9.2 Patterns in a Table of Values

***MathLinks 8*, pages 342–351**

Suggested Timing
100–120 minutes

Materials
- grid paper
- ruler
- toothpicks
- quarters and dimes
- square tiles
- coloured counters

Blackline Masters
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
BLM 9–3 Chapter 9 Warm-Up
BLM 9–7 Section 9.2 Extra Practice
BLM 9–8 Section 9.2 Math Link

Mathematical Processes
- ☑ Communication (C)
- ☑ Connections (CN)
- ☑ Mental Mathematics and Estimation (ME)
- ☑ Problem Solving (PS)
- ☐ Reasoning (R)
- ☑ Technology (T)
- ☑ Visualization (V)

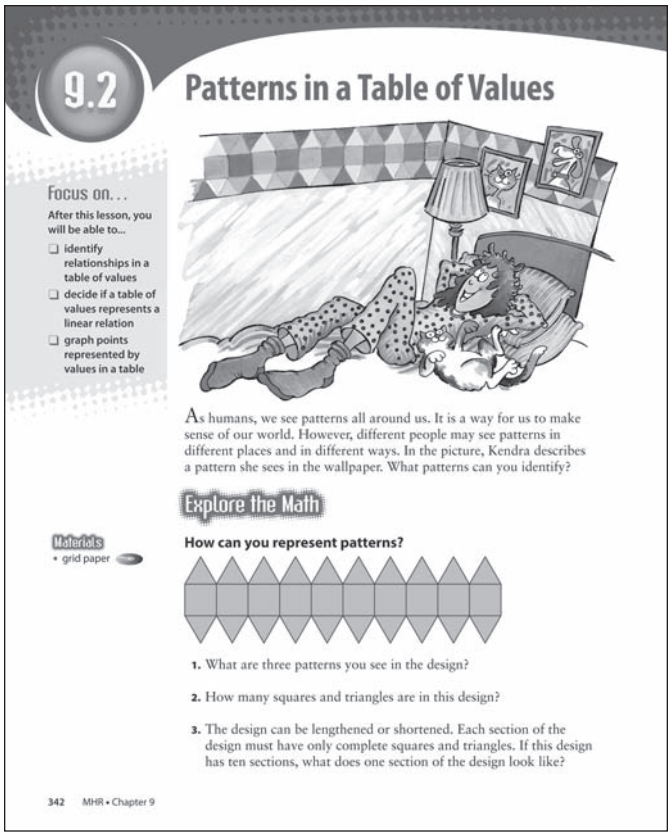
Specific Outcomes
PR1 Graph and analyze two-variable linear relations.

Category	Question Numbers
Essential (minimum questions to cover the outcomes)	1, 3, 4, 6, 8, 10, 12, Math Link
Typical	1, 3, 4, 6, 8, 10, 12–16, Math Link
Extension/Enrichment	1, 3, 17–20

Planning Notes

Have students complete the warm-up questions on **BLM 9–3 Chapter 9 Warm-Up** to reinforce material learned in previous sections.

Have students examine the wallpaper border. Encourage them to find as many patterns in the design as they can. Make a list of all the patterns identified by the class.


9.2 Patterns in a Table of Values

Focus on...
After this lesson, you will be able to...
- identify relationships in a table of values
- decide if a table of values represents a linear relation
- graph points represented by values in a table

As humans, we see patterns all around us. It is a way for us to make sense of our world. However, different people may see patterns in different places and in different ways. In the picture, Kendra describes a pattern she sees in the wallpaper. What patterns can you identify?

Explore the Math

Materials
• grid paper

How can you represent patterns?

1. What are three patterns you see in the design?
2. How many squares and triangles are in this design?
3. The design can be lengthened or shortened. Each section of the design must have only complete squares and triangles. If this design has ten sections, what does one section of the design look like?

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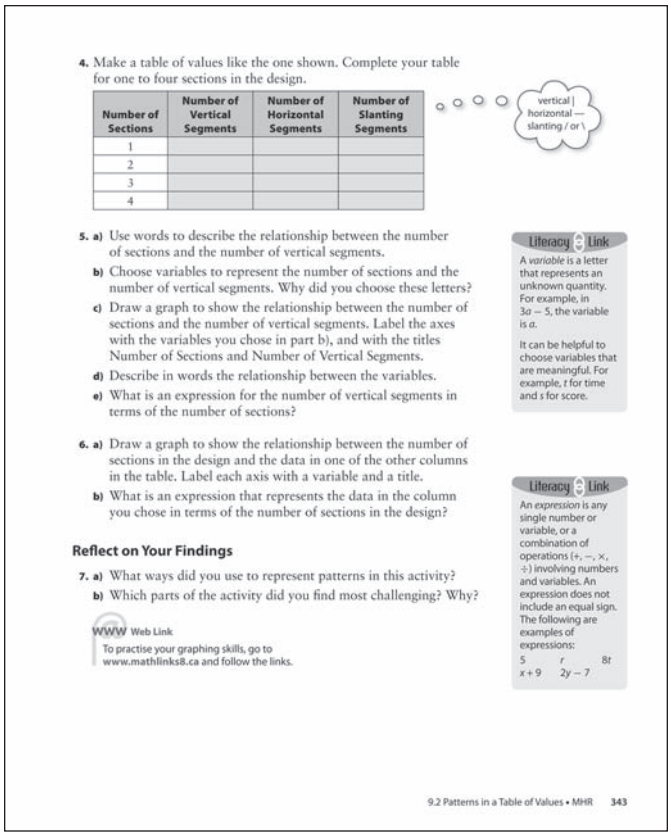
Explore the Math

In this exploration, students further examine and analyse the patterns in the wallpaper border. After the discussion noted above, students should be able to, individually or in pairs, work their way through the Explore the Math. In this activity, patterns are represented in four different ways:
- using a table of values
- in words
- with a graph
- using a variable to write an expression

Students might also use concrete materials, such as toothpicks, to represent the patterns.

To draw the graph, students will need grid paper. You may wish to hand out **Master 8 Centimetre Grid Paper** or **Master 9 0.5 Centimetre Grid Paper**.



4. Make a table of values like the one shown. Complete your table for one to four sections in the design.

Number of Sections	Number of Vertical Segments	Number of Horizontal Segments	Number of Slanting Segments
1			
2			
3			
4			

vertical | horizontal — slanting / or \

5. a) Use words to describe the relationship between the number of sections and the number of vertical segments.
b) Choose variables to represent the number of sections and the number of vertical segments. Why did you choose these letters?
c) Draw a graph to show the relationship between the number of sections and the number of vertical segments. Label the axes with the variables you chose in part b), and with the titles Number of Sections and Number of Vertical Segments.
d) Describe in words the relationship between the variables.
e) What is an expression for the number of vertical segments in terms of the number of sections?

Literacy Link
A *variable* is a letter that represents an unknown quantity. For example, in $3a - 5$, the variable is a.
It can be helpful to choose variables that are meaningful. For example, t for time and s for score.

6. a) Draw a graph to show the relationship between the number of sections in the design and the data in one of the other columns in the table. Label each axis with a variable and a title.
b) What is an expression that represents the data in the column you chose in terms of the number of sections in the design?

Literacy Link
An *expression* is any single number or variable, or a combination of operations (+, −, ×, ÷) involving numbers and variables. An expression does not include an equal sign. The following are examples of expressions:
5 r $8t$
$x + 9$ $2y - 7$

Reflect on Your Findings

7. a) What ways did you use to represent patterns in this activity?
b) Which parts of the activity did you find most challenging? Why?

WWW Web Link
To practise your graphing skills, go to www.mathlinks8.ca and follow the links.

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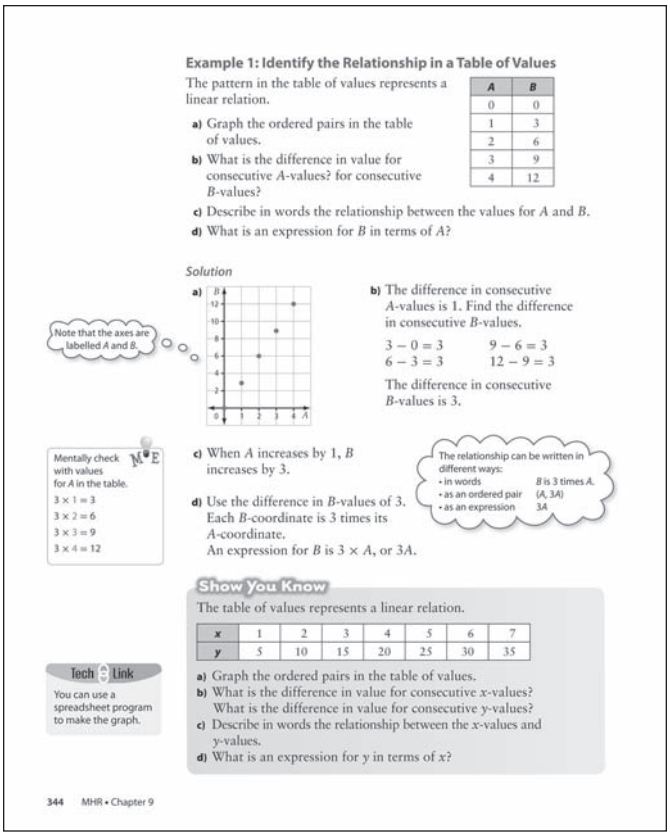

Example 1: Identify the Relationship in a Table of Values

The pattern in the table of values represents a linear relation.

A	B
0	0
1	3
2	6
3	9
4	12

a) Graph the ordered pairs in the table of values.
b) What is the difference in value for consecutive A-values? for consecutive B-values?
c) Describe in words the relationship between the values for A and B.
d) What is an expression for B in terms of A?

Solution

a)

Note that the axes are labelled A and B.

b) The difference in consecutive A-values is 1. Find the difference in consecutive B-values.
$3 - 0 = 3$ $9 - 6 = 3$
$6 - 3 = 3$ $12 - 9 = 3$
The difference in consecutive B-values is 3.

Mentally check with values for A in the table.
$3 \times 1 = 3$
$3 \times 2 = 6$
$3 \times 3 = 9$
$3 \times 4 = 12$

c) When A increases by 1, B increases by 3.

The relationship can be written in different ways:
• in words: B is 3 times A.
• as an ordered pair: $(A, 3A)$
• as an expression: $3A$

d) Use the difference in B-values of 3. Each B-coordinate is 3 times its A-coordinate.
An expression for B is $3 \times A$, or $3A$.

Show You Know

The table of values represents a linear relation.

x	1	2	3	4	5	6	7
y	5	10	15	20	25	30	35

a) Graph the ordered pairs in the table of values.
b) What is the difference in value for consecutive x-values? What is the difference in value for consecutive y-values?
c) Describe in words the relationship between the x-values and y-values.
d) What is an expression for y in terms of x?

Tech Link
You can use a spreadsheet program to make the graph.

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Method 1 Have students work in small groups to complete #1 to #6 of the Explore the Math. Then, have each group contribute to a class discussion revolving around the questions in #7. Expand the discussion to include students' ideas about the strengths and weaknesses of each method for representing a pattern.

Method 2 Complete #1 to #5 as a class. Students will then be prepared to complete #6 individually or in pairs since it echoes what was done in #5. Have students discuss #7 with a partner.

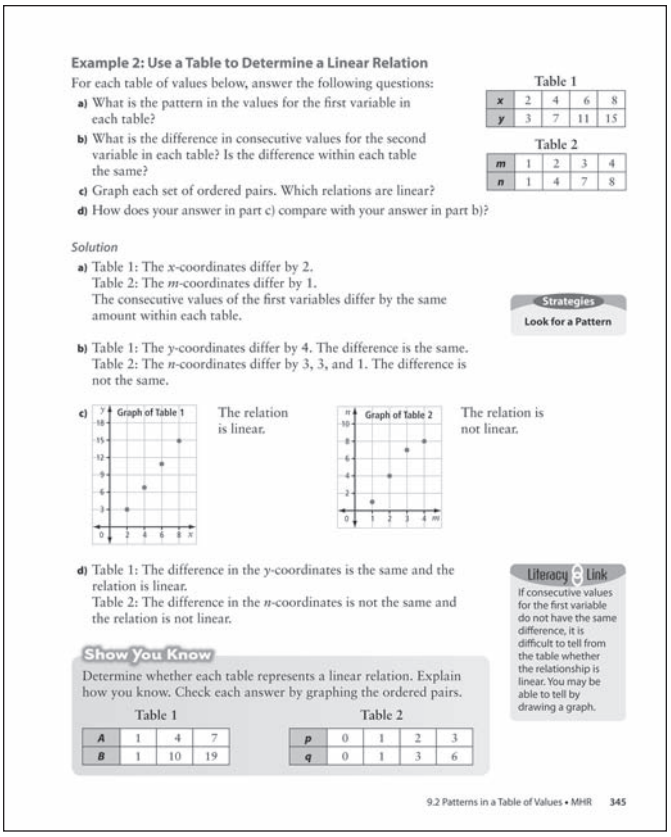
Literacy Link The Literacy Links on page 343 assist students in recalling what a variable and an expression are. Reinforce this information by having students provide examples of expressions and then identify the variable in each one. Have students record these examples in their Foldable for future reference.

Example 1

Example 1 leads students through a series of steps culminating in showing a relationship using a variable as part of an expression. It is important that students understand what an expression is telling them. It is equally important for students to use correct vocabulary in describing an expression. For example, the expression $3a$ consists of a numerical coefficient, 3, and a variable, a.

Remind students that in section 9.1 they worked with questions that started with a graph and then required them to make a table of values using the data from the graph. In section 9.2, questions begin with a table of values and students are required to look for patterns in the table and then use the table to make a graph of the relationship.

The Show You Know question gives students an opportunity to complete a similar question to Example 1.



Example 2: Use a Table to Determine a Linear Relation

For each table of values below, answer the following questions:

a) What is the pattern in the values for the first variable in each table?

b) What is the difference in consecutive values for the second variable in each table? Is the difference within each table the same?

c) Graph each set of ordered pairs. Which relations are linear?

d) How does your answer in part c) compare with your answer in part b)?

Table 1

x	2	4	6	8
y	3	7	11	15

Table 2

m	1	2	3	4
n	1	4	7	8

Solution

a) Table 1: The x-coordinates differ by 2.
Table 2: The m-coordinates differ by 1.
The consecutive values of the first variables differ by the same amount within each table.

Strategies: Look for a Pattern

b) Table 1: The y-coordinates differ by 4. The difference is the same.
Table 2: The n-coordinates differ by 3, 3, and 1. The difference is not the same.

c) Graph of Table 1 — The relation is linear.

Graph of Table 2 — The relation is not linear.

d) Table 1: The difference in the y-coordinates is the same and the relation is linear.
Table 2: The difference in the n-coordinates is not the same and the relation is not linear.

Literacy Link: If consecutive values for the first variable do not have the same difference, it is difficult to tell from the table whether the relationship is linear. You may be able to tell by drawing a graph.

Show You Know

Determine whether each table represents a linear relation. Explain how you know. Check each answer by graphing the ordered pairs.

Table 1

A	1	4	7
B	1	10	19

Table 2

p	0	1	2	3
q	0	1	3	6

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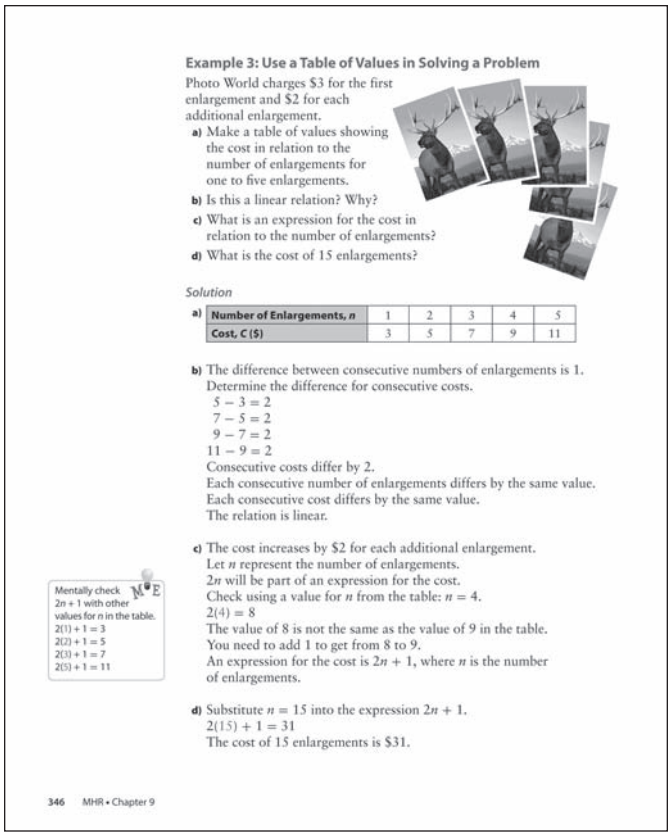

Example 3: Use a Table of Values in Solving a Problem

Photo World charges $3 for the first enlargement and $2 for each additional enlargement.

a) Make a table of values showing the cost in relation to the number of enlargements for one to five enlargements.

b) Is this a linear relation? Why?

c) What is an expression for the cost in relation to the number of enlargements?

d) What is the cost of 15 enlargements?

Solution

a)

Number of Enlargements, n	1	2	3	4	5
Cost, C ($)	3	5	7	9	11

b) The difference between consecutive numbers of enlargements is 1.
Determine the difference for consecutive costs.
$5 - 3 = 2$
$7 - 5 = 2$
$9 - 7 = 2$
$11 - 9 = 2$
Consecutive costs differ by 2.
Each consecutive number of enlargements differs by the same value.
Each consecutive cost differs by the same value.
The relation is linear.

Mentally check
$2n + 1$ with other values for n in the table.
$2(1) + 1 = 3$
$2(2) + 1 = 5$
$2(3) + 1 = 7$
$2(5) + 1 = 11$

c) The cost increases by $2 for each additional enlargement.
Let n represent the number of enlargements.
$2n$ will be part of an expression for the cost.
Check using a value for n from the table: $n = 4$.
$2(4) = 8$
The value of 8 is not the same as the value of 9 in the table.
You need to add 1 to get from 8 to 9.
An expression for the cost is $2n + 1$, where n is the number of enlargements.

d) Substitute $n = 15$ into the expression $2n + 1$.
$2(15) + 1 = 31$
The cost of 15 enlargements is $31.

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Example 2

This example uses patterns in a table of values to help students determine whether the table represents a linear relation. The notion of consecutive differences should be connected to the horizontal and vertical distances marked in red on the graphs in part a) of the solutions for Examples 1 and 2 in section 9.1.

Literacy Link Discuss the Literacy Link on page 345. Provide an example of a table of values in which consecutive values of the first variable do not have the same difference, and then show that it is possible to see that the relationship is not linear by making a graph from the table of values. For example:

x	0	1	2	5
y	1	3	5	14

Give another example of a table of values in which consecutive values of the first variable do not have the same difference, and then show how you can determine that the relationship is linear by making a graph from the table of values. For example,

x	0	1	2	5
y	1	3	5	11

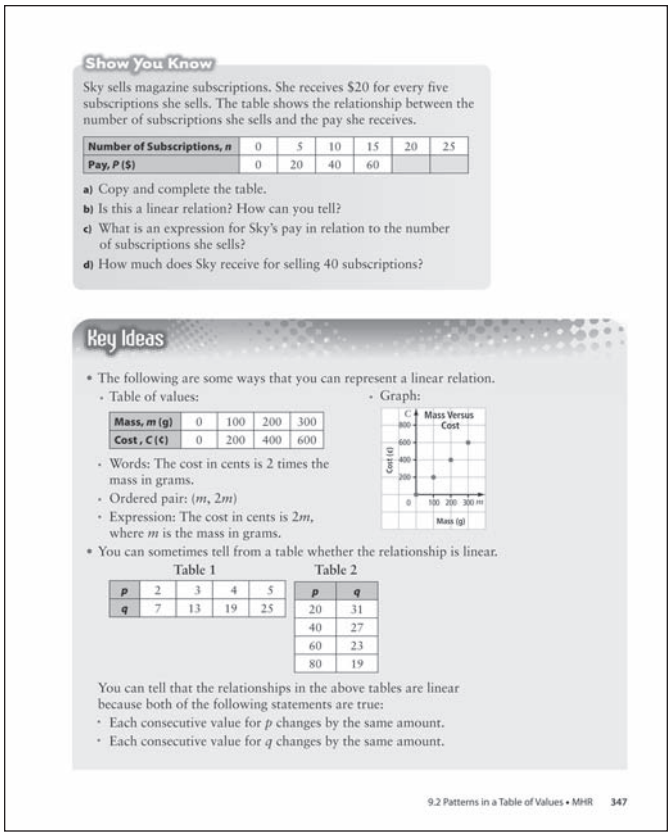
Example 3

Example 3 uses the patterns introduced in Examples 1 and 2 in the context of the cost of photo enlargements. Emphasize that this example uses the same techniques as Example 1 and 2, the only difference being that a table of values must be created first.

Students should complete the Show You Know before continuing. Check to see that each student understands how to use the patterns in the table of values to answer the questions.

Meeting Student Needs

- Help students explicitly connect the patterns in a table of values to those on a graph and those in the expression for the relationship.
- Have students work through each example individually or in pairs, and then try the Show You Know individually.
- It may be better for your class to complete the Explore the Math as a whole-class activity. Work through the various steps, ensuring students understand the vocabulary and activities before moving on.



Show You Know

Sky sells magazine subscriptions. She receives $20 for every five subscriptions she sells. The table shows the relationship between the number of subscriptions she sells and the pay she receives.

Number of Subscriptions, n	0	5	10	15	20	25
Pay, P ($)	0	20	40	60		

a) Copy and complete the table.
b) Is this a linear relation? How can you tell?
c) What is an expression for Sky's pay in relation to the number of subscriptions she sells?
d) How much does Sky receive for selling 40 subscriptions?

Key Ideas

- The following are some ways that you can represent a linear relation.
  - Table of values:

Mass, m (g)	0	100	200	300
Cost, C (¢)	0	200	400	600

  - Graph:

  - Words: The cost in cents is 2 times the mass in grams.
  - Ordered pair: $(m, 2m)$
  - Expression: The cost in cents is $2m$, where m is the mass in grams.
- You can sometimes tell from a table whether the relationship is linear.

Table 1

p	2	3	4	5
q	7	13	19	25

Table 2

p	q
20	31
40	27
60	23
80	19

You can tell that the relationships in the above tables are linear because both of the following statements are true:
- Each consecutive value for p changes by the same amount.
- Each consecutive value for q changes by the same amount.

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- Some students may benefit from having at least one additional set of questions for each example before they go on to the Check Your Understanding section.
- You may wish to use examples of patterns that are more relevant to students and their community. For example, have students research the Sacred Run. The Sacred Run is inspired by the Aboriginal tradition of running great distances to pass on messages, news, and information. The tradition of the Sacred Run has been revived through a multicultural, international, spiritual run. Consider having students find out what the run involves and then connect it to linear relations by determining the distance travelled in terms of time. For more information about the Sacred Run, see the Web Link on this page.

ELL

- Use the Explore the Math to teach terms associated with long and short, such as *lengthened* and *shortened*. Explain that *lengthened* means to be made longer, and *shortened* means to be made shorter.
- Write 1, 2, 3 and 56, 57, 58 on the board. Pointing to the numbers, explain the word *consecutive*.
- Have a discussion about the various terms associated with subtraction and addition. For example, subtraction can also be expressed through the terms *minus*, *difference*, *less than*, etc. Addition can also be expressed through the terms *plus*, *sum*, *total*, *more than*, etc.
- Explain to English language learners what the word *subscriptions* means.

Gifted and Enrichment

- Challenge students to use a spreadsheet program to create patterns in tables and to use formulas to find values for the tables.

Common Errors

- Some students may check the values of only one variable in a table of values before deciding whether the data represents a linear relation.

R_x Remind students that in any graph there are two variables, one naming the horizontal axis and the other naming the vertical axis. Since there are two variables, it is necessary to check the consecutive differences in the values of both before indicating whether the relationship is linear.

- Some students may have difficulty finding consecutive differences when the values are decreasing.

R_x The consecutive differences will be negative if the pattern is decreasing. The difficulty likely lies in the process of subtracting integers. Remind students that a consecutive difference of –2 means the numbers are decreasing by 2. A difference of 2 means the numbers are increasing by 2.

Web Link

Encourage students go online to practise their skills in graphing equations of the form $y = mx + b$. Go to www.mathlinks8.ca and follow the links.

For more information about the Sacred Run, go to www.mathlinks8.ca and follow the links.

Answers

Explore the Math

1. Answers may vary. Example: There are two triangles attached to each square. Each of the squares is attached to two squares except the first and last squares. There are two rows of triangles that are separated by a row of squares.

2. squares: 10; triangles: 20

3.

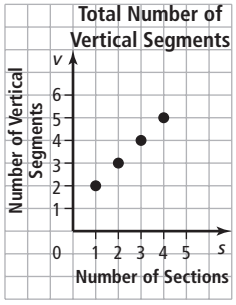
4.

Number of Sections	Number of Vertical Segments	Number of Horizontal Segments	Number of Slanting Segments
1	2	2	4
2	3	4	8
3	4	6	12
4	5	8	16

5. a) Answers may vary. Example: There is one more vertical segment than the number of sections.

b) Answers may vary. Example: The letter s can represent the number of sections and the letter v can represent the number of vertical segments. Each of these is the first letter of one of the words in their descriptions.

c)

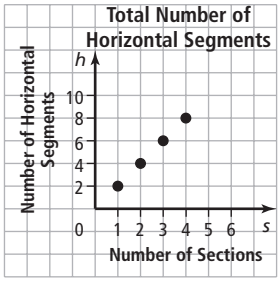


d) The value of v is 1 more than the value of s.

e) $s + 1$

6. Answers may vary. Example:

a)



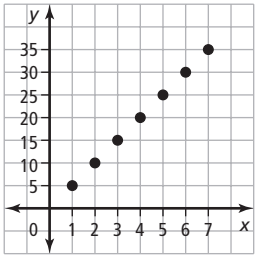
b) $2s$

7. a) Answers may vary. Example: Drawings, tables of values, graphs, expressions, and words are used to represent patterns.

b) Answers may vary. Example: Writing the expressions was the most challenging part of the activity. Working with variables is a relatively new activity.

Show You Know: Example 1

a)



b) The difference in value for consecutive values of x is 1. The difference in value for consecutive values of y is 5.

c) For every increase of 1 in the values of x, there is an increase of 5 in the values of y.

d) $5x$

Show You Know: Example 2

Table 1: The difference in consecutive values of A is the same and the difference in consecutive values of B is the same. Table 1 is a linear relation.

Table 2: The difference in consecutive values of p is the same, but the difference in consecutive values of q is not the same. Table 2 is not a linear relation.

Show You Know: Example 3

a)

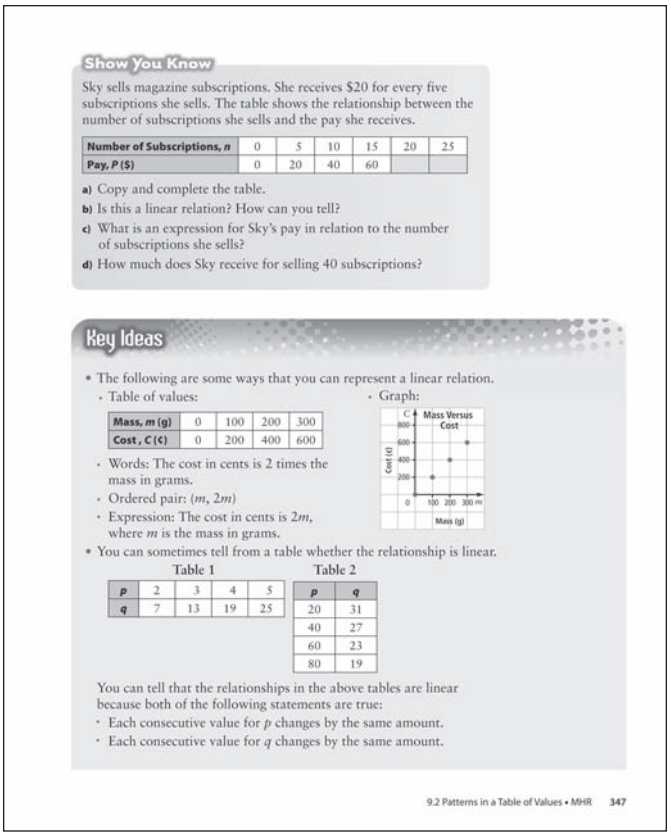
Number of Subscriptions, n	0	5	10	15	20	25
Pay, P ($)	0	20	40	60	80	100

b) Answers may vary. Example: Yes, it is a linear relation. The consecutive values of n have the same difference, and the consecutive values of P have the same difference.

c) $4n$

d) $160

Assessment	Supporting Learning
Assessment *as* Learning	
Reflect on Your Findings Listen as students discuss what they discovered during Explore the Math. Try to have students explain different ways to represent patterns and reach a conclusion for #7b).	• Explain to students that the Explore the Math identifies methods for representing patterns: a diagram, a table of values, words, a graph, and an expression. • In #7b), students take a position and identify the method that they find most challenging. This does not mean that they necessarily find it difficult. The question is attempting in a non-threatening way to have students think about their learning. All students would benefit from a class discussion about #7b). This may serve as a springboard for learners who still need assistance.
Assessment *for* Learning	
Example 1 Have students do the Show You Know related to Example 1.	• Encourage students to verbalize their thinking. • You may wish to have students work with a partner. • Ensure that all students label the axes on their graph correctly. They should use the variable from the top row of the table of values (x) for the horizontal axis and the variable from the bottom row (y) for the vertical axis. • Refer students to Example 1, which follows an identical sequence of questions. • Some students may benefit from drawing the horizontal and vertical distances on the graph in order to use patterning to identify the differences in the values of x and the values of y. • Some learners may benefit from verbalizing the pattern they see before attempting to write it as an expression.
Example 2 Have students do the Show You Know related to Example 2.	• Encourage students to verbalize their thinking. • You may wish to have students work with a partner. Encourage each student to try the questions individually and then to check with their partner. • If students find the more general nature of the questions in the Show You Know challenging, remind them simply to do what was shown in Example 2. • Have students write their own Literacy Link, explaining how the data in a table of values can be used to determine if the relation is linear. • Have students verbalize how the differences in the values of x and the values of y help to determine whether a set of values represents a linear relation.
Example 3 Have students do the Show You Know related to Example 3.	• Encourage students to verbalize their thinking and to listen to how other students word the processes they are using. • You may wish to have students work with a partner. • Some students may need more than one Show You Know activity. Have students provide a scenario for Communicate the Ideas #2 and then use that data for this purpose. • Encourage students by pointing out that the Show You Know requires less work than Example 3 because it provides the table of values. • Some student may benefit from assistance in recalling their skills in evaluating an expression.



Show You Know

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Pay, P ($)	0	20	40	60		

a) Copy and complete the table.
b) Is this a linear relation? How can you tell?
c) What is an expression for Sky's pay in relation to the number of subscriptions she sells?
d) How much does Sky receive for selling 40 subscriptions?

Key Ideas

- The following are some ways that you can represent a linear relation.
  - Table of values:

Mass, m (g)	0	100	200	300
Cost, C (¢)	0	200	400	600

  - Graph:

  - Words: The cost in cents is 2 times the mass in grams.
  - Ordered pair: $(m, 2m)$
  - Expression: The cost in cents is $2m$, where m is the mass in grams.
- You can sometimes tell from a table whether the relationship is linear.

Table 1

p	2	3	4	5
q	7	13	19	25

Table 2

p	q
20	31
40	27
60	23
80	19

You can tell that the relationships in the above tables are linear because both of the following statements are true:
- Each consecutive value for p changes by the same amount.
- Each consecutive value for q changes by the same amount.

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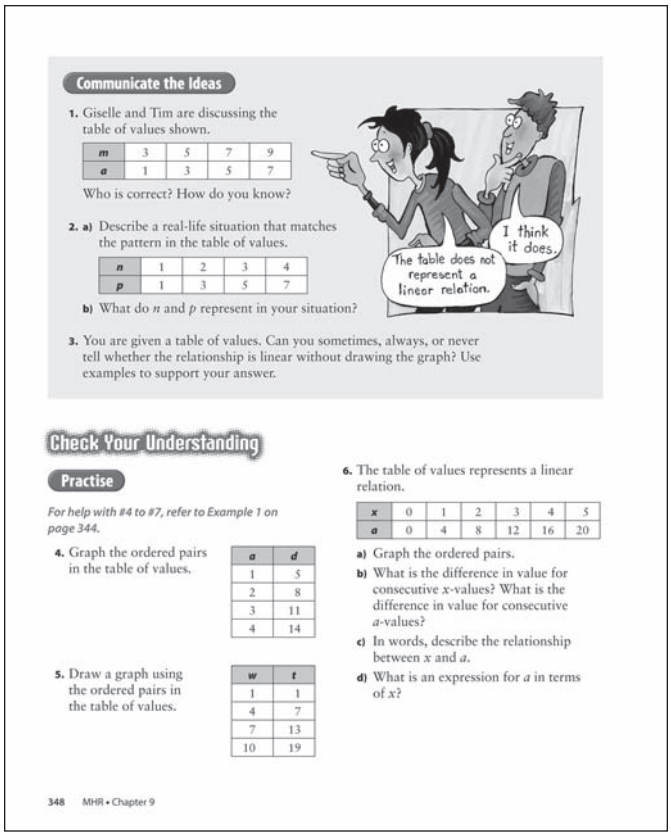

Communicate the Ideas

1. Giselle and Tim are discussing the table of values shown.

m	3	5	7	9
a	1	3	5	7

Who is correct? How do you know?

2. a) Describe a real-life situation that matches the pattern in the table of values.

n	1	2	3	4
p	1	3	5	7

b) What do n and p represent in your situation?

3. You are given a table of values. Can you sometimes, always, or never tell whether the relationship is linear without drawing the graph? Use examples to support your answer.

Check Your Understanding

Practise

For help with #4 to #7, refer to Example 1 on page 344.

4. Graph the ordered pairs in the table of values.

a	d
1	5
2	8
3	11
4	14

5. Draw a graph using the ordered pairs in the table of values.

w	t
1	1
4	7
7	13
10	19

6. The table of values represents a linear relation.

x	0	1	2	3	4	5
a	0	4	8	12	16	20

a) Graph the ordered pairs.
b) What is the difference in value for consecutive x-values? What is the difference in value for consecutive a-values?
c) In words, describe the relationship between x and a.
d) What is an expression for a in terms of x?

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Key Ideas

The Key Ideas provide a summary of section 9.2. They identify five ways to represent a linear relation. Using an ordered pair was not emphasized in this section but was used more extensively in grade 7. Students should be able to make a table of values, draw a graph, and write an expression for a linear relation.

Students should not simply copy the Key Ideas as notes but identify vocabulary, ideas, and concepts that are important to them. Have students make note of these items in their Foldable.

Communicate the Ideas

All students should answer #1 and #3. In #2, students identify a context that matches the data in a table of values. This is similar to #2 in the exercises for section 9.1.

The answer to #3 is "sometimes" since it is possible to have a linear relation even if you cannot tell from the table of values. The following example is linear even though the differences do not appear to be constant or the same:

x	1	2	3	4	7
y	3	4	7	9	15

The following are the missing values:

x	5	6
y	11	13

You may wish to discuss this example with the class, and then get students to provide an additional example.

Meeting Student Needs

- Encourage students to make their own summary for section 9.2. Students should limit their summary to what is important to them and/or less familiar or less comfortable.
- Have students who are less confident with the material use the summary points in the Key Ideas but include their own examples.
- Have classmates discuss #1 by taking the roles of Giselle and Tim.

ELL

- Allow English language learners to write their answers to the Communicate the Ideas in their own language and then explain their thoughts and ideas in English.

Answers

Communicate the Ideas

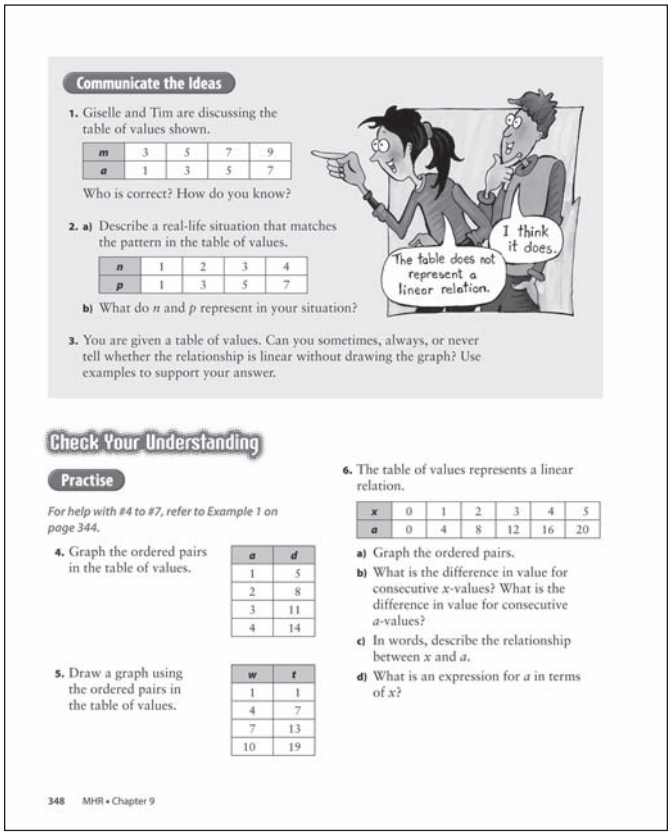
1. Tim is correct. Answers may vary. Example: The relation is linear because all consecutive values of m differ by 2, and all consecutive values of a differ by 2.

2. a) Answers may vary. Example: Tickets are sold by the student council for the upcoming dance.

b) Let n represent the number of tickets sold for the school dance and let p represent the profits, in dollars.

3. Sometimes. Answers may vary. Example: You can determine if the relationship is linear by calculating the differences between the consecutive values of the variables; if consecutive values for both variables have the same difference, the relationship is linear. It is difficult to determine if the relationship is linear if the differences between the consecutive values of the first variable are not the same.

Assessment	Supporting Learning
Assessment *as* Learning	
Communicate the Ideas Have all students complete #1 and #3. Check each student's response for understanding and appropriate wording.	• Let students work in small groups on #3. Have them report their findings to the class. Having a discussion about the responses to this question would benefit all students. • Have students write general conclusions for #3 in their Foldable.



Communicate the Ideas

1. Giselle and Tim are discussing the table of values shown.

m	3	5	7	9
a	1	3	5	7

Who is correct? How do you know?

2. a) Describe a real-life situation that matches the pattern in the table of values.

n	1	2	3	4
p	1	3	5	7

b) What do n and p represent in your situation?

3. You are given a table of values. Can you sometimes, always, or never tell whether the relationship is linear without drawing the graph? Use examples to support your answer.

Check Your Understanding

Practise

For help with #4 to #7, refer to Example 1 on page 344.

4. Graph the ordered pairs in the table of values.

a	d
1	5
2	8
3	11
4	14

5. Draw a graph using the ordered pairs in the table of values.

w	t
1	1
4	7
7	13
10	19

6. The table of values represents a linear relation.

x	0	1	2	3	4	5
a	0	4	8	12	16	20

a) Graph the ordered pairs.

b) What is the difference in value for consecutive x-values? What is the difference in value for consecutive a-values?

c) In words, describe the relationship between x and a.

d) What is an expression for a in terms of x?

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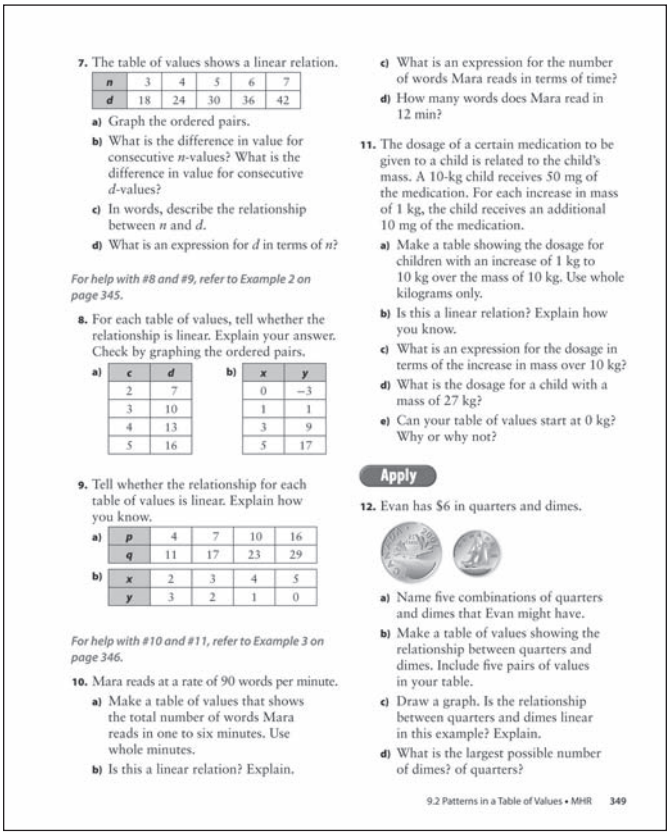

7. The table of values shows a linear relation.

n	3	4	5	6	7
d	18	24	30	36	42

a) Graph the ordered pairs.

b) What is the difference in value for consecutive n-values? What is the difference in value for consecutive d-values?

c) In words, describe the relationship between n and d.

d) What is an expression for d in terms of n?

For help with #8 and #9, refer to Example 2 on page 345.

8. For each table of values, tell whether the relationship is linear. Explain your answer. Check by graphing the ordered pairs.

a)

c	d
2	7
3	10
4	13
5	16

b)

x	y
0	−3
1	1
3	9
5	17

9. Tell whether the relationship for each table of values is linear. Explain how you know.

a)

p	4	7	10	16
q	11	17	23	29

b)

x	2	3	4	5
y	3	2	1	0

For help with #10 and #11, refer to Example 3 on page 346.

10. Mara reads at a rate of 90 words per minute.

a) Make a table of values that shows the total number of words Mara reads in one to six minutes. Use whole minutes.

b) Is this a linear relation? Explain.

c) What is an expression for the number of words Mara reads in terms of time?

d) How many words does Mara read in 12 min?

11. The dosage of a certain medication to be given to a child is related to the child's mass. A 10-kg child receives 50 mg of the medication. For each increase in mass of 1 kg, the child receives an additional 10 mg of the medication.

a) Make a table showing the dosage for children with an increase of 1 kg to 10 kg over the mass of 10 kg. Use whole kilograms only.

b) Is this a linear relation? Explain how you know.

c) What is an expression for the dosage in terms of the increase in mass over 10 kg?

d) What is the dosage for a child with a mass of 27 kg?

e) Can your table of values start at 0 kg? Why or why not?

Apply

12. Evan has $6 in quarters and dimes.

a) Name five combinations of quarters and dimes that Evan might have.

b) Make a table of values showing the relationship between quarters and dimes. Include five pairs of values in your table.

c) Draw a graph. Is the relationship between quarters and dimes linear in this example? Explain.

d) What is the largest possible number of dimes? of quarters?

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Check Your Understanding

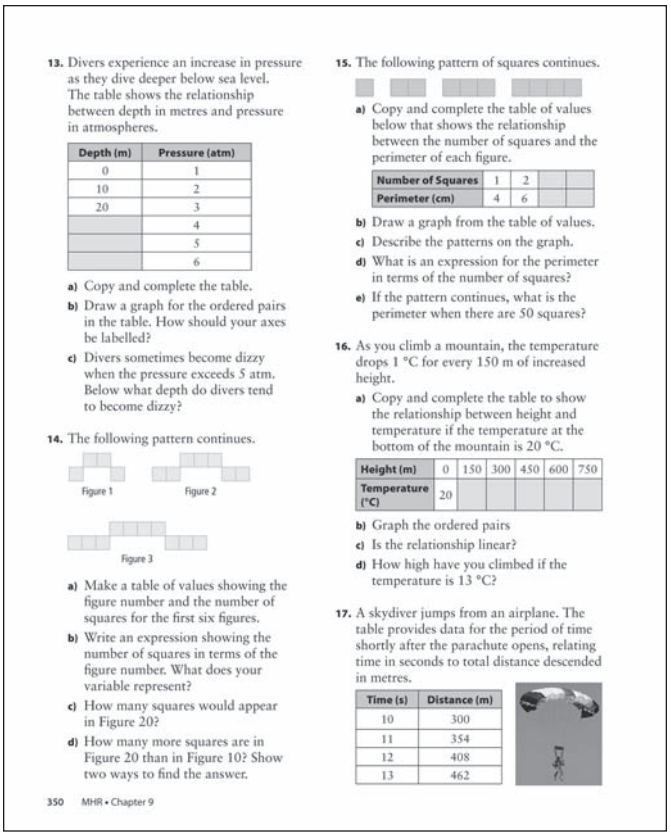
Practise

Students should be given a choice of doing #4 or #5, #6 or #7, #8 or #9, and #10 or #11 since each pair of questions is similar. If students are given this choice, ask them why they chose #10 or #11 to help you to determine student interest.

Apply

The Apply questions provide a range of contexts. Assign questions based on student interest and/or familiarity with the contexts.

The patterns in #14 and #15 are relatively simple ones that can be modelled with square tiles or coloured counters. This strategy should help students who find it challenging to extend a pattern.



13. Divers experience an increase in pressure as they dive deeper below sea level. The table shows the relationship between depth in metres and pressure in atmospheres.

Depth (m)	Pressure (atm)
0	1
10	2
20	3
	4
	5
	6

a) Copy and complete the table.
b) Draw a graph for the ordered pairs in the table. How should your axes be labelled?
c) Divers sometimes become dizzy when the pressure exceeds 5 atm. Below what depth do divers tend to become dizzy?

14. The following pattern continues.

Figure 1 Figure 2

Figure 3

a) Make a table of values showing the figure number and the number of squares for the first six figures.
b) Write an expression showing the number of squares in terms of the figure number. What does your variable represent?
c) How many squares would appear in Figure 20?
d) How many more squares are in Figure 20 than in Figure 10? Show two ways to find the answer.

15. The following pattern of squares continues.

a) Copy and complete the table of values below that shows the relationship between the number of squares and the perimeter of each figure.

Number of Squares	1	2		
Perimeter (cm)	4	6		

b) Draw a graph from the table of values.
c) Describe the patterns on the graph.
d) What is an expression for the perimeter in terms of the number of squares?
e) If the pattern continues, what is the perimeter when there are 50 squares?

16. As you climb a mountain, the temperature drops 1 °C for every 150 m of increased height.

a) Copy and complete the table to show the relationship between height and temperature if the temperature at the bottom of the mountain is 20 °C.

Height (m)	0	150	300	450	600	750
Temperature (°C)	20					

b) Graph the ordered pairs
c) Is the relationship linear?
d) How high have you climbed if the temperature is 13 °C?

17. A skydiver jumps from an airplane. The table provides data for the period of time shortly after the parachute opens, relating time in seconds to total distance descended in metres.

Time (s)	Distance (m)
10	300
11	354
12	408
13	462

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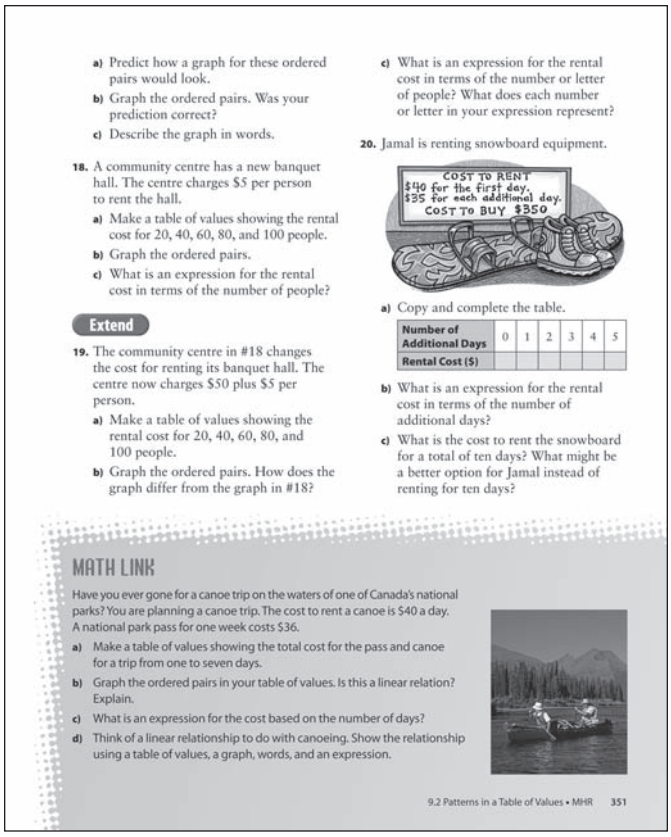


a) Predict how a graph for these ordered pairs would look.
b) Graph the ordered pairs. Was your prediction correct?
c) Describe the graph in words.

18. A community centre has a new banquet hall. The centre charges $5 per person to rent the hall.

a) Make a table of values showing the rental cost for 20, 40, 60, 80, and 100 people.
b) Graph the ordered pairs.
c) What is an expression for the rental cost in terms of the number of people?

Extend

19. The community centre in #18 changes the cost for renting its banquet hall. The centre now charges $50 plus $5 per person.

a) Make a table of values showing the rental cost for 20, 40, 60, 80, and 100 people.
b) Graph the ordered pairs. How does the graph differ from the graph in #18?
c) What is an expression for the rental cost in terms of the number or letter of people? What does each number or letter in your expression represent?

20. Jamal is renting snowboard equipment.

a) Copy and complete the table.

Number of Additional Days	0	1	2	3	4	5
Rental Cost ($)						

b) What is an expression for the rental cost in terms of the number of additional days?
c) What is the cost to rent the snowboard for a total of ten days? What might be a better option for Jamal instead of renting for ten days?

MATH LINK

Have you ever gone for a canoe trip on the waters of one of Canada's national parks? You are planning a canoe trip. The cost to rent a canoe is $40 a day. A national park pass for one week costs $36.

a) Make a table of values showing the total cost for the pass and canoe for a trip from one to seven days.
b) Graph the ordered pairs in your table of values. Is this a linear relation? Explain.
c) What is an expression for the cost based on the number of days?
d) Think of a linear relationship to do with canoeing. Show the relationship using a table of values, a graph, words, and an expression.

9.2 Patterns in a Table of Values • MHR 351

Some students may benefit from a reminder to read the introduction in each assigned question and then to indicate how the introduction relates to the table of values.

Extend

Since #19 is an extension of the idea of renting a banquet hall in #18, students will need to complete #18 in order to do #19. In #20, students work with data on snowboard rentals.

Math Link

This Math Link involves a canoe trip in a national park. Students are given a scenario for which they make a table of values, graph the data, and find an expression for the linear relationship. Then, students come up with their own linear relationship associated with canoeing. The questions parallel those used in section 9.2 and will assist students when they work on the Wrap It Up! at the end of the chapter.

Meeting Student Needs

- Give students as much variety and choice as possible to encourage them to take responsibility for their learning. Another benefit of variety is that it provides differentiated learning opportunities.
- It may be better for students in your class to complete the Practise questions for Example 1 immediately after working on that example, and then do the same for Examples 2 and 3. It might also be beneficial for them to work in pairs on the Practise questions.
- Provide **BLM 9–7 Section 9.2 Extra Practice** to students who would benefit from more practice.

ELL

- Explain the following words in context: *dosage* and *medication*.
- For Apply # 12, use manipulatives to show students what the word *combinations* means in terms of coins.
- For Apply # 13, ensure that students understand what divers do and how pressure works under water.

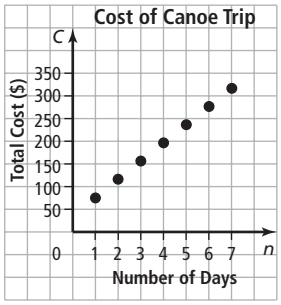
Answers

Math Link

a)

Number of Days, n	1	2	3	4	5	6	7
Total Cost, C ($)	76	116	156	196	236	276	316

b)



Yes, it is a linear relation. Answers may vary. Example: The difference between the consecutive values for each of the variables is the same.

c) $40n + 36$

d) Answers will vary.

Assessment	Supporting Learning
Assessment *for* Learning	
Practise and Apply Have students do #4, #6, #8, #10, and #12. Students who have no problems with these questions can go on to the remaining Apply questions.	• Students who have difficulty with #4, #6, and #8a) will need additional coaching on Examples 1 and 2. Help students work through #4 and then have them try #5. Similarly, after working through #6, assign #7, and after #8a), assign #9a). • Encourage students to review information in their Foldable to help answer the questions in Check Your Understanding. • Encourage students to talk through each solution. That way, you can begin to understand their thinking and identify potential areas that need clarification. • Some students will benefit from drawing diagrams of the possible combinations of coins in #12. You might even want to provide students with actual quarters and dimes to model the combinations. Assist them in organizing their data into a table and then let them verbalize the pattern that they see. • Some students may need to use trial and error to answer #12d). Once they have completed the response, refer them back to their table of values and link their response to the pattern in the table.
Math Link The Math Link on page 351 is intended to help students work toward the chapter problem wrap-up titled Wrap It Up! on page 363.	• Although it is not necessary for students to complete the Math Link, it gives them practice with skills they will need in order to complete the Wrap It Up! at the end of the chapter. • Reinforce that the Math Link is like any other question within a context. In this case, the context is a canoe trip. • Students who need help getting started could use **BLM 9–8 Section 9.2 Math Link**, which provides scaffolding for this activity.
Assessment *as* Learning	
Math Learning Log Have students respond to the following prompts: • How are the questions in section 9.2 similar and different from those in section 9.1? • I can get the following information from a table of values …	• Have students present answers in oral and written form. Then, have the presenters indicate which method they prefer and why. • Help students who need assistance by having them select an example from section 9.2 and compare it with a similar example from section 9.1. • Encourage students to use the What I Need to Work On section of their chapter Foldable to note what they continue to have difficulties with.