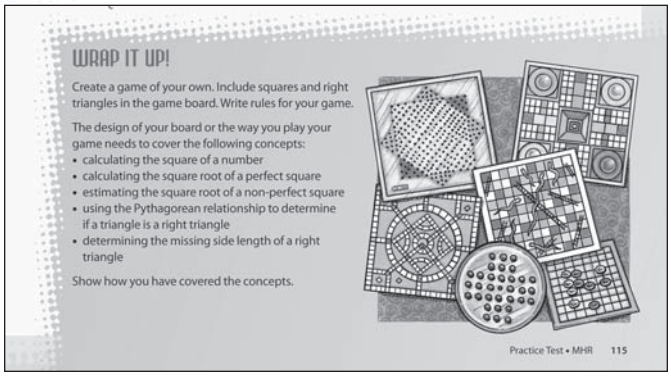
Wrap It Up!



***MathLinks 8*, page 115**

Suggested Timing
80–100 minutes

Materials
- poster board, cardboard
- coloured pencils, coloured markers
- scissors
- glue
- game pieces
- ruler
- protractor
- grid paper
- other materials for creating a board game

Blackline Masters
Master 1 Project Rubric
Master 8 Centimetre Grid Paper
Master 9 0.5 Centimetre Grid Paper
BLM 3–1 Chapter 3 Math Link Introduction
BLM 3–8 Section 3.1 Math Link
BLM 3–11 Section 3.2 Math Link
BLM 3–13 Section 3.3 Math Link
BLM 3–15 Section 3.4 Math Link
BLM 3–17 Section 3.5 Math Link
BLM 3–19 Chapter 3 Wrap It Up!

Specific Outcomes
N1 Demonstrate an understanding of perfect square and square root, concretely, pictorially and symbolically (limited to whole numbers).
N2 Determine the approximate square root of numbers that are not perfect squares (limited to whole numbers).
SS1 Develop and apply the Pythagorean theorem to solve problems.

Planning Notes

Introduce the problem and clarify the assessment criteria. Students will design a game board and write rules for their game. They must include the five listed concepts in the game board design or in the rules of the game.

Meeting Student Needs

- Show, or even have students play, a trivia board game to give them an example of the type of game that they can develop. Remind students that the difference is that they will create a game that includes math questions.
- Some students may benefit from creating some or all of their game board on grid paper. Then, to make the game board more durable, they could glue the grid paper onto poster board or cardboard. You may wish to provide students with **Master 8 Centimetre Grid Paper** or **Master 9 0.5 Centimetre Grid Paper**.

Common Errors

- Some students may not know how to write the rules for their game.

R_x Make sure students focus on the five concepts that they need to cover. Explain that one possibility is for the concepts to be covered in specific questions that players of the game must answer.

Assessment	Supporting Learning
Assessment *of* Learning	
Wrap It Up! This chapter problem wrap-up gives students an opportunity to apply and show their knowledge of squares, square roots, and the Pythagorean relationship. It is important for students to demonstrate their understanding by displaying the computations in an easy-to-follow manner. **Master 1 Project Rubric** provides a holistic descriptor that will assist you in assessing student work on this Wrap It Up! Page 141 in this TR provides notes on how to use this rubric for the Wrap It Up!	• You may wish to have students review the work they completed in the Math Links before they begin the Wrap It Up! • If students have not completed the Math Links earlier, you may wish to provide them with **BLM 3–1 Chapter 3 Math Link Introduction**, **BLM 3–7 Section 3.1 Math Link**, **BLM 3–11 Section 3.2 Math Link**, **BLM 3–13 Section 3.3 Math Link**, **BLM 3–15 Section 3.4 Math Link**, and **BLM 3–17 Section 3.5 Math Link**. • You may wish to have students use **BLM 3–19 Chapter 3 Wrap It Up!**, which provides scaffolding for the chapter problem wrap-up. • Consider dividing the class into small groups to develop the games. • You might encourage students to gather ideas from games shown in the Math Links. • Remind students that their game must address all of the concepts outlined in the Wrap It 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 and correct solution that may contain a communication error or justification error that does not affect the solution
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 correct response and board design, with one bullet not addressed *or* • provides a board design that is not clear or is missing some design element requirements, but all bullets are addressed and supported *or* • provides complete response to all bullets but the game board design is not clear
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	• correctly completes responses to bullets 1, 2, and 3 and one of bullets 4 and 5 *or* • provides a complete solution with answers only and attempts no justification for the bullets
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**	• correctly completes any three bullets; includes weak or sporadic communication
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**	• provides a correct response to any two bullets *or* • correctly completes a game board design with some initial steps towards the rules for the game

Math Games

***MathLinks 8*, page 116**

Suggested Timing
30–40 minutes

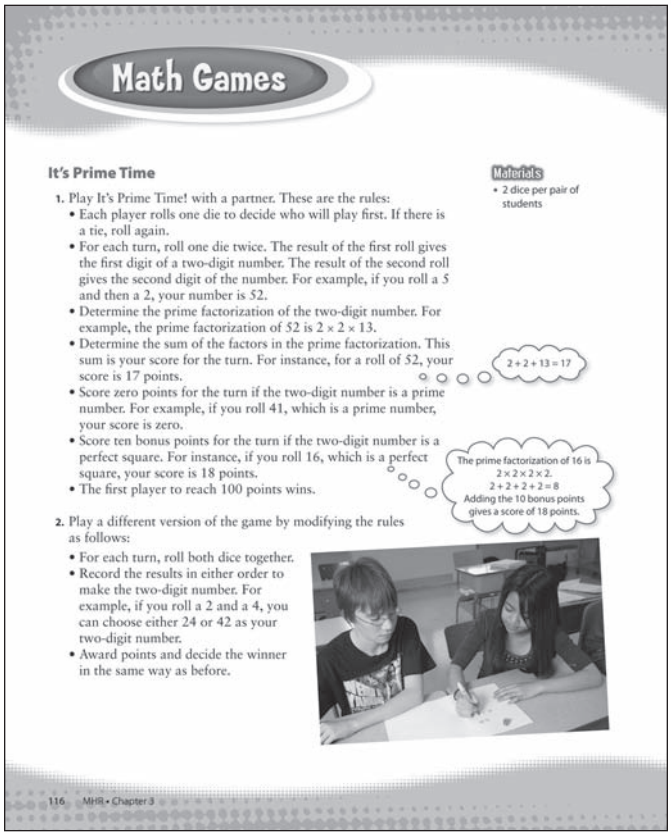
Materials
- two dice per pair of students

Specific Outcomes
N1 Demonstrate an understanding of perfect square and square root, concretely, pictorially and symbolically (limited to whole numbers).

Planning Notes

This activity gives students practice in factoring numbers to their prime factors and identifying perfect squares. Before having students play the game, you may wish to read the directions with the class and then play a demonstration round.

The modification in #2 requires students to use decision-making skills since the better choice is not always obvious. For example, 25 (which scores 20 points, including the bonus points) is a better choice than 52 (which scores 17 points). However, 64 (which scores 22 points, including the bonus points) is a worse choice than 46 (which scores 25 points). Some choices give equal scores (e.g., 13 and 31 are both prime numbers and both score zero).


Math Games

It's Prime Time

Materials
- 2 dice per pair of students

1. Play It's Prime Time! with a partner. These are the rules:
- Each player rolls one die to decide who will play first. If there is a tie, roll again.
- For each turn, roll one die twice. The result of the first roll gives the first digit of a two-digit number. The result of the second roll gives the second digit of the number. For example, if you roll a 5 and then a 2, your number is 52.
- Determine the prime factorization of the two-digit number. For example, the prime factorization of 52 is 2 × 2 × 13.
- Determine the sum of the factors in the prime factorization. This sum is your score for the turn. For instance, for a roll of 52, your score is 17 points.
- Score zero points for the turn if the two-digit number is a prime number. For example, if you roll 41, which is a prime number, your score is zero.
- Score ten bonus points for the turn if the two-digit number is a perfect square. For instance, if you roll 16, which is a perfect square, your score is 18 points.
- The first player to reach 100 points wins.

2 + 2 + 13 = 17

The prime factorization of 16 is 2 × 2 × 2 × 2. 2 + 2 + 2 + 2 = 8. Adding the 10 bonus points gives a score of 18 points.

2. Play a different version of the game by modifying the rules as follows:
- For each turn, roll both dice together.
- Record the results in either order to make the two-digit number. For example, if you roll a 2 and a 4, you can choose either 24 or 42 as your two-digit number.
- Award points and decide the winner in the same way as before.

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Meeting Student Needs

- You may wish to allow students to use calculators.

Common Errors

- Some students may calculate scores incorrectly by not factoring numbers all the way to their prime factors, by incorrectly adding the prime factors, or by forgetting to add bonus points.

R_x Suggest that partners check each other's scores.

Assessment	Supporting Learning
Assessment *for* Learning	
It's Prime Time Have student play the game with a partner.	• You may wish to assist students in recalling the divisibility rules to help them with prime factorization. • It may be beneficial for some students to review Example 1 in section 3.1.

Challenge in Real Life

***MathLinks 8*, page 117**

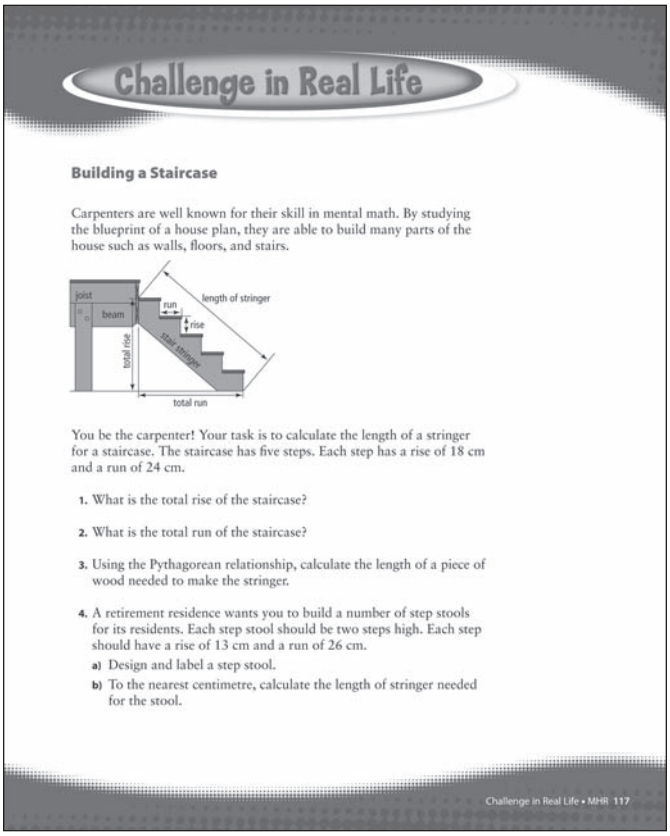
Suggested Timing
40–50 minutes

Materials
- grid paper
- ruler

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

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

Specific Outcomes
N1 Demonstrate an understanding of perfect square and square root, concretely, pictorially and symbolically (limited to whole numbers).
N2 Determine the approximate square root of numbers that are not perfect squares (limited to whole numbers).
SS1 Develop and apply the Pythagorean theorem to solve problems.



Challenge in Real Life

Building a Staircase

Carpenters are well known for their skill in mental math. By studying the blueprint of a house plan, they are able to build many parts of the house such as walls, floors, and stairs.

You be the carpenter! Your task is to calculate the length of a stringer for a staircase. The staircase has five steps. Each step has a rise of 18 cm and a run of 24 cm.

1. What is the total rise of the staircase?
2. What is the total run of the staircase?
3. Using the Pythagorean relationship, calculate the length of a piece of wood needed to make the stringer.
4. A retirement residence wants you to build a number of step stools for its residents. Each step stool should be two steps high. Each step should have a rise of 13 cm and a run of 26 cm.
   a) Design and label a step stool.
   b) To the nearest centimetre, calculate the length of stringer needed for the stool.

Planning Notes

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

1. Discuss and explain the following terms used in the Challenge in Real Life, and the related mathematical terms: *length of stringer* (hypotenuse), *total rise* (leg), and *total run* (leg). H ave students consider the amount of mathematics involved in the construction industry.
2. Discuss the role of the rise and run and their effect on the steepness of a set of steps and the length of the stringer. Ask students when the steepness of steps may have to be adjusted for special circumstances. An example is making steps for the elderly.
3. Read through the challenge as a class. Divide students into small groups to discuss approaches to solving the challenge.
4. Clarify that the task is to
   - calculate the total rise and run of the set of steps shown
   - calculate the length of the stringer
   - design a step stool that meets the parameters
   - calculate the length of the stringer for the stool
5. Hand out grid paper or provide students with **Master 8 Centimetre Grid Paper** or **Master 9 0.5 Centimetre Grid Paper**. Students will also need a ruler.
6. Review the **Master 1 Project Rubric** with students so that they will know what is expected.
7. You may wish to suggest that the groups compare solutions and discuss any possible reasons for differences. Encourage students to explain the thinking behind their stool design.

Meeting Student Needs

- Concrete and kinesthetic learners may benefit from cutting out rise and run segments and experimenting with creating stringers of various lengths to match various combinations of rise and run.

Gifted and Enrichment

- Students might wish to do an alternative design from the one in the student resource. Give them the following instructions: Design a staircase from the ground up to the bottom of a door 180 cm above the ground. A 1-m wide landing is needed at the door level. Draw the plan, including measurements, for a staircase from the ground to the landing. Include as many steps as you wish. Justify the size and number of steps. Calculate the stringer length.
- Have students explore the rise and run of different sets of steps by researching the dimensions of structures such as the pyramids of Egypt and South America.

Web Link

For information about the pyramids of Egypt and the Americas, go to www.mathlinks8.ca and follow the links.

Answers

Building a Staircase

1. $5 \times 18 = 90$. The total rise of the staircase is 90 cm.

2. $5 \times 24 = 120$. The total run of the staircase is 120 cm.

3. Length of stringer $= \sqrt{90^2 + 120^2}$
$= 150$
The length of wood needed for the stringer is 150 cm.

4. a) Designs will vary.

b) Total rise: $2 \times 13 = 26$; total run: $2 \times 26 = 52$
Length of stringer $= \sqrt{26^2 + 52^2}$
≈ 58.14
≈ 58
The length of the stringer for the stool is 58 cm.

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

Assessment	Supporting Learning
Assessment *for* Learning	
Building a Staircase Discuss the challenge with the class. Have students work in small groups to complete the calculations and design the stool.	• For a second challenge, complete with teaching notes and student exemplars, go to www.mathlinks8.ca, access the online Teacher Centre, go to Assessment, and then follow the links.
Assessment *of* Learning	
Building a Staircase Introduce the challenge to the class. In small groups, have students discuss strategies for working on the challenge. Then, have them work individually to complete the calculations and design the stool.	• **Master 1 Project Rubric** provides a holistic descriptor that will assist you in assessing student work on this challenge. Page 145 provides notes on how to use this rubric for the challenge. • To view student exemplars, go to www.mathlinks8.ca, access the online Teacher Centre, 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 most justification present, and provides data and analysis that supports the report
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 response but uses weak communication skills *or* • provides a complete response but the new step stool design has no labels indicating the measurements *or* • provides a complete response with a calculation error
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	• provides correct #1, #2, and #3 *or* • provides a correct and complete #4 *or* • provides correct #1 and #2 and partially correct #3 and #4 *or* • provides a correct solution to the entire problem without using the Pythagorean relationship (uses scale drawings) *or* • provides a correct and complete solution to #1 to #3, and #4a)
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**	• correctly completes #1 and #2 for the diagram given or for their own design *or* • completes #1, #2, and #4a) with no evidence of understanding of the Pythagorean relationship
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**	• correctly completes #1 or #2 for either the given diagram or their own design *or* • designs the step stool and provides only labels

For student exemplars, go to www.mathlinks8.ca and follow the links.