1 Coordinates and Design

General Outcome

- Describe and analyze position and motion of objects and shapes.

Specific Outcomes

SS4 Identify and plot points in the four quadrants of a Cartesian plane using integral ordered pairs.
SS5 Perform and describe transformations (translations, rotations or reflections) of a 2-D shape in all four quadrants of a Cartesian plane (limited to integral number vertices).

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

Section	Understanding Concepts, Skills, and Processes
1.1	✓ label the origin and axes of a Cartesian plane
	✓ identify points on a Cartesian plane
	✓ plot points on a Cartesian plane
1.2	✓ create a design on a Cartesian plane
	✓ identify the points used to make a design
	✓ identify the coordinates of vertices of a 2-D shape
1.3	✓ perform a translation, reflection, and rotation
	✓ describe the image resulting from a transformation
1.4	✓ describe the movement of a point on a Cartesian plane using the terms *horizontal* and *vertical*
	✓ determine the horizontal and vertical distances between two points
	✓ describe how the vertices of a 2-D shape change position when they are transformed one or more times

Assessment *as* Learning	Supported Learning
Use the Before column of **BLM 1–2 Chapter 1 Self-Assessment** to provide students with the big picture for this chapter and to help them identify what they already know, understand, and can do. You may wish to have students keep this master in their math portfolio and refer back to it during the chapter.	• As students complete each section of the chapter or complete the Chapter 1 Review, have them review the related parts of **BLM 1–2 Chapter 1 Self-Assessment**, fill in the appropriate part of the During column, and report what they might do about any items that they have marked either red or yellow.

Chapter 1 Planning Chart

Section Suggested Timing	Exercise Guide	Teacher's Resource Blackline Masters	Materials and Technology Tools
Chapter Opener • 20–30 minutes		BLM 1–1 *MathLinks 7* Scavenger Hunt BLM 1–2 Chapter 1 Self-Assessment BLM 1–3 Coordinates and Design	• 11 × 17 paper • grid paper • scissors • ruler • glue • stapler
1.1 The Cartesian Plane • 80–100 minutes	**Essential:** 1a), b), 5, 7, 9, 11, Math Link **Typical:** 1a), b), one of 2, 3, *or* 4, 5, 7, 9, 11, 12, 14, 16, Math Link **Extension/Enrichment:** 1a), b), one of 2, 3, *or* 4, 13–18	Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper Master 2 Two Stars and One Wish BLM 1–2 Chapter 1 Self-Assessment BLM 1–4 Section 1.1 Extra Practice BLM 1–5 Section 1.1 Math Link	• grid paper • ruler • 11 × 17 paper • scissors • glue • computer with Internet access (optional)
1.2 Create Designs • 80–100 minutes	**Essential:** 1–3, 5, 8, Math Link **Typical:** 1–3, 5, 7, 8, 10, 11, Math Link **Extension/Enrichment:** 1, 2, 8, 9, 11–14	Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 1–2 Chapter 1 Self-Assessment BLM 1–6 Section 1.2 Extra Practice BLM 1–7 Section 1.2 Math Link	• grid paper • ruler • coloured pencils • computer with Internet access (optional)
1.3 Transformations • 120–150 minutes	**Essential:** 1, 2, 5, 11, 16, 19, Math Link **Typical:** 1–3, 5 11, 16, 19, 20, Math Link **Extension/Enrichment:** 1, 2, 21–25	Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 1–2 Chapter 1 Self-Assessment BLM 1–8 Section 1.3 Extra Practice BLM 1–9 Section 1.3 Math Link	• coloured pencils • grid paper • ruler • scissors • tracing paper • Mira or mirror (optional) • magazines • computer with Internet access (optional)
1.4 Horizontal and Vertical Distances • 80–100 minutes	**Essential:** 1–3, 6, 9, Math Link **Typical:** 1–3, 6–9, 11, Math Link **Extension/Enrichment:** 1, 2, 10–14	Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 1–2 Chapter 1 Self-Assessment BLM 1–10 Section 1.4 Extra Practice	• grid paper • ruler • overhead projector (optional) • computer with Internet access (optional)
Chapter 1 Review • 40–50 minutes	Have students do at least one question related to any concept, skill, or process that has been giving them trouble.	Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 1–2 Chapter 1 Self-Assessment BLM 1–4 Section 1.1 Extra Practice BLM 1–6 Section 1.2 Extra Practice BLM 1–8 Section 1.3 Extra Practice BLM 1–10 Section 1.4 Extra Practice BLM 1–11 Chapter 1 Key Words Puzzle	• grid paper • ruler • scissors (optional) • tracing paper (optional)
Chapter 1 Practice Test • 40–50 minutes	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:** 1–3, 5–10, 13	Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 1–2 Chapter 1 Self-Assessment BLM 1–12 Chapter 1 Test	• grid paper • ruler • scissors (optional) • tracing paper (optional)
Chapter 1 Wrap It Up! • 80–100 minutes		Master 1 Project Rubric Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 1–5 Section 1.1 Math Link BLM 1–7 Section 1.2 Math Link BLM 1–9 Section 1.3 Math Link BLM 1–13 Chapter 1 Wrap It Up!	• grid paper • ruler • coloured pencils • scissors (optional) • tracing paper (optional) • string, coloured beads (optional)

Chapter 1 Planning Chart (continued)

Section Suggested Timing	Exercise Guide	Teacher's Resource Blackline Masters	Materials and Technology Tools
Chapter 1 Math Games • 40–50 minutes		BLM 1–14 Going Fishing Game Boards	• coins • coloured pencils (optional)
Chapter 1 Challenge in Real Life • 40–50 minutes		Master 1 Project Rubric Master 8 Centimetre Grid Paper Master 9 0.5 Centimetre Grid Paper BLM 1–15 Chapter 1 *MathLinks 7* Student Resource Answers BLM 1–16 Chapter 1 BLM Answers	• grid paper • scissors • coloured pencils • stapler

Chapter 1 Assessment Planner

Assessment Options	Type of Assessment	Assessment Tool
Chapter Opener	Assessment *as* Learning (TR pages i, 3)	BLM 1–2 Chapter 1 Self-Assessment Chapter 1 Foldable
1.1 The Cartesian Plane	Assessment *as* Learning (TR pages 6, 8, 10) Assessment *for* Learning (TR pages 10, 11, 13, 15)	Math Learning Log (TR page 10) Master 2 Two Stars and One Wish BLM 1–2 Chapter 1 Self-Assessment
1.2 Create Designs	Assessment *as* Learning (TR pages 13, 15, 17) Assessment *for* Learning (TR pages 14, 16, 17)	Math Learning Log (TR page 17) BLM 1–2 Chapter 1 Self-Assessment
1.3 Transformations	Assessment *as* Learning (TR pages 20, 24, 28) Assessment *for* Learning (TR pages 21, 22, 26, 29)	Math Learning Log (TR page 28) BLM 1–2 Chapter 1 Self-Assessment
1.4 Horizontal and Vertical Distances	Assessment *as* Learning (TR pages 31, 33, 35) Assessment *for* Learning (TR pages 32, 34)	Math Learning Log (TR page 35) BLM 1–2 Chapter 1 Self-Assessment
Chapter 1 Review	Assessment *for* Learning (TR page 36) Assessment *as* Learning (TR page 37)	Math Learning Log (TR page 37) BLM 1–2 Chapter 1 Self-Assessment
Chapter 1 Practice Test	Assessment *as* Learning (TR page 38) Assessment *of* Learning (TR page 39)	BLM 1–2 Chapter 1 Self-Assessment BLM 1–12 Chapter 1 Test
Chapter 1 Wrap It Up!	Assessment *of* Learning (TR page 39a)	Master 1 Project Rubric
Chapter 1 Math Games	Assessment *for* Learning (TR page 40)	
Chapter 1 Challenge in Real Life	Assessment *for* Learning (TR page 40a) Assessment *of* Learning (TR page 40a)	Master 1 Project Rubric

You may wish to use one or more of the following materials to help you assess student readiness for Chapter 1.

Assessment *for* Learning	Supported Learning
Method 1: Have students develop a journal entry to explain what they personally know about number lines, coordinate grids, and transformations, and when they might have used graphing and transformations to make designs of different shapes. **Method 2:** Have students complete **BLM 1–3 Coordinates and Design** to check their conceptual understanding. Remind students that you are looking for the scope of their knowledge.	• Students who require reinforcement of prerequisite skills may wish to complete the Get Ready materials available in the *MathLinks 7 Workbook* and at the **www.mathlinks7.ca** book site.

Chapter Opener

Suggested Timing
20–30 minutes

Materials
- 11 × 17 paper
- grid paper
- ruler
- scissors
- glue
- stapler

Blackline Masters
BLM 1–1 *Math Links 7* Scavenger Hunt
BLM 1–2 Chapter 1 Self-Assessment

Key Words
Cartesian plane
x-axis
y-axis
origin
quadrants
coordinates
vertex
transformation
translation
reflection
rotation

What's the Math?

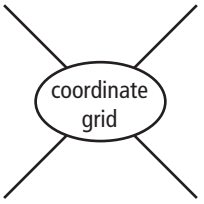
In this chapter, students learn about the coordinate grid. They start by identifying and labelling the parts of a coordinate grid. They then learn how to identify and plot points. Students move on to creating designs and locating shapes by identifying the vertices. Students also learn how to perform transformations: translations, reflections, and rotations. Finally, they describe how the vertices of a 2-D shape change in position, horizontally and vertically, when they are transformed.

Activity Planning Notes

Introduce students to the various parts and aspects of the *MathLinks 7* student resource by having them complete **BLM 1–1 *MathLinks 7* Scavenger Hunt**.

Then start Chapter 1 by explaining that the chapter is about using geometric transformations to create cultural designs. This will involve plotting points and creating shapes on a coordinate grid. Discuss with students when they have used graphing and transformations—translations, reflections, and rotations—to make designs with different shapes.

Before students open the student resource, have them complete a web on a blank 11 × 17 paper to show what they remember from previous years about the term *coordinate grid* (or *Cartesian plane*, depending on the term that they are most familiar with).



Encourage students to free associate any ideas they may have or remember. Allow them to use words, diagrams, drawings, and numbers in their free association. Collect these webs to help you to discover what students already know and what they have misconceptions about. Allow students to hand in a blank piece of paper, as you may choose to revisit this activity at the end of the chapter so that students may add concepts that they have learned through the course of the chapter.

Math Link

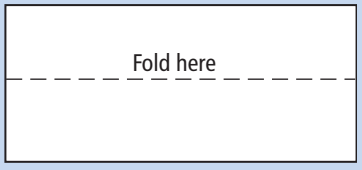
Aboriginal peoples from all over the world use beads and designs to decorate their ceremonial clothing and other items. Have students research some of these designs in the library, in magazines, on the Internet, and through other sources of information, like an Elder. At the end of the chapter, students will have an opportunity to create a bead design of their own. In this chapter, students will learn how to plot points and how to translate designs so that they can make a plan for their design.

FOLDABLES™
Study Tool

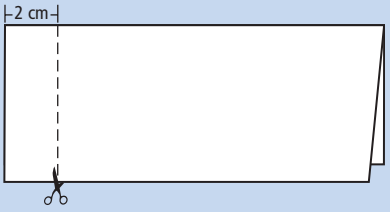
Have students make the Foldable in the student resource to keep track of the information in the chapter.

You may wish to have students keep track of Key Words using a design specifically for that purpose. Students can make the following Foldable and write vocabulary terms on the front of each tab. Have them use the space beneath the tab to write definitions and provide examples.

Step 1 Cut a sheet of grid paper horizontally in half. Fold the half sheet in two horizontally.

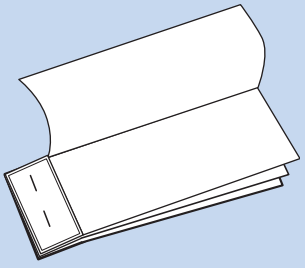


Step 2 Draw a line 2 cm from the left side of the folded paper. Cut the top part of the fold along this line.



Step 3 Make one of these folded sheets for each Key Word. Staple the tabs together to make a booklet.

Step 4 Write a Key Word on the front of each tab. Write definitions and give examples underneath the tabs.



Note: You can have students make the complete vocabulary Foldable at the beginning of the chapter, or have them add the number of tabs needed for each section as they do it.

Assessment *as* Learning	Supported Learning
Chapter 1 Foldable As students work on each section in Chapter 1, have them keep track of any problems they are having under the What I Need to Work On tab in their chapter Foldable.	• As students complete each section, have them review the list of items they need to work on and then have them check off any that have been handled.

Supported Learning

Learning Style

- Create a space in your classroom where students can post questions and comments on sticky notes under the headings "Questions I Still Have" and "Things I'm Not Sure About." These notes will help you address issues as they arise. Names should be optional.

Meeting the Needs of All Learners

- Invite a person who does beading to show some patterns that include transformations. Also, you may wish to show students these two publications: *Copper and Caribou Inuit Skin Clothing Production* by Jillian Oakes (Canadian Museum of Civilization, 1991) and *Sinews of Survival: The Living Legacy of Inuit Clothing* by Betty Kobayashi Issenman (UBC Press, 1997).

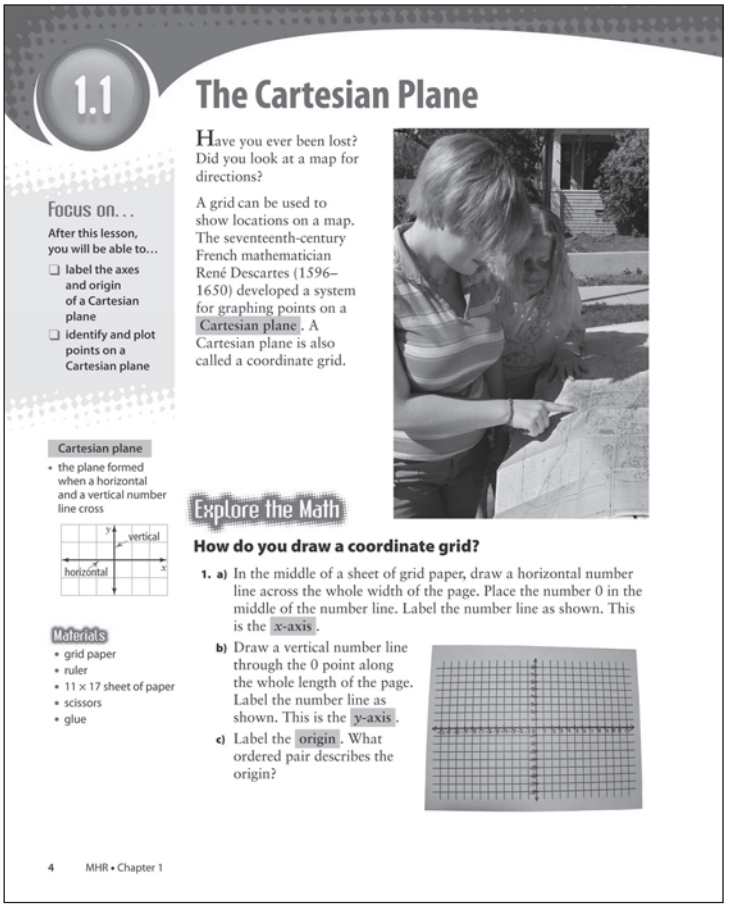
1.1 The Cartesian Plane

Suggested Timing
80–100 minutes

Materials
- grid paper
- ruler
- 11 × 17 paper
- scissors
- glue
- computer with Internet access (optional)

Blackline Masters
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
Master 2 Two Stars and One Wish
BLM 1–2 Chapter 1 Self-Assessment
BLM 1–4 Section 1.1 Extra Practice
BLM 1–5 Section 1.1 Math Link

Mathematical Processes
- ☑ Communication
- ☑ Connections
- ☐ Mental Mathematics and Estimation
- ☑ Problem Solving
- ☑ Reasoning
- ☑ Technology
- ☑ Visualization



1.1 The Cartesian Plane

Have you ever been lost? Did you look at a map for directions?

A grid can be used to show locations on a map. The seventeenth-century French mathematician René Descartes (1596–1650) developed a system for graphing points on a Cartesian plane. A Cartesian plane is also called a coordinate grid.

Focus on...
After this lesson, you will be able to...
- label the axes and origin of a Cartesian plane
- identify and plot points on a Cartesian plane

Cartesian plane
- the plane formed when a horizontal and a vertical number line cross

vertical
horizontal

Materials
- grid paper
- ruler
- 11 × 17 sheet of paper
- scissors
- glue

Explore the Math

How do you draw a coordinate grid?

1. a) In the middle of a sheet of grid paper, draw a horizontal number line across the whole width of the page. Place the number 0 in the middle of the number line. Label the number line as shown. This is the *x*-axis.
   b) Draw a vertical number line through the 0 point along the whole length of the page. Label the number line as shown. This is the *y*-axis.
   c) Label the origin. What ordered pair describes the origin?

4 MHR • Chapter 1

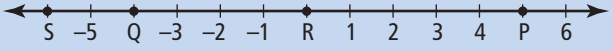
Specific Outcomes

SS4 Identify and plot points in the four quadrants of a Cartesian plane using integral ordered pairs.

Warm-Up

1. Draw a number line from −10 to 10 and label it by 5s.

2. For each letter on the number line, identify the integer.



3. Draw a number line from –5 to 5. Plot the following points on it:
A 3 **B** −1 **C** 0 **D** −5

4. For each of the following ordered pairs, identify the *x*-coordinate and the *y*-coordinate.
a) (5, 1) **b)** (2, 7) **c)** (0, 9)

5. Draw a coordinate grid and plot the following points: J(2, 3), K(5, 0), L(0, 0), and M(4, 5).

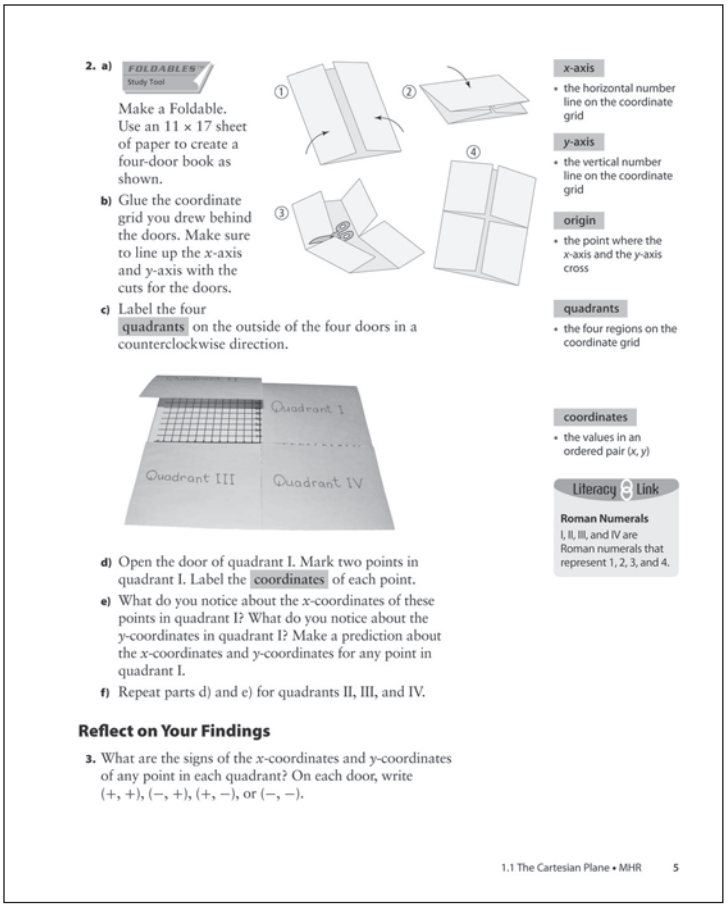
Mental Math

6. Skip count by 2s from 0 to 10.

7. Skip count by 5s from 0 to 25.

8. Skip count by 10s from 0 to 100.

9. Skip count by 2s from 40 to 50.



2. a) FOLDABLES Study Tool

Make a Foldable. Use an 11 × 17 sheet of paper to create a four-door book as shown.

b) Glue the coordinate grid you drew behind the doors. Make sure to line up the *x*-axis and *y*-axis with the cuts for the doors.

c) Label the four quadrants on the outside of the four doors in a counterclockwise direction.

Quadrant I
Quadrant III
Quadrant IV

d) Open the door of quadrant I. Mark two points in quadrant I. Label the coordinates of each point.

e) What do you notice about the *x*-coordinates of these points in quadrant I? What do you notice about the *y*-coordinates in quadrant I? Make a prediction about the *x*-coordinates and *y*-coordinates for any point in quadrant I.

f) Repeat parts d) and e) for quadrants II, III, and IV.

Reflect on Your Findings

3. What are the signs of the *x*-coordinates and *y*-coordinates of any point in each quadrant? On each door, write (+, +), (−, +), (+, −), or (−, −).

x-axis
- the horizontal number line on the coordinate grid

y-axis
- the vertical number line on the coordinate grid

origin
- the point where the *x*-axis and the *y*-axis cross

quadrants
- the four regions on the coordinate grid

coordinates
- the values in an ordered pair (*x*, *y*)

Literacy Link

Roman Numerals
I, II, III, and IV are Roman numerals that represent 1, 2, 3, and 4.

1.1 The Cartesian Plane • MHR 5

Answers

Warm-Up

1. −10, −5, 0, 5, 10

2. P 5, Q −4, R 0, S −6

3. D −4, −3, −2, B, C, 1, 2, A, 4, 5

4. **a)** $x = 5, y = 1$ **b)** $x = 2, y = 7$ **c)** $x = 0, y = 9$

5. M, J, L, K

6. 0, 2, 4, 6, 8, 10 **7.** 0, 5, 10, 15, 20, 25

8. 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

9. 40, 42, 44, 46, 48, 50

Explore the Math

1. **c)** O(0, 0)

2. **e)** *x*-coordinates are positive; *y*-coordinates are positive. In quadrant I, all *x*-coordinates and *y*-coordinates will be positive.

f) In quadrant II, *x*-coordinates are negative and *y*-coordinates are positive. In quardrant III, *x*-coordinates and *y*-coordinates are negative. In quadrant IV, *x*-coordinates are positive and *y*-coordinates are negative.

3. quadrant I: (+, +); quadrant II: (−, +);
quadrant III: (−, −); quadrant IV: (+, −)

Activity Planning Notes

Start the lesson by inviting students to relate a time when they were lost. Explain that maps were created to help people find their way and that this lesson deals with using grids to understand location.

Read the short explanation about the Cartesian plane. Tell students that Descartes came up with the idea of the Cartesian plane when he was lying sick in bed and saw a fly on the ceiling. He thought that he should be able to describe the exact location of the fly to his nurse and realized a grid would make it possible.

Explore the Math

Start students off by explaining that they will be creating a Foldable. The coordinate grid will be glued into the Foldable. You may wish to have students create the Foldable prior to drawing the axes on the paper, so that they have an idea of where they need to draw their lines on the grid paper. It is a good idea to have an example made prior to class to show to students.

As students label the quadrants, direct their attention to the Literacy Link about Roman numerals. Then ask why Roman numerals are used to describe the quadrants (to avoid confusion with the numbers on the axes).

Supported Learning

ESL

- Some students might not understand the word *map*. Have a map to show to students. Since the words *horizontal* and *vertical* are key to this lesson, have students draw these lines in their notebooks and/or show with their bodies what these lines look like.

Common Errors

- Some students may not remember horizontal and vertical.

R_x Post a reminder on the wall that shows a line labelled *vertical* and a line labelled *horizontal*.

Answers

Show You Know: Example 1

T(2, −3), R(−6, −4), A(−5, 0), I(−1, 6), N(0, 3)

Supported Learning

ESL, Language, and Memory

- Ensure students understand the terms *ordered pair*, *x-coordinate*, and *y-coordinate*.

ESL

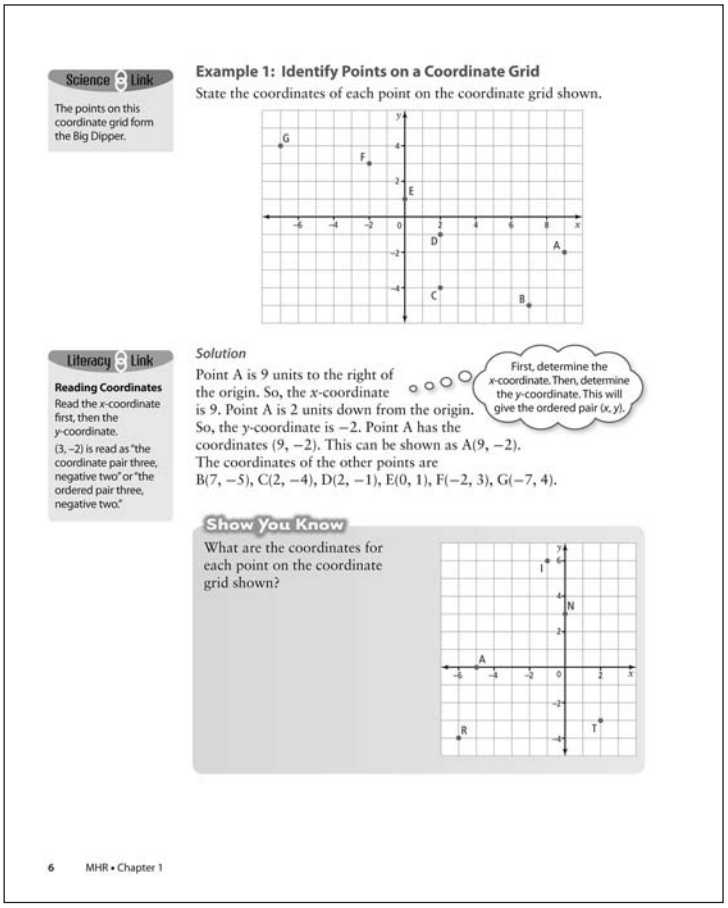
- Students are asked to make a "prediction" in the Explore the Math. Assist students with their understanding of this word, and encourage them to add it to their translation dictionary.

Motor

- Students may find it more manageable to create their coordinate grid using **Master 8 Centimetre Grid Paper**, instead of **Master 9 0.5 Centimetre Grid Paper**.

Meeting the Needs of All Learners

- Work through the Explore the Math at least twice. Have students tell you what to do as you draw the coordinate grid the second time.
- If possible, bring in a map of your community or region. Give students plenty of time to examine the map and locate places they have visited. This exploration will help tie their learning into their experiences. Use the map to support your discussion of the coordinate grid.



Science Link

The points on this coordinate grid form the Big Dipper.

Example 1: Identify Points on a Coordinate Grid

State the coordinates of each point on the coordinate grid shown.

Literacy Link

Reading Coordinates

Read the *x*-coordinate first, then the *y*-coordinate.

(3, −2) is read as "the coordinate pair three, negative two" or "the ordered pair three, negative two."

Solution

Point A is 9 units to the right of the origin. So, the *x*-coordinate is 9. Point A is 2 units down from the origin. So, the *y*-coordinate is −2. Point A has the coordinates (9, −2). This can be shown as A(9, −2).

First, determine the *x*-coordinate. Then, determine the *y*-coordinate. This will give the ordered pair (*x*, *y*).

The coordinates of the other points are B(7, −5), C(2, −4), D(2, −1), E(0, 1), F(−2, 3), G(−7, 4).

Show You Know

What are the coordinates for each point on the coordinate grid shown?

6 MHR • Chapter 1

Assessment *as* Learning	Supported Learning
Reflect on Your Findings Listen as students discuss what symbols should go on each door of their Foldable. During this process, they are generalizing what they have learned during the Explore the Math.	• Encourage students to develop a memory device to help them remember that the *x*-coordinate comes before the *y*-coordinate. For example, *x* comes before *y* in the alphabet. • Have students design a class poster showing the coordinate grid with labelled parts. Hang it in the classroom for easy reference.

After students complete the Example 1 Show You Know, have them share their answers with a classmate.

Assessment *for* Learning	Supported Learning
Example 1 Have students do the Show You Know related to Example 1.	• Encourage kinesthetic and concrete learners to walk through the steps. For example, they may wish to run their finger across the *x*-axis to find the *x*-coordinate, and then run their finger up or down the *y*-axis to find the *y*-coordinate. • You may wish to provide additional points on a coordinate grid for students who would benefit from extra practice: **a)** Place B at (2, 0). (Some students may need practice in moving on only one axis.) **b)** Place C at (6, −6). (Some students may confuse the coordinates when they have a pair with a negative number and a positive number. Remind them to identify the *x*-coordinate first.) Coach students through a), and then have them try b) on their own.

Example 2: Plot Points on a Coordinate Grid

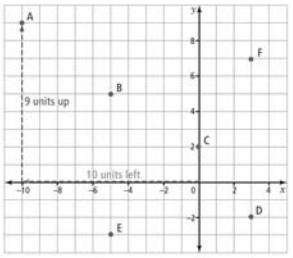
Plot the following points to form a constellation:
A(−10, 9), B(−5, 5), C(0, 2), D(3, −2), E(−5, −3), F(3, 7).

Solution

To plot points on the coordinate grid, always start at the origin.

For point A(−10, 9), count 10 units to the left.
Then, count 9 units up.
Make a dot. Label the point A.

Plot points B, C, D, E, and F.



Count *x* units right if the *x*-coordinate is positive, and left if it is negative. Then, count *y* units up if the *y*-coordinate is positive, and down if it is negative.

Science Link

The points on this coordinate grid form the constellation called Cygnus, the swan.

If the *x*-coordinate is 0, do not count left or right. If the *y*-coordinate is 0, do not count up or down.

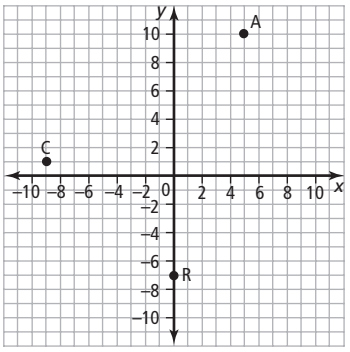
Show You Know

Plot the following points on a coordinate grid:
C(−9, 1), A(5, 10), R(0, −7).

1.1 The Cartesian Plane • MHR 7

Answers

Show You Know: Example 2



Common Errors

- Some students may place the labels for the *x*-axis and *y*-axis incorrectly.

R$_x$ Remind students to label the *x*-axis under the horizontal number line and the *y*-axis on the left side of the vertical number line. Refer them to the Foldable they created for the Explore the Math.

- Some students may draw a coordinate grid with intervals that are unequal.

R$_x$ Give students opportunities to gain greater understanding by studying the intervals on rulers and other gradient materials, like measuring cups, thermometers, etc.

Consider inviting someone from the community to speak about cultural philosophies on the stars and the universe. For example, a Cree Elder may talk about how the Cree philosophies are based on the coordinate grid and on everything being in relation to the origin. To Inuit, the Big Dipper is generally thought to represent a caribou or a group of caribou. In Inuktitut, it is called *Tukturjuk* or *Tukturjuit* (plural). You may wish to refer to *The Arctic Sky: Inuit Astronomy, Star Lore, and Legend*, John MacDonald (Royal Ontario Museum, 1998).

Have students look at Example 2. Ask how the exercise is the same or different from Example 1. Again, have students share their answers upon completing the Show You Know.

Supported Learning

Learning Style

- Students may benefit from helping to create a coordinate grid on the floor of the class using masking tape. As you teach the location of points, have them walk to locate the point.

Assessment *for* Learning	Supported Learning
Example 2 Have students do the Show You Know related to Example 2.	• You may wish to have students who would benefit from it plot additional points on their coordinate grid: **a)** Plot D at (1, −9). (Having student do the reverse pair that they did in the original exercise.) **b)** Plot O at (−8, −4). (Some students may have more difficulty working in quadrant III). **c)** Plot G at (−8, 0). (Check that students remember how to handle a point on one of the axes.) Coach students through a), and then have them try b) and c) on their own.

Answers

Communicate the Ideas

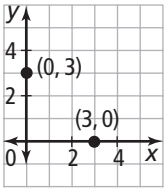
1. a) Answers may vary. For example: The first number in the ordered pair is the x-coordinate. Find the value on the x-axis. The second number is the y-coordinate. Find this value on the y-axis. Find a line through the y-coordinate and parallel to the x-axis. Find a line through the x-coordinate and parallel to the y-axis. Where the two lines intersect is where the point is located.

b) Answers may vary. For example: From the point, run your finger directly up or down to the x-axis. The number on the x-axis is the x-coordinate. From the point, run your finger left or right to the y-axis. The number on the y-axis is the y-coordinate. Place the two values in brackets separated by a comma (x, y).

2. a) Answers may vary. For example: Grid A and Grid B share the same ranges for the x-axis and y-axis. Grid A has all the integer values listed for its range of numbers, but Grid B does not.

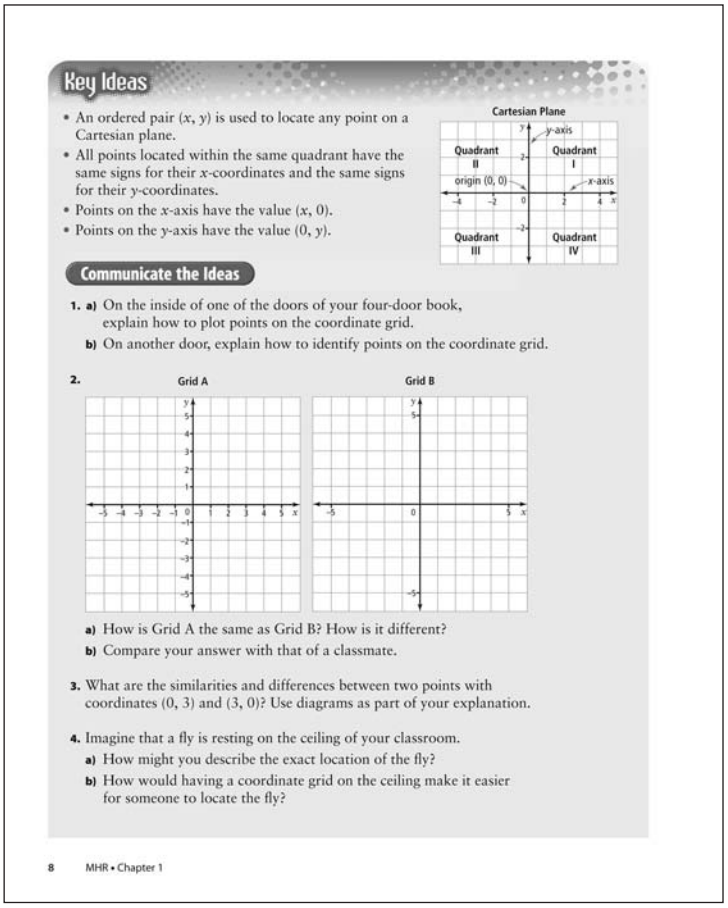
b) Answers may vary.

3. Answers may vary. For example:
Similarity: Both points are located on an axis.
Difference: The point (0, 3) is on the y-axis and the point (3, 0) is on the x-axis.



4. a) Answers may vary. For example: Describe the fly's location as up/down, left/right from a recognized point (e.g., a light).

b) It would be possible to describe the location of the fly in a very precise way, by identifying the x-coordinate and y-coordinate on the grid.



Key Ideas

- An ordered pair (x, y) is used to locate any point on a Cartesian plane.
- All points located within the same quadrant have the same signs for their x-coordinates and the same signs for their y-coordinates.
- Points on the x-axis have the value $(x, 0)$.
- Points on the y-axis have the value $(0, y)$.

Cartesian Plane
y-axis
Quadrant II
Quadrant I
origin (0, 0)
x-axis
Quadrant III
Quadrant IV

Communicate the Ideas

1. a) On the inside of one of the doors of your four-door book, explain how to plot points on the coordinate grid.
b) On another door, explain how to identify points on the coordinate grid.

2. Grid A Grid B

a) How is Grid A the same as Grid B? How is it different?
b) Compare your answer with that of a classmate.

3. What are the similarities and differences between two points with coordinates (0, 3) and (3, 0)? Use diagrams as part of your explanation.

4. Imagine that a fly is resting on the ceiling of your classroom.
a) How might you describe the exact location of the fly?
b) How would having a coordinate grid on the ceiling make it easier for someone to locate the fly?

8 MHR • Chapter 1

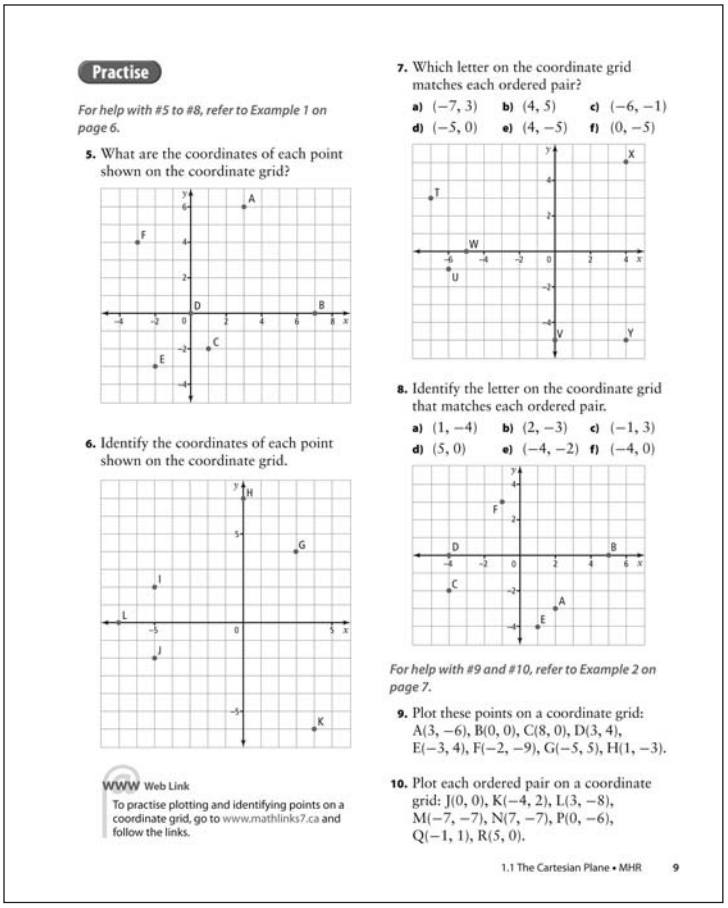
Key Ideas

Have students relate the Key Ideas to the Communicate the Ideas. For example, you might point out that the Key Idea "An ordered pair (x, y) is used to locate any point on a coordinate grid" relates to #1.

Communicate the Ideas

The Communicate the Ideas gives students an opportunity to explain their understanding of plotting coordinate points on a plane. In addition, students are provided the opportunity to apply their understanding by discussing how to describe the position of a fly in #4.

Assessment *as* Learning	Supported Learning
Communicate the Ideas Have all students complete #1, and then have students choose one or two of the other three questions to respond to in their journals.	• Encourage students to consider their own learning style when answering #1. More abstract learners may understand what quadrant to move to depending on the signs of the numbers in the pair. • Use **Master 2 Two Stars and One Wish** to have students critique another student's response to #3. This master allows them to write two things they like about a piece and one thing they would improve. Work with the class to develop criteria for judging the response.



Practise

For help with #5 to #8, refer to Example 1 on page 6.

5. What are the coordinates of each point shown on the coordinate grid?

6. Identify the coordinates of each point shown on the coordinate grid.

WWW Web Link
To practise plotting and identifying points on a coordinate grid, go to www.mathlinks7.ca and follow the links.

7. Which letter on the coordinate grid matches each ordered pair?
a) $(-7, 3)$ **b)** $(4, 5)$ **c)** $(-6, -1)$
d) $(-5, 0)$ **e)** $(4, -5)$ **f)** $(0, -5)$

8. Identify the letter on the coordinate grid that matches each ordered pair.
a) $(1, -4)$ **b)** $(2, -3)$ **c)** $(-1, 3)$
d) $(5, 0)$ **e)** $(-4, -2)$ **f)** $(-4, 0)$

For help with #9 and #10, refer to Example 2 on page 7.

9. Plot these points on a coordinate grid:
A(3, −6), B(0, 0), C(8, 0), D(3, 4), E(−3, 4), F(−2, −9), G(−5, 5), H(1, −3).

10. Plot each ordered pair on a coordinate grid: J(0, 0), K(−4, 2), L(3, −8), M(−7, −7), N(7, −7), P(0, −6), Q(−1, 1), R(5, 0).

1.1 The Cartesian Plane • MHR 9

Supported Learning

ESL

- English language learners may have difficulty with questions that involve a lot of text. In the Communicate the Ideas, students should be encouraged to use their first language to answer the questions and then translate their ideas to you. (This strategy allows students to demonstrate their understanding in detail rather than be hindered by their understanding of the language.)
- In Communicate the Ideas #4, students are asked to imagine a fly. Some students may not know what a fly is and how big it would be. Provide a picture and a visual estimate of the size.

Category	Question Numbers
Essential (minimum questions to cover the outcomes)	1a), b), 5, 7, 9, 11, Math Link
Typical	1a), b), one of 2, 3, *or* 4, 5, 7, 9, 11, 12, 14, 16, Math Link
Extension/Enrichment	1a), b), one of 2, 3, *or* 4, 13–18

Practise

Have students work in pairs or groups of up to four. Students should discuss the work and agree on answers.

Assessment *for* Learning	Supported Learning
Practise Have students do #5, #7, and #9. Students who have no problems with these questions can go on to the Apply questions.	• Students who have problems with #5 and #7 will need additional coaching with Example 1. Have these students explain how they are identifying coordinates. Clarify any misunderstandings. Coach students through point G in #6 and point A in #8, and then have them complete the rest of these questions on their own. • Students who have problems with #9 will need additional coaching with Example 2. Have these students explain how they are plotting points. Clarify any misunderstandings. Coach students through point J in #10, and then have them complete the rest of this question on their own. • Check back with them several times to make sure that they understand the concepts.

Supported Learning

ESL and Language

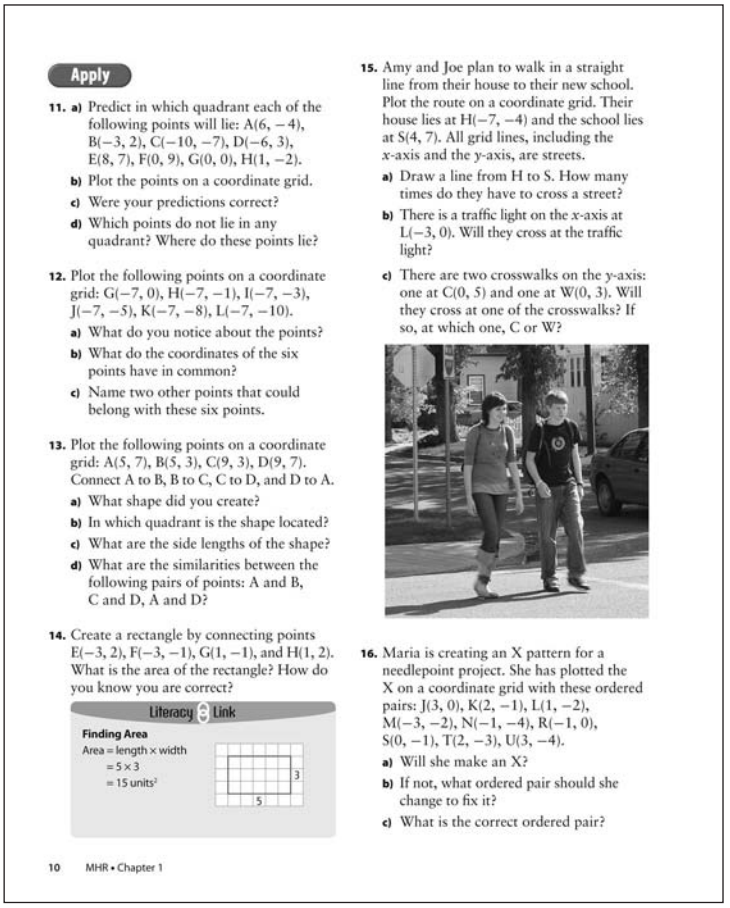
- For #14, students may need to have the concepts of traffic lights and crosswalks explained to them, especially if they are new to Canada or living in a small isolated community.
- A lot of reading is required for #11 to #16. Assign only one or two questions for students as it will take them longer to deal with the language.

ESL

- Extend #18 refers to Hurricane Katrina. This is a cultural reference that may be unfamiliar to recent immigrants to Canada. Explain what happened and where the hurricane occurred.

Learning Style and Memory

- You may wish to provide **BLM 1–4 Section 1.1 Extra Practice** to students who require more practice. You will find the answers to this master on **BLM 1–16 Chapter 1 BLM Answers**.



Apply

11. **a)** Predict in which quadrant each of the following points will lie: A(6, −4), B(−3, 2), C(−10, −7), D(−6, 3), E(8, 7), F(0, 9), G(0, 0), H(1, −2).
b) Plot the points on a coordinate grid.
c) Were your predictions correct?
d) Which points do not lie in any quadrant? Where do these points lie?

12. Plot the following points on a coordinate grid: G(−7, 0), H(−7, −1), I(−7, −3), J(−7, −5), K(−7, −8), L(−7, −10).
a) What do you notice about the points?
b) What do the coordinates of the six points have in common?
c) Name two other points that could belong with these six points.

13. Plot the following points on a coordinate grid: A(5, 7), B(5, 3), C(9, 3), D(9, 7). Connect A to B, B to C, C to D, and D to A.
a) What shape did you create?
b) In which quadrant is the shape located?
c) What are the side lengths of the shape?
d) What are the similarities between the following pairs of points: A and B, C and D, A and D?

14. Create a rectangle by connecting points E(−3, 2), F(−3, −1), G(1, −1), and H(1, 2). What is the area of the rectangle? How do you know you are correct?

Literacy Link

Finding Area

Area = length × width
= 5 × 3
= 15 units²

15. Amy and Joe plan to walk in a straight line from their house to their new school. Plot the route on a coordinate grid. Their house lies at H(−7, −4) and the school lies at S(4, 7). All grid lines, including the *x*-axis and the *y*-axis, are streets.
a) Draw a line from H to S. How many times do they have to cross a street?
b) There is a traffic light on the *x*-axis at L(−3, 0). Will they cross at the traffic light?
c) There are two crosswalks on the *y*-axis: one at C(0, 5) and one at W(0, 3). Will they cross at one of the crosswalks? If so, at which one, C or W?

16. Maria is creating an X pattern for a needlepoint project. She has plotted the X on a coordinate grid with these ordered pairs: J(3, 0), K(2, −1), L(1, −2), M(−3, −2), N(−1, −4), R(−1, 0), S(0, −1), T(2, −3), U(3, −4).
a) Will she make an X?
b) If not, what ordered pair should she change to fix it?
c) What is the correct ordered pair?

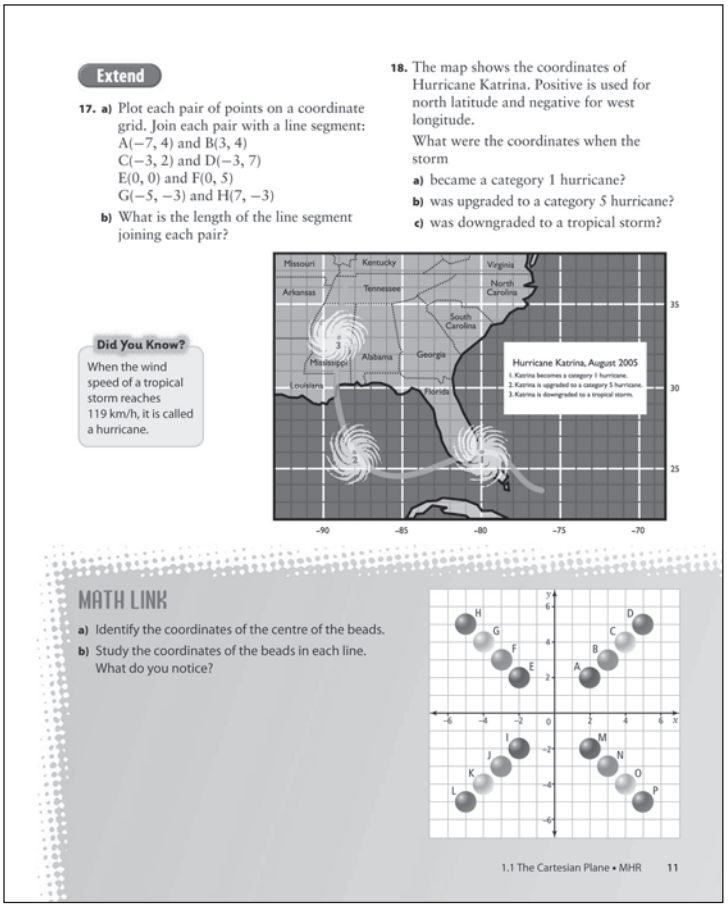
10 MHR • Chapter 1

Apply and Extend

For #15b), students may need to be reminded that the area of a rectangle is found by multiplying the length by the width. Refer students to the Literacy Link: Finding Area.

For #17b), allow students to determine the lengths either by measuring with a ruler or by plotting the points on centimetre grid paper. You may wish to provide students with **Master 8 Centimetre Grid Paper**.

Assessment *as* Learning	Supported Learning
Math Learning Log Have students reflect on two or three items they have improved on and how they think they have improved. Have students also pick a weaker area and reflect on how they plan to improve this area of learning.	• Have students check the What I Need to Work On section of their chapter Foldable. Encourage them to keep track of the items that are giving them difficulty and to check off each item as the problem is resolved. • Work with students to develop a plan for dealing with the areas in which they are having difficulty. • Depending on students' learning style, have them provide oral or written answers. • Have students review the part related to section 1.1 in **BLM 1–2 Chapter 1 Self-Assessment**, fill in the appropriate part of the During column, and report what they might do about any items that they have marked either red or yellow.



Extend

17. a) Plot each pair of points on a coordinate grid. Join each pair with a line segment:
A(−7, 4) and B(3, 4)
C(−3, 2) and D(−3, 7)
E(0, 0) and F(0, 5)
G(−5, −3) and H(7, −3)
b) What is the length of the line segment joining each pair?

18. The map shows the coordinates of Hurricane Katrina. Positive is used for north latitude and negative for west longitude.
What were the coordinates when the storm
a) became a category 1 hurricane?
b) was upgraded to a category 5 hurricane?
c) was downgraded to a tropical storm?

Did You Know?
When the wind speed of a tropical storm reaches 119 km/h, it is called a hurricane.

MATH LINK

a) Identify the coordinates of the centre of the beads.
b) Study the coordinates of the beads in each line. What do you notice?

Assessment *for* Learning	Supported Learning
Math Link The Math Link on page 11 is intended to help students work toward the chapter problem wrap-up titled Wrap It Up! on page 39.	• Encourage students to notice what happens to a design when they use the same numbers in each quadrant of a coordinate plane. • Observe students as they work on the Math Link, making sure that they identify the correct coordinates and report on what they notice about the coordinates of the design. • Have students explain to a partner how they discovered the pattern. • Students who are having difficulty getting started could use **BLM 1–5 Section 1.1 Math Link**, which provides scaffolding for this activity.

Answers

Math Link

a) A(2, 2), B(3, 3), C(4, 4), D(5, 5), E(−2, 2), F(−3, 3), G(−4, 4), H(−5, 5), I(−2, −2), J(−3, −3), K(−4, −4), L(−5, −5), M(2, −2), N(3, −3), O(4, −4), P(5, −5)

b) Answers may vary. For example: Each quadrant has beads with similar coordinate pairs (i.e., the numbers are the same but the signs vary).

Web Link

Allow students to work as a group online to practise their skills with the coordinate grid. Go to **www.mathlinks7.ca** and follow the links. Have someone report the findings of the group to the class.

MATH LINK

This Math Link is part of the chapter problem introduced in the Math Link in the chapter opener. Doing this activity will assist students with the Wrap It Up! at the end of the chapter. This activity also helps to prepare students for section 1.2, in which they will create designs on a coordinate grid, and for section 1.3, in which they perform transformations. You may wish to discuss briefly with students how the design in this Math Link might have been created using transformations.

1.2 Create Designs

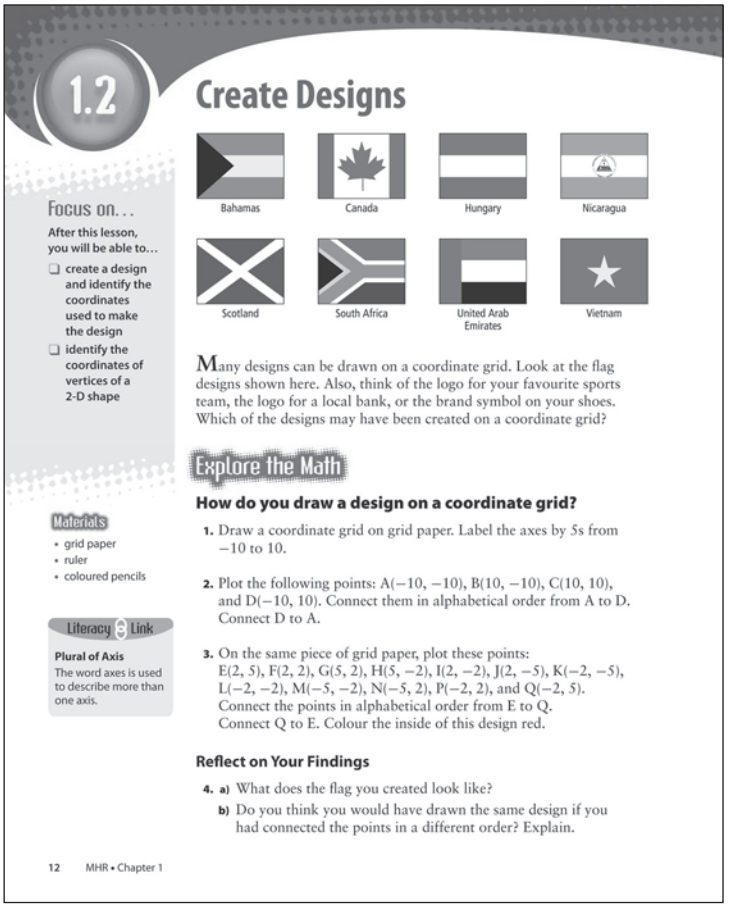
Suggested Timing
80–100 minutes

Materials
- grid paper
- ruler
- coloured pencils
- computer with Internet access (optional)

Blackline Masters
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
BLM 1–2 Chapter 1 Self-Assessment
BLM 1–6 Section 1.2 Extra Practice
BLM 1–7 Section 1.2 Math Link

Mathematical Processes

- [x] Communication
- [x] Connections
- [ ] Mental Mathematics and Estimation
- [x] Problem Solving
- [x] Reasoning
- [ ] Technology
- [x] Visualization



1.2 Create Designs

Bahamas Canada Hungary Nicaragua
Scotland South Africa United Arab Emirates Vietnam

Focus on...
After this lesson, you will be able to...
- create a design and identify the coordinates used to make the design
- identify the coordinates of vertices of a 2-D shape

Many designs can be drawn on a coordinate grid. Look at the flag designs shown here. Also, think of the logo for your favourite sports team, the logo for a local bank, or the brand symbol on your shoes. Which of the designs may have been created on a coordinate grid?

Explore the Math

Materials
- grid paper
- ruler
- coloured pencils

Literacy Link
Plural of Axis
The word axes is used to describe more than one axis.

How do you draw a design on a coordinate grid?

1. Draw a coordinate grid on grid paper. Label the axes by 5s from −10 to 10.
2. Plot the following points: A(−10, −10), B(10, −10), C(10, 10), and D(−10, 10). Connect them in alphabetical order from A to D. Connect D to A.
3. On the same piece of grid paper, plot these points: E(2, 5), F(2, 2), G(5, 2), H(5, −2), I(2, −2), J(2, −5), K(−2, −5), L(−2, −2), M(−5, −2), N(−5, 2), P(−2, 2), and Q(−2, 5). Connect the points in alphabetical order from E to Q. Connect Q to E. Colour the inside of this design red.

Reflect on Your Findings

4. a) What does the flag you created look like?
   b) Do you think you would have drawn the same design if you had connected the points in a different order? Explain.

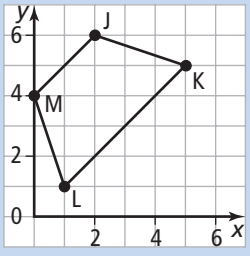
12 MHR • Chapter 1

Specific Outcomes

SS4 Identify and plot points in the four quadrants of a Cartesian plane using integral ordered pairs.

Warm-Up

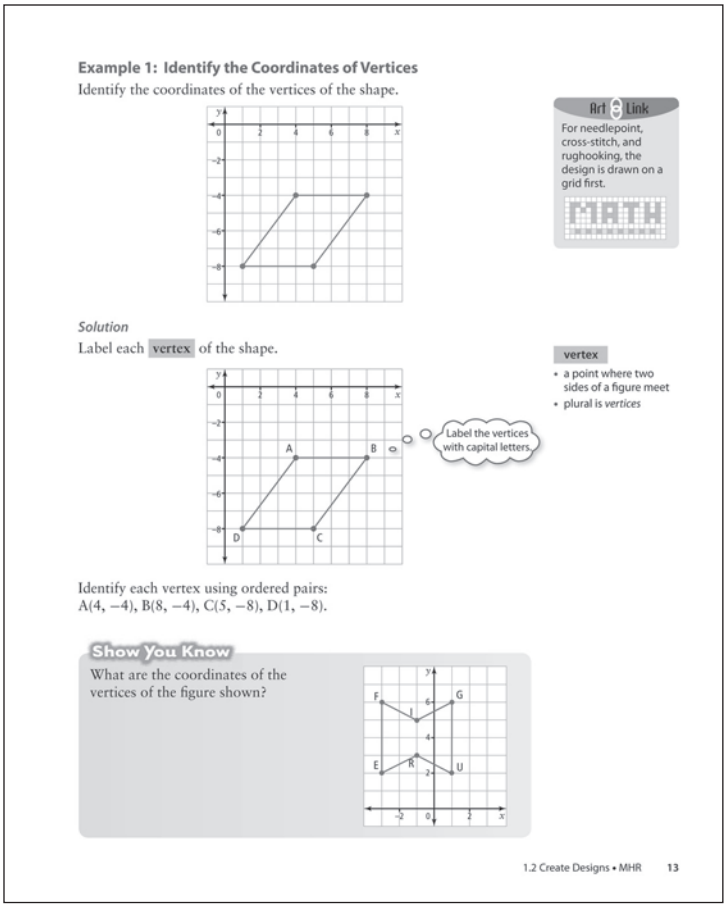
1. Draw a coordinate grid. Label the axes by 2s from −10 to 10.
2. Identify the coordinates of points J, K, L, and M.



3. Draw a coordinate grid with axes from 0 to 8. Plot the following points: A(1, 2), B(3, 8), C(5, 8), D(7, 8), E(7, 6), F(7, 4). Use a ruler to join the points in alphabetical order. Join F to A. What shape do you see?

Mental Math

4. Skip count by 2s from 80 to 100.
5. Skip count by 5s from 35 to 50.
6. Skip count by 10s from 90 to 150.
7. Skip count backward by 2s from 10 to 0.
8. Skip count backward by 5s from 25 to 0.
9. Skip count backward by 10s from 50 to 0.



Example 1: Identify the Coordinates of Vertices

Identify the coordinates of the vertices of the shape.

Art Link

For needlepoint, cross-stitch, and rughooking, the design is drawn on a grid first.

Solution

Label each vertex of the shape.

vertex

- a point where two sides of a figure meet
- plural is *vertices*

Label the vertices with capital letters.

Identify each vertex using ordered pairs:
A(4, −4), B(8, −4), C(5, −8), D(1, −8).

Show You Know

What are the coordinates of the vertices of the figure shown?

1.2 Create Designs • MHR 13

Activity Planning Notes

Discuss with students which types of logos and flags would be easier to draw on a coordinate grid and why (logos and flags with straight lines).

Explore the Math

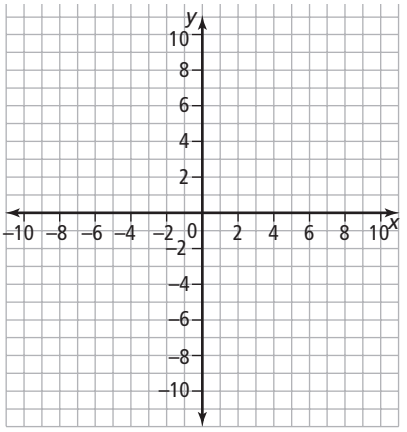
Have students check each other's work to make sure that the increments are equally spaced and that the points are in the correct position on the coordinate grid.

Assessment *as* Learning	Supported Learning
Reflect on Your Findings Listen as students discuss whether connecting the points in a different order would result in a different design. During this process, they are expanding their understanding of what they have learned during the Explore the Math.	• If students are unfamiliar with the Red Cross Symbol, they might briefly research this organization on the Internet. • Encourage students to develop steps for creating a design. For example: – Plot the vertices of the design. – Identify and label the vertices. – Connect the vertices. – Colour the design (if it has colour). You may wish to record these steps on a poster to hang in the classroom.

Answers

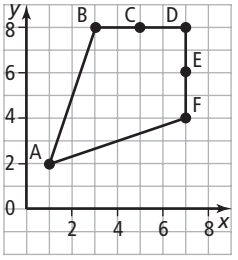
Warm-Up

1.



2. J(2, 6), K(5, 5), L(1, 1), M(0, 4)

3.



Answers may vary. For example: kite or quadrilateral

4. 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100

5. 35, 40, 45, 50

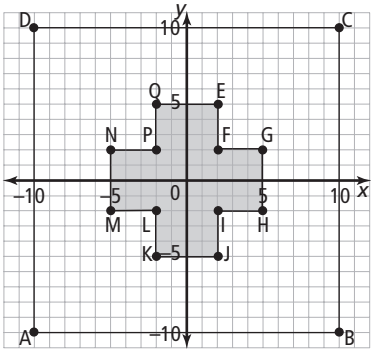
6. 90, 100, 110, 120, 130, 140, 150

7. 10, 8, 6, 4, 2, 0 **8.** 25, 20, 15, 10, 5, 0

9. 50, 40, 30, 20, 10, 0

Explore the Math

1.–3.



4. a) Answers may vary. For example: The Red Cross symbol

b) Answers may vary. For example: No, each point (or set of coordinates) has nine different points that it can connect to that will change the shape.

Answers

Show You Know: Example 1

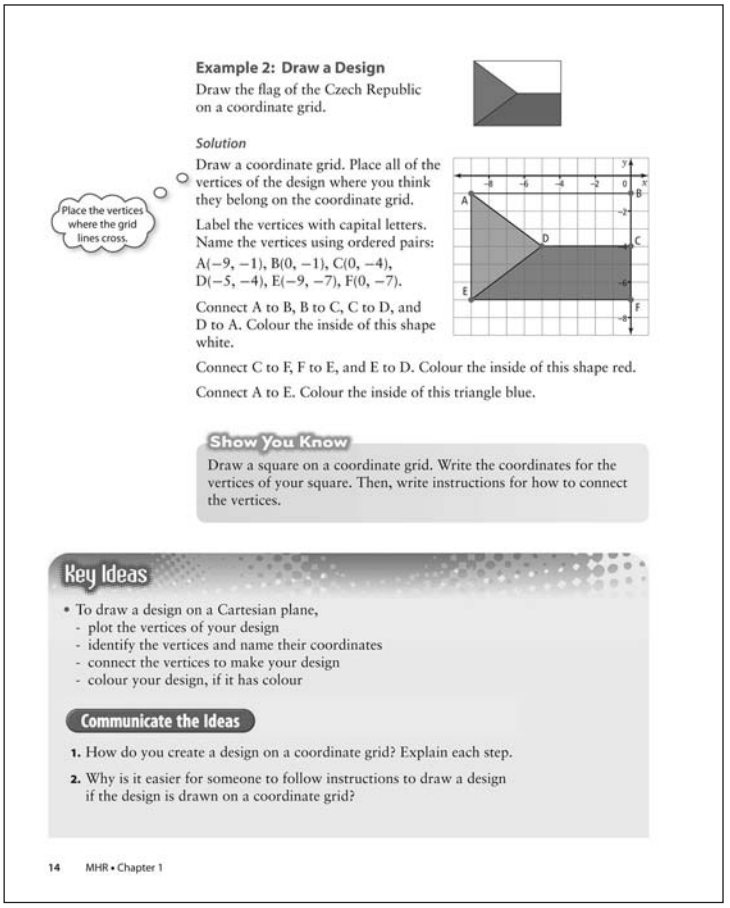
F(−3, 6), I(−1, 5), G(1, 6), U(1, 2), R(−1, 3), E(−3, 2)

Show You Know: Example 2

Answers will vary. Look for clear, logical instructions.

Communicate the Ideas

1. Answers may vary. For example: Place the design on a coordinate grid as a series of vertices. Label each vertex with an ordered pair and/or letter. State the order in which the ordered pairs and/or letters are to be connected.
2. Answers may vary. For example: The instructions give exact locations for each vertex and line to be drawn.



Example 2: Draw a Design

Draw the flag of the Czech Republic on a coordinate grid.

Solution

Draw a coordinate grid. Place all of the vertices of the design where you think they belong on the coordinate grid.

Place the vertices where the grid lines cross.

Label the vertices with capital letters. Name the vertices using ordered pairs: A(−9, −1), B(0, −1), C(0, −4), D(−5, −4), E(−9, −7), F(0, −7).

Connect A to B, B to C, C to D, and D to A. Colour the inside of this shape white.

Connect C to F, F to E, and E to D. Colour the inside of this shape red.

Connect A to E. Colour the inside of this triangle blue.

Show You Know

Draw a square on a coordinate grid. Write the coordinates for the vertices of your square. Then, write instructions for how to connect the vertices.

Key Ideas

- To draw a design on a Cartesian plane,
  - plot the vertices of your design
  - identify the vertices and name their coordinates
  - connect the vertices to make your design
  - colour your design, if it has colour

Communicate the Ideas

1. How do you create a design on a coordinate grid? Explain each step.
2. Why is it easier for someone to follow instructions to draw a design if the design is drawn on a coordinate grid?

14 MHR • Chapter 1

Supported Learning

ESL

- Terms that some English language learners might have difficulty with include *logo, flag, design, brand, symbol,* and *different order*.
- Be sensitive to the fact that not all students come from languages that use the English alphabet. Explore the Math #2 has students connect the dots in alphabetical order. Post an alphabet on the wall or provide an alphabet for students.

Language

- For students who have difficulty with language, you may wish to allow them to explain their instructions for the Example 2 Show You Know orally.

Common Errors

- Some students may have difficulty counting up and down by 2s, 5s, and 10s.

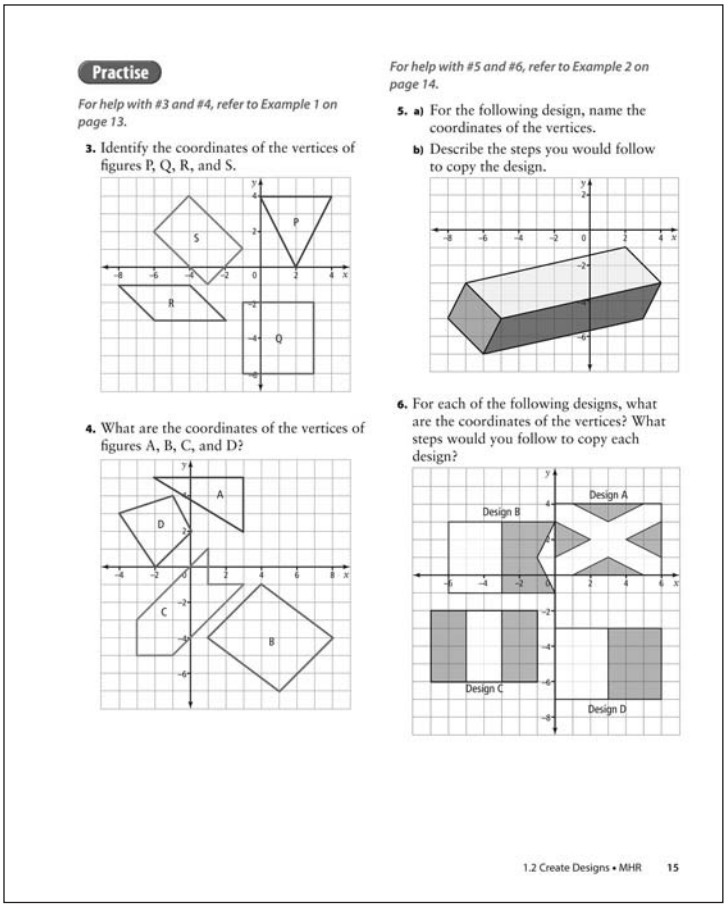
R_x Many opportunities in the classroom to "skip count" would help students with this problem.

Once students complete the Example 1 Show You Know individually, have them check each other's work. Make sure that students agree about where the coordinates lie.

Assessment *for* Learning	Supported Learning
Example 1 Have students do the Show You Know on page 13 related to Example 1.	• Encourage kinesthetic and concrete learners to run their finger across the x-axis to find the x-coordinate, and then run their finger up or down the y-axis to find the y-coordinate.

Ask them to compare their flag in Example 2 with a classmate's. Divide students into pairs for the Show You Know and have them try to follow the instructions for drawing their partner's square.

Assessment *for* Learning	Supported Learning
Example 2 Have students do the Show You Know related to Example 2.	• You may wish to provide students with **Master 9 0.5 Centimetre Grid Paper**. Students with motor difficulties may have more success using **Master 8 Centimetre Grid Paper**. • Make sure students understand that the vertices of a shape must lie on intersecting grid lines of the coordinate grid. • You might have students research and design a flag of their choice.



Practise

For help with #3 and #4, refer to Example 1 on page 13.

3. Identify the coordinates of the vertices of figures P, Q, R, and S.

4. What are the coordinates of the vertices of figures A, B, C, and D?

For help with #5 and #6, refer to Example 2 on page 14.

5. a) For the following design, name the coordinates of the vertices.

b) Describe the steps you would follow to copy the design.

6. For each of the following designs, what are the coordinates of the vertices? What steps would you follow to copy each design?

Design A
Design B
Design C
Design D

1.2 Create Designs • MHR 15

Communicate the Ideas

The Communicate the Ideas is intended to allow students to explain their understanding of creating a design on the coordinate plane and identifying the coordinates of the vertices.

Assessment *as* Learning	Supported Learning
Communicate the Ideas Have all students complete #1 individually, and then complete #2 as a class.	• For #1, some students may prefer to sketch a design on a plain piece of paper before plotting the vertices on a coordinate grid. • For #2, direct students to create a simple design that is not on a coordinate grid. Have them write instructions for the design and exchange with a classmate.

Category	Question Numbers
Essential (minimum questions to cover the outcomes)	1–3, 5, 8, Math Link
Typical	1–3, 5, 7, 8, 10, 11, Math Link
Extension/Enrichment	1, 2, 8, 9, 11–14

Practise

Students may need to be reminded of the names of shapes and what they look like before doing #3 and #4. Shapes that may need to be reviewed are square, triangle, parallelogram, rectangle, trapezoid, and arrow.

Supported Learning

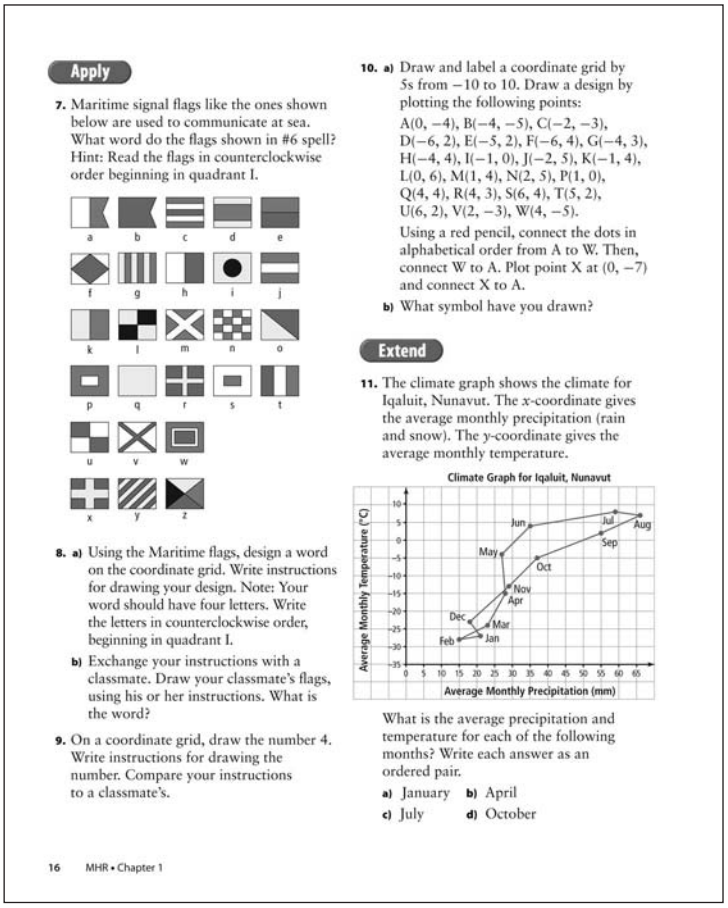
ESL

- In Communicate the Ideas, students are asked to explain each step when creating a design on a coordinate grid. Teach the English language learners in the class transition words such as *first, then, after, before, next*, and *following*. Students could also show the steps visually.

Supported Learning

Learning Style and Memory

- You may wish to provide **BLM 1–6 Section 1.2 Extra Practice** to students who require more practice.



Apply

7. Maritime signal flags like the ones shown below are used to communicate at sea. What word do the flags shown in #6 spell? Hint: Read the flags in counterclockwise order beginning in quadrant I.

a b c d e
f g h i j
k l m n o
p q r s t
u v w
x y z

8. a) Using the Maritime flags, design a word on the coordinate grid. Write instructions for drawing your design. Note: Your word should have four letters. Write the letters in counterclockwise order, beginning in quadrant I.

b) Exchange your instructions with a classmate. Draw your classmate's flags, using his or her instructions. What is the word?

9. On a coordinate grid, draw the number 4. Write instructions for drawing the number. Compare your instructions to a classmate's.

10. a) Draw and label a coordinate grid by 5s from −10 to 10. Draw a design by plotting the following points:
A(0, −4), B(−4, −5), C(−2, −3), D(−6, 2), E(−5, 2), F(−6, 4), G(−4, 3), H(−4, 4), I(−1, 0), J(−2, 5), K(−1, 4), L(0, 6), M(1, 4), N(2, 5), P(1, 0), Q(4, 4), R(4, 3), S(6, 4), T(5, 2), U(6, 2), V(2, −3), W(4, −5).
Using a red pencil, connect the dots in alphabetical order from A to W. Then, connect W to A. Plot point X at (0, −7) and connect X to A.

b) What symbol have you drawn?

Extend

11. The climate graph shows the climate for Iqaluit, Nunavut. The *x*-coordinate gives the average monthly precipitation (rain and snow). The *y*-coordinate gives the average monthly temperature.

Climate Graph for Iqaluit, Nunavut

What is the average precipitation and temperature for each of the following months? Write each answer as an ordered pair.

a) January **b)** April
c) July **d)** October

16 MHR • Chapter 1

Assessment *for* Learning	Supported Learning
Practise Have students do #3 and #5. Students who have no problems with these questions can go on to the Apply questions.	• Students who have problems with #3 and #5 will need additional coaching. Have these students explain how they are identifying coordinates of vertices and describing how to create a design. Clarify any misunderstandings. Coach students through Figure C in #4 and Design A in #6, and then have them complete the rest of each question on their own.

Apply and Extend

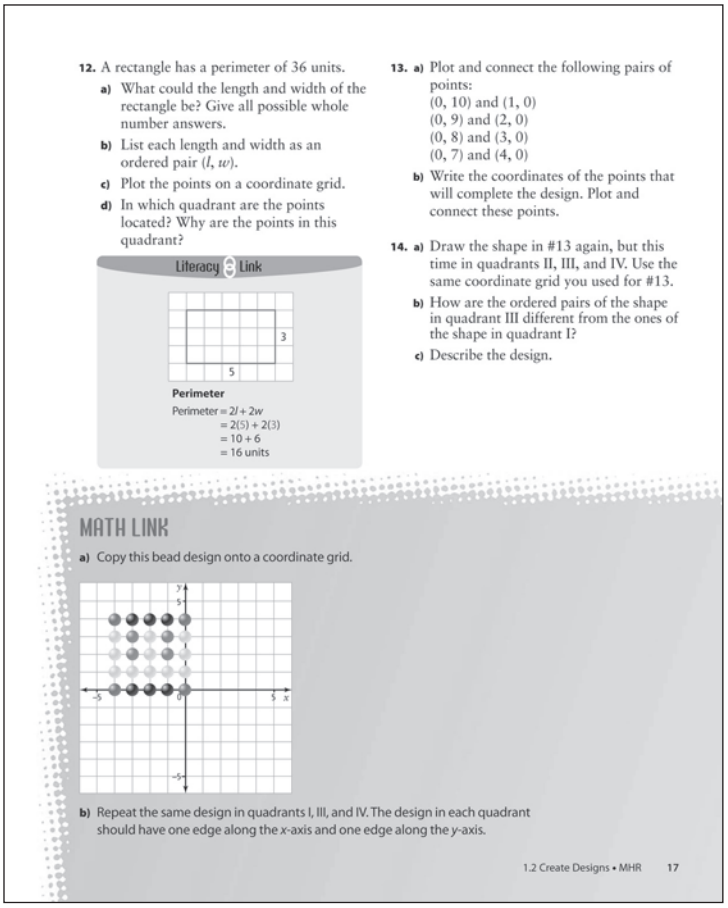
For #8, be aware that students may want to create some inappropriate words on the grids. Brainstorm appropriate four-letter words as a class.

For #11, have students create a similar climate graph for the community in which they live.

For #12, students may benefit from using a table to list the lengths and widths as ordered pairs, for example:

Length	Width	Ordered Pair
1	17	(1, 17)
2	16	(2, 16)

Students may need to be given grid paper to determine the perimeter of the rectangles. You may wish to provide them with **Master 9 0.5 Centimetre Grid Paper**. Have students refer to the Literacy Link on page 17 to remind them of the formula for perimeter.



12. A rectangle has a perimeter of 36 units.
a) What could the length and width of the rectangle be? Give all possible whole number answers.
b) List each length and width as an ordered pair (l, w).
c) Plot the points on a coordinate grid.
d) In which quadrant are the points located? Why are the points in this quadrant?

Literacy Link

Perimeter

Perimeter = $2l + 2w$
$= 2(5) + 2(3)$
$= 10 + 6$
$= 16$ units

13. a) Plot and connect the following pairs of points:
(0, 10) and (1, 0)
(0, 9) and (2, 0)
(0, 8) and (3, 0)
(0, 7) and (4, 0)
b) Write the coordinates of the points that will complete the design. Plot and connect these points.

14. a) Draw the shape in #13 again, but this time in quadrants II, III, and IV. Use the same coordinate grid you used for #13.
b) How are the ordered pairs of the shape in quadrant III different from the ones of the shape in quadrant I?
c) Describe the design.

MATH LINK

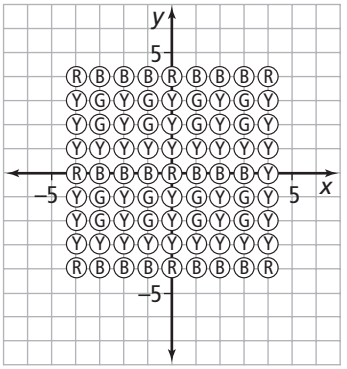
a) Copy this bead design onto a coordinate grid.

b) Repeat the same design in quadrants I, III, and IV. The design in each quadrant should have one edge along the x-axis and one edge along the y-axis.

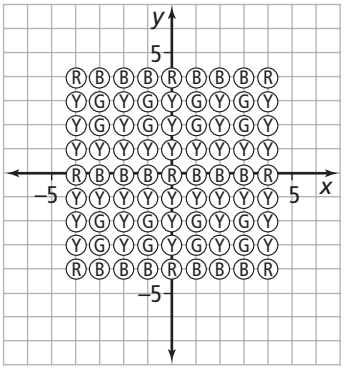
Answers

Math Link

a), b)



or



R = red
B = black
Y = yellow
G = green

Students could add #13 and #14 to their art portfolios, explaining how the piece of art is relevant to the study of mathematics.

Assessment *as* Learning	Supported Learning
Math Learning Log Have students reflect on two or three items they have improved on and how they think they have improved. Have students also pick one weaker area and have them reflect on how they plan to improve in this area of learning.	• Have students check the What I Need to Work On section of their chapter Foldable. Encourage them to keep track of the items that are giving them difficulty and to check off each item as the problem is resolved. • Depending on students' learning style, have them provide oral or written answers. • Have students review the part related to section 1.2 in **BLM 1–2 Chapter 1 Self-Assessment**, fill in the appropriate part of the During column, and report what they might do about any items that they have marked either red or yellow.

Assessment *for* Learning	Supported Learning
Math Link The Math Link on page 17 is intended to help students work toward the chapter problem wrap-up titled Wrap It Up! on page 39.	• Have students do this Math Link to consolidate their understanding of drawing designs and to prepare them for section 1.3. • Students who are having difficulty getting started could use **BLM 1–7 Section 1.2 Math Link**, which provides scaffolding for this activity.

MATH LINK

Doing this activity will assist students with the Wrap It Up! at the end of the chapter. You may wish to have students explore different ways of repeating the design since it could be translated or reflected (see the two possible solutions in the Math Link answers above).

1.3 Transformations

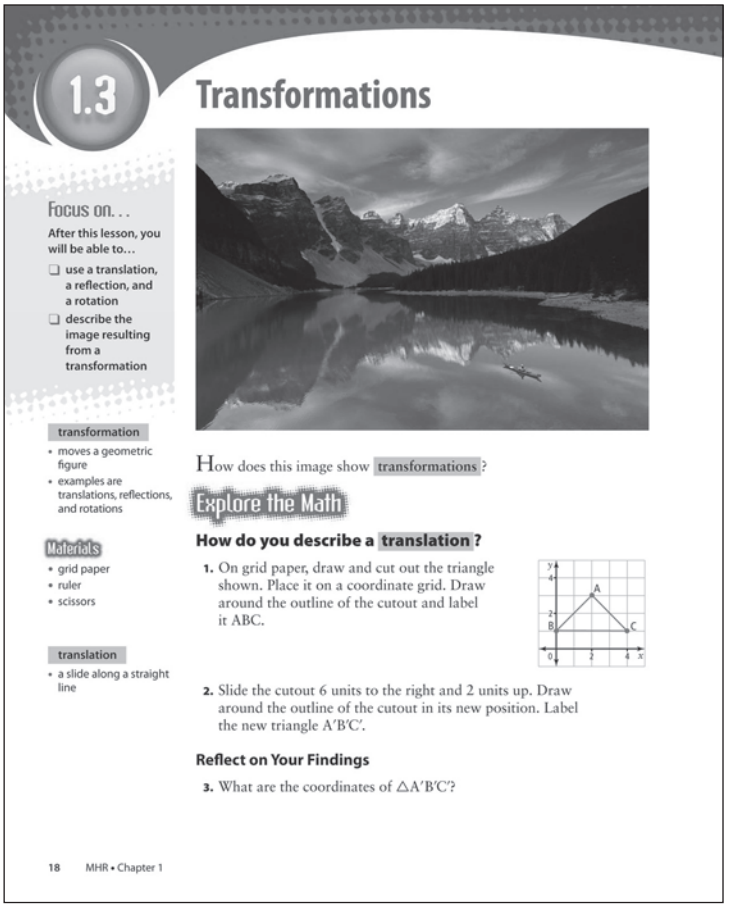
Suggested Timing
120–150 minutes

Materials
- coloured pencils
- grid paper
- ruler
- scissors
- tracing paper
- Mira or mirror (optional)
- magazines
- computer with Internet access (optional)

Blackline Masters
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
BLM 1–2 Chapter 1 Self-Assessment
BLM 1–8 Section 1.3 Extra Practice
BLM 1–9 Section 1.3 Math Link

Mathematical Processes

- [x] Communication
- [x] Connections
- [ ] Mental Mathematics and Estimation
- [x] Problem Solving
- [x] Reasoning
- [x] Technology
- [x] Visualization



1.3 Transformations

Focus on...
After this lesson, you will be able to...
- use a translation, a reflection, and a rotation
- describe the image resulting from a transformation

transformation
- moves a geometric figure
- examples are translations, reflections, and rotations

Materials
- grid paper
- ruler
- scissors

translation
- a slide along a straight line

How does this image show transformations?

Explore the Math

How do you describe a translation?

1. On grid paper, draw and cut out the triangle shown. Place it on a coordinate grid. Draw around the outline of the cutout and label it ABC.

2. Slide the cutout 6 units to the right and 2 units up. Draw around the outline of the cutout in its new position. Label the new triangle A′B′C′.

Reflect on Your Findings

3. What are the coordinates of △A′B′C′?

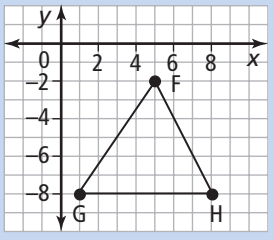
18 MHR • Chapter 1

Specific Outcomes

SS5 Perform and describe transformations (translations, rotations or reflections) of a 2-D shape in all four quadrants of a Cartesian plane (limited to integral number vertices).

Warm-Up

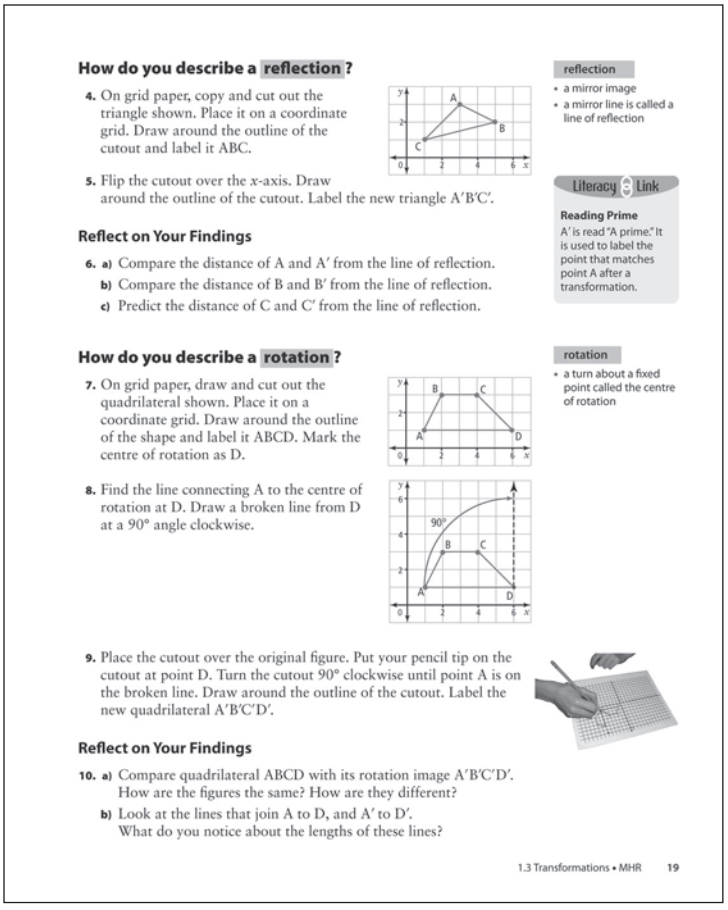
1. Sketch a coordinate grid. Label each quadrant.
2. Draw a vertical line 3 cm long.
3. Plot each point on a coordinate grid: A(4, 4), B(4, −4), C(−4, −4), and D(−4, 4). Join the points in alphabetical order. Join D to A.
4. What shape did you make in #3?
5. Identify the coordinates of the vertices of the shape using ordered pairs.



6. What quadrant is the shape in #5 in? How do you know?

Mental Math

7. Skip count by 10s from 210 to 300.
8. Skip count backward by 2s from 90 to 60.
9. Skip count backward by 5s from 105 to 75.
10. Skip count backward by 10s from 190 to 90.



How do you describe a reflection?

4. On grid paper, copy and cut out the triangle shown. Place it on a coordinate grid. Draw around the outline of the cutout and label it ABC.

5. Flip the cutout over the x-axis. Draw around the outline of the cutout. Label the new triangle A′B′C′.

reflection
- a mirror image
- a mirror line is called a line of reflection

Literacy Link

Reading Prime
A′ is read "A prime." It is used to label the point that matches point A after a transformation.

Reflect on Your Findings

6. a) Compare the distance of A and A′ from the line of reflection.
b) Compare the distance of B and B′ from the line of reflection.
c) Predict the distance of C and C′ from the line of reflection.

How do you describe a rotation?

7. On grid paper, draw and cut out the quadrilateral shown. Place it on a coordinate grid. Draw around the outline of the shape and label it ABCD. Mark the centre of rotation as D.

8. Find the line connecting A to the centre of rotation at D. Draw a broken line from D at a 90° angle clockwise.

rotation
- a turn about a fixed point called the centre of rotation

9. Place the cutout over the original figure. Put your pencil tip on the cutout at point D. Turn the cutout 90° clockwise until point A is on the broken line. Draw around the outline of the cutout. Label the new quadrilateral A′B′C′D′.

Reflect on Your Findings

10. a) Compare quadrilateral ABCD with its rotation image A′B′C′D′. How are the figures the same? How are they different?
b) Look at the lines that join A to D, and A′ to D′. What do you notice about the lengths of these lines?

1.3 Transformations • MHR 19

Activity Planning Notes

Have students study the visual on page 18 and describe any transformations they see. Students will likely notice the reflection of the mountains in the water. You may wish to point out that the kayak moving across the water is a translation. Invite students to share other real-life examples of transformations.

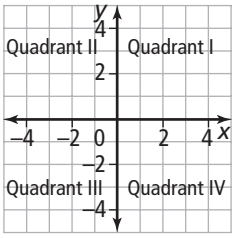
Explore the Math

There are three concepts to present to students in this Explore the Math: translation, reflection, and rotation. The first part deals with a translation, or slide. Have students look at the coordinates of ΔABC and see if they can see a relation to the new coordinates of ΔA′B′C′. Ask them to identify a pattern for what happens to the x-coordinate and what happens to the y-coordinate after the translation.

Answers

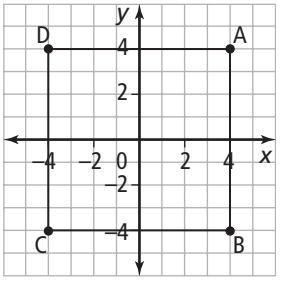
Warm-Up

1.



2.

3.



4. a square

5. F(5, −2), G(1, −8), H(8, −8)

6. This shape is in quadrant IV. The signs are +, −.

7. 210, 220, 230, 240, 250, 260, 270, 280, 290, 300

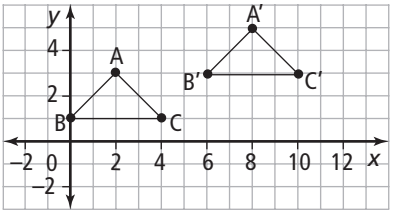
8. 90, 88, 86, 84, 82, 80, 78, 76, 74, 72, 70, 68, 66, 64, 62, 60

9. 105, 100, 95, 90, 85, 80, 75

10. 190, 180, 170, 160, 150, 140, 130, 120, 110, 100, 90

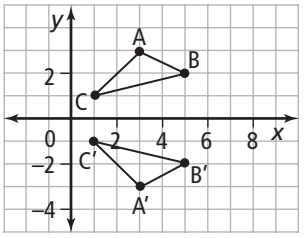
Explore the Math

1., 2.



3. A′(8, 5), B′(6, 3), C′(10, 3)

4., 5.

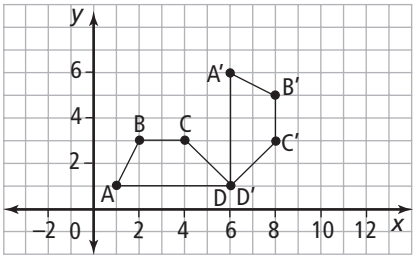


6. **a)** same distance **b)** same distance **c)** same distance

Answers

Explore the Math

7.–9.

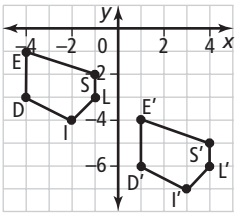


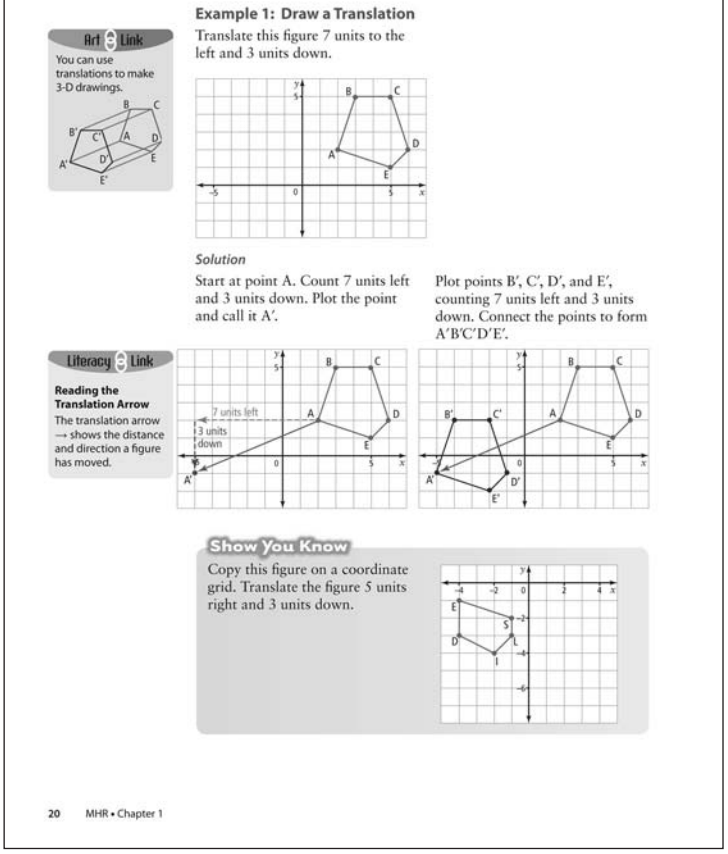
10. Answers may vary. For example:

a) The figures are the same shape (congruent). The figures are in different positions on the graph.

b) The lines are equal in length.

Show You Know: Example 1





Example 1: Draw a Translation

Translate this figure 7 units to the left and 3 units down.

Art Link

You can use translations to make 3-D drawings.

Solution

Start at point A. Count 7 units left and 3 units down. Plot the point and call it A′.

Plot points B′, C′, D′, and E′, counting 7 units left and 3 units down. Connect the points to form A′B′C′D′E′.

Literacy Link

Reading the Translation Arrow

The translation arrow → shows the distance and direction a figure has moved.

7 units left
3 units down

Show You Know

Copy this figure on a coordinate grid. Translate the figure 5 units right and 3 units down.

20 MHR • Chapter 1

Supported Learning

ESL

- Words that some English language learners might have difficulty with in the Explore the Math include *outline, flip, mark, label, compare, counterclockwise,* and *clockwise*. Have students add these words to their translation dictionary.

Meeting the Needs of All Learners

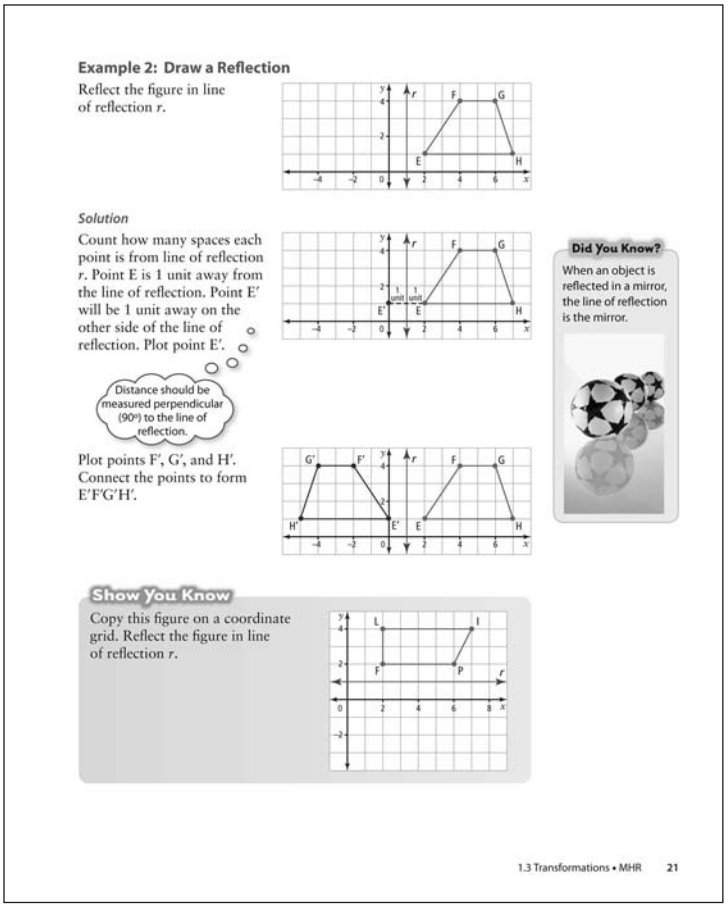
- Ask a quilt maker to come in and talk to students about quilt patterns, which often include transformations. Show some examples, such as in the book *Morning Star Quilts: A Presentation of the Work and Lives of Northern Plains Indian Women* by Florence Pulford (Leone Publications, 1989). Have students create their own quilt pattern on a coordinate grid.

Discuss how reflections are mirror images. The "mirror" is the line of reflection. It is important for students to understand that the part of the object closest to the line of reflection will also be closest on the other side of the line of reflection. Ask why we say that a figure is "flipped" when it is reflected.

The concept of rotations sometimes gives students difficulty. Make sure students understand that a centre of rotation, like a line of reflection, can be placed anywhere on the coordinate grid. Rotations can be clockwise or counterclockwise, and they can be any angle (90°, 180°, 270°, and 360° are covered in this chapter).

Assessment *as* Learning	Supported Learning
Reflect on Your Findings Listen as students discuss the characteristics of translations, reflections, and rotations. During this process, they are generalizing what they have learned during the Explore the Math.	• Encourage students to experiment with several objects and a Mira or mirror. Discuss what they notice as they reflect different objects. • Spend time making sure students understand the more challenging concept of rotations. Reinforce the vocabulary: *centre of rotation, clockwise, counterclockwise, angle of rotation*, etc. • Ask students how the transformations are alike and how they are different to help reinforce their understanding.

Have students work independently through Example 1. Ask them to predict what would have happened if the translation had been 9 units right and 4 units down, 6 units left and 5 units up, or 8 units left and 4 units down.



Example 2: Draw a Reflection

Reflect the figure in line of reflection r.

Solution

Count how many spaces each point is from line of reflection r. Point E is 1 unit away from the line of reflection. Point E′ will be 1 unit away on the other side of the line of reflection. Plot point E′.

Distance should be measured perpendicular (90°) to the line of reflection.

Plot points F′, G′, and H′. Connect the points to form E′F′G′H′.

Did You Know?

When an object is reflected in a mirror, the line of reflection is the mirror.

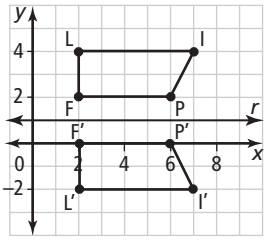
Show You Know

Copy this figure on a coordinate grid. Reflect the figure in line of reflection r.

1.3 Transformations • MHR 21

Answers

Show You Know: Example 2



Assessment *for* Learning	Supported Learning
Example 1 Have students do the Show You Know on page 20 related to Example 1.	• You may wish to have students who would benefit from it perform additional translations on the figure in Example 1: **a)** Translate 1 unit left and 1 unit down. (Students first practise with a translation similar to the example.) **b)** Translate 4 units right and 2 units up. (Monitor how students manage a translation similar to the Show You Know.) **c)** Translate 6 units down. (Check that students know how to handle a translation in only one direction.) Coach students through a), and then have them try b) and c) on their own.

As students work through Example 2, make sure that they understand that however many units away from the line of reflection point E is, point E′ is the same distance away on the other side of the line of reflection, and that this is also the case for points F, G, and H.

Assessment *for* Learning	Supported Learning
Example 2 Have students do the Show You Know related to Example 2.	• You may wish to have students who would benefit from it perform additional reflections on the figure in Example 2: **a)** Reflect the figure in the y-axis. (Students first practise with a reflection similar to the example.) **b)** Reflect the figure in the x-axis. (Students perform a reflection in a horizontal line of reflection as in the Show You Know.) Coach students through a), and then have them try b) on their own.

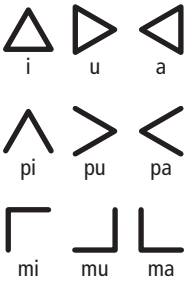
Supported Learning

Motor

- Students with dexterity problems may benefit from creating the coordinate grids on **Master 8 Centimetre Grid Paper** instead of **Master 9 0.5 Centimetre Grid Paper** since the larger grid will allow them to make their drawings on a larger scale.

Web Link

The Inuit syllabic alphabet is written using shapes. A small part of the alphabet is shown below.



Students may enjoy working out how to reflect and rotate one symbol to form the other symbols. For more information on Inuktitut, including the complete syllabic alphabet, go to **www.mathlinks7.ca**.

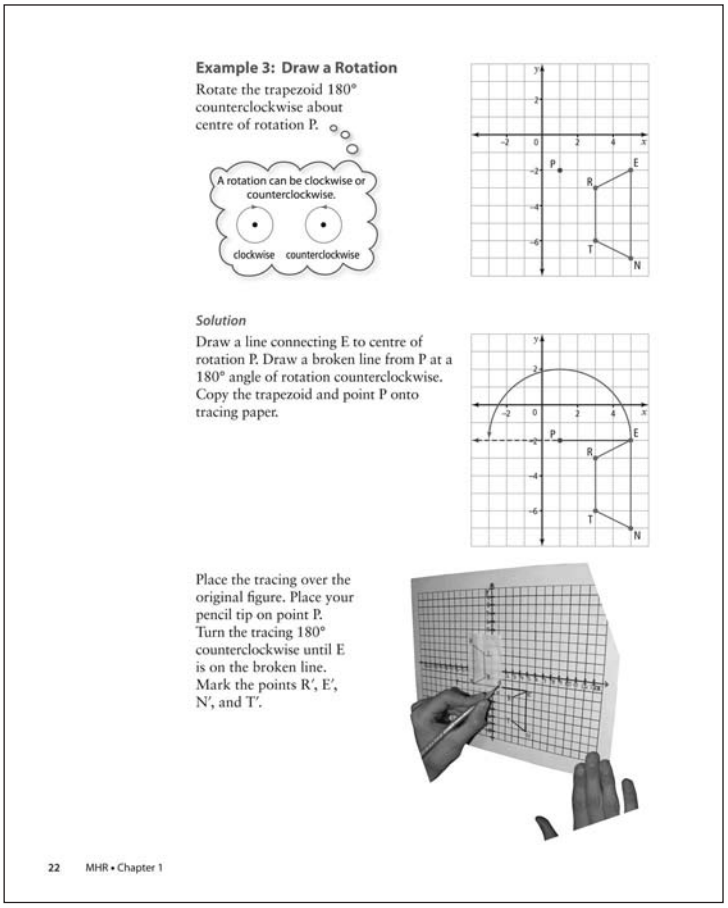
Supported Learning

Learning Style

- You may wish to have students show you different rotations as a physical activity. Have students turn 90°, 180°, 270°, and 360° in a clockwise and counterclockwise direction. It may help some students to relate the centre of rotation to the pivot foot in basketball or to relate rotation to the hand on a clock.

Meeting the Needs of All Learners

- Consider inviting someone to speak about the significance of clockwise and counterclockwise directions in cultural ceremonies. For example, an Elder in the community might talk about how all the parts of a ceremony are done in a clockwise direction.



Example 3: Draw a Rotation

Rotate the trapezoid 180° counterclockwise about centre of rotation P.

A rotation can be clockwise or counterclockwise.

clockwise counterclockwise

Solution

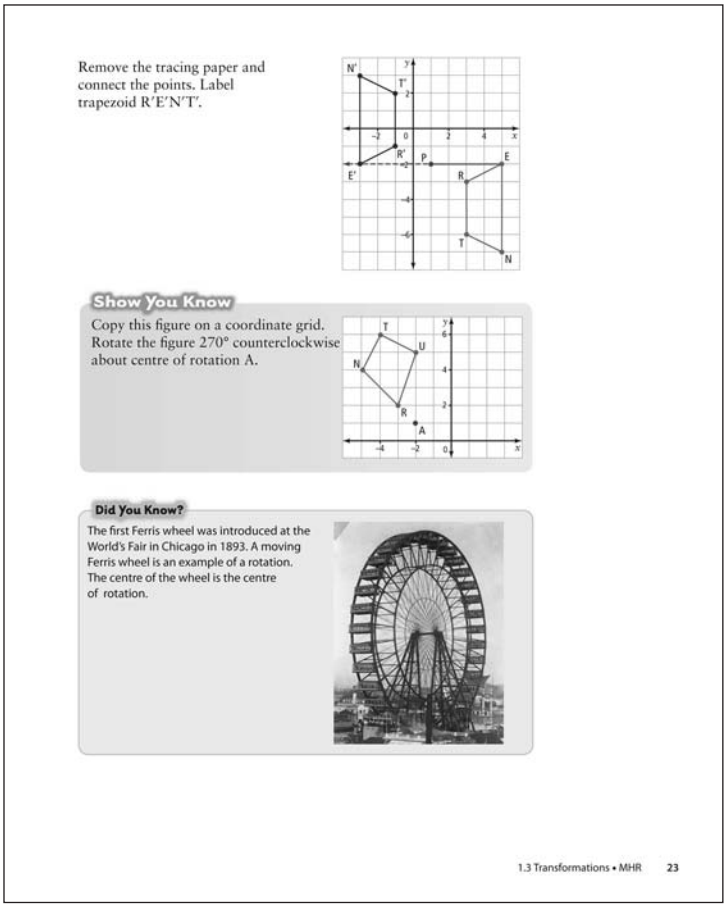
Draw a line connecting E to centre of rotation P. Draw a broken line from P at a 180° angle of rotation counterclockwise. Copy the trapezoid and point P onto tracing paper.

Place the tracing over the original figure. Place your pencil tip on point P. Turn the tracing 180° counterclockwise until E is on the broken line. Mark the points R′, E′, N′, and T′.

22 MHR • Chapter 1

Remind students as they work individually through Example 3 that it is important that the pencil tip is held securely in place while the tracing is being turned, but not so firmly that the paper might tear.

Assessment *for* Learning	Supported Learning
Example 3 Have students do the Show You Know on page 23 related to Example 3.	• You may wish to have students who would benefit from it perform additional rotations on the figure in Example 3: **a)** Rotate the figure 180° clockwise about the origin. (Students first practise with a rotation that is visually more straightforward.) **b)** Rotate the figure 90° counterclockwise about centre of rotation (1, −1). (Students perform a rotation that is slightly more challenging.) Coach students through a), and then have them try b) on their own.



Remove the tracing paper and connect the points. Label trapezoid R′E′N′T′.

Show You Know

Copy this figure on a coordinate grid. Rotate the figure 270° counterclockwise about centre of rotation A.

Did You Know?

The first Ferris wheel was introduced at the World's Fair in Chicago in 1893. A moving Ferris wheel is an example of a rotation. The centre of the wheel is the centre of rotation.

1.3 Transformations • MHR 23

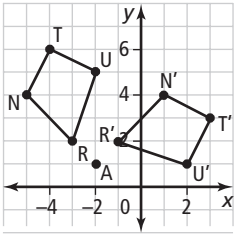
Depending on your students' grasp of rotations, you may wish to introduce another method: the "robotic arm." Demonstrate how to use this method by rotating ΔABC 90° clockwise about a centre of rotation at $(-1, -1)$. Have students draw an arm that traces how many units left or right then up or down the centre of rotation is from the closest vertex. Students then rotate the arm 90° clockwise and redraw the arm in its new position.

At the end of the arm, they draw the point for the closest vertex and then they plot the rest of the vertices.

Concrete and kinesthetic learners may benefit from following this method using a tracing of the triangle and robotic arm and then rotating the tracing by holding a pencil at the centre of rotation.

Answers

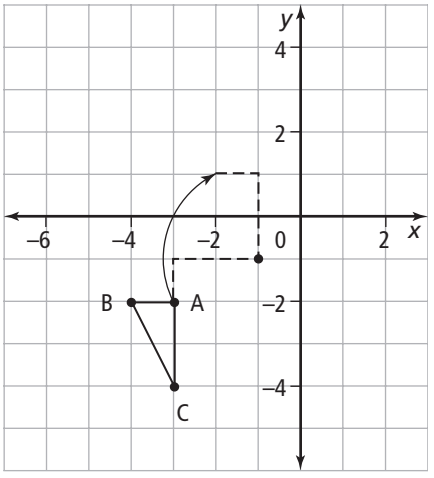
Show You Know: Example 3

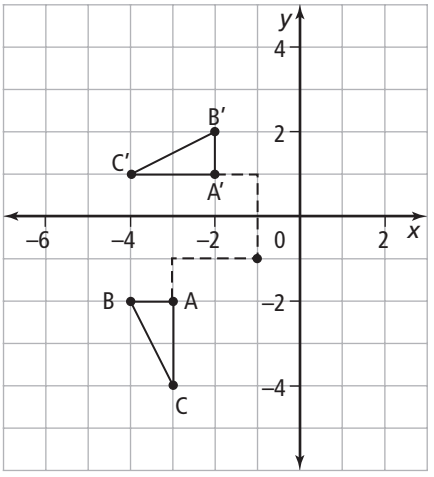


Supported Learning

Meeting the Needs of All Learners

- Provide students with additional examples of translations, reflections, and rotations, which they should continue to solve concretely using cutouts of the shapes. Once students are able to perform the transformations using cutouts, move on to plotting the coordinates to transform each shape.





Answers

Communicate the Ideas

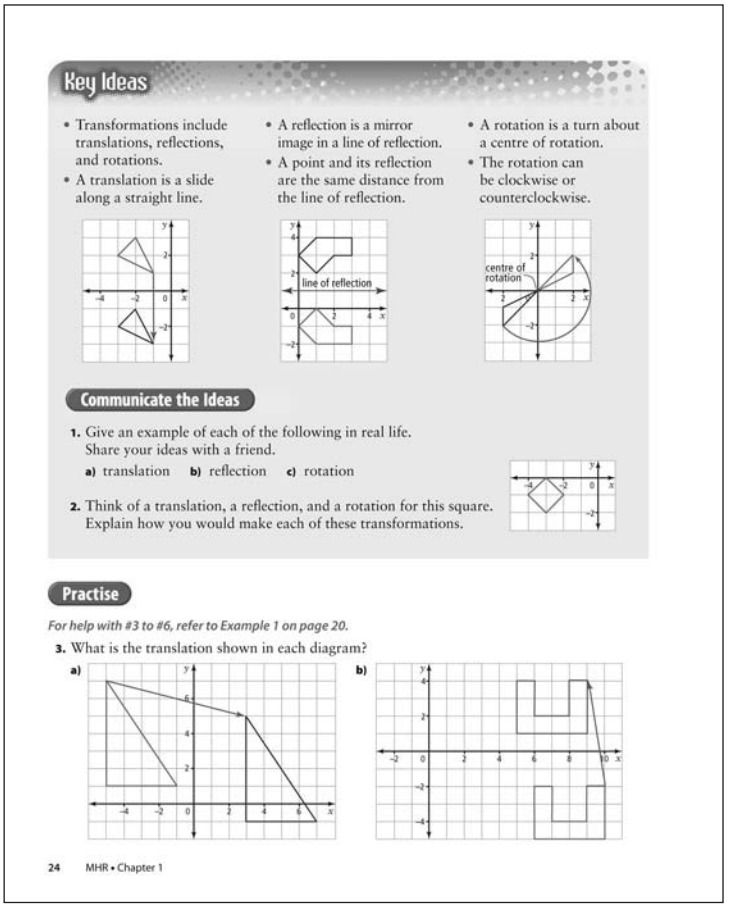
1. Answers may vary. For example:

a) driving in Calgary, which is laid out in a grid fashion

b) a face reflected in a mirror

c) a lazy Susan cupboard

2. Answers may vary. For example:
Translation: Move the square 2 units right, and then 3 units up.
Reflection: Reflect the square in a line of reflection along the x-axis.
Rotation: Rotate the square 90° clockwise about a centre of rotation at $(-1, -1)$.



Key Ideas

- Transformations include translations, reflections, and rotations.
- A translation is a slide along a straight line.
- A reflection is a mirror image in a line of reflection.
- A point and its reflection are the same distance from the line of reflection.
- A rotation is a turn about a centre of rotation.
- The rotation can be clockwise or counterclockwise.

line of reflection

centre of rotation

Communicate the Ideas

1. Give an example of each of the following in real life. Share your ideas with a friend.

a) translation **b)** reflection **c)** rotation

2. Think of a translation, a reflection, and a rotation for this square. Explain how you would make each of these transformations.

Practise

For help with #3 to #6, refer to Example 1 on page 20.

3. What is the translation shown in each diagram?

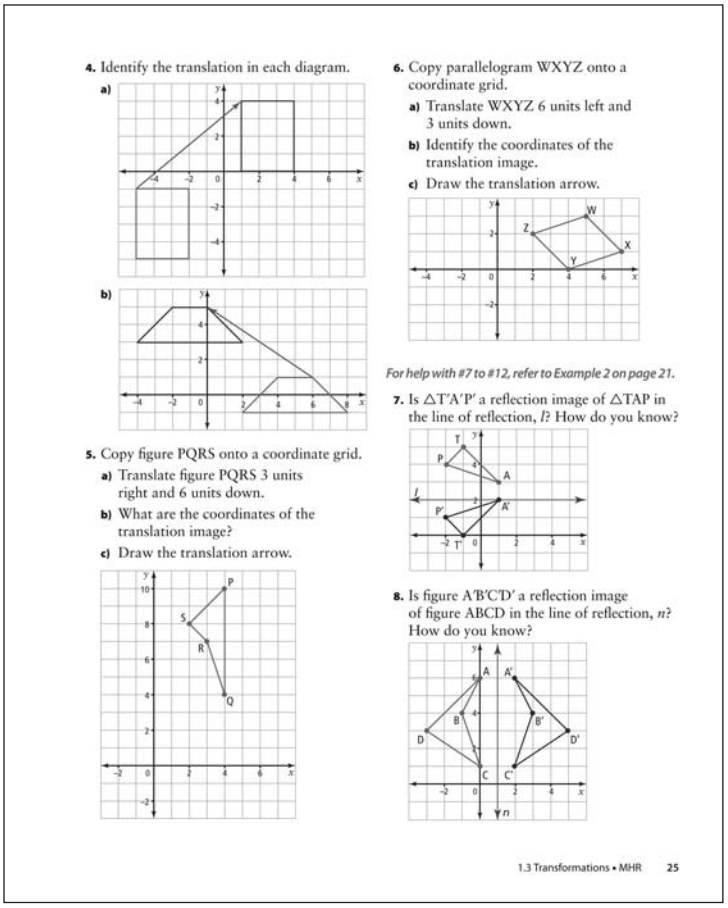
a) **b)**

24 MHR • Chapter 1

Communicate the Ideas

The Communicate the Ideas gives students an opportunity to explain their understanding of transformations and apply it to a real-world scenario. The transformation of the square allows students to explain their thinking in achieving the different types of transformations.

Assessment *as* Learning	Supported Learning
Communicate the Ideas Have all students complete #1 and #2.	• For #1, students with language difficulties might draw a picture to illustrate the transformations, or they might find pictures of transformations in magazines. They can then identify the transformations and explain in their own way how the pictures represent the transformations. • As students work on #2, observe them for correct use of the terms related to each type of transformation. Reinforce the vocabulary as necessary. • Have students share with a partner the transformations that they made to the square in #2. Sharing will allow them to verbalize their thinking and check each other's understanding.



4. Identify the translation in each diagram.

a)

b)

5. Copy figure PQRS onto a coordinate grid.

a) Translate figure PQRS 3 units right and 6 units down.

b) What are the coordinates of the translation image?

c) Draw the translation arrow.

6. Copy parallelogram WXYZ onto a coordinate grid.

a) Translate WXYZ 6 units left and 3 units down.

b) Identify the coordinates of the translation image.

c) Draw the translation arrow.

For help with #7 to #12, refer to Example 2 on page 21.

7. Is $\triangle T'A'P'$ a reflection image of $\triangle TAP$ in the line of reflection, l? How do you know?

8. Is figure A'B'C'D' a reflection image of figure ABCD in the line of reflection, n? How do you know?

1.3 Transformations • MHR 25

Common Errors

- Some students may have difficulty with the language of this section.

R_x Tying the vocabulary to words they already know will help students remember the new words. Finding real-life examples of the transformations will also help students remember and make sense of the concepts.

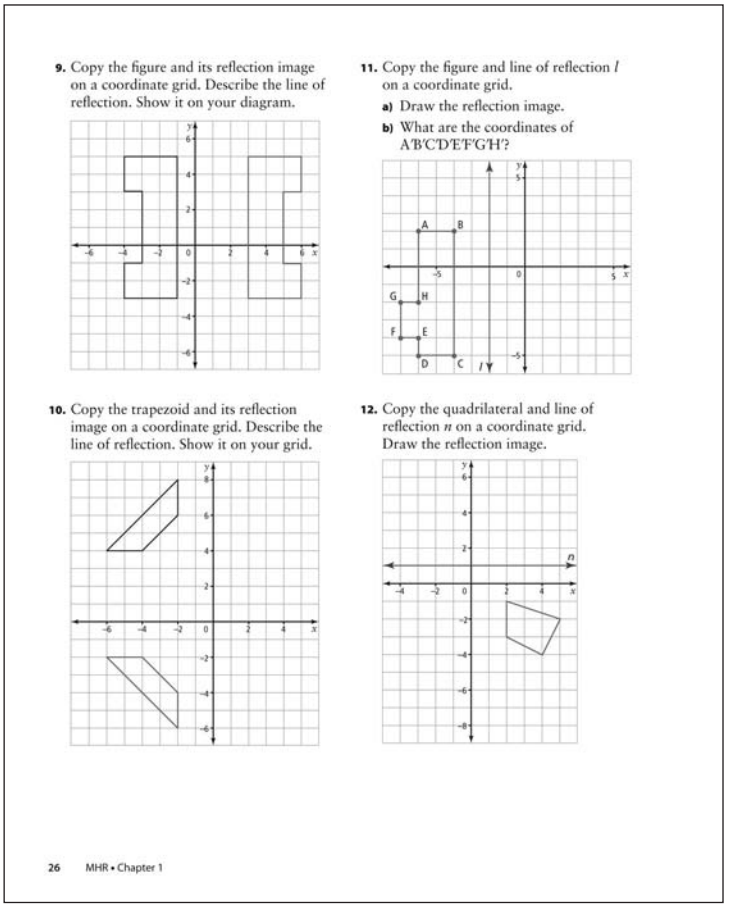
Category	Question Numbers
Essential (minimum questions to cover the outcomes)	1, 2, 5, 11, 16, 19, Math Link
Typical	1–3, 5, 11, 16, 19, 20, Math Link
Extension/Enrichment	1, 2, 21–25

Practise

There are many opportunities for students to work on the different transformations in the Practise section. Have students choose from a list of questions or options (see the table above). Research shows that students do better when they have a choice in how they work. Allow students to work in groups. Plan to spend time observing them as they work. Exemplars of what the work should look like (preferably more than one) will help the struggling learners.

Web Link

Many of M.C. Escher's works of art will provide students with examples of transformations. It is also a lot of fun to try to create some Escher art. This might be an opportunity to collaborate with the art teacher. Have students research the life and work of this artist. To visit the official web site for M.C. Escher, go to **www.mathlinks7.ca** and follow the links.



9. Copy the figure and its reflection image on a coordinate grid. Describe the line of reflection. Show it on your diagram.

10. Copy the trapezoid and its reflection image on a coordinate grid. Describe the line of reflection. Show it on your grid.

11. Copy the figure and line of reflection l on a coordinate grid.

a) Draw the reflection image.

b) What are the coordinates of A′B′C′D′E′F′G′H′?

12. Copy the quadrilateral and line of reflection n on a coordinate grid. Draw the reflection image.

26 MHR • Chapter 1

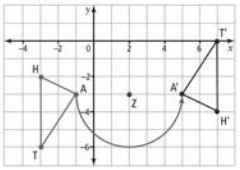
Assessment *for* Learning	Supported Learning
Practise Have students do #5, #11, and #16. Students who have no problems with these questions can go on to the Apply questions.	• Students who have problems with #5 will need additional coaching with Example 1. Have these students explain how they are performing translations. Clarify any misunderstandings. Coach students through #3a), and then have them complete #3b) on their own. Then encourage them to complete #6 independently. • Students who have problems with #11 will need additional coaching with Example 2. Have these students explain how they are performing reflections. Clarify any misunderstandings. Coach students through #9, and then have them complete #10 on their own. Then encourage them to complete #12 independently. • Students who have problems with #16 will need additional coaching with Example 3. Have these students explain how they are performing rotations. Clarify any misunderstandings. Coach students through #13, and then have them complete #14 on their own. Then encourage them to complete #17 independently.

For help with #13 to #18, refer to Example 3 on pages 22–23.

13. The diagram shows △HAT, its rotation image, and centre of rotation Z.

a) What are the coordinates of △HAT and △H′A′T′?

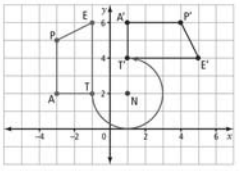
b) What are the direction and angle of rotation?



14. The diagram shows figure TAPE, its rotation image, and centre of rotation N.

a) What are the coordinates of TAPE and T′A′P′E′?

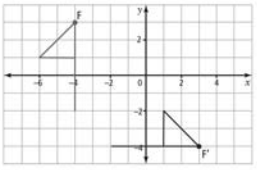
b) What are the direction and angle of rotation?



15. The diagram shows a figure and its rotation image.

a) What are the coordinates of the centre of rotation?

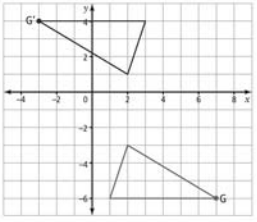
b) What are the direction and angle of rotation? Give more than one answer, if possible.



16. The diagram shows a triangle and its rotation image.

a) What are the coordinates of the centre of rotation?

b) What are the direction and angle of rotation? Give more than one answer, if possible.



1.3 Transformations • MHR 27

Supported Learning

Learning Style

- As students work on the Practise, Apply, and Extend questions, help to focus their learning by asking them questions.

Apply and Extend

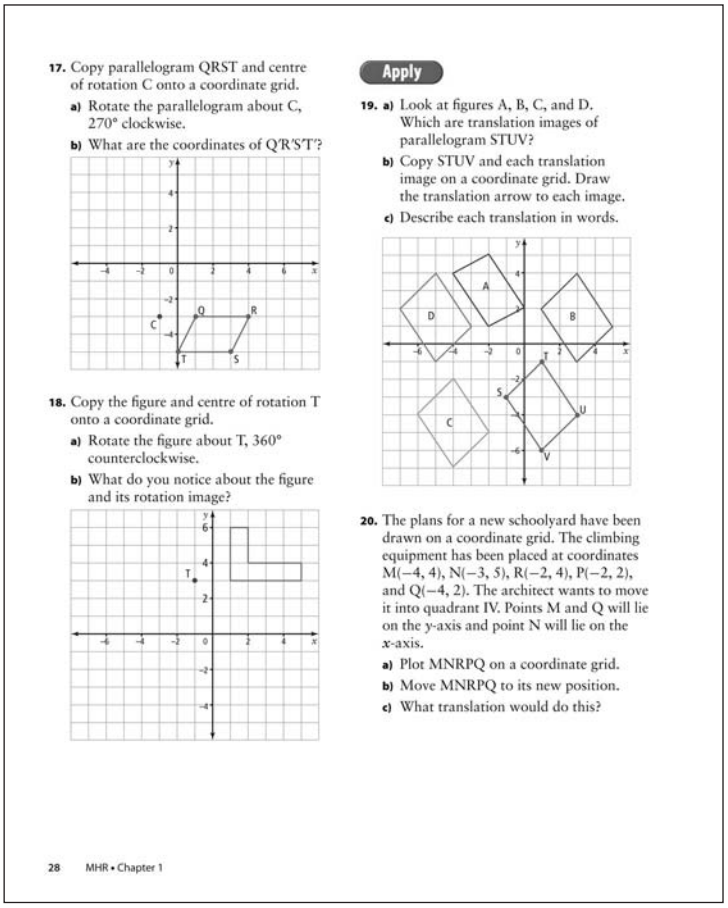
The Apply questions give students opportunities to justify their thinking. Make sure that students fully explain their answers, especially for #19 to #21 and #23.

For #25, students who have fully grasped the concept of transformations should understand how some translations can make an image that appears the same. For students who still might be having difficulty with this notion, ask them to translate and reflect a square. Have them explain how the squares are alike and how they are different after the transformations.

Supported Learning

Learning Style and Memory

- You may wish to provide **BLM 1–8 Section 1.3 Extra Practice** to students who require more practice. For enrichment with this blackline master, tell students that there are other letters on which you can draw a vertical or a horizontal line of reflection so that the letter reflects on itself. Ask them which letters they are, and have them draw the letters and the lines of reflection.



17. Copy parallelogram QRST and centre of rotation C onto a coordinate grid.

a) Rotate the parallelogram about C, 270° clockwise.

b) What are the coordinates of Q′R′S′T′?

18. Copy the figure and centre of rotation T onto a coordinate grid.

a) Rotate the figure about T, 360° counterclockwise.

b) What do you notice about the figure and its rotation image?

Apply

19. a) Look at figures A, B, C, and D. Which are translation images of parallelogram STUV?

b) Copy STUV and each translation image on a coordinate grid. Draw the translation arrow to each image.

c) Describe each translation in words.

20. The plans for a new schoolyard have been drawn on a coordinate grid. The climbing equipment has been placed at coordinates M(−4, 4), N(−3, 5), R(−2, 4), P(−2, 2), and Q(−4, 2). The architect wants to move it into quadrant IV. Points M and Q will lie on the *y*-axis and point N will lie on the *x*-axis.

a) Plot MNRPQ on a coordinate grid.

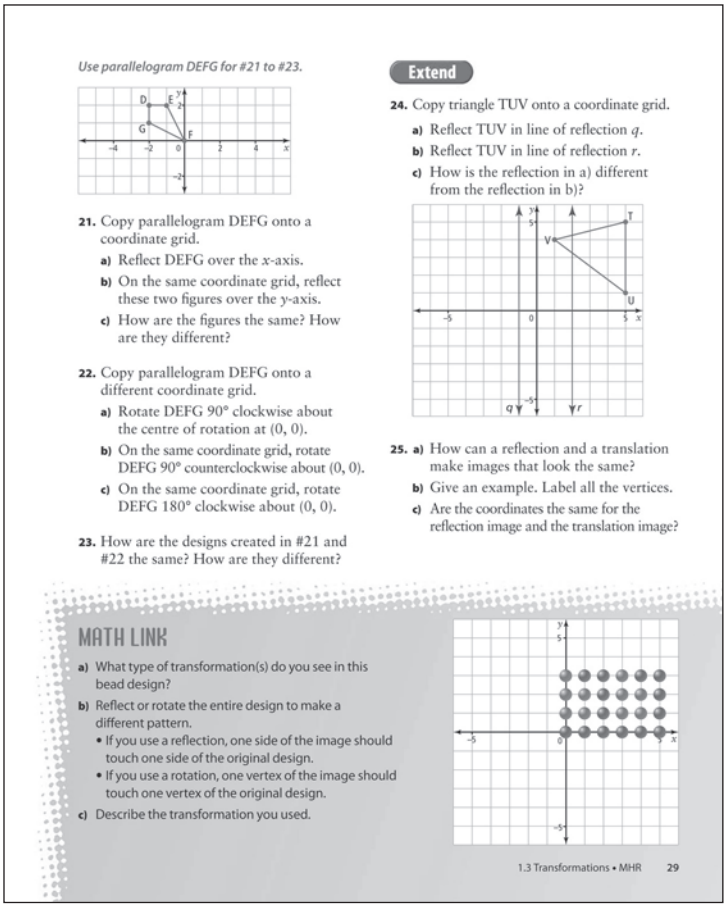
b) Move MNRPQ to its new position.

c) What translation would do this?

28 MHR • Chapter 1

Students are expected to learn many concepts in this lesson. It is important that time be given to develop the ideas presented in section 1.3 before moving on to section 1.4.

Assessment *as* Learning	Supported Learning
Math Learning Log Have students reflect on two or three items they have improved on and how they think they have improved. Have students also pick one area in which they feel they did not learn as much as they should or could have. Have them reflect on how they plan to improve in this area of learning.	• Have students check the What I Need to Work On section of their chapter Foldable. Encourage them to keep track of the items that are giving them difficulty and to check off each item as the problem is resolved. • Work with students to develop a plan for dealing with the areas in which they are having difficulty. • Depending on students' learning style, have them provide oral or written answers. • Have students write about strategies that have helped them understand transformations. • Invite students to write an acrostic poem about transformations using the stem TRANSFORMATIONS. • Keep a record of student reflections in their learning portfolio. You may wish to have them return to these reflections at the end of the chapter. • Have students review the part related to section 1.3 in **BLM 1–2 Chapter 1 Self-Assessment**, fill in the appropriate part of the During column, and report what they might do about any items that they have marked either red or yellow.



Use parallelogram DEFG for #21 to #23.

21. Copy parallelogram DEFG onto a coordinate grid.
- **a)** Reflect DEFG over the x-axis.
- **b)** On the same coordinate grid, reflect these two figures over the y-axis.
- **c)** How are the figures the same? How are they different?

22. Copy parallelogram DEFG onto a different coordinate grid.
- **a)** Rotate DEFG 90° clockwise about the centre of rotation at (0, 0).
- **b)** On the same coordinate grid, rotate DEFG 90° counterclockwise about (0, 0).
- **c)** On the same coordinate grid, rotate DEFG 180° clockwise about (0, 0).

23. How are the designs created in #21 and #22 the same? How are they different?

Extend

24. Copy triangle TUV onto a coordinate grid.
- **a)** Reflect TUV in line of reflection q.
- **b)** Reflect TUV in line of reflection r.
- **c)** How is the reflection in a) different from the reflection in b)?

25. **a)** How can a reflection and a translation make images that look the same?
- **b)** Give an example. Label all the vertices.
- **c)** Are the coordinates the same for the reflection image and the translation image?

MATH LINK
- **a)** What type of transformation(s) do you see in this bead design?
- **b)** Reflect or rotate the entire design to make a different pattern.
  - If you use a reflection, one side of the image should touch one side of the original design.
  - If you use a rotation, one vertex of the image should touch one vertex of the original design.
- **c)** Describe the transformation you used.

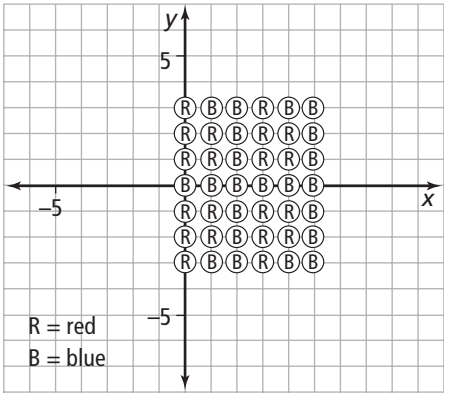
Answers

Math Link

Answers may vary. For example:

a) translation 3 units right

b)



c) I reflected the design in the x-axis.

MATH LINK

Doing this activity will assist students with the Wrap It Up! at the end of the chapter. As they work on the Math Link, observe how students decide which transformation to apply, and look for logic and order in their description of the transformation.

Assessment *for* Learning	Supported Learning
Math Link The Math Link on page 29 is intended to help students work toward the chapter problem wrap-up titled Wrap It Up! on page 39.	• You may wish to have students do this Math Link in order to provide them with practice in identifying and performing transformations. • Observe students as they work on the Math Link, making sure that they identify the transformations and perform their own transformation correctly. • Have students explain their transformation to a partner. • Students who are having difficulty getting started could use **BLM 1–9 Section 1.3 Math Link**, which provides scaffolding for this activity.

1.4 Horizontal and Vertical Distances

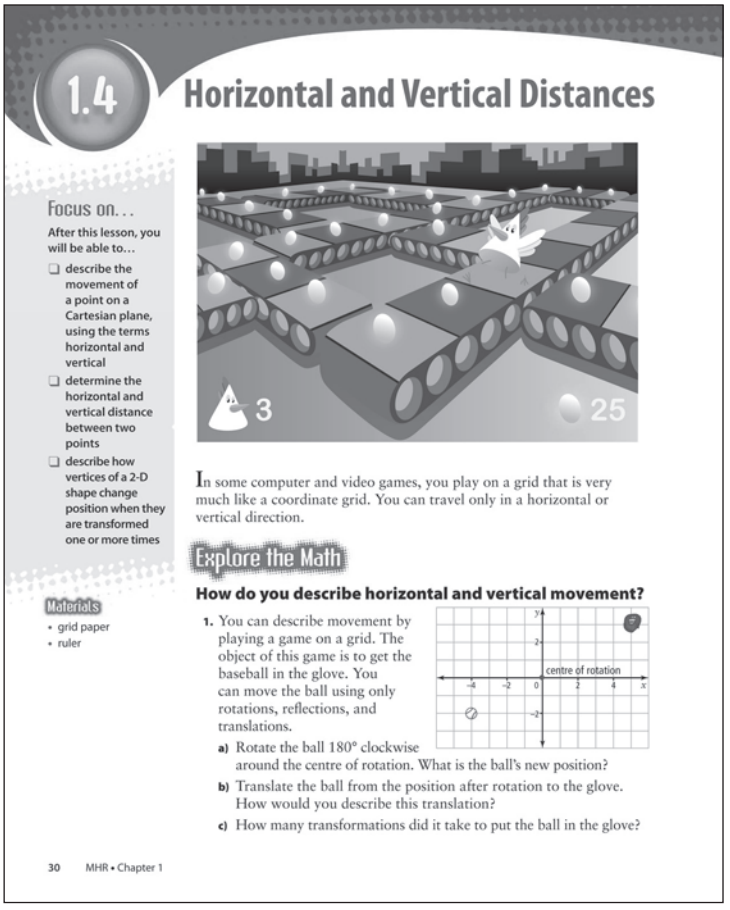
Suggested Timing
80–100 minutes

Materials
- grid paper
- ruler
- overhead projector (optional)
- computer with Internet access (optional)

Blackline Masters
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
BLM 1–2 Chapter 1 Self-Assessment
BLM 1–10 Section 1.4 Extra Practice

Mathematical Processes

- [x] Communication
- [x] Connections
- [ ] Mental Mathematics and Estimation
- [x] Problem Solving
- [x] Reasoning
- [x] Technology
- [x] Visualization



1.4 Horizontal and Vertical Distances

Focus on...

After this lesson, you will be able to...
- describe the movement of a point on a Cartesian plane, using the terms horizontal and vertical
- determine the horizontal and vertical distance between two points
- describe how vertices of a 2-D shape change position when they are transformed one or more times

In some computer and video games, you play on a grid that is very much like a coordinate grid. You can travel only in a horizontal or vertical direction.

Explore the Math

How do you describe horizontal and vertical movement?

Materials
- grid paper
- ruler

1. You can describe movement by playing a game on a grid. The object of this game is to get the baseball in the glove. You can move the ball using only rotations, reflections, and translations.
   a) Rotate the ball 180° clockwise around the centre of rotation. What is the ball's new position?
   b) Translate the ball from the position after rotation to the glove. How would you describe this translation?
   c) How many transformations did it take to put the ball in the glove?

centre of rotation

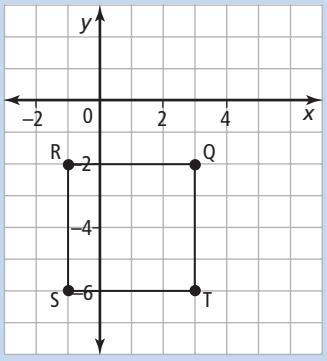
30 MHR • Chapter 1

Specific Outcomes

S5 Perform and describe transformations (translations, rotations or reflections) of a 2-D shape in all four quadrants of a Cartesian plane (limited to integral number vertices).

Warm-Up

1. Identify the coordinates of the vertices of figure QRST.



2. Sketch a coordinate grid with each axis labelled by 2s from −5 to 5.

3. On the grid from #2, plot the following points: R(4, 5), I(5, 0), G(1, −5), H(−3, −1), T(−2, 2).

4. Draw a horizontal line 5 cm long.

5. Draw an example of a reflection.

Mental Math

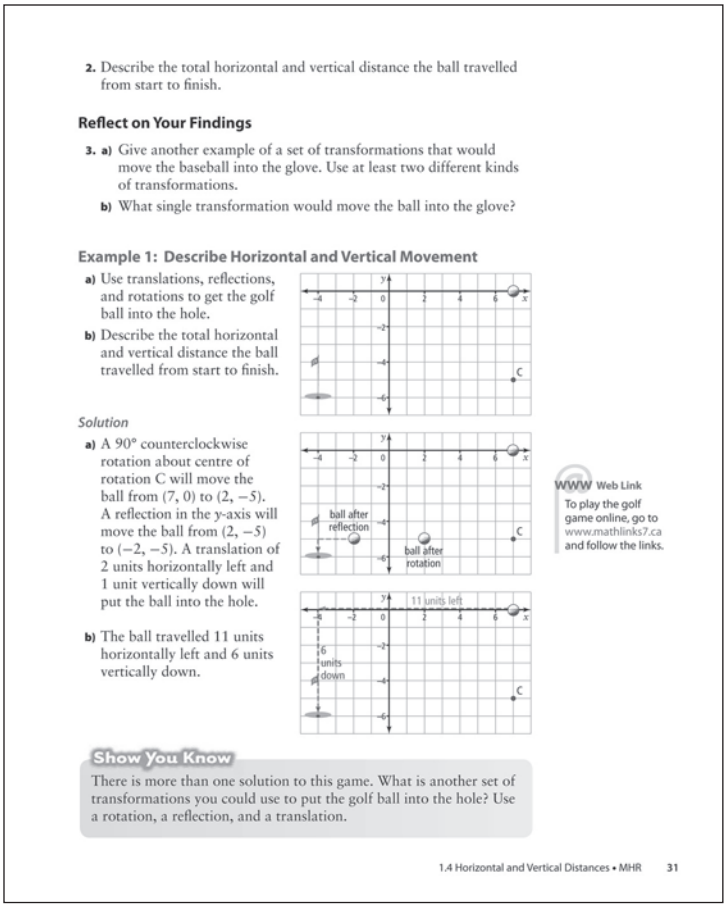
6. Skip count backward by 10s from 500 to 410.

7. Skip count backward by 5s from 185 to 100.

8. Skip count backward by 2s from 1000 to 980.

9. Skip count backward by 10s from 290 to 210.

10. Skip count by 5s from 1005 to 1045.



2. Describe the total horizontal and vertical distance the ball travelled from start to finish.

Reflect on Your Findings

3. a) Give another example of a set of transformations that would move the baseball into the glove. Use at least two different kinds of transformations.
   b) What single transformation would move the ball into the glove?

Example 1: Describe Horizontal and Vertical Movement

a) Use translations, reflections, and rotations to get the golf ball into the hole.
b) Describe the total horizontal and vertical distance the ball travelled from start to finish.

Solution

a) A 90° counterclockwise rotation about centre of rotation C will move the ball from (7, 0) to (2, −5). A reflection in the *y*-axis will move the ball from (2, −5) to (−2, −5). A translation of 2 units horizontally left and 1 unit vertically down will put the ball into the hole.

b) The ball travelled 11 units horizontally left and 6 units vertically down.

WWW Web Link
To play the golf game online, go to www.mathlinks7.ca and follow the links.

Show You Know

There is more than one solution to this game. What is another set of transformations you could use to put the golf ball into the hole? Use a rotation, a reflection, and a translation.

1.4 Horizontal and Vertical Distances • MHR 31

Activity Planning Notes

As a class, brainstorm examples of video games and board games involving movement on a grid.

Explore the Math

Provide students with **Master 9 0.5 Centimetre Grid Paper** or **Master 8 Centimetre Grid Paper** for drawing their coordinate grids. Have students share their solutions to #3 with the class by demonstrating their transformations on an overhead projector, if available.

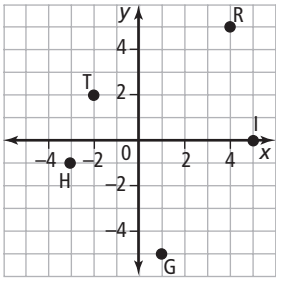
Assessment *as* Learning	Supported Learning
Reflect on Your Findings Listen as students discuss what transformations would move the ball into the glove. During this process, they are generalizing what they have learned during the Explore the Math.	• As a class, compose a statement about transformations between two fixed points. For example: "Different transformations may be used to get from one fixed point to another, but the total distance does not change."

Answers

Warm Up

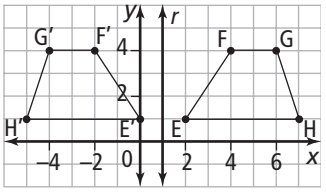
1. Q(3, –2), R(–1, –2), S(–1, –6), T(3, –6)

2., 3.



4. _____

5. Answers will vary. For example:



6. 500, 490, 480, 470, 460, 450, 440, 430, 420, 410

7. 185, 180, 175, 170, 165, 160, 155, 150, 145, 140, 135, 130, 125, 120, 115, 110, 105, 100

8. 1000, 998, 996, 994, 992, 990, 988, 986, 984, 982, 980

9. 290, 280, 270, 260, 250, 240, 230, 220, 210

10. 1005, 1010, 1015, 1020, 1025, 1030, 1035, 1040, 1045

Explore the Math

1. a) (4, 2)
   b) 1 unit horizontally right, 1 unit vertically up
   c) 2

2. 9 units horizontally right, 5 units vertically up

3. Answers may vary. For example:
   a) Rotate the ball 180° clockwise about the point (1, 1), and then translate the ball 1 unit horizontally left and 1 unit vertically down
   b) Reflect the ball in the *y*-axis, and then translate the ball 1 unit horizontally right and 5 units vertically up.
   c) Translate the ball 9 units horizontally right and 5 units vertically up.

Show You Know: Example 1

Answers will vary. Check for accuracy and that students use each type of transformation.

Supported Learning

ESL

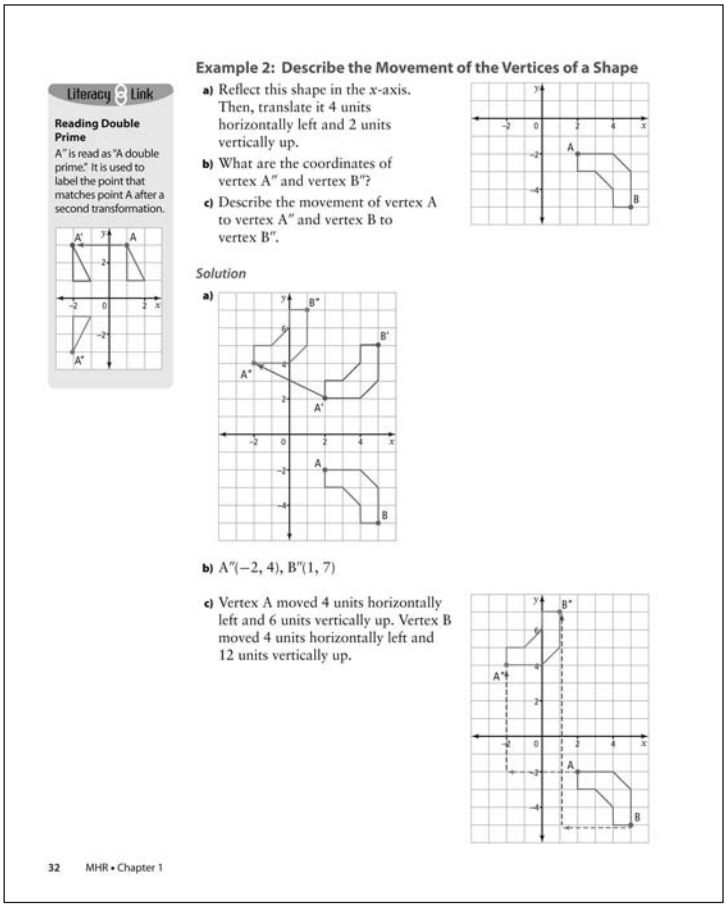
- Words that some English language learners might have difficulty with in the Explore the Math include *travel, position*, and *total*. Have students add these words to their translation dictionary.
- Note that some students may come from a country where people do not play baseball and golf. It is important that students understand the objective of these sports in order to make a connection to the lesson.

Motor

- You may wish to provide **Master 8 Centimetre Grid Paper** to students with dexterity problems to that they can draw their coordinate grids on a larger scale.

Meeting the Needs of All Learners

- Introduce these activities using paper cutouts or game markers that can be physically moved over the grid. Then introduce the counting of units and plotting on the grid.
- Use the coordinate grid on the floor to have students physically perform the transformations outlined in the Explore the Math.



Example 2: Describe the Movement of the Vertices of a Shape

Literacy Link

Reading Double Prime

A″ is read as "A double prime." It is used to label the point that matches point A after a second transformation.

a) Reflect this shape in the *x*-axis. Then, translate it 4 units horizontally left and 2 units vertically up.

b) What are the coordinates of vertex A″ and vertex B″?

c) Describe the movement of vertex A to vertex A″ and vertex B to vertex B″.

Solution

a)

b) A″(−2, 4), B″(1, 7)

c) Vertex A moved 4 units horizontally left and 6 units vertically up. Vertex B moved 4 units horizontally left and 12 units vertically up.

32 MHR • Chapter 1

Web Link

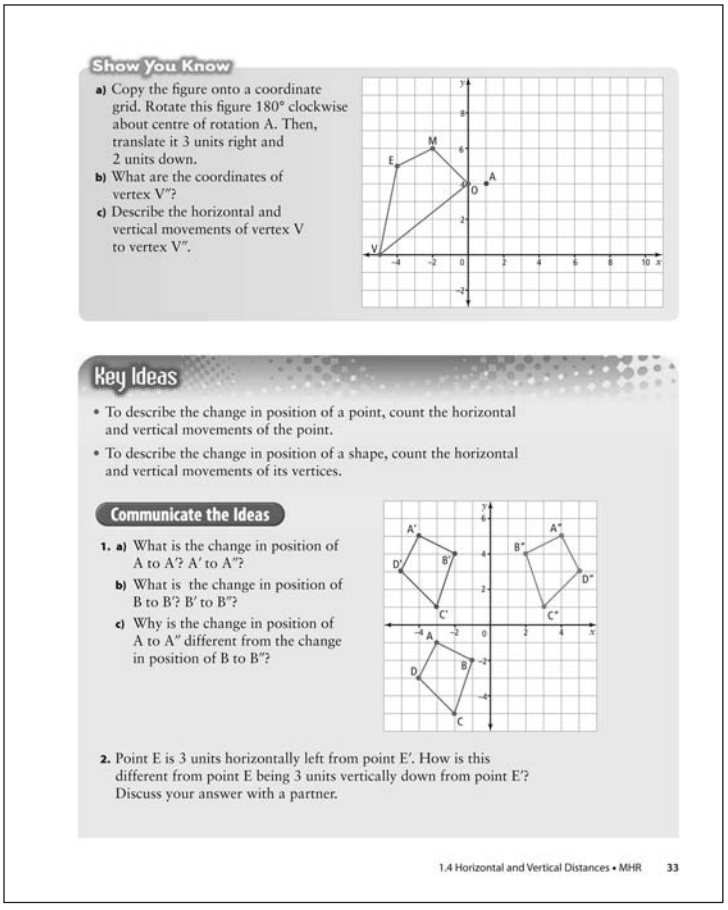
Give students the opportunity to play the golf game online by going to **www.mathlinks7.ca** and following the links.

Have students work through Example 1 independently, and then direct them to come up with two solutions for the Show You Know.

Assessment *for* Learning	Supported Learning
Example 1 Have students do the Show You Know on page 31 related to Example 1.	• Have students work in groups to share and test each other's solutions to Example 1. • You may wish to encourage students who would benefit from it to come up with more straightforward transformations that will put the golf ball into the hole: **a)** Use one translation. **b)** Use one reflection and one translation. Coach students through a), and then have them try b) on their own.

After completing Example 2, discuss whether the distance would change if the order of the transformations changed.

Assessment *for* Learning	Supported Learning
Example 2 Have students do the Show You Know on page 33 related to Example 2.	• Encourage kinesthetic and concrete learners to use their fingers to count the number of units left or right and then up or down to determine the movement of the vertex. • You may wish to have students who would benefit from it also describe the movement of vertices M, O, and E. (Students will note that the distance each vertex moved is different from the others.) Coach students through vertex M, and then have them try vertices O and E on their own.



Show You Know

a) Copy the figure onto a coordinate grid. Rotate this figure 180° clockwise about centre of rotation A. Then, translate it 3 units right and 2 units down.
b) What are the coordinates of vertex V″?
c) Describe the horizontal and vertical movements of vertex V to vertex V″.

Key Ideas

- To describe the change in position of a point, count the horizontal and vertical movements of the point.
- To describe the change in position of a shape, count the horizontal and vertical movements of its vertices.

Communicate the Ideas

1. a) What is the change in position of A to A′? A′ to A″?
   b) What is the change in position of B to B′? B′ to B″?
   c) Why is the change in position of A to A″ different from the change in position of B to B″?

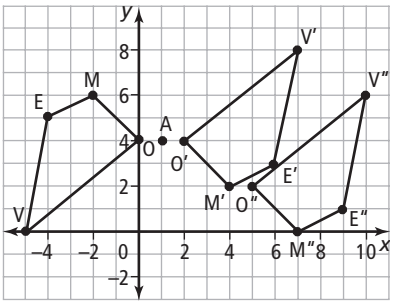
2. Point E is 3 units horizontally left from point E′. How is this different from point E being 3 units vertically down from point E′? Discuss your answer with a partner.

1.4 Horizontal and Vertical Distances • MHR 33

Answers

Show You Know: Example 2

a)



b) (10, 6)

c) Vertex V moved 15 units horizontally right and 6 units vertically up to vertex V″.

Communicate the Ideas

1. a) A to A′: 1 unit horizontally left, 6 units vertically up; A′ to A″: 8 units horizontally right

b) B to B′: 1 unit horizontally left, 6 units vertically up; B′ to B″: 4 units horizontally right

c) It is different because image A″B″C″D″ is a reflection of ABCD and not a translation.

2. Answers may vary. For example: Point E has been translated 3 units horizontally right rather than 3 units vertically up.

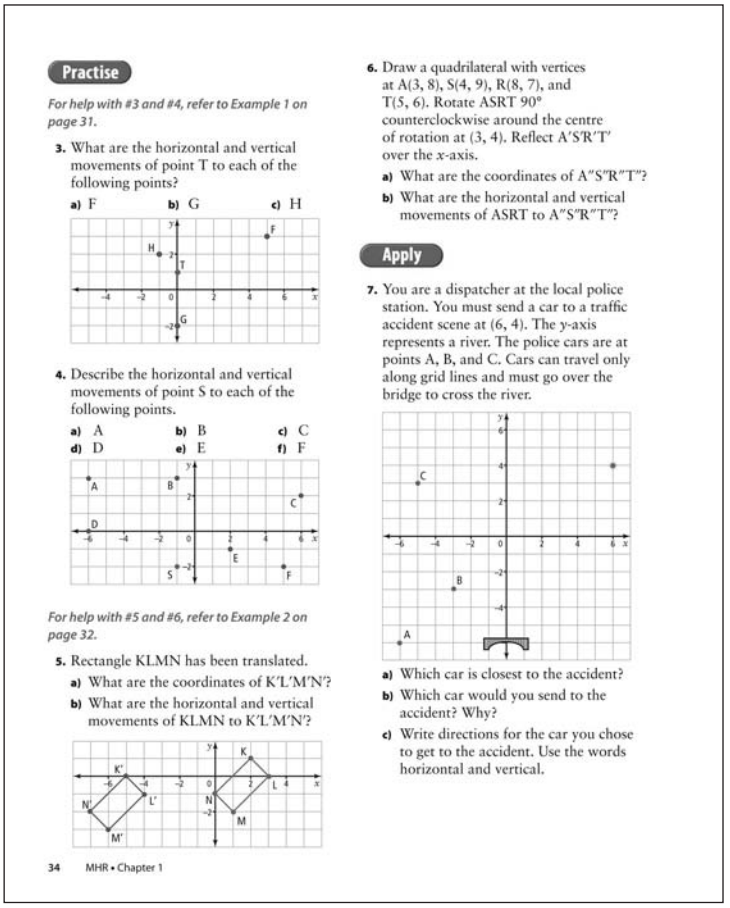
Key Ideas

In their journals, have students state how the two Key Ideas are alike and how they are different.

Communicate the Ideas

The Communicate the Ideas is intended to allow students to explain their understanding of the change in position of a point by counting horizontal and vertical movements. It also allows students to answer why the positional changes are different for the different vertices of a shape.

Assessment *as* Learning	Supported Learning
Communicate the Ideas Have students complete #1 and #2 in pairs, and then discuss #1c) and #2 as a class.	• In #1c), students have the opportunity to express in their own words the learning from Example 2. • For students who have had difficulty with the terms *horizontal* and *vertical*, #2 gives them a chance to clarify their thinking.



Practise

For help with #3 and #4, refer to Example 1 on page 31.

3. What are the horizontal and vertical movements of point T to each of the following points?

a) F **b)** G **c)** H

4. Describe the horizontal and vertical movements of point S to each of the following points.

a) A **b)** B **c)** C
d) D **e)** E **f)** F

For help with #5 and #6, refer to Example 2 on page 32.

5. Rectangle KLMN has been translated.

a) What are the coordinates of K′L′M′N′?

b) What are the horizontal and vertical movements of KLMN to K′L′M′N′?

6. Draw a quadrilateral with vertices at A(3, 8), S(4, 9), R(8, 7), and T(5, 6). Rotate ASRT 90° counterclockwise around the centre of rotation at (3, 4). Reflect A′S′R′T′ over the *x*-axis.

a) What are the coordinates of A″S″R″T″?

b) What are the horizontal and vertical movements of ASRT to A″S″R″T″?

Apply

7. You are a dispatcher at the local police station. You must send a car to a traffic accident scene at (6, 4). The *y*-axis represents a river. The police cars are at points A, B, and C. Cars can travel only along grid lines and must go over the bridge to cross the river.

a) Which car is closest to the accident?

b) Which car would you send to the accident? Why?

c) Write directions for the car you chose to get to the accident. Use the words horizontal and vertical.

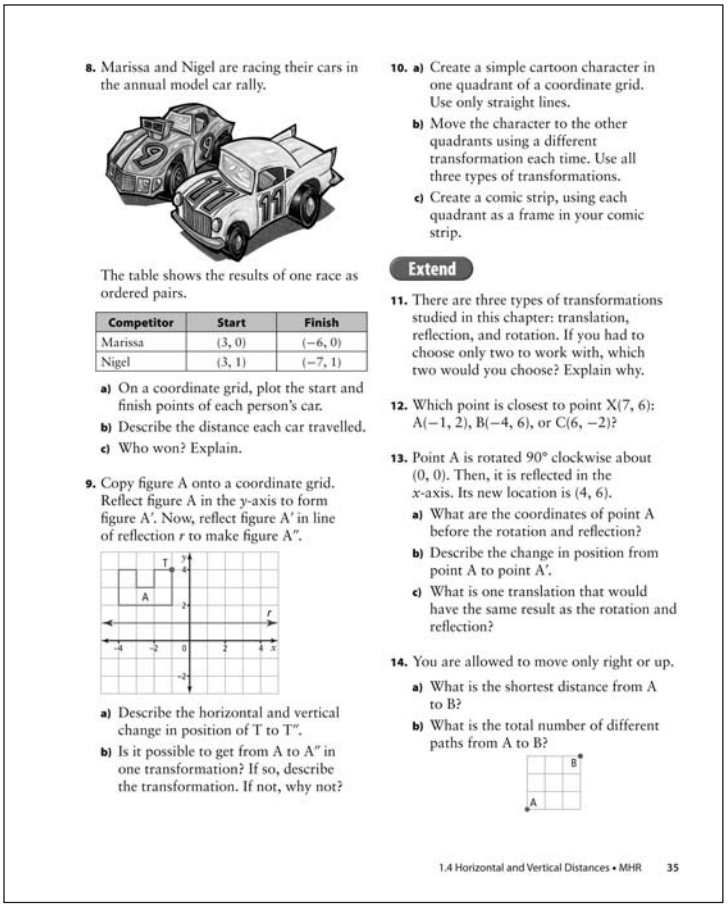
34 MHR • Chapter 1

Category	Question Numbers
Essential (minimum questions to cover the outcomes)	1–3, 6, 9, Math Link
Typical	1–3, 6–9, 11, Math Link
Extension/Enrichment	1, 2, 10–14

Practise

Have students work in groups to complete the Practise questions. Make sure that they describe the movement using the words *vertical* and *horizontal*. Encourage students to check each other's work as they complete it.

Assessment *for* Learning	Supported Learning
Practise Have students do #3 and #6. Students who have no problems with these questions can go on to the Apply questions.	• Students who have problems with #3 will need additional coaching with Example 1. Have these students explain how they are identifying horizontal and vertical movement of a point. Clarify any misunderstandings. Coach students through point A in #4, and then have them complete the rest of the question on their own. • Students who have problems with #6 will need additional coaching with Example 2. Have these students explain how they are identifying horizontal and vertical movement of vertices. Clarify any misunderstandings. Coach students through point K in #5, and then have them complete the rest of the question on their own.



8. Marissa and Nigel are racing their cars in the annual model car rally.

The table shows the results of one race as ordered pairs.

Competitor	Start	Finish
Marissa	(3, 0)	(−6, 0)
Nigel	(3, 1)	(−7, 1)

a) On a coordinate grid, plot the start and finish points of each person's car.
b) Describe the distance each car travelled.
c) Who won? Explain.

9. Copy figure A onto a coordinate grid. Reflect figure A in the *y*-axis to form figure A′. Now, reflect figure A′ in line of reflection *r* to make figure A″.

a) Describe the horizontal and vertical change in position of T to T″.
b) Is it possible to get from A to A″ in one transformation? If so, describe the transformation. If not, why not?

10. a) Create a simple cartoon character in one quadrant of a coordinate grid. Use only straight lines.
b) Move the character to the other quadrants using a different transformation each time. Use all three types of transformations.
c) Create a comic strip, using each quadrant as a frame in your comic strip.

Extend

11. There are three types of transformations studied in this chapter: translation, reflection, and rotation. If you had to choose only two to work with, which two would you choose? Explain why.

12. Which point is closest to point X(7, 6): A(−1, 2), B(−4, 6), or C(6, −2)?

13. Point A is rotated 90° clockwise about (0, 0). Then, it is reflected in the *x*-axis. Its new location is (4, 6).
a) What are the coordinates of point A before the rotation and reflection?
b) Describe the change in position from point A to point A′.
c) What is one translation that would have the same result as the rotation and reflection?

14. You are allowed to move only right or up.
a) What is the shortest distance from A to B?
b) What is the total number of different paths from A to B?

1.4 Horizontal and Vertical Distances • MHR 35

Apply and Extend

For #10, tell students that their cartoon character may end up right side up, sideways, or upside down in the different quadrants. Explain that they should create a comic strip that incorporates these positions in a fun way. Once they are completed, display the comic strips. Students might add them to their portfolios, along with an explanation of how the comic strip was created.

Consider using #11 as a journal question. It could also be used for a creative writing piece by some of the more literary students.

Assessment *as* Learning	Supported Learning
Math Learning Log Have students reflect on two or three items they have improved on and how they think they have improved. Have students also pick one area in which they feel they did not learn as much as they should or could have. Have them reflect on how they plan to improve in this area of learning.	• Have students check the What I Need to Work On section of their chapter Foldable. Encourage them to keep track of the items that are giving them difficulty and to check off each item as the problem is resolved. • Work with students to develop a plan for dealing with the areas in which they are having difficulty. • Depending on students' learning style, have them provide oral or written answers. • Keep a record of student reflections in their learning portfolio. You may wish to have them return to these reflections at the end of the chapter. • Have students review the part related to section 1.4 in **BLM 1–2 Chapter 1 Self-Assessment**, fill in the appropriate part of the During column, and report what they might do about any items that they have marked either red or yellow.

Supported Learning

ESL

- Words that some English language learners might have difficulty with in the Apply section are *bridge, closest,* and *comic strip*. Have students add these words to their translation dictionary.

Learning Style and Memory

- You may wish to provide **BLM 1–10 Section 1.4 Extra Practice** to students who require more practice.

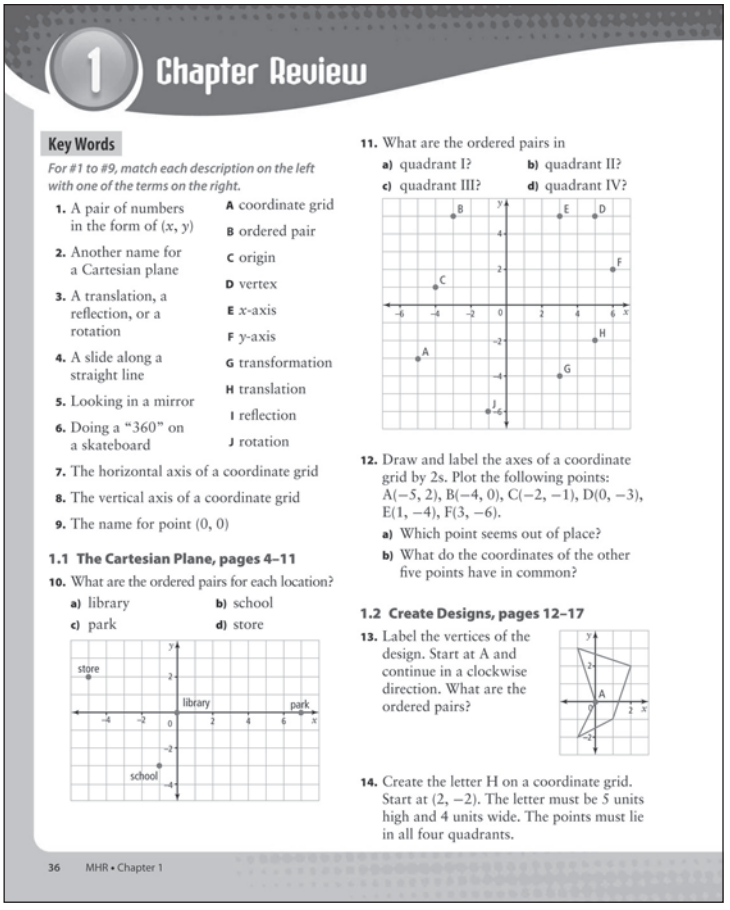
1 Chapter Review

Suggested Timing
40–50 minutes

Materials
- grid paper
- ruler
- scissors (optional)
- tracing paper (optional)

Blackline Masters
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
BLM 1–2 Chapter 1 Self-Assessment
BLM 1–4 Section 1.1 Extra Practice
BLM 1–6 Section 1.2 Extra Practice
BLM 1–8 Section 1.3 Extra Practice
BLM 1–10 Section 1.4 Extra Practice
BLM 1–11 Chapter 1 Key Words Puzzle

Assessment *for* Learning	Supported Learning
Chapter 1 Review The Chapter 1 Review is an opportunity for students to assess themselves by completing selected questions in each section and checking their answers against the answers in the back of the student resource.	• Have students revisit the concept web that they created in the Chapter Opener so that they may add concepts that they have learned through the course of the chapter. Students might make these additions in a different colour so that you can see what they have learned. • Have students check the contents of the What I Need to Work On tab of their chapter Foldable and do at least one question related to each item on that tab. • Have students revisit any section that they are having difficulty with prior to working on the chapter test.


1 Chapter Review

Key Words

For #1 to #9, match each description on the left with one of the terms on the right.

1. A pair of numbers in the form of (x, y)
2. Another name for a Cartesian plane
3. A translation, a reflection, or a rotation
4. A slide along a straight line
5. Looking in a mirror
6. Doing a "360" on a skateboard
7. The horizontal axis of a coordinate grid
8. The vertical axis of a coordinate grid
9. The name for point (0, 0)

A coordinate grid
B ordered pair
C origin
D vertex
E x-axis
F y-axis
G transformation
H translation
I reflection
J rotation

1.1 The Cartesian Plane, pages 4–11

10. What are the ordered pairs for each location?
a) library b) school
c) park d) store

store, library, park, school

11. What are the ordered pairs in
a) quadrant I? b) quadrant II?
c) quadrant III? d) quadrant IV?

12. Draw and label the axes of a coordinate grid by 2s. Plot the following points: A(−5, 2), B(−4, 0), C(−2, −1), D(0, −3), E(1, −4), F(3, −6).
a) Which point seems out of place?
b) What do the coordinates of the other five points have in common?

1.2 Create Designs, pages 12–17

13. Label the vertices of the design. Start at A and continue in a clockwise direction. What are the ordered pairs?

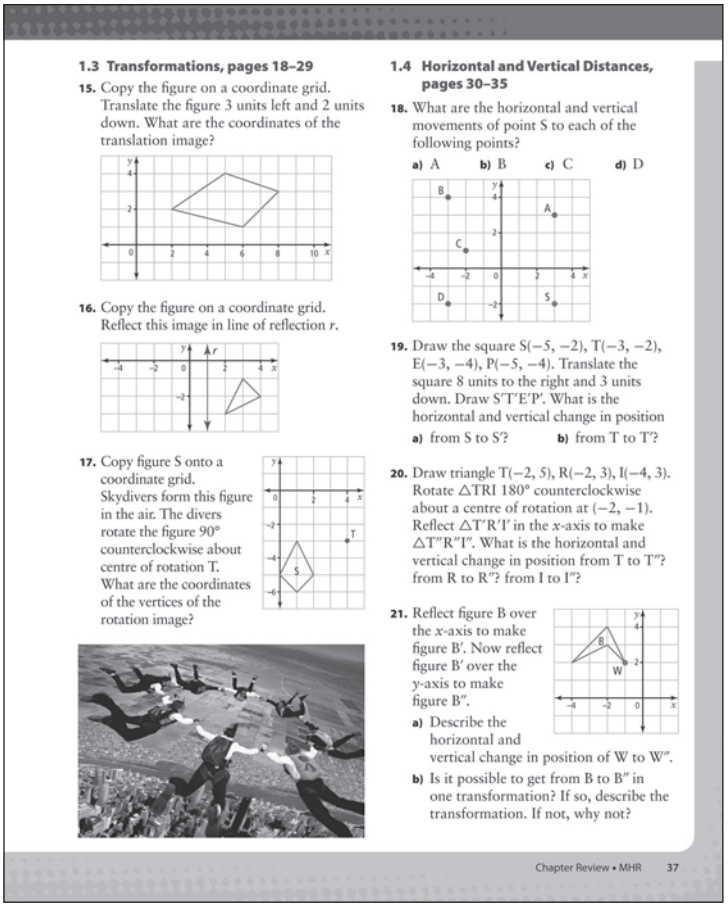
14. Create the letter H on a coordinate grid. Start at (2, −2). The letter must be 5 units high and 4 units wide. The points must lie in all four quadrants.

36 MHR • Chapter 1

Activity Planning Notes

For #1 to #9 of the Chapter 1 Review, students may wish to review the words in pairs. One student could read the definition and the other could say the word. They may want to do the exercise backward: one student could read the word and the other could find the definition. As an alternative to or in addition to this exercise, give students **BLM 1–11 Chapter 1 Key Words Puzzle**.

Have students work individually to place the numbers 10 to 21 in two columns in their notebooks. Instruct them to look at the question related to the number in the Chapter 1 Review and decide how well they understand it. Tell them to circle each number according to the colours they used on **BLM 1–2 Chapter 1 Self-Assessment**.



1.3 Transformations, pages 18–29

15. Copy the figure on a coordinate grid. Translate the figure 3 units left and 2 units down. What are the coordinates of the translation image?

16. Copy the figure on a coordinate grid. Reflect this image in line of reflection *r*.

17. Copy figure S onto a coordinate grid. Skydivers form this figure in the air. The divers rotate the figure 90° counterclockwise about centre of rotation T. What are the coordinates of the vertices of the rotation image?

1.4 Horizontal and Vertical Distances, pages 30–35

18. What are the horizontal and vertical movements of point S to each of the following points?

a) A **b)** B **c)** C **d)** D

19. Draw the square S(−5, −2), T(−3, −2), E(−3, −4), P(−5, −4). Translate the square 8 units to the right and 3 units down. Draw S′T′E′P′. What is the horizontal and vertical change in position

a) from S to S′? **b)** from T to T′?

20. Draw triangle T(−2, 5), R(−2, 3), I(−4, 3). Rotate △TRI 180° counterclockwise about a centre of rotation at (−2, −1). Reflect △T′R′I′ in the *x*-axis to make △T″R″I″. What is the horizontal and vertical change in position from T to T″? from R to R″? from I to I″?

21. Reflect figure B over the *x*-axis to make figure B′. Now reflect figure B′ over the *y*-axis to make figure B″.

a) Describe the horizontal and vertical change in position of W to W″.

b) Is it possible to get from B to B″ in one transformation? If so, describe the transformation. If not, why not?

Chapter Review • MHR 37

Supported Learning

Learning Style

- Allow students to continue to use tracing paper and cutouts, as necessary, to perform rotations.

Learning Style and Memory

- Students who require more practice on a particular topic may refer to the following blackline masters: **BLM 1–4 Section 1.1 Extra Practice**, **BLM 1–6 Section 1.2 Extra Practice**, **BLM 1–8 Section 1.3 Extra Practice**, and **BLM 1–10 Section 1.4 Extra Practice**.

Gifted and Enrichment

- Some students may already be familiar with skills handled in this review. To provide questions for enrichment and extra challenge for gifted students, go to **www.mathlinks7.ca** and follow the links.

Assessment *as* Learning	Supported Learning
Math Learning Log Once students have completed the Chapter 1 Review, have them reflect on the chapter as a whole. Ask them to answer at least three of the following questions. – What two or three things did you find easy? Why? – What surprised you in the chapter? Why? – What was fun in the chapter? Why? – What concepts did you find difficult? What help do you need to understand these concepts? How will you get the help you need? – How well do you understand the chapter? Explain. – How would you explain the main concepts of the chapter to someone in a letter? – When might you or someone else use the concepts in this chapter in real life?	• Have students use the What I Need to Work On section of their chapter Foldable to provide information about what they continue to have problems with and what problems they had that have now been resolved. • You may wish to have students refer to **BLM 1–2 Chapter 1 Self-Assessment** when they report on what they found easy and how well they understand the chapter.

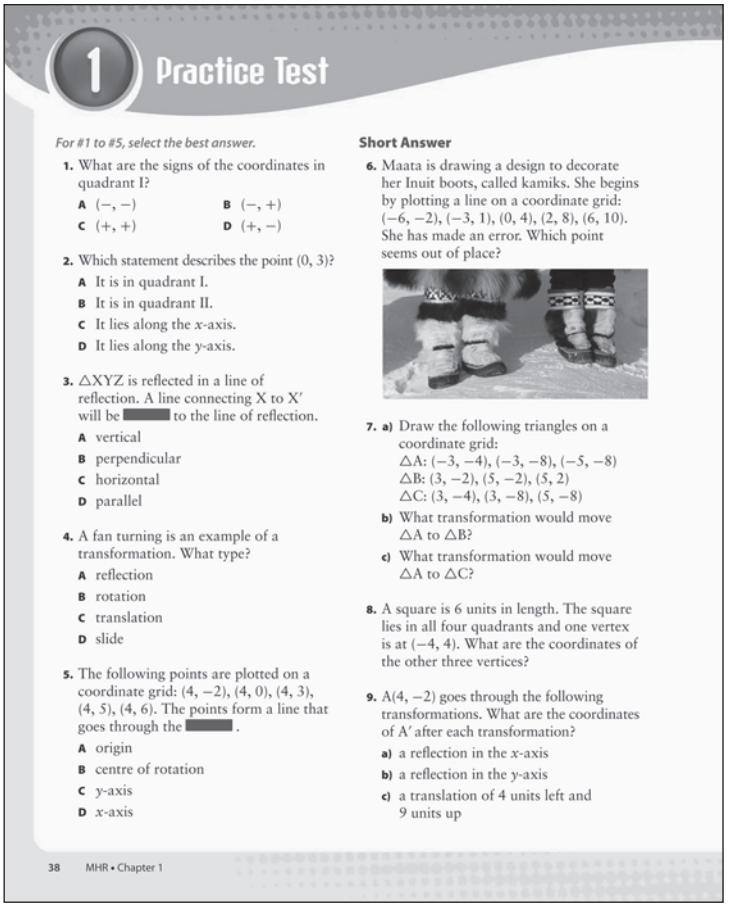
1 Practice Test

Suggested Timing
40–50 minutes

Materials
- grid paper
- ruler
- scissors (optional)
- tracing paper (optional)

Blackline Masters
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
BLM 1–2 Chapter 1 Self-Assessment
BLM 1–12 Chapter 1 Test

Assessment *as* Learning	Supported Learning
Chapter 1 Self-Assessment Have students review their earlier responses on **BLM 1–2 Chapter 1 Self-Assessment**.	• Have students use their responses on the practice test and work they completed earlier in the chapter to complete the After column of this self-assessment. Before the chapter test, coach them in the areas in which they are having problems.



1 Practice Test

For #1 to #5, select the best answer.

1. What are the signs of the coordinates in quadrant I?
   A (−, −) B (−, +) C (+, +) D (+, −)

2. Which statement describes the point (0, 3)?
   A It is in quadrant I.
   B It is in quadrant II.
   C It lies along the *x*-axis.
   D It lies along the *y*-axis.

3. △XYZ is reflected in a line of reflection. A line connecting X to X′ will be [redacted] to the line of reflection.
   A vertical
   B perpendicular
   C horizontal
   D parallel

4. A fan turning is an example of a transformation. What type?
   A reflection
   B rotation
   C translation
   D slide

5. The following points are plotted on a coordinate grid: (4, −2), (4, 0), (4, 3), (4, 5), (4, 6). The points form a line that goes through the [redacted].
   A origin
   B centre of rotation
   C *y*-axis
   D *x*-axis

Short Answer

6. Maata is drawing a design to decorate her Inuit boots, called kamiks. She begins by plotting a line on a coordinate grid: (−6, −2), (−3, 1), (0, 4), (2, 8), (6, 10). She has made an error. Which point seems out of place?

7. a) Draw the following triangles on a coordinate grid:
   △A: (−3, −4), (−3, −8), (−5, −8)
   △B: (3, −2), (5, −2), (5, 2)
   △C: (3, −4), (3, −8), (5, −8)
   b) What transformation would move △A to △B?
   c) What transformation would move △A to △C?

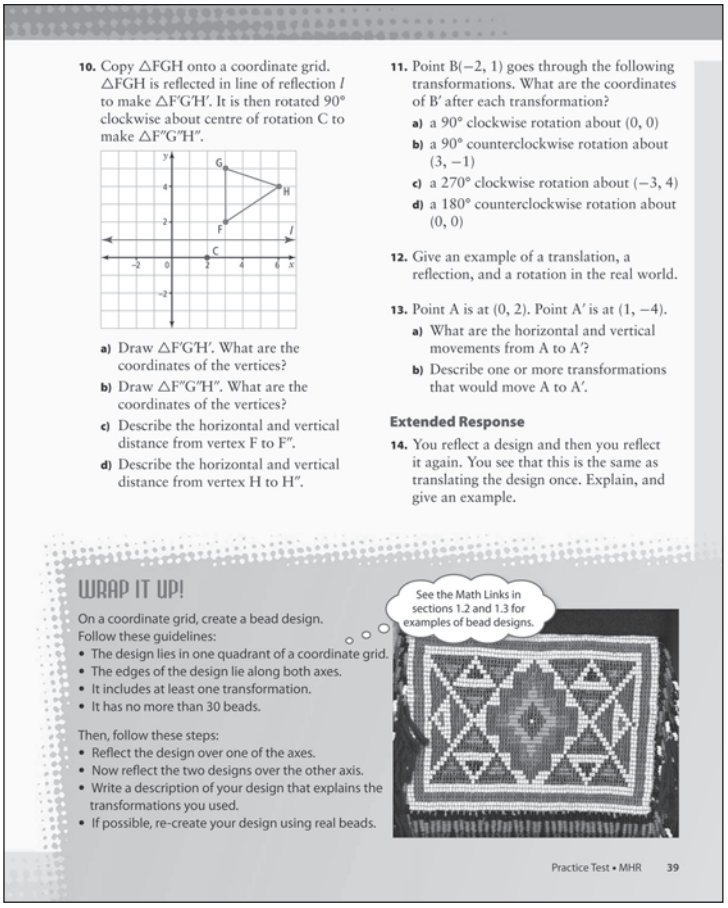
8. A square is 6 units in length. The square lies in all four quadrants and one vertex is at (−4, 4). What are the coordinates of the other three vertices?

9. A(4, −2) goes through the following transformations. What are the coordinates of A′ after each transformation?
   a) a reflection in the *x*-axis
   b) a reflection in the *y*-axis
   c) a translation of 4 units left and 9 units up

38 MHR • Chapter 1

Study Guide

Question(s)	Section(s)	Refer to	I can …
1, 2, 5	1.1	Explore the Math Example 2	✓ identify points on a Cartesian plane
3	1.3	Example 2	✓ perform a reflection
4	1.3	Example 3	✓ perform a rotation
6, 8	1.2	Example 1	✓ identify the coordinates of the vertices of a 2-D shape
7	1.3	Example 1 Example 3	✓ perform a translation ✓ perform a rotation
9, 10	1.3	Explore the Math	✓ perform a translation, a reflection, and a rotation ✓ describe the image resulting from a transformation
11	1.4	Example 2	✓ describe how the vertices of a 2-D shape change position when they are transformed one or more times
12, 14	1.3	Examples 1, 2, 3	✓ perform a translation, a reflection, and a rotation
13	1.4	Explore the Math Example 1	✓ describe the movement of a point on a Cartesian plane using the terms *horizontal* and *vertical* ✓ determine the horizontal and vertical distance between two points



10. Copy △FGH onto a coordinate grid. △FGH is reflected in line of reflection *l* to make △F′G′H′. It is then rotated 90° clockwise about centre of rotation C to make △F″G″H″.

a) Draw △F′G′H′. What are the coordinates of the vertices?
b) Draw △F″G″H″. What are the coordinates of the vertices?
c) Describe the horizontal and vertical distance from vertex F to F″.
d) Describe the horizontal and vertical distance from vertex H to H″.

11. Point B(−2, 1) goes through the following transformations. What are the coordinates of B′ after each transformation?
a) a 90° clockwise rotation about (0, 0)
b) a 90° counterclockwise rotation about (3, −1)
c) a 270° clockwise rotation about (−3, 4)
d) a 180° counterclockwise rotation about (0, 0)

12. Give an example of a translation, a reflection, and a rotation in the real world.

13. Point A is at (0, 2). Point A′ is at (1, −4).
a) What are the horizontal and vertical movements from A to A′?
b) Describe one or more transformations that would move A to A′.

Extended Response

14. You reflect a design and then you reflect it again. You see that this is the same as translating the design once. Explain, and give an example.

WRAP IT UP!

On a coordinate grid, create a bead design. Follow these guidelines:
- The design lies in one quadrant of a coordinate grid.
- The edges of the design lie along both axes.
- It includes at least one transformation.
- It has no more than 30 beads.

Then, follow these steps:
- Reflect the design over one of the axes.
- Now reflect the two designs over the other axis.
- Write a description of your design that explains the transformations you used.
- If possible, re-create your design using real beads.

See the Math Links in sections 1.2 and 1.3 for examples of bead designs.

Practice Test • MHR 39

Activity Planning Notes

Have students start the practice test the same way they started the chapter review—by writing the question numbers in their notebooks and circling each number according to the colours they used for **BLM 1–2 Chapter 1 Self-Assessment**. Have students first complete the questions they know they can do. Then have them complete the questions they know something about. Finally, have them do their best on the questions that they are still struggling with.

This practice test can be assigned as an in-class or take-home assignment. These are the minimum questions that will meet the related curriculum outcomes: #1–#3, #5–#10, and #13.

Answers to the Chapter 1 Practice Test are provided on **BLM 1-15 Chapter 1 *MathLinks 7* Student Resource Answers**.

Supported Learning

Learning Style

- Allow kinesthetic and concrete learners to use tracing paper and cutouts to perform rotations as they work on the test.
- You may wish to differentiate for some students the questions you feel they *must* know, the questions they *should* know, and the questions that are *nice* to know.

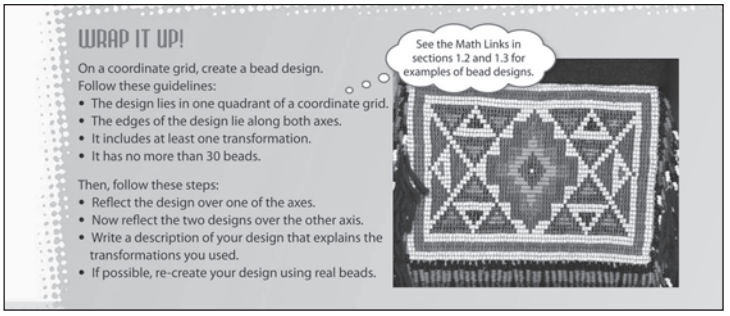
Assessment *of* Learning	Supported Learning
Chapter 1 Test After students complete the practice test, you may wish to use **BLM 1–12 Chapter 2 Test** as a summative assessment.	• Consider allowing students to use their chapter Foldable. • Consider using the Math Games on page 40 or the Challenge in Real Life on page 41 to assess the knowledge and skills of students who have difficulty with tests.

Wrap It Up!

Suggested Timing
80–100 minutes

Materials
- grid paper
- ruler
- coloured pencils
- scissors (optional)
- tracing paper (optional)
- string, coloured beads (optional)

Blackline Masters
Master 1 Project Rubric
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
BLM 1–5 Section 1.1 Math Link
BLM 1–7 Section 1.2 Math Link
BLM 1–9 Section 1.3 Math Link
BLM 1–13 Chapter 1 Wrap It Up!



Specific Outcomes

SS4 Identify and plot points in the four quadrants of a Cartesian plane using integral ordered pairs.

SS5 Perform and describe transformations (translations, rotations or reflections) of a 2-D shape in all four quadrants of a Cartesian plane (limited to integral number vertices).

Common Errors

- Some students may not have included a transformation in their design.

R_x Have them look at some class exemplars to help them come up with ideas.

- Some students may not have reflected their designs properly.

R_x You may wish to have students copy the designs onto tracing paper to help them with the reflections.

Activity Planning Notes

As a class, brainstorm some helpful hints so that all students can feel successful in developing the design. For example:

- Get an idea of how much space you have by counting a rectangle of 30 beads. (Include the two axes in your counting.)
- As you draw the transformations, make note of the transformations you use.
- First, draw all the beads that will lie on the axes, and then fill in the rest of the beads of your design.

Assessment *of* Learning	Supported Learning
Wrap It Up! This chapter problem wrap-up gives students an opportunity to use and display their knowledge of transformations on a coordinate grid in a useful and artistic way. It is important for students to use mathematical language in their descriptions of their designs. **Master 1 Project Rubric** provides a holistic descriptor that will assist you in assessing student work on this Wrap It Up! Page 39a provides notes on how to use this rubric for the Wrap It Up!	• You may wish students to review the work they have completed in the Math Links in sections 1.1, 1.2, and 1.3 before they begin. • If students have not completed the Math Links, you may wish to provide them with **BLM 1–5 Section 1.1 Math Link**, **BLM 1–7 Section 1.2 Math Link**, and **BLM 1–9 Section 1.3 Math Link**. • If students have difficulty creating a design, – reduce the number of beads they must use – do not expect them to include transformations – have them copy a simple design • Observe how accurately students transform their designs and describe their transformations. • If you have time, allow students to re-create their designs using real beads. • Consider inviting someone from the community who does beading to show patterns that include transformations. This person might help students re-create their designs with real beads. • You may wish to have students use **BLM 1–13 Chapter 1 Wrap It Up!**, which provides scaffolding for the chapter problem wrap-up.

The chart below shows the **Master 1 Project Rubric** for tasks such as the Wrap It Up! and provides notes that specify how to identify the level of specific answers for the project.

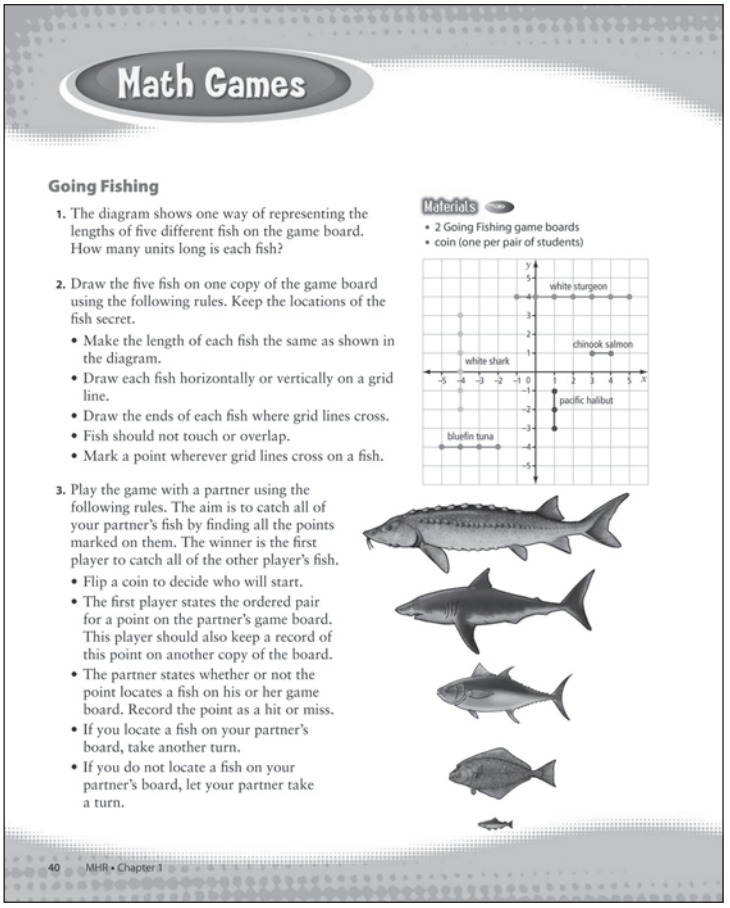
Score/Level	Holistic Descriptor	Specific Question Notes
5 **(Standard of Excellence)**	❑ Applies/develops **thorough** strategies and mathematical processes making **significant** comparisons/connections that demonstrate a **comprehensive** understanding of how to develop a complete solution ❑ Procedures are **efficient and effective** and may contain a **minor mathematical error** that does not affect understanding ❑ Uses **significant** mathematical language to explain their understanding and provides **in-depth** support for their conclusion	• provides a complete solution with one or more initial transformations • includes reflections that may contain a minor point error that does not affect the understanding • provides an explanation that is clear and complete
4 **(Above Acceptable)**	❑ Applies/develops **thorough** strategies and mathematical processes for making **reasonable** comparisons/connections that demonstrate a **clear** understanding ❑ Procedures are **reasonable** and may contain a **minor mathematical error** that may hinder the understanding in one part of a complete solution ❑ Uses **appropriate** mathematical language to explain their understanding and provides **clear** support for their conclusion	• provides a complete design with at least one initial transformation • plots points with some errors present as a result of the transformation and/or reflection (two at most) • includes a clear explanation that addresses most of the requirements
3 **(Meets Acceptable)**	❑ Applies/develops **relevant** strategies and mathematical processes making **some** comparisons/connections that demonstrate a **basic** understanding ❑ Procedures are **basic** and may contain a **major error or omission** ❑ Uses **common** language to explain their understanding and provides **minimal** support for their conclusion	• creates a basic design with only one initial transformation • makes some errors in the transformations • includes a minimal explanation
2 **(Below Acceptable)**	❑ Applies/develops **some relevant** mathematical processes making **minimal** comparisons/connections that lead to a **partial solution** ❑ Procedures are **basic** and may contain **several major mathematical errors** ❑ Communication is **weak**	• creates a design that is missing several of the basic requirements for the initial design • fails to include the transformation, or the transformation has an error and/or the reflection is in one axis only • provides little or no explanation
1 **(Beginning)**	❑ Applies/develops an **initial start** that may be **partially correct** or could have led to a correct solution ❑ Communication is **weak or absent**	• begins design in one quadrant *or* • draws a design that does not contain a transformation attempt, and a reflection may be attempted but many errors are present

Math Games

Suggested Timing
40–50 minutes

Materials
- coins
- coloured pencils (optional)

Blackline Masters
BLM 1–14 Going Fishing Game Boards


Math Games

Going Fishing

1. The diagram shows one way of representing the lengths of five different fish on the game board. How many units long is each fish?

2. Draw the five fish on one copy of the game board using the following rules. Keep the locations of the fish secret.
- Make the length of each fish the same as shown in the diagram.
- Draw each fish horizontally or vertically on a grid line.
- Draw the ends of each fish where grid lines cross.
- Fish should not touch or overlap.
- Mark a point wherever grid lines cross on a fish.

3. Play the game with a partner using the following rules. The aim is to catch all of your partner's fish by finding all the points marked on them. The winner is the first player to catch all of the other player's fish.
- Flip a coin to decide who will start.
- The first player states the ordered pair for a point on the partner's game board. This player should also keep a record of this point on another copy of the board.
- The partner states whether or not the point locates a fish on his or her game board. Record the point as a hit or miss.
- If you locate a fish on your partner's board, take another turn.
- If you do not locate a fish on your partner's board, let your partner take a turn.

Materials
- 2 Going Fishing game boards
- coin (one per pair of students)

white sturgeon
chinook salmon
white shark
pacific halibut
bluefin tuna

40 MHR • Chapter 1

Supported Learning

ESL

- Words that some English language learners might have difficulty with include *locations, touch, overlap, hit*, and *miss*. Take the time to explain the game using visuals to show students what it means if they hit or miss a coordinate. *Hit* and *miss* in this context have different meanings from what students may be more familiar with.

Meeting the Needs of All Learners

- Have students use alternatives that are most familiar to them, for example, animals of different lengths such as fox, seal, polar bear, caribou; or cars of different lengths.

Common Errors

- Some students may repeat guesses that they have already made.

R_x Make sure students mark all their guesses, both correct and incorrect, on the bottom game board of the BLM.

Specific Outcomes

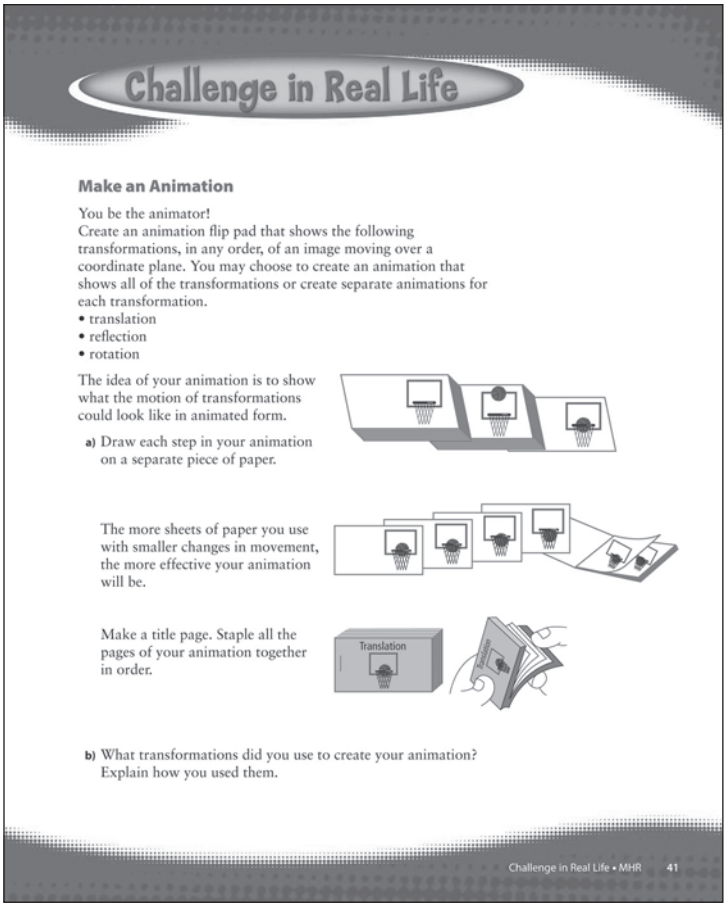
SS4 Identify and plot points in the four quadrants of a Cartesian plane using integral ordered pairs.

Activity Planning Notes

Read through the game with students. You might want to mention that the given values are the approximate lengths of full-grown fish in metres. Discuss with students games similar to this one that they may have played before.

Assessment *for* Learning	Supported Learning
Going Fishing Have students play this game with a partner of similar math ability.	• You may wish to give each student a copy of **BLM 1–14 Going Fishing Game Boards**. • Encourage students to record their guesses using correct notation for ordered pairs. • After students have played the game one or more times, brainstorm winning strategies, such as guessing points around a hit until you catch the entire fish and keeping track of which fish have been caught and which still need to be located.

Challenge in Real Life


Challenge in Real Life

Make an Animation

You be the animator!
Create an animation flip pad that shows the following transformations, in any order, of an image moving over a coordinate plane. You may choose to create an animation that shows all of the transformations or create separate animations for each transformation.
- translation
- reflection
- rotation

The idea of your animation is to show what the motion of transformations could look like in animated form.

a) Draw each step in your animation on a separate piece of paper.

The more sheets of paper you use with smaller changes in movement, the more effective your animation will be.

Make a title page. Staple all the pages of your animation together in order.

Translation

b) What transformations did you use to create your animation? Explain how you used them.

Challenge in Real Life • MHR 41

Suggested Timing
40–50 minutes

Materials
- grid paper
- scissors
- coloured pencils
- stapler

Blackline Masters
Master 1 Project Rubric
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper

Mathematical Processes

- [x] Communication
- [x] Connections
- [ ] Mental Mathematics and Estimation
- [x] Problem Solving
- [x] Reasoning
- [x] Technology
- [x] Visualization

Specific Outcomes

SS5 Perform and describe transformations (translations, rotations or reflections) of a 2-D shape in all four quadrants of a Cartesian plane (limited to integral number vertices).

Activity Planning Notes

You may wish to use the following steps to introduce and complete this challenge:

1. Read through Make an Animation as a class. Some students may already make animations by drawing pictures on, and then flipping, the corners of their notebooks. Have these students share their knowledge of how to get items to "move" by drawing consecutive views with the object in a slightly different position. For example, they might show a basketball going through a basket or a gymnast doing a flip on a trampoline.
2. With the class, discuss how this idea might work on a coordinate grid. For example, students might draw a car moving from one quadrant to another, or they might show something more complicated, such as an athlete moving from one field event to another. Students who do not draw well could animate shapes or emoticons.

Supported Learning

Learning Style

- Kinesthetic learners and concrete learners could be encouraged to cut out the shape that they are going to animate and physically move it across a coordinate grid before they start drawing.

Motor

- For easy flipping, the stapled booklets need to have a very smooth edge.

Meeting the Needs of All Learners

- Students could be encouraged to use items and events relevant to their cultural group.

Gifted and Enrichment

- Point out that the more sheets of paper students use with smaller changes in movement, the more fluid the animation.

3. Have students work individually to make a rough sketch of the item that they are going to animate, and consider how they will move it. You may wish to provide **Master 8 Centimetre Grid Paper** or **Master 9 0.5 Centimetre Grid Paper**, depending on how large or small the animation is going to be. (Students should cut the paper into pieces in order to make the animation.)
4. Clarify that the task is to
   - draw one or more animations that show a translation, reflection, and rotation
   - describe what transformations were used and how each was used

   NOTE: You may wish to control the number of sheets of paper per animation. A total of eight to ten sheets is a good starting point. At this age, students' ability to flip the pages is sometimes related to their small motor skills.
5. Review the **Master 1 Project Rubric** with students so that they will know what is expected.

This challenge can be used for either Assessment *for* Learning or Assessment *of* Learning

Assessment *for* Learning	Supported Learning
Make an Animation Discuss the challenge with the class. Have students brainstorm the types of activities they could use for an animation, sketch the beginning and final picture, and then discuss what might go in between. Students should individually do the animation sketches. Note that these can be simple. It is the transformations that are important, not the artwork.	• Review with students how to transform an object across a coordinate grid. • Allow students with motor difficulties to create their animation on the corners of a notebook rather than produce their own flip book. • For a second challenge, complete with teaching notes and student exemplars, go to **www.mathlinks7.ca**, access the Teachers' Site, go to Assessment, and then follow the links.

Assessment *of* Learning	Supported Learning
Make an Animation Discuss the challenge with the class. Once students have formulated their idea and drawn a rough sketch, have them share their concept with a partner for peer feedback. Then have them work individually to complete parts a) and b).	• **Master 1 Project Rubric** provides a holistic descriptor that will assist you in assessing student work on this challenge. Page 41a provides notes on how to use this rubric for this challenge. • To view student exemplars, go to **www.mathlinks7.ca**, access the Teachers' Site, go to Assessment, and then follow the links.

The chart below shows the **Master 1 Project Rubric** for tasks such as the Challenge in Real Life and provides notes that specify how to identify the level of specific answers for this project.

Score/Level	Holistic Descriptor	Specific Question Notes
5 **(Standard of Excellence)**	❑ Applies/develops **thorough** strategies and mathematical processes making **significant** comparisons/connections that demonstrate a **comprehensive** understanding of how to develop a complete solution ❑ Procedures are **efficient and effective** and may contain a **minor mathematical error** that does not affect understanding ❑ Uses **significant** mathematical language to explain their understanding and provides **in-depth** support for their conclusion	• provides a complete and correct solution with justification
4 **(Above Acceptable)**	❑ Applies/develops **thorough** strategies and mathematical processes for making **reasonable** comparisons/connections that demonstrate a **clear** understanding ❑ Procedures are **reasonable** and may contain a **minor mathematical error** that may hinder the understanding in one part of a complete solution ❑ Uses **appropriate** mathematical language to explain their understanding and provides **clear** support for their conclusion	• completes one or more transformations over the coordinate grid, describing what and how each was used • uses communication that is weak or unclear *or* • provides a complete solution with minor errors in the vertices
3 **(Meets Acceptable)**	❑ Applies/develops **relevant** strategies and mathematical processes making **some** comparisons/connections that demonstrate a **basic** understanding ❑ Procedures are **basic** and may contain a **major error or omission** ❑ Uses **common** language to explain their understanding and provides **minimal** support for their conclusion	• completes one or more transformations over the coordinate grid, describing what transformation was used • includes vertices that may have errors *or* • uses more than one transformation with an error in points or application of one of the transformations
2 **(Below Acceptable)**	❑ Applies/develops **some relevant** mathematical processes making **minimal** comparisons/connections that lead to a **partial solution** ❑ Procedures are **basic** and may contain **several major mathematical errors** ❑ Communication is **weak**	• completes a transformation on the coordinate grid
1 **(Beginning)**	❑ Applies/develops an **initial start** that may be **partially correct** or could have led to a correct solution ❑ Communication is **weak or absent**	• attempts a transformation with some coordinate points correct • includes a response that is weak and does not show a basic understanding