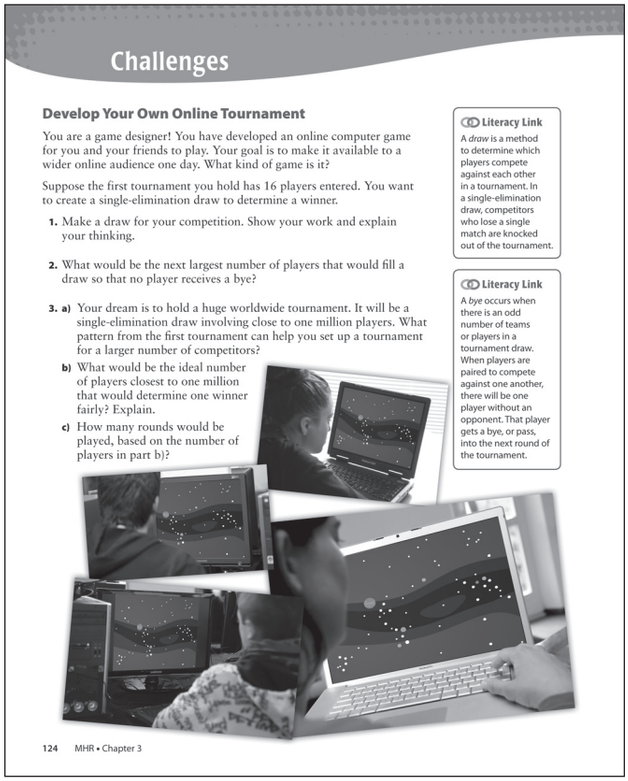

Challenges

Develop Your Own Online Tournament

You are a game designer! You have developed an online computer game for you and your friends to play. Your goal is to make it available to a wider online audience one day. What kind of game is it?

Suppose the first tournament you hold has 16 players entered. You want to create a single-elimination draw to determine a winner.

1. Make a draw for your competition. Show your work and explain your thinking.
2. What would be the next largest number of players that would fill a draw so that no player receives a bye?
3. a) Your dream is to hold a huge worldwide tournament. It will be a single-elimination draw involving close to one million players. What pattern from the first tournament can help you set up a tournament for a larger number of competitors?
   b) What would be the ideal number of players closest to one million that would determine one winner fairly? Explain.
   c) How many rounds would be played, based on the number of players in part b)?

Literacy Link

A *draw* is a method to determine which players compete against each other in a tournament. In a single-elimination draw, competitors who lose a single match are knocked out of the tournament.

Literacy Link

A *bye* occurs when there is an odd number of teams or players in a tournament draw. When players are paired to compete against one another, there will be one player without an opponent. That player gets a bye, or pass, into the next round of the tournament.

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Planning Notes: Develop Your Own Online Tournament

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

1. Ask students if they are familiar with tournaments and how teams or players are paired up at each round. Have them use a chart, table, or tree diagram to illustrate how teams are paired to compete.
2. With the class, discuss some of the ways that games are played to speed up the process of making a draw when many teams or games are involved. For example, random pairing might be used, rather than pairing players or teams according to their previous record or standing. Discuss what might be the fairest method of pairing teams.

***MathLinks 9*, page 124**

Suggested Timing
40–50 minutes

Materials
- chips or counters (optional)

Blackline Masters
Master 1 Project Rubric

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 powers with integral bases (excluding base 0) and whole number exponents by:
- representing repeated multiplication using powers
- using patterns to show that a power with an exponent of zero is equal to one
- solving problems involving powers.

N2 Demonstrate an understanding of operations on powers with integral bases (excluding base 0) and whole number exponents.
N4 Explain and apply the order of operations, including exponents, with and without technology.

3. Clarify that the task is to
   - use powers of 2 to show how a competition could be set up
   - consider the number of players needed to make the competition fair
   - explain how to use the pattern from a small tournament to plan a larger one.
4. Review **Master 1 Project Rubric** with students so that they will know what is expected.

Meeting Student Needs

- Some students might find it helpful to do the following:
  - Place a piece of paper lengthwise on a desk, dividing it into five or more columns.
  - Place a number of chips or counters on the leftmost column (column 1); at the bottom of the column record the number of chips.
  - Divide the chips into pairs, representing pairs of opponents. If there is an uneven number of chips, the odd one sits alone.
  - For each pair of chips, pick one chip as the "winner" and move it to the next column. If there is a lone chip without an "opponent," it gets a bye and is moved into the next column.
  - Once all winners for the round have been moved into column 2, at the bottom of the second column record the number of chips.
  - Repeat the procedure above for the chips in column 2, and all subsequent columns until only one chip advances. This single chip is the tournament winner.

  Have students do the above steps several times, using various numbers of chips, including odd and even numbers, as well as numbers that are powers of 2 and numbers that are not. Ask:
  - What numbers of chips progress to a final winner without there ever being a bye?
  - Write these numbers in numerical order. What pattern do you notice?

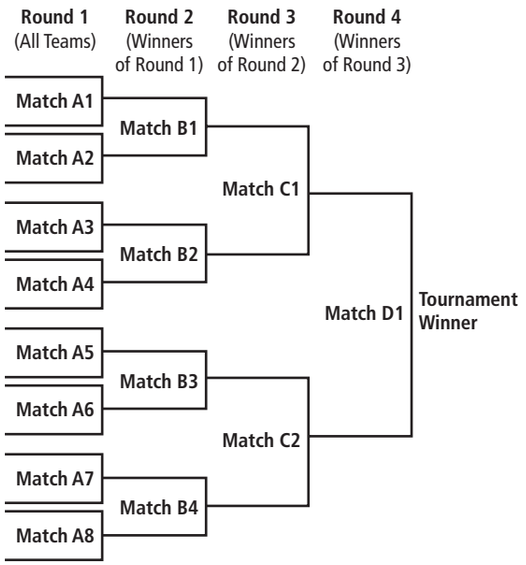
Gifted and Enrichment

- Have students research and describe the structure of a round-robin tournament. Ask them:
  - What are some of the challenges and restrictions in running a round-robin tournament? (Example: A round robin is a tournament in which each player or team plays against every other player or team. This type of tournament can result in a large number of games. The number of players or teams must be kept small; otherwise, you will need a large amount of time or multiple locations, and a large number of volunteers. The tournament could stretch over many hours or even days.)
  - What is the ideal number of players for a round robin?
  - Create a formula to calculate the total number of games played, given a certain number of players.
  - What is a fair way to determine the winner of a round-robin tournament? (Example: In general, if there are n players, you can use $\frac{(n-1)(n)}{2}$ to determine the number of games played. So, for example, 10 players would require 45 games for a round-robin tournament. Without any elimination, the fairest way to determine a winner is by using the cumulative scores earned by each team.)

Answers

Develop Your Own Online Tournament

1. Example:



2. 32

3. a) Example: The best number of teams would be a power of 2, because this number results in no team receiving a bye in any of the rounds.

b) If round one involves pairing up two players at a time and the winner going on to the second round, the closest power of 2 to one million is $2^{20} = 1\ 048\ 576$ players.

c) It would take 20 rounds to arrive at a single winner.

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

Assessment	Supporting Learning
Assessment *for* Learning	
Develop Your Own Online Tournament Discuss the Challenge with students. Have students complete the activity in pairs.	• You may wish to assist students in using models, such as chips, counters, or diagrams, to help them determine their answers.
Assessment *of* Learning	
Develop Your Own Online Tournament Introduce the Challenge to students. Have students complete the activity in pairs.	• **Master 1 Project Rubric** provides a holistic descriptor that will assist you in assessing student work on this Challenge. Page 172 provides notes on how to use this rubric for the Challenge. • To view student exemplars, go to www.mathlinks9.ca, access the Teacher Centre on the Online Learning Centre, go to Assessment, and then follow the links.

The chart below shows the **Master 1 Project Rubric** for tasks such as this Challenge, Develop Your Own Online Tournament, 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
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	Demonstrates one of the following: • provides a complete response to all parts of the problem, with a weak justification • provides a complete and correct response that contains one error in #3b) or c)
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	Demonstrates one of the following: • correctly completes #1, 2, and #3a) • provides a complete response to #3 • provides correct partial solutions to all parts of the problem, with some communication and justification present
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**	Demonstrates one of the following: • provides correct #1 and 2 • provides a correct #2 based on an incorrect #1
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**	Demonstrates one of the following: • provides a correct response to #1

For student exemplars, go to www.mathlinks9.ca and follow the links.