1+1/(x-1)$. There is a zero in a denominator at x=1. This is where the function is discontinuous.