CHAPTER

6

Analyse Linear Relations

Vocabulary

x-intercept
parallel lines
perpendicular lines
negative reciprocals
linear system
point of intersection

Curriculum Expectations

Mathematical Process Expectations

Throughout this course, students will:

PROBLEM SOLVING

MPS.01 develop, select, apply, and compare a variety of problem-solving strategies as they pose and solve problems and conduct investigations, to help deepen their mathematical understanding;

REASONING AND PROVING

MPS.02 develop and apply reasoning skills (e.g., recognition of relationships, generalization through inductive reasoning, use of counter-examples) to make mathematical conjectures, assess conjectures, and justify conclusions, and plan and construct organized mathematical arguments;

REFLECTING

MPS.03 demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem (e.g., by assessing the effectiveness of strategies and processes used, by proposing alternative approaches, by judging the reasonableness of results, by verifying solutions);

SELECTING TOOLS AND COMPUTATIONAL STRATEGIES

MPS.04 select and use a variety of concrete, visual, and electronic learning tools and appropriate computational strategies to investigate mathematical ideas and to solve problems;

CONNECTING

MPS.05 make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts (e.g., other curriculum areas, daily life, current events, art and culture, sports);

REPRESENTING

MPS.06 create a variety of representations of mathematical ideas (e.g., numeric, geometric, algebraic, graphical, pictorial representations; onscreen dynamic representations), connect and compare them, and select and apply the appropriate representations to solve problems;

COMMUNICATING

MPS.07 communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.

Additional information and teaching materials for this chapter are available on the McGraw-Hill Ryerson web site at http://www.mcgrawhill.ca/books/principles9. You will need your password to access this material.

Strand:
Analytic Geometry

Overall Expectations

By the end of this course, students will:
AGV.01 determine the relationship between the form of an equation and the shape of its graph with respect to linearity and non-linearity;
AGV.02 determine, through investigation, the properties of the slope and *y*-intercept of a linear relation;
AGV.03 solve problems involving linear relations.

Specific Expectations

Investigating the Relationship Between the Equation of a Relation and the Shape of Its Graph

By the end of this chapter, students will:
AG1.01 determine, through investigation, the characteristics that distinguish the equation of a straight line from the equations of non-linear relations (e.g., use a graphing calculator or graphing software to graph a variety of linear and non-linear relations from their equations; classify the relations according to the shapes of their graphs; connect an equation of degree one to a linear relation);
AG1.02 identify, through investigation, the equation of a line in any of the forms $y = mx + b$, $Ax + By + C = 0$, $x = a$, $y = b$;
AG1.03 express the equation of a line in the form $y = mx + b$, given the form $Ax + By + C = 0$.

Investigating the Properties of Slope

By the end of this chapter, students will:
AG2.02 identify, through investigation with technology, the geometric significance of m and b in the equation $y = mx + b$;
AG2.04 identify, through investigation, properties of the slopes of lines and line segments (e.g., direction, positive or negative rate of change, steepness, parallelism, perpendicularity), using graphing technology to facilitate investigations, where appropriate.

Using the Properties of Linear Relations to Solve Problems

By the end of this chapter, students will:
AG3.01 graph lines by hand, using a variety of techniques (e.g., graph $y = x - 4$ using the *y*-intercept and slope; graph $2x + 3y = 6$ using the *x*- and *y*-intercepts);
AG3.02 determine the equation of a line from information about the line (e.g., the slope and *y*-intercept; the slope and a point; two points);
AG3.03 describe the meaning of the slope and *y*-intercept for a linear relation arising from a realistic situation (e.g., the cost to rent the community gym is $40 per evening, plus $2 per person for equipment rental; the vertical intercept, 40, represents the $40 cost of renting the gym; the value of the rate of change, 2, represents the $2 cost per person), and describe a situation that could be modelled by a given linear equation (e.g., the linear equation $M = 50 + 6d$ could model the mass of a shipping package, including 50 g for the packaging material, plus 6 g per flyer added to the package);
AG3.04 identify and explain any restrictions on the variables in a linear relation arising from a realistic situation (e.g., in the relation $C = 50 + 25n$, C is the cost of holding a party in a hall and n is the number of guests; n is restricted to whole numbers of 100 or less, because of the size of the hall, and C is consequently restricted to $50 to $2550);
AG3.05 determine graphically the point of intersection of two linear relations, and interpret the intersection point in the context of an application.

Chapter Problem

The Chapter Problem is introduced in the Chapter Opener. Ask students if they have ever heard of geocaching, or used a Global Positioning System (GPS). Mathcaching is a similar idea. Students use mathematics, in this case coordinate geometry, to find cues to solve a puzzle. There are four Chapter Problem questions (Sections 6.1, 6.2, 6.5, and 6.7), in which students will find clues to a mystery city located somewhere in Ontario. You may wish to have students complete the Chapter Problem questions as part of the regular exercises or assign the Chapter Problem questions all at once as a review or performance task. These questions are designed to help students move toward the Chapter Problem Wrap-Up on page 355, in which students are invited to design a mathcaching puzzle of their own.

Chapter 6 Planning Chart

Section Suggested Timing	Student Text Page (s)	Teacher's Resource Blackline Masters	Assessment	Tools
Chapter 6 Opener • 15 min	292–293			
Get Ready • 60–80 min	294–295	• BLM G10 Grid Paper • BLM 6.GR.1 Practice: Get Ready	• BLM 6.GR.2 Get Ready Self-Assessment Checklist	**Tools** • grid paper
6.1 The Equation of a Line in Slope *y*-Intercept Form: $y = mx + b$ • 80 min	296–307	• BLM G16 Investigate Graph • BLM G2 Vertical Number Line • BLM G10 Grid Paper • BLM 6.1.1 Practice: The Equation of a Line in Slope *y*-Intercept Form: $y = mx + b$	• BLM A9 Communication General Scoring Rubric	**Tools** • masking tape • metre sticks • stopwatches or watches that measure seconds **Technology Tools** • graphing calculators • CBR™ motion sensor
6.2 The Equation of a Line in Standard Form: $Ax + By + C = 0$ • 80 min	308–314	• BLM G10 Grid Paper • BLM G16 Investigate Graph • BLM G2 Vertical Number Line • BLM 6.2.1 Practice: The Equation of a Line in Standard Form: $Ax + By + C = 0$ • BLM T7 The Computer Algebra System (CAS) on the TI-89 Calculator	• BLM A8 Application General Scoring Rubric • BLM 6.2.2 Achievement Check Rubric	**Tools** • grid paper **Technology Tools** • graphing calculators • Computer Algebra System • TI-89 calculators
6.3 Graph a Line Using Intercepts • 80 min	315–322	• BLM G16 Investigate Graph • BLM G10 Grid Paper • BLM 6.3.1 Practice: Graph a Line Using Intercepts • BLM T4 *The Geometer's Sketchpad*® 3 • BLM T5 *The Geometer's Sketchpad*® 4	• BLM A2 Attitudes Assessment Checklist	**Tools** • grid paper **Technology Tools** • *The Geometer's Sketchpad*® • computers • graphing calculators • CBR™ motion sensor
Use Technology: Use *The Geometer's Sketchpad*® to Explore Parallel and Perpendicular Lines • 80 min	323–325	• BLM T4 *The Geometer's Sketchpad*® 3 • BLM T5 The *The Geometer's Sketchpad*® 4 • BLM 6.UT.1 Use Technology: Using a Slider • BLM 6.UT.2 Use Technology: Use the TI-83 Plus or TI-84 Graphing Calculator to Explore Parallel and Perpendicular Lines • BLM G4 Protractor	• BLM A9 Communication General Scoring Rubric	**Tools** • protractors **Technology Tools** • *The Geometer's Sketchpad*® • computers • graphing calculators
6.4 Parallel and Perpendicular Lines • 80 min	326–329	• BLM G16 Investigate Graph • BLM G10 Grid Paper • BLM G4 Protractor • BLM 6.4.1 Practice: Parallel and Perpendicular Lines • BLM T4 *The Geometer's Sketchpad*® 3 • BLM T5 *The Geometer's Sketchpad*® 4	• BLM A7 Thinking General Scoring Rubric • BLM 6.4.2 Achievement Check Rubric	**Tools** • grid paper • protractors **Technology Tools** • graphing calculators • *The Geometer's Sketchpad*® • computers
6.5 Find an Equation for a Line Given the Slope and a Point • 80 min	330–337	• BLM G10 Grid Paper • BLM 6.5.1 Practice: Find an Equation for a Line Given the Slope and a Point • BLM T4 *The Geometer's Sketchpad*® 3 • BLM T5 *The Geometer's Sketchpad*® 4	• BLM A5 Problem Solving Checklist	**Tools** • grid paper **Technology Tools** • *The Geometer's Sketchpad*® • computers • graphing calculators
6.6 Find the Equation for a Line Given Two Points • 80 min	338–343	• BLM G16 Investigate Graph • BLM G10 Grid Paper • BLM 6.6.1 Practice: Find the Equation for a Line Given Two Points • BLM 6.6.2 Student Success: Think Aloud	• BLM A18 My Progress as a Problem Solver	**Tools** • grid paper • rulers **Technology Tools** • CBR™ motion sensor • graphing calculators

Section Suggested Timing	Student Text Page (s)	Teacher's Resource Blackline Masters	Assessment	Tools
6.7 Linear Systems • 80 min	344–351	• BLM G16 Investigate Graph • BLM G10 Grid Paper • BLM 6.7.1 Ski Club Plans • BLM 6.7.2 Practice: Linear Systems • BLM T4 *The Geometer's Sketchpad*® 3 • BLM T5 *The Geometer's Sketchpad*® 4	• BLM A20 Learning Skills Checklist • BLM 6.7.3 Achievement Check Rubric	**Tools** • grid paper • rulers **Technology Tools** • graphing calculators • *The Geometer's Sketchpad*® • computers
Chapter 6 Review • 80 min	352–353	• BLM G10 Grid Paper • BLM 6.CR.1 Chapter 6 Review	• BLM A16 My Progress as a Mathematician	**Tools** • grid paper
Chapter 6 Practice Test • 60–80 min	354–355	• BLM G10 Grid Paper	• BLM 6.PT.1 Chapter 6 Practice Test • BLM 6.CT.1 Chapter 6 Test	**Tools** • grid paper
Chapter 6 Problem Wrap-Up • 40–80 min	355		• BLM 6.CP.1 Chapter 6 Problem Wrap-Up Rubric	**Technology Tools** • Internet • computers
Chapters 4 to 6 Review • 80 min	356–357	• BLM G10 Grid Paper • BLM A14 Self-Assessment Recording Sheet • BLM A15 Self-Assessment Checklist		**Tools** • grid paper
Task: Salary and Commission • 20–40 min	358	• BLM G10 Grid Paper • BLM T4 *The Geometer's Sketchpad*® 3 • BLM T5 *The Geometer's Sketchpad*® 4	• BLM 6.T1.1 Task: Salary and Commission Rubric	**Tools** • grid paper **Technology Tools** • graphing calculators • *The Geometer's Sketchpad*® • computers
Task: Cod Fish Catches • 20–40 min	359	• BLM G10 Grid Paper • BLM T4 *The Geometer's Sketchpad*® 3 • BLM T5 *The Geometer's Sketchpad*® 4	• BLM 6.T2.1 Task: Cod Fish Catches Rubric	**Tools** • grid paper **Technology Tools** • graphing calculators • *The Geometer's Sketchpad*® • computers

Chapter 6 Blackline Masters Checklist

	BLM	Title	Purpose
Get Ready			
	BLM 6.GR.1	Practice: Get Ready	Practice
	BLM G10	Grid Paper	Student Support
	BLM 6.GR.2	Get Ready Self-Assessment Checklist	Student Self-Assessment
6.1: The Equation of a Line in Slope *y*-Intercept Form: $y = mx + b$			
	BLM G16	Investigate Graph	Student Support
	BLM G2	Vertical Number Line	Student Support
	BLM G10	Grid Paper	Student Support
	BLM 6.1.1	Practice: The Equation of a Line in Slope *y*-Intercept Form: $y = mx + b$	Practice
	BLM A9	Communication General Scoring Rubric	Assessment
6.2: The Equation of a Line in Standard Form: $Ax + By + C = 0$			
	BLM G10	Grid Paper	Student Support
	BLM G16	Investigate Graph	Student Support
	BLM G2	Vertical Number Line	Student Support
	BLM 6.2.1	Practice: The Equation of a Line in Standard Form: $Ax + By + C = 0$	Practice
	BLM A8	Application General Scoring Rubric	Assessment
	BLM 6.2.2	Achievement Check Rubric	Assessment
	BLM T7	The Computer Algebra System (CAS) on the TI-89 Calculator	Technology
6.3: Graph a Line Using Intercepts			
	BLM G16	Investigate Graph	Student Support
	BLM A2	Attitudes Assessment Checklist	Assessment
	BLM G10	Grid Paper	Student Support
	BLM 6.3.1	Practice: Graph a Line Using Intercepts	Practice
	BLM T4	*The Geometer's Sketchpad*® 3	Technology
	BLM T5	*The Geometer's Sketchpad*® 4	Technology
Use Technology: Use *The Geometer's Sketchpad*® to Explore Parallel and Perpendicular Lines			
	BLM T4	*The Geometer's Sketchpad*® 3	Technology
	BLM T5	*The Geometer's Sketchpad*® 4	Technology
	BLM 6.UT.1	Use Technology: Using a Slider	Student Support Technology
	BLM 6.UT.2	Use Technology: Use the TI-83 Plus or TI-84 Graphing Calculator to Explore Parallel and Perpendicular Lines	Student Support Technology
	BLM A9	Communication General Scoring Rubric	Assessment
	BLM G4	Protractor	Student Support

	BLM	Title	Purpose
6.4: Parallel and Perpendicular Lines			
	BLM G16	Investigate Graphs	Student Support
	BLM G10	Grid Paper	Student Support
	BLM G4	Protractor	Student Support
	BLM 6.4.1	Practice: Parallel and Perpendicular Lines	Practice
	BLM A7	Thinking General Scoring Rubric	Assessment
	BLM 6.4.2	Achievement Check Rubric	Assessment
	BLM T4	*The Geometer's Sketchpad*® 3	Technology
	BLM T5	*The Geometer's Sketchpad*® 4	Technology
6.5: Find an Equation for a Line Given the Slope and a Point			
	BLM G10	Grid Paper	Student Support
	BLM 6.5.1	Practice: Find an Equation for a Line Given the Slope and a Point	Practice
	BLM T4	*The Geometer's Sketchpad*® 3	Technology
	BLM T5	*The Geometer's Sketchpad*® 4	Technology
	BLM A5	Problem Solving Checklist	Assessment
6.6: Find the Equation for a Line Given Two Points			
	BLM G16	Investigate Graph	Student Support
	BLM A18	My Progress as a Problem Solver	Student Self-Assessment
	BLM G10	Grid Paper	Student Support
	BLM 6.6.1	Practice: Find the Equation for a Line Given Two Points	Practice
	BLM 6.6.2	Student Success: Think Aloud	Student Success
6.7: Linear Systems			
	BLM G16	Investigate Graph	Student Support
	BLM G10	Grid Paper	Student Support
	BLM 6.7.1	Ski Club Plans	Student Support
	BLM A20	Learning Skills Checklist	Assessment
	BLM 6.7.2	Practice: Linear Systems	Practice
	BLM T4	*The Geometer's Sketchpad*® 3	Technology
	BLM T5	*The Geometer's Sketchpad*® 4	Technology

	BLM	Title	Purpose
Chapter 6 Review			
	BLM G10	Grid Paper	Student Support
	BLM A16	My Progress as a Mathematician	Student Self-Assessment
	BLM 6.CR.1	Chapter 6 Review	Practice
Chapter 6 Practice Test			
	BLM PT.1	Chapter 6 Practice Test	Diagnostic Assessment
	BLM 6.CT.1	Chapter 6 Test	Summative Assessment
	BLM G10	Grid Paper	Student Support
Chapter 6 Problem Wrap-Up			
	BLM 6.CP.1	Chapter 6 Problem Wrap-Up Rubric	Summative Assessment
Chapters 4 to 6 Review			
	BLM G10	Grid Paper	Student Support
	BLM A14	Self-Assessment Recording Sheet	Student Self-Assessment
	BLM A15	Self-Assessment Checklist	Student Self-Assessment
Task: Salary and Commission			
	BLM G10	Grid Paper	Student Support
	BLM T4	*The Geometer's Sketchpad*® 3	Technology
	BLM T5	*The Geometer's Sketchpad*® 4	Technology
	BLM 6.T1.1	Task: Salary and Commission Rubric	Summative Assessment
Task: Cod Fish Catches			
	BLM G10	Grid Paper	Student Support
	BLM T4	*The Geometer's Sketchpad*® 3	Technology
	BLM T5	*The Geometer's Sketchpad*® 4	Technology
	BLM 6.T2.1	Task: Cod Fish Catches Rubric	Summative Assessment

Get Ready

Student Text Pages
294 to 295

Suggested Timing
60–80 min

Tools
- grid paper

Related Resources
BLM G10 Grid Paper

BLM 6.GR.1 Practice: Get Ready

BLM 6.GR.2 Get Ready Self-Assessment Checklist

Common Errors

- Some students may assign variables to improper axes.

R_x Review the concepts of dependent and independent variable. By mathematical convention, the independent variable is normally assigned to the (horizontal) *x*-axis.

- Some students may struggle with applying the slope formula properly, either by incorrect substitution or by integer calculation errors.

R_x Have students label the coordinates of the points they are going to use in the formula with x_1, x_2, y_1, and y_2 before substituting. Provide remediation for adding and subtracting integers, as needed. You may wish to use **BLM 6.GR.1 Practice: Get Ready** for remediation or extra practice.

Accommodations

Gifted and Enrichment–Encourage students to investigate geocaching on the Internet.

Visual–For students with visual challenges, consider enlarging graphs and providing grid paper with larger grid squares.

Motor–For students with weak motor skills, consider providing grid paper with larger grid squares.

Memory–For students with memory difficulties, consider allowing them to create and use a formula sheet. This may help them with remembering things, such as the slope formula.

Teaching Suggestions

- Have students work independently on the Get Ready questions.
- You may wish to use **BLM G10 Grid Paper** to support the Get Ready activities.
- You may wish to use **BLM 6.GR.1 Practice: Get Ready** for remediation or extra practice.
- All BLMs referred to throughout this chapter can be found in the *Principles of Mathematics 9* Teacher's Resource CD-ROM.

Assessment

Assess student readiness to proceed by informal observation as students are working on the exercises. A formal test would be inappropriate since this material is not part of the grade 9 curriculum for this chapter. Student self-assessment is also an effective technique; have students place a checkmark beside topics in the Get Ready in which they feel confident, or have students use **BLM 6.GR.2 Get Ready Self-Assessment Checklist**. Remedial action can be taken in small groups or with a whole class skill review.