9 Linear Relations

General Outcomes

- Use patterns to describe the world and solve problems.

Specific Outcomes

PR1 Graph and analyze two-variable linear relations.

By the end of this chapter, students will be able to:

Section	Understanding Concepts, Skills, and Processes
9.1	✓ describe patterns on the graph of a linear equation
	✓ create a table of values using the points on a graph
	✓ determine the missing value in an ordered pair for a linear equation
9.2	✓ describe the relationship between the variables of a graph
	✓ decide if a table of values represents a linear relation
	✓ graph points from a table of values
9.3	✓ create a table of values by substituting into a linear equation
	✓ construct a graph from a linear equation using integers
	✓ determine the missing value in an ordered pair for a given equation

Assessment	Supporting Learning
Assessment *for* Learning	
Method 1: Use the Math Link introduction on page 331 in *MathLinks 8* to activate student prior knowledge about the skills and processes that will be covered in this chapter. **Method 2:** Have students develop a journal to explain what they personally know about linear relations, including what the graph of a linear relation looks like, and about linear equations, including the different ways that these equations can show the relationship between two sets of data.	• **BLM 4–1 Chapter 4 Math Link Introduction** provides scaffolding for the Math Link introduction. • Have students use the What I Need to Work On section of their chapter Foldable to keep track of the skills and processes that need attention. They can check off each item as they develop the skill or process at an appropriate level. • Students who require activation of prerequisite skills may wish to complete the Get Ready materials available on **BLM 4–2 Chapter 4 Get Ready**, in the *MathLinks 8 Practice and Homework Book*, and at the www.mathlinks8.ca book site.
Assessment *as* Learning	
Literacy Link (page 329) Before starting the chapter or after completing the Math Link introduction on page 331, have students use a KWL chart to identify what they know and want to learn about linear relations. As they complete each section, have them revisit their KWL chart and list what they have learned in the What I **Learned** column.	• Use student responses in the What I **Know** column to identify any misconceptions they may have about the topic. Deal with these when you come to an appropriate lesson during the chapter. • Before filling out the What I **Want** to Know column, have students scan the chapter by reading each section title, studying the picture, and reading the opening text. Have them write down what they want to learn sparked by this brief scan. • As students complete each section, you may wish to have them answer any relevant questions from their What I **Want** to Know column • Before the practice test, have students fill out the What I **Learned** column.
Chapter 9 Foldable As students work on each section in Chapter 9, have them keep track of any problems they are having in the What I Need to Work On section.	• As students complete each section, have them review the list of items they need to work on and check off any that have been handled.
Assessment *for* Learning	
BLM 9–3 Chapter 9 Warm-Up This BLM includes three warm-ups, one to be used at the beginning of each section. Each warm-up provides cumulative review questions for the entire student resource to that point, as well as mental math practice.	• As students complete questions from previous chapters, note which skills they are retaining and which ones may need additional reinforcement. • Use the warm-up to provide additional opportunities for students to demonstrate their understanding of the chapter material. • Have students share their strategies for completing mental math calculations.

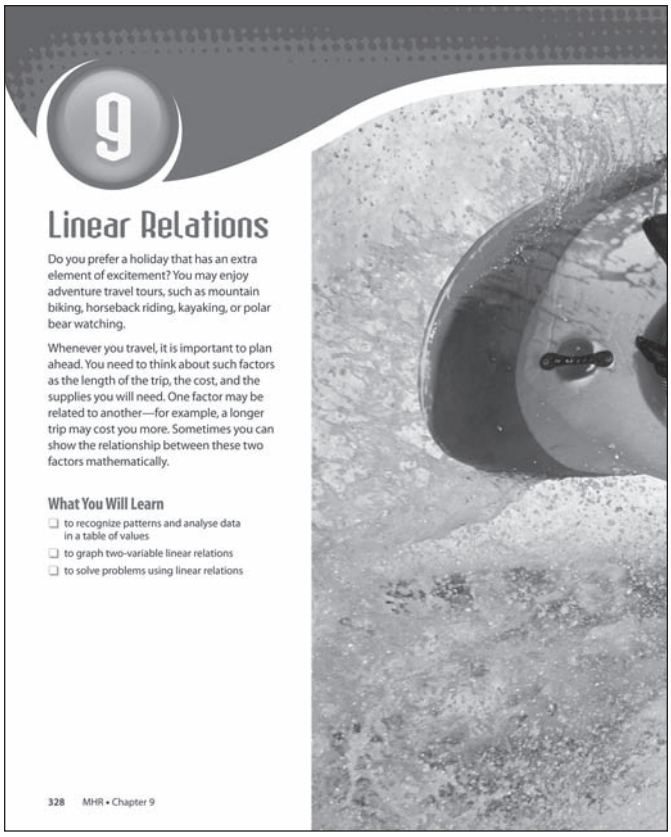
Problems of the Week

Have all students try at least one of the problems on **BLM 9–4 Chapter 9 Problems of the Week**. Many of these problems require students to think outside the box and experiment with a variety of approaches. Some have definitive answers; others can be answered in more than one way.

Students can take the problems home and consult with parents or guardians, work with other students when their work is completed, or try them on their own. The questions take a varying amount of time to solve, depending on the particular student and the problem itself. You may wish to assign these problems at the beginning of the chapter and discuss the solutions at appropriate times throughout your work on the chapter.

Chapter 9 Planning Chart

Section/ Suggested Timing	Prerequisite Skills	Materials/Technology	Teacher's Resource Blackline Masters	Exercise Guide	Extra Support	Assessment		
						Assessment *as* Learning	Assessment *for* Learning	Assessment *of* Learning
Chapter Opener • 40–50 minutes (TR page 451)	Students should be familiar with • describing patterns from data • plotting points from data in a table • describing general patterns from a graph • labelling axes of a coordinate grid	• 11 × 17 sheet of paper • seven sheets of centimetre grid paper or 0.5 cm grid paper • stapler • scissors • grid paper • ruler	Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 9–1 Chapter 9 Math Link Introduction BLM 9–2 Chapter 9 Get Ready BLM 9–4 Chapter 9 Problems of the Week		Online Learning Centre	TR page 442 Chapter 9 Foldable, TR page 442	TR page 442	
9.1 Analysing Graphs of Linear Relations • 100–120 minutes (TR page 455)	Students should be familiar with • identifying the coordinates for points on a grid • plotting points from data in a table • describing general patterns from a graph	• cardboard circle • coloured counters • square tiles	BLM 9–3 Chapter 9 Warm-Up BLM 9–5 Section 9.1 Extra Practice BLM 9–6 Section 9.1 Math Link	**Essential:** 1, 3, 4, 6, 9, Math Link **Typical:** 1, 3, 4, 6, 8–13, Math Link **Extension/Enrichment:** 1, 3, 13–18	*MathLinks 8 Practice and Homework Book* *MathLinks 8 Solutions Manual*	TR pages 459, 461 Math Learning Log, TR page 465 Chapter 9 Foldable, TR page 465	TR pages 459, 465	
9.2 Patterns in a Table of Values • 100–120 minutes (TR page 466)	Students should be familiar with • plotting points identified by coordinates • subtracting integers • describing patterns in a table of values	• grid paper • ruler • toothpicks • quarters and dimes • square tiles • coloured counters	Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 9–3 Chapter 9 Warm-Up BLM 9–7 Section 9.2 Extra Practice BLM 9–8 Section 9.2 Math Link	**Essential:** 1, 3, 4, 6, 8, 10, 12, Math Link **Typical:** 1, 3, 4, 6, 8, 10, 12–16, Math Link **Extension/Enrichment:** 1, 3, 17–20	*MathLinks 8 Practice and Homework Book* *MathLinks 8 Solutions Manual*	TR pages 471, 473 Math Learning Log, TR page 475 Chapter 9 Foldable, TR page 475	TR pages 471, 475	
9.3 Linear Relationships • 100–120 minutes (TR page 476)	Students should be familiar with • substituting values into a formula • substituting into a linear equation • solving equations • plotting points in all four quadrants	• metre stick or measuring tape • masking tape • different-sized tubes such as from paper towel rolls • grid paper • ruler	Master 2 Two Stars and One Wish Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 9–3 Chapter 9 Warm-Up BLM 9–9 Section 9.3 Extra Practice	**Essential:** 1–3, 5, 7, 9, 11, 14 **Typical:** 1–3, 5, 7, 9, 11, 14–17 **Extension/Enrichment:** 1–3, 18–22	*MathLinks 8 Practice and Homework Book* *MathLinks 8 Solutions Manual*	TR pages 479, 481 Math Learning Log, TR page 483 Chapter 9 Foldable, TR page 483 Master 2 Two Stars and One Wish	TR pages 479, 483	
Chapter 9 Review • 40–50 minutes (TR page 484)		• grid paper • ruler	Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 9–5 Section 9.1 Extra Practice BLM 9–7 Section 9.2 Extra Practice BLM 9–9 Section 9.3 Extra Practice	Have students do at least one question related to any concept, skill, or process that has been giving them trouble.	*MathLinks 8 Practice and Homework Book* *MathLinks 8 CAB*	Chapter 9 Foldable, TR page 485	TR page 485	
Chapter 9 Practice Test • 40–50 minutes (TR page 486)		• grid paper • ruler	Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 9–10 Chapter 9 Test	Provide students with the number of questions they can comfortably do in one class. Choose at least one question for each concept, skill, or process. **Minimum:** 2, 4, 6, 8–10	*MathLinks 8 CAB*	TR page 487		TR page 487 BLM 9–10 Chapter 9 Test
Chapter 9 Wrap It Up! • 80–100 minutes (TR page 488)		• grid paper • ruler	Master 1 Project Rubric Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 9–1 Chapter 9 Math Link Introduction BLM 9–6 Section 9.1 Math Link BLM 9–8 Section 9.2 Math Link BLM 9–11 Chapter 9 Wrap It Up!		Online Learning Centre			TR page 488 Master 1 Project Rubric
Chapter 9 Math Games • 20–30 minutes (TR page 490)		• paper clip	BLM 9–12 Friends and Relations Spinner BLM 9–13 Friends and Relations Game Cards BLM 9–14 Friends and Relations Record Sheet				TR page 490	
Chapter 9 Challenge in Real Life • 80–100 minutes (TR page 491)		• grid paper • ruler • computer graphing software or graphing calculator (optional)	Master 1 Project Rubric Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 9–15 Chapter 9 BLM Answers		Online Learning Centre		TR page 493	TR page 493 Master 1 Project Rubric



***MathLinks 8*, pages 328–331**

Suggested Timing
40–50 minutes

Materials
- 11 × 17 sheet of paper
- seven sheets of centimetre grid paper or 0.5 cm grid paper
- stapler
- scissors
- grid paper
- ruler

Blackline Masters
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
BLM 9–1 Chapter 9 Math Link Introduction
BLM 9–2 Chapter 9 Get Ready
BLM 9–4 Chapter 9 Problems of the Week

Key Words

relationship	table of values	linear relation
variable	expression	formula
equation		

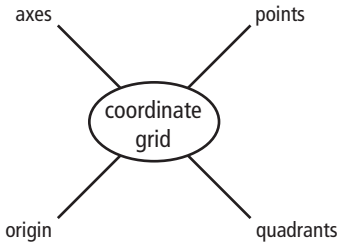
What's the Math?

In this chapter, students solve problems that involve coordinate grids, tables of values, and linear relationships. They begin by working from the graph. Students make a table of values, using the points on a graph, and learn to analyse a graph by describing patterns on the graph and answering specific questions from the graph. They also determine the missing value in an ordered pair. Next, students reverse the process. Beginning with a table of values, they identify relationships between variables, decide if the table represents a liner relation, and graph the points represented by the values in the table. Finally, students create a table of values by substituting into a linear equation. They also graph from a formula, graph linear equations using integers, and solve problems involving linear relationships.

Planning Notes

Start by telling students that they will learn about coordinate grids, tables of values, and linear relationships. Ask students to recall what they know about coordinate grids and linear relationships, and have them draw an example of the graph of a linear relation. Emphasize the labelling of axes, how the points line up, what the coordinates represent, and why a graph is useful. Encourage all students to participate.

An alternative suggestion is to have students, individually or in pairs, complete a mind map on a plain piece of paper. Encourage students to include everything they remember about coordinate grids. For example:



After students are finished, create a large mind map for the classroom.

Have students look at the photo showing the adventure travel action shot at the beginning of Chapter 9 and ask them to identify possible graphs associated with such an adventure.

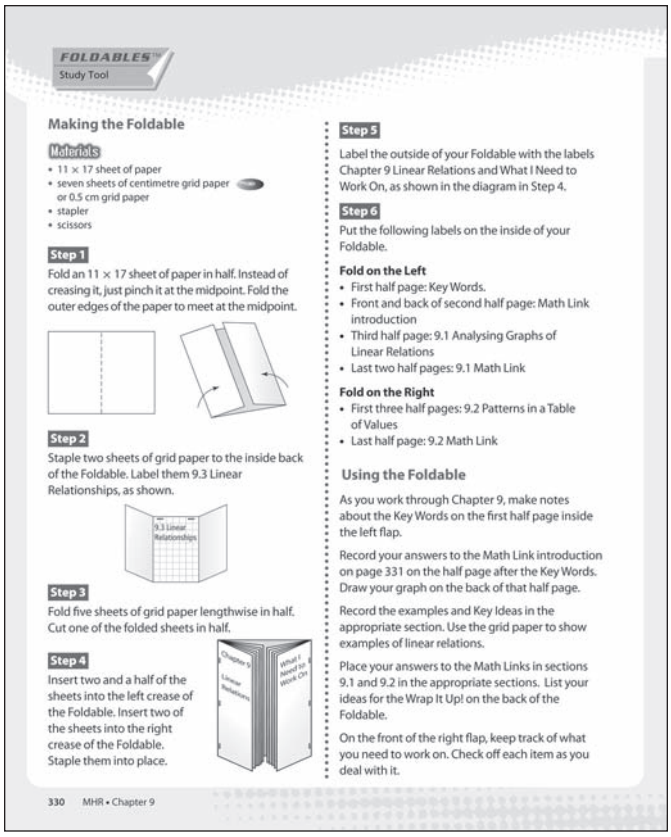
Literacy Link Have students fill out the first two columns of a KWL chart, either before starting work on the chapter or after they have completed the Math Link introduction on page 331. At the end of each section, have students list what they have learned in the third column.

Meeting Student Needs

- Before beginning this chapter, some students may benefit from having their knowledge and skills reactivated in the following areas:
  - understanding the terms *x-axis*, *y-axis*, *ordered pairs*, *coordinates*, *expressions*, and *equations*
  - working with expressions, formulas, and equations
  - making tables of values
  - drawing graphs from a table of values

ELL

- Discuss with the class the different activities mentioned in the chapter opener, such as *mountain biking*, *horseback riding*, *kayaking*, and *polar bear watching*. Show English language learners pictures of each activity.



FOLDABLES™
Study Tool

Making the Foldable

Materials
- 11 × 17 sheet of paper
- seven sheets of centimetre grid paper or 0.5 cm grid paper
- stapler
- scissors

Step 1
Fold an 11 × 17 sheet of paper in half. Instead of creasing it, just pinch it at the midpoint. Fold the outer edges of the paper to meet at the midpoint.

Step 2
Staple two sheets of grid paper to the inside back of the Foldable. Label them 9.3 Linear Relationships, as shown.

Step 3
Fold five sheets of grid paper lengthwise in half. Cut one of the folded sheets in half.

Step 4
Insert two and a half of the sheets into the left crease of the Foldable. Insert two of the sheets into the right crease of the Foldable. Staple them into place.

Step 5
Label the outside of your Foldable with the labels Chapter 9 Linear Relations and What I Need to Work On, as shown in the diagram in Step 4.

Step 6
Put the following labels on the inside of your Foldable.

Fold on the Left
- First half page: Key Words.
- Front and back of second half page: Math Link introduction
- Third half page: 9.1 Analysing Graphs of Linear Relations
- Last two half pages: 9.1 Math Link

Fold on the Right
- First three half pages: 9.2 Patterns in a Table of Values
- Last half page: 9.2 Math Link

Using the Foldable

As you work through Chapter 9, make notes about the Key Words on the first half page inside the left flap.

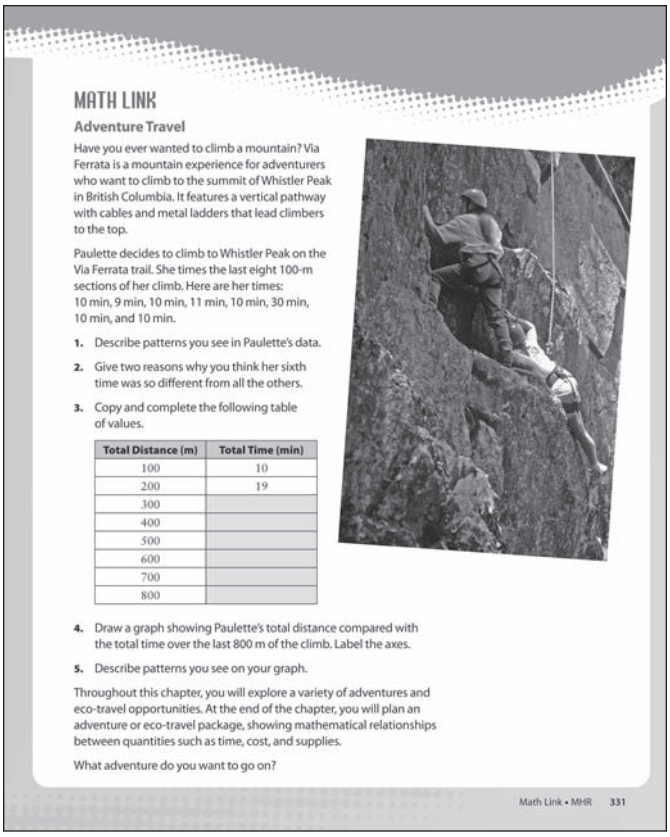
Record your answers to the Math Link introduction on page 331 on the half page after the Key Words. Draw your graph on the back of that half page.

Record the examples and Key Ideas in the appropriate section. Use the grid paper to show examples of linear relations.

Place your answers to the Math Links in sections 9.1 and 9.2 in the appropriate sections. List your ideas for the Wrap It Up! on the back of the Foldable.

On the front of the right flap, keep track of what you need to work on. Check off each item as you deal with it.

330 MHR • Chapter 9



MATH LINK

Adventure Travel

Have you ever wanted to climb a mountain? Via Ferrata is a mountain experience for adventurers who want to climb to the summit of Whistler Peak in British Columbia. It features a vertical pathway with cables and metal ladders that lead climbers to the top.

Paulette decides to climb to Whistler Peak on the Via Ferrata trail. She times the last eight 100-m sections of her climb. Here are her times: 10 min, 9 min, 10 min, 11 min, 10 min, 30 min, 10 min, and 10 min.

1. Describe patterns you see in Paulette's data.
2. Give two reasons why you think her sixth time was so different from all the others.
3. Copy and complete the following table of values.

Total Distance (m)	Total Time (min)
100	10
200	19
300	
400	
500	
600	
700	
800	

4. Draw a graph showing Paulette's total distance compared with the total time over the last 800 m of the climb. Label the axes.
5. Describe patterns you see on your graph.

Throughout this chapter, you will explore a variety of adventures and eco-travel opportunities. At the end of the chapter, you will plan an adventure or eco-travel package, showing mathematical relationships between quantities such as time, cost, and supplies.

What adventure do you want to go on?

Math Link • MHR 331

Foldables Study Tool

Have students make the Foldable in the student resource to keep track of the information in the chapter. Filling in the What I Need to Work On section as they progress through the chapter will assist them in identifying and solving any difficulties with concepts, skills, and processes.

Some students may not need five sheets of grid paper in Step 3; three sheets may be sufficient. Suggest to students that they share the cut sheet with a peer to prevent wasted paper.

Math Link

The Math Link for this chapter is about adventure travel. Read the first paragraph of the Math Link introduction on page 331 as a class. Have a class discussion based on this paragraph and the photo of the two people mountain climbing. Ask questions such as
- Have you ever gone mountain climbing?
- Would you like to climb Via Ferrata? Why?

Have students work individually or in pairs to complete the questions in the Math Link. These questions have students begin to think about an adventure and how it might be related to a table of values and coordinate grid. To draw their graphs, you may wish to provide students with **Master 8 Centimetre Grid Paper** or **Master 9 0.5 Centimetre Grid Paper**.

Have students read the Wrap It Up! on page 363 to give them a sense of where the Math Link is heading. The Wrap It Up! is a summative assessment. The Math Links throughout this chapter relate to adventure travel and linear relations. As students work through the chapter, it is not necessary for them to complete all of the Math Links to complete the Wrap It Up! at the end of the chapter. However, the Math Links will give them practice with the required skills and will help them to be better prepared for the Wrap It Up!

Meeting Student Needs

- Consider creating the chapter Foldable ahead of time to use as a model.
- To help them to get started with the Math Link, some students may benefit from using **BLM 9–1 Chapter 9 Math Link Introduction**, which provides scaffolding for this activity.
- Some students may not be familiar with adventure travel and eco-travel or what kinds of trips might be possible. It might be a good idea to make suggestions of possible trips; for example, kayaking down a river, tracking and photographing polar bears, or taking a hot-air balloon ride.
- Consider inviting a travel agent familiar with adventure travel to talk to the class. You might also have students research a travel adventure, using magazines, travel brochures, or the Internet.
- Discuss with students the kinds of adventure travel available in their community. For example, if you live in a Northern community, you might have students find out what kinds of adventure tours are offered in the Arctic by typing *Arctic adventure tours* into a search engine. Also, see the Web Link below.
- For the graph in #4 of the Math Link, you may need to guide students to put Total Distance on the horizontal axis and Total Time on the vertical axis.

ELL

- Explain the following terms in context to English language learners: *cost*, *supplies*, *cables*, *metal ladders*, *graph*, and *axes*.

Web Link

For information about adventure tours in the Arctic, go to www.mathlinks8.ca and follow the links.

Answers

Math Link

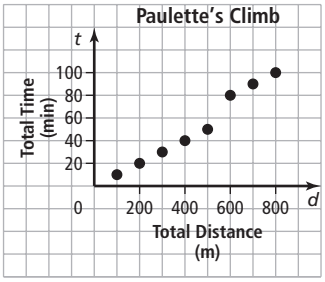
1. Answers may vary. Example: Seven of the eight times are between 9 min and 11 min for each 100-m section. The sixth time is significantly higher than the other seven times.

2. Answers may vary. Example: The terrain could have been more difficult or Paulette may have taken a break during this section of her climb.

3.

Total Distance (m)	Total Time (min)
100	10
200	19
300	29
400	40
500	50
600	80
700	90
800	100

4.



5. Answers may vary. Example: The first five dots appear to lie along a straight line and the second three dots appear to lie along a straight line.