Chapter 3 Lesson Plans

MathLinks 9 Pre-Planning for Chapter 3

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

1. Before getting started with lesson planning for Chapter 3 Powers and Exponents, you need to understand what skills students have already been exposed to.

- If students in your jurisdiction have *not* completed the new Grade 8 WNCP (2006) curriculum, they should have some understanding of the following outcomes from the previous curriculum:
  Grade 7 (1995):
  ☑ Define and use power, base and exponent to represent repeated multiplication.
  ☑ Write a whole number as:
  - an expanded numeral, using powers of 10
  - scientific notation, and vice versa.

  Grade 8 (1995):
  ☑ Demonstrate and explain the meaning of a negative exponent, using patterns (limit to base 10).
  ☑ Represent any number in scientific notation.

- If students in your jurisdiction *have* completed the new Grade 8 WNCP (2006) curriculum, they should have some understanding of the following:
  Grade 8 (2006):
  ☑ Demonstrate an understanding of multiplying and dividing positive fractions and mixed numbers, concretely, pictorially and symbolically.
  Note: Powers and exponents are relatively new concepts in Grade 9.

2. Note that not every section within each chapter is meant to be a stand-alone lesson. In order to allow students time to experience the depth and breadth of the concept, some sections may take two or three classes to complete. The Teacher's Resource suggests time lines.

3. Before starting Chapter 3, read through the **chapter opener** (p. 88), **Key Words** (p. 89), **Math Links** (pp. 91, 98, 113, and 119,), and **Math Link: Wrap It Up!** (p. 123). These sections will provide a sense of how the chapter concepts are tied together and how students will be asked to apply their learning.

4. The chapter begins with a **Literacy Link** showing a graphic organizer (p. 89) and a **Foldable** feature (p. 90).

a) The spider map helps students organize their learning and activate previously learned concepts.

b) Foldables provide unique ways for students to:

- organize their learning
- keep track of key words and examples
- organize their thinking
- track what they need to work on in the particular chapter and use for review later in the course

5. As part of your pre-planning for each chapter, review the related material in:

- the Teacher's Resource for support in meeting the needs of all learners, a list of common errors, language learning skills, and rubric notes for the Math Link: Wrap It Up! questions,
- the Blackline Masters (BLMs) for additional questions, scaffolding of all Math Links, a chapter test, and assessment assistance,
- the *MathLinks 9 Practice and Homework Book* for additional exercises and scaffolding for concepts, and
- the Teacher Centre of the McGraw-Hill Ryerson Online Learning Centre for examples of student work for the Challenges and Tasks, scoring rubrics, additional Challenges for students, and final exams.

MathLinks 9 Chapter 3, Lesson 1

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Resources/Materials:
- *MathLinks 9*, pp. 88–91
- Master 17 Spider Map
- BLM 3–1 Chapter 3 Math Link Introduction
- BLM 3–2 Chapter 3 Get Ready or *MathLinks 9 Practice and Homework Book,* pp. 28–29
- BLM 3–4 Chapter 3 Problems of the Week
- sample chapter Foldable
- six sheets of 8.5 × 11 paper
- scissors
- ruler
- stapler

Teacher's Resource:
pp. 127–130

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Starting Chapter 3:
If you do not have access to the Teacher's Resource, tell students that Chapter 3 focuses on simplifying exponential expressions. They learn and apply the exponent laws for multiplying and dividing powers with like bases, raising a power to an exponent, raising a product and a quotient to an exponent, and

powers with an exponent of zero. Next, students apply proper order of operations to simplify expressions that contain powers. Finally, they use and develop formulas to solve problems involving powers. The chapter problem involves designing a mobile. The individual Math Links help students develop the skills needed to complete the Math Link: Wrap It Up!

Introduction:
Before working on Chapter 3, review the Get Ready and the Math Link (p. 91). Decide whether students will complete both of the activities or only one of them. The Get Ready assesses how well students know the prerequisite skills for this chapter. The Math Link also activates students' prior knowledge and skills related to Chapter 3 and, in addition, introduces the chapter problem.

Read the chapter opener together (p. 88). Read through the What You Will Learn (p. 88) and the Key Words (p. 89). How many students can already define or describe the key words?

Use the opening paragraph to discuss extreme sports. Explain that the photograph shows white-water rafting on the Maligne River in Jasper National Park, Alberta. Sports such as bungee jumping and sky diving involve a free fall. Point out the formula that relates distance fallen due to gravity and time. Point out the exponent. You might ask:

- What is the purpose of the raised 2 in the formula?
- What other formulas do you know that have exponents?
- How do you calculate a number with an exponent?

Tell students that they will learn how to simplify exponential expressions and use what they have learned to design and build a mobile at the end of the chapter.

Procedures/Activities/Instruction:

1. Have students complete the Get Ready. Use **BLM 3–2 Chapter 3 Get Ready** or *MathLinks 9 Practice and Homework Book* (pp. 28–29).
2. Have students create a spider map (see Teacher's Resource p. 128 for instructions). Make **Master 17 Spider Map** available. Have students complete the part of the spider map related to each section as they work through the chapter to help reinforce the key concepts.
3. Explain the purpose of a Foldable and show students the one you have made. Identify the materials they need to make their own. Make the Foldable together as a class or have students make their own following the instructions (p. 90). They could label it as shown or according to your directions. Explain that they can use their Foldable to keep track of their learning throughout the chapter and record ideas for the Math Link: Wrap It Up!
4. Have students complete the Math Link. Begin by reading the Math Link as a class. Explain that the chapter problem involves using formulas with exponents to design and build a mobile. Use the photograph (p. 91) and/or actual mobiles to help discuss what a mobile is. Have students complete the

questions either orally as a class or individually. This Math Link will not take much time to complete. Some students may benefit from using **BLM 3–1 Chapter 3 Math Link Introduction**, which provides scaffolding.
Discuss and remediate any areas that students have difficulty with before beginning the next lesson.

Problems of the Week:
BLM 3–4 Chapter 3 Problems of the Week provides additional problems to encourage ongoing problem solving and opportunities for students to use personal strategies in mathematics. These problems require students to think from different perspectives and experiment with a variety of approaches. Students can take the problems home and consult with parents, or work with a partner in class. Encourage students to complete at least one problem in each chapter.

Assessment:
1. Get Ready (Assessment *for* Learning)
2. Math Link (p. 91) (Assessment *for* Learning). You might use **BLM 3–1 Chapter 3 Math Link Introduction**.
3. Foldable (Assessment *for* Learning)

Math Link:
Have students start a section in their notebook or the right flap of the front of their Foldable to record ideas for the Math Link: Wrap It Up! As a class, consider reading through each Math Link (pp. 91, 98, 113, and 119), and the Math Link: Wrap It Up! (p. 123) so students have a good understanding of the chapter problem. The individual Math Links in the chapter help develop the skills needed to complete the Math Link: Wrap It Up! Notes about the Math Links throughout the chapter will appear under Assessment.

Foldable Entry:
Encourage students to add the following terms from the Get Ready and Math Link to their Foldable. Have them use diagrams and words to define each term. Remind them to use their own words and examples.
- For *formula*, have students use an example to show how to substitute into a formula.
- For *volume* and *surface area*, have students develop an example of the volume and the surface area of a right prism.

square	square root	formula	volume	surface area

MathLinks 9 Chapter 3, Lesson 2

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Demonstrate the differences between the exponent and the base by building models of a given power, such as 2^3 and 3^2.
- ☑ Explain, using repeated multiplication, the difference between two given powers in which the exponent and base are interchanged, e.g., 10^3 and 3^{10}.
- ☑ Express a given power as a repeated multiplication.
- ☑ Express a given repeated multiplication as a power.
- ☑ Explain the role of parentheses in powers by evaluating a given set of powers, e.g., $(–2)^4$, $(–2^4)$ and $–2^4$.
- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.

Resources/Materials:
- *MathLinks 9*, pp. 92–96
- BLM 3–3 Chapter 3 Warm-Up
- calculator
- Foldable

Teacher's Resource:
pp. 131–136

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
As a class, read and discuss the paragraph about *Alice in Wonderland* (p. 92). Get students thinking about repeated multiplication by asking them how they might estimate how many pieces of cake Alice will need to eat.

In the Explore, the story of Alice in Wonderland is given a twist in order to develop the concept of powers. In this section, students will represent repeated multiplication with exponents and explore how powers represent repeated multiplication.

Procedures/Activities/Instruction:

1. Have students complete the warm-up questions for section 3.1 on **BLM 3–3 Chapter 3 Warm-Up** to reinforce material learned previously.
2. After introducing the Explore, have students complete #1 to 3 individually and then, as a class, discuss the answers. In particular, ask them to describe any patterns in the table for #1.
   Have them complete Reflect and Check #4 and 5 individually or in pairs. Before they do, discuss the definitions for *power*, *base*, and *exponent* (p. 93). Write several examples of powers on the board and have students practise using the terms correctly. Then direct them to the Literacy Link to introduce how to read a power. Provide practice by writing a few powers in symbolic form on the board and having students read them. Encourage them to record an example of reading a power in their Foldable.
3. Walk through Examples 1 to 3 (pp. 93–95) as a class. Example 1 develops the concept of a power as it relates to repeated multiplication.
   Example 2 illustrates how to evaluate powers with positive bases using repeated multiplication. Direct students to the visual models of a square and a cube that represent powers with exponents 2 and 3. It is very important for students to see the models of the square and cube of a number before they use technology in part c).
   Example 3 introduces negative bases and parentheses to indicate that the exponent should be applied to the negative sign in the power. Check that students are clear about why in part a) the base is negative (–2 is enclosed in parentheses), but in part b) it is positive. Do not assign the Show You Know if students do not understand this. Instead, provide an additional question, such as $(–3)^4$, $–(3)^4$, and $–3^4$. Encourage students to develop their own example and explanation in their Foldable.
   After each worked example, have students complete the related Show You Know before going on.
4. As a class, discuss the Key Ideas. Have students record their own summary of the Key Ideas in their Foldable.
5. Assign and then collect all students' individual work for Communicate the Ideas #1 to 3 (p. 96).

Assessment:

1. Section 3.1 on **BLM 3–3 Chapter 3 Warm-Up** (Assessment *for* Learning)
2. Reflect and Check #4 and 5 (p. 93) (Assessment *as* Learning)
3. Show You Know (pp. 93–95) (Assessment *for* Learning)
4. Communicate the Ideas #1 to 3 (p. 96) (Assessment *as* Learning)
5. Math Learning Log (Assessment *as* Learning)

Foldable Entry:

Have students use their Foldable to define each of the following terms and provide an example for each.

repeated multiplication	power	base	exponent	exponential form

Math Learning Log:

Have students complete the following statements:

- You can read 5^4 in two ways. You can say ... or ...
- When evaluating -3^2 and $(-3)^2$, the parentheses make the answers different because ...

MathLinks 9 Chapter 3, Lesson 3

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Demonstrate the differences between the exponent and the base by building models of a given power, such as 2^3 and 3^2.
- ☑ Explain, using repeated multiplication, the difference between two given powers in which the exponent and base are interchanged, e.g., 10^3 and 3^{10}.
- ☑ Express a given power as a repeated multiplication.
- ☑ Express a given repeated multiplication as a power.
- ☑ Explain the role of parentheses in powers by evaluating a given set of powers, e.g., $(–2)^4$, $(–2^4)$ and $–2^4$.
- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.

Resources/Materials:

- *MathLinks 9,* pp. 96–98
- *MathLinks 9 Practice and Homework Book*, pp. 30–31
- Master 2 Communication Peer Evaluation
- BLM 3–5 Section 3.1 Extra Practice
- BLM 3–6 Section 3.1 Math Link
- calculator
- Foldable

Teacher's Resource:

pp. 136–138

***MathLinks 9* Adapted Resource:**

See corresponding chapter for adapted materials to support individual students.

Introduction:
Have students recall the Key Ideas. You might provide an example such as $(4)^3$ and ask students to use the terms *power*, *base*, and *exponent* to describe the power. Have them use their Foldable to explain what each component means.

Explain that students will apply their knowledge of exponents.

Procedures/Activities/Instruction:
1. As a class, discuss the responses to Communicate the Ideas #1 to 3. Have students use **Master 2 Communication Peer Evaluation** to assess another student's response to one of #1 to 3.
2. Assign questions as outlined in the Assessment section below. Ensure that students are successful with the Practise questions before proceeding to the Apply questions. Support for remediation or alternative approaches for students who are not successful with the Practise questions can be found in the Teacher's Resource under Assessment – Supporting Learning (p. 138).

Assessment:
1. Student assignments (Assessment *for* Learning)
   Essential: #5, 6, 8, 11, 12, 14, Math Link
   Typical: #5, 6, 8, 11, 12, 14, 16, Math Link
   Extension/Enrichment: #12, 16–23
   Note: Some students may benefit from completing **BLM 3–5 Section 3.1 Extra Practice**, if they have not already done so.
   If students complete the assigned questions before the end of class, have them begin the Math Link (p. 98). **BLM 3–6 Section 3.1 Math Link** is available for students who may benefit from scaffolding to get started.
2. The *MathLinks 9 Practice and Homework Book* provides additional problems (Assessment *for* Learning).
3. Literacy Link (Assessment *as* Learning)
4. Math Learning Log (Assessment *as* Learning)

Foldable Entry:
Have students define and illustrate the following term in their Foldable.

prime factorization

Literacy Link:
Have students work in pairs to complete the upper left leg of the spider map entitled Using Exponents. Have them include all the rules and terms they learned that are associated with powers.

Math Learning Log:
Have students respond to the following questions.
- How are the solutions for -5^2 and $(-5)^2$ different?
- How are repeated multiplication and exponents related?

MathLinks 9 Chapter 3, Lesson 4

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Express a given power as a repeated multiplication.
- ☑ Demonstrate, using patterns, that a^0 is equal to 1 for a given value of a ($a \neq 0$).
- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
- ☑ Explain, using examples, the exponent laws of powers with integral bases (excluding base 0) and whole number exponents:
  - $(a^m)(a^n) = a^{m+n}$
  - $a^m \div a^n = a^{m-n}$, $m > n$
  - $(a^m)^n = a^{mn}$
  - $(ab)^m = a^m b^m$
  - $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0.$
- ☑ Evaluate a given expression by applying the exponent laws.
- ☑ Identify the error(s) in a given simplification of an expression involving powers.

Resources/Materials:

- *MathLinks 9*, pp. 99–105
- BLM 3–3 Chapter 3 Warm-Up
- calculator
- Foldable

Teacher's Resource:
pp. 139–145

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
Explain to students that they will explore the exponent laws. As a class, read the opening paragraph to introduce the Explore.

In the Explore, students investigate how they can use exponents to determine the area of a plot of land if the dimensions are known, and how they can use exponents to determine the width of a plot of land if they know the area and the length. It is important that students have a good working knowledge of multiplication and division of integers.

Procedures/Activities/Instruction:
1. Have students complete the warm-up questions for section 3.2 on **BLM 3–3 Chapter 3 Warm-Up** to reinforce material learned previously. You may wish to review their work.
2. Collect, orally mark, or take up the previous lesson's homework. Remind students to note any questions they had difficulty with in the What I Need to Work On section of their Foldable.
3. Have students complete the Explore (pp. 99–100) individually or in pairs. Some students may find it easier to sketch rectangles with an area of 64 m^2 on grid paper. Encourage them to find all sets of dimensions for these rectangles. Check that students have included 1 × 64 and 8 × 8. Often students forget that a square is a rectangle. Have students observe and discuss the patterns they created in #2 and 3 with another student pair. Have students complete Reflect and Check #4 and 5 (p. 100). Encourage them to solve #4 using more than one method. Have students discuss their answers with another student pair and then as a class.
4. As a class, work through Examples 1 to 4 (pp. 101–104). Example 1 demonstrates how to multiply powers with a common base, while Example 2 demonstrates how to divide powers with a common base. For each Example, check that students work through both methods and not only apply the exponent laws. It is important for students to realize that there are usually several methods for evaluating powers. For Example 1, direct students to the Literacy Link (p. 101) that explains that *factored form* is another term for repeated multiplication. Use both terms throughout the chapter. After each of Example 1 and 2, direct students to the related Literacy Links (p. 101–102) about the exponent laws for multiplying and dividing powers with the same base. You might ask what numbers in part a) of Example 1 correspond to *a*, *m*, and *n* in the Literacy Link. Similarly, ask what numbers in part b) of Example 2 correspond to *a*, *m*, and *n* in the related Literacy Link.

In Example 3, students apply the exponent laws to powers of powers, powers of products, and powers of quotients. After part a), direct students to the Literacy Link related to raising a power to an exponent. Ask what numbers in part a) correspond to *a*, *m*, and *n.* After part b), direct students to the Literacy Link related to raising a product to an exponent. Ask what numbers in part b) correspond to *a*, *m*, and *n.* After part c), direct students to the Literacy Link related to raising a quotient to an exponent. Ask what numbers in part c) correspond to *a*, *m*, and *n.*

Example 4 uses a patterning exercise to develop the concept that a non-negative base with an exponent of zero is equal to 1. After Example 4, direct students to the Literacy Link (p. 104) related to a power with an exponent of zero. Explain that the base cannot equal zero because the power 0^0 is not defined. If students try this on a calculator, the calculator should return some type of error.

After each Example, have students complete the related Show You Know questions. Encourage them to solve the questions using more than one method, when possible. Discuss the solutions as a class.

5. If time permits, assign and then collect all students' individual work for Communicate the Ideas #1 to 4.

Assessment:

1. Section 3.2 on **BLM 3–3 Chapter 3 Warm-Up** (Assessment *for* Learning)
2. Reflect and Check #4 and 5 (p. 100) (Assessment *as* Learning)
3. Show You Know (pp. 101–104) (Assessment *for* Learning)
4. Communicate the Ideas #1 to 4 (Assessment *as* Learning)

Foldable Entry:

Have students record an explanation in their own words for each exponent law listed in their Foldable. Encourage them to develop their own example of each.

Have students define the following term in their Foldable.

factored form

MathLinks 9 Chapter 3, Lesson 5

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Demonstrate, using patterns, that a^0 is equal to 1 for a given value of a ($a \neq 0$).
- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
- ☑ Explain, using examples, the exponent laws of powers with integral bases (excluding base 0) and whole number exponents:
  - $(a^m)(a^n) = a^{m+n}$
  - $a^m \div a^n = a^{m-n}$, $m > n$
  - $(a^m)^n = a^{mn}$
  - $(ab)^m = a^m b^m$
  - $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0.$
- ☑ Evaluate a given expression by applying the exponent laws.
- ☑ Identify the error(s) in a given simplification of an expression involving powers.

Resources/Materials:

- *MathLinks 9*, pp. 105–107
- *MathLinks 9 Practice and Homework Book*, pp. 32–33
- Master 2 Communication Peer Evaluation
- BLM 3–7 Section 3.2 Extra Practice
- calculator
- Foldable

Teacher's Resource:
pp. 143–147

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
As a class, use the Key Ideas (p. 105) to reactivate students' learning. You might have students verify each example by expanding and simplifying.

Tell students that they will apply the exponent laws.

Procedures/Activities/Instruction:
1. As a class, discuss the responses to Communicate the Ideas. Have students note any question they had difficulty with in the What I Need to Work On section of their Foldable. Have students use **Master 2 Communication Peer Evaluation** to assess another student's response to #2 or 3.
2. Assign questions as outlined in the Assessment section below. Ensure that students are successful with the Practise questions before proceeding to the Apply questions. Support for remediation or alternative approaches for students who are not successful with the Practise questions can be found in the Teacher's Resource under Assessment – Supporting Learning (p. 147).

Assessment:
1. Student assignments (Assessment *for* Learning)
   Essential: #6, 7, 9, 11, 14, 17, 19
   Typical: #6–9, 11, 14, 17, 19–21
   Extension/Enrichment: #13, 15, 17, 20–23, 25, 26
   Note: Some students may benefit from completing **BLM 3–7 Section 3.2 Extra Practice**, if they have not already done so.
2. The *MathLinks 9 Practice and Homework Book* provides additional problems (Assessment *for* Learning).
3. Literacy Link (Assessment *as* Learning)
4. Math Learning Log (Assessment *as* Learning)

Foldable Entry:
Have students write the page reference and question numbers they had difficulty with in the What I Need to Work On section of their Foldable.

Literacy Link:
Have students work in pairs to complete the upper right leg of the spider map entitled Exponent Laws. Have them include each exponent law and an explanation of each one using their own words and examples.

Math Learning Log:
Have students comment on two or three items they feel they have improved on and explain how they have improved.

MathLinks 9 Chapter 3, Lesson 6

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
- ☑ Evaluate a given expression by applying the exponent laws.
- ☑ Determine the sum of two given powers, e.g., $5^2 + 5^3$, and record the process.
- ☑ Determine the difference of two given powers, e.g., $4^3 – 4^2$, and record the process.
- ☑ Solve a given problem by applying the order of operations without the use of technology.
- ☑ Solve a given problem by applying the order of operations with the use of technology.
- ☑ Identify the error in applying the order of operations in a given incorrect solution.

Resources/Materials:

- *MathLinks 9*, pp. 108–111
- BLM 3–3 Chapter 3 Warm-Up
- calculator
- Foldable

Teacher's Resource:

pp. 148–152

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
As a class, read the opening paragraph (p. 108) and briefly discuss current game shows that students are familiar with, in which contestants try to answer questions correctly in order to claim a hierarchical set of monetary prizes (e.g., Are You Smarter Than a Fifth Grader?, Who Wants to Be a Millionaire?).

In the Explore, students focus on the product of a power and the order of operations as they create and assess exponential expressions.

Procedures/Activities/Instruction:
1. Have students complete the warm-up questions for section 3.3 on **BLM 3–3 Chapter 3 Warm-Up** to reinforce material learned previously.
2. Collect, orally mark, or take up the previous lesson's homework. Remind students to note any question they had difficulty with in the What I Need to Work On section of their Foldable.
3. Begin the Explore by writing the prize values shown in the illustration (p. 108) on the board. Have students rewrite each prize value using prime factorization. Then, have students answer #1. Have students work in pairs to answer #2 and 3 using the prime factorizations listed on the board. Check that students complete the brackets and exponents associated with brackets first. Discuss the results for #1 to 3 as a class.
   Have students complete Reflect and Check #4 and 5 individually. Direct them to the Literacy Link related to the term *coefficient*. Reinforce that the power must be evaluated before the coefficient is multiplied. Check that students can explain the difference between a power and a coefficient.
4. Example 1 (p. 109) models simplifying powers with coefficients other than 1. The focus is the importance of the placement of parentheses. For part c), ask students how they know that the exponent does not apply to the negative sign. Direct students to the Literacy Link related to the order of operations. You might remind students of the mnemonic BEDMAS to remember this order. Direct students to the Tech Link about key sequences and check that students can sequence the operations correctly on a calculator to verify their solution.
   Before students work through Example 2 (p. 110), they need to know the proper order of operations. You might have students identify the operations by writing them in a different colour when they record each expression in their notebook. Check that students are using the proper keying sequence for their calculator. You might have students record the correct keying sequence for their calculator in their Foldable.
   After each Example, have students complete the related Show You Know questions (pp. 109–110) individually and compare their solutions with those of a partner and then with the class.

5. As a class, discuss the Key Ideas (p. 110).Have students add notes to their Foldable to summarize the Key Ideas using their own words and examples.
6. Assign and then collect all students' individual work for Communicate the Ideas #1 to 4 (p. 111).

Assessment:

1. Section 3.3 on **BLM 3–3 Chapter 3 Warm-Up** (Assessment *for* Learning)
2. Reflect and Check #4 and 5 (p. 108) (Assessment *as* Learning)
3. Show You Know (pp. 109–110) (Assessment *for* Learning)
4. Communicate the Ideas #1 to 4 (Assessment *as* Learning)
5. Math Learning Log (Assessment *as* Learning)

Foldable Entry:

Have students provide an explanation of the following terms in their Foldable. Have them simplify an expression of their choice using the order of operations.

coefficient order of operations

Math Learning Log:

Have students develop and solve an addition of two exponential expressions using the numbers 0 to 5.

MathLinks 9 Chapter 3, Lesson 7

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
- ☑ Evaluate a given expression by applying the exponent laws.
- ☑ Determine the sum of two given powers, e.g., $5^2 + 5^3$, and record the process.
- ☑ Determine the difference of two given powers, e.g., $4^3 – 4^2$, and record the process.
- ☑ Solve a given problem by applying the order of operations without the use of technology.
- ☑ Solve a given problem by applying the order of operations with the use of technology.
- ☑ Identify the error in applying the order of operations in a given incorrect solution.

Resources/Materials:

- *MathLinks 9*, pp. 111–113
- *MathLinks 9 Practice and Homework Book*, pp. 34–35
- Master 2 Communication Peer Evaluation
- BLM 3–8 Section 3.3 Extra Practice
- Foldable

Teacher's Resource:

pp. 152–154

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
Discuss the Communicate the Ideas. Remind students to note any question they had difficulty with in the What I Need to Work On section of their Foldable.

Tell students that they will apply the exponent laws and use the order of operations to evaluate expressions with powers.

Procedures/Activities/Instruction:
1. Have students use **Master 2 Communication Peer Evaluation** to assess another student's response to Communicate the Ideas #2.
2. Assign questions as outlined in the Assessment section below. Ensure that students are successful with the Practise questions before proceeding to the Apply questions. Support for remediation or alternative approaches for students who are not successful with the Practise questions can be found in the Teacher's Resource under Assessment – Supporting Learning (p. 154).

Assessment:
1. Student assignments (Assessment *for* Learning)
   Essential: #5–8, 10, 11, 15, Math Link
   Typical: #5–8, 10, 11, 14, 15, 18, Math Link
   Extension/Enrichment: #11, 12, 17, 18
   Note: Some students may benefit from completing **BLM 3–8 Section 3.3 Extra Practice**, if they have not already done so.
   Encourage students who work quickly to start the Math Link (p. 113).
   BLM 3–9 Section 3.3 Math Link is available for students who may benefit from scaffolding to get started on the Math Link.
2. The *MathLinks 9 Practice and Homework Book* provides additional problems (Assessment *for* Learning).
3. Literacy Link (Assessment *as* Learning)
4. Math Learning Log (Assessment *as* Learning)

Foldable Entry:
Have students write the page reference and question numbers they had difficulty with in the What I Need to Work On section of their Foldable.

Literacy Link:
Have students work in pairs to complete the lower left leg of the spider map entitled Order of Operations. Have them include all the rules they learned that are associated with order of operations involving powers.

Math Learning Log:
Have students complete the following statement: The steps I would follow to evaluate $(-3) \times (2 + 3)^2 \div 2 + 10$ are …

MathLinks 9 Chapter 3, Lesson 8

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
- ☑ Evaluate a given expression by applying the exponent laws.
- ☑ Solve a given problem by applying the order of operations without the use of technology.
- ☑ Solve a given problem by applying the order of operations with the use of technology.

Resources/Materials:
- *MathLinks 9*, pp. 114–118
- BLM 3–3 Chapter 3 Warm-Up
- ruler
- Foldable

Teacher's Resource:
pp. 155–159

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
Note: Students need to be familiar with the Pythagorean relationship and the formulas for the area of a circle and the surface area of a cube.

As a class, discuss the information about pine beetles (p. 114). You might ask why the growth of this pest is a concern and why dead trees pose a problem.

In the Explore, students create and simplify an exponential expression in the context of population growth. Students discover that some growth is exponential and that a population's doubling or tripling corresponds to the base of the exponential term.

Procedures/Activities/Instruction:

1. Have students complete the warm-up questions for section 3.4 on **BLM 3–3 Chapter 3 Warm-Up** to reinforce material learned previously.
2. Collect, orally mark, or take up the previous lesson's homework. Remind students to note any question they had difficulty with in the What I Need to Work On section of their Foldable.
3. Have students work in pairs to construct the table of data for #1 and 2. Encourage them to use the patterning they observed in the table to help answer #4 and 5. Discuss the results for #1 to 5 as a class.
   Students could complete Reflect and Check #6 and 7 individually; however, it may be beneficial to complete these questions as a class. In either case, have students recall the meaning of *exponential form*. Some students may have a difficult time with a variable as an exponent. Develop several concrete examples and values that pattern the beetle growth before introducing the variable exponent. Provide several values that represent *n* years for students to try on their calculator to ensure that they understand the meaning of *n*. As a class, develop a formula for when the population would triple each year. This will provide some scaffolding to assist students with questions that come up in the Check Your Understanding. If students complete the Reflect and Check individually, encourage them to share their method for #7 with a classmate so that students have an opportunity to see more than one method for solving the problem.
4. As a class, work through Examples 1 and 2 (pp. 115–117). Students use formulas that contain exponents to simplify exponential expressions in context. Students must determine the appropriate formula, substitute the correct values, and then simplify using proper order of operations.
   For Example 2, students need to develop an exponential expression to solve a problem involving bacterial growth.
   Have them note concepts they are having difficulty with in the What I Need to Work On section of their Foldable.
   After each Example, have students complete the related Show You Know questions (pp. 116–117) individually, compare their solutions with a partner, and then discuss the solutions as a class. For Example 2 Show You Know, encourage students to use repeated multiplication and extend the pattern before writing an exponential expression.
5. As a class, discuss the Key Ideas (p. 117). Have students add notes to their Foldable to summarize the Key Ideas using their own words and examples.

6. Assign and then collect all students' individual work for Communicate the Ideas #1 and 2 (p. 118).

Assessment:
1. Section 3.4 on **BLM 3–3 Chapter 3 Warm-Up** (Assessment *for* Learning)
2. Reflect and Check #6 and 7 (p. 114) (Assessment *as* Learning)
3. Show You Know (pp. 116–117) (Assessment *for* Learning)
4. Communicate the Ideas #1 and 2 (Assessment *as* Learning)
5. Math Learning Log (Assessment *as* Learning)

Foldable Entry:
Have students record formulas that contain powers in their Foldable (surface area of a cube, area of a circle, Pythagorean relationship). Encourage them to record their own problem and solution to illustrate each formula.

Have students explain the following term in their Foldable.

exponential form

Math Learning Log:
Have students explain what each number and letter represents in the following formula about population growth: Number in population = $50(3)^{n}$.

MathLinks 9 Chapter 3, Lesson 9

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
- ☑ Evaluate a given expression by applying the exponent laws.
- ☑ Solve a given problem by applying the order of operations without the use of technology.
- ☑ Solve a given problem by applying the order of operations with the use of technology.

Resources/Materials:

- *MathLinks 9*, pp. 118–119
- *MathLinks 9 Practice and Homework Book*, pp. 36–37
- Master 2 Communication Peer Evaluation
- BLM 3–10 Section 3.4 Extra Practice
- BLM 3–11 Section 3.4 Math Link
- ruler
- Foldable

Teacher's Resource:

pp. 159–161

***MathLinks 9* Adapted Resource:**

See corresponding chapter for adapted materials to support individual students.

Introduction:
As a class, discuss the responses to Communicate the Ideas. Remind students to note any question they had difficulty with in the What I Need to Work On section of their Foldable. You might have students recall their learning using a cube labelled with its edge length or #3 (p. 118), and ask students for the exponential expression that would help solve the problem.

Tell students that they will apply their learning about powers to solve problems.

Procedures/Activities/Instruction:
1. Have students use **Master 2 Communication Peer Evaluation** to assess another student's response to Communicate the Ideas #2.
2. Assign questions as outlined in the Assessment section below. Ensure that students are successful with the Practise questions before proceeding to the Apply questions. Support for remediation or alternative approaches for students who are not successful with the Practise questions can be found in the Teacher's Resource under Assessment – Supporting Learning (p. 161).

Assessment:
1. Student assignments (Assessment *for* Learning)
   Essential: #3, 5, 7, 9, Math Link
   Typical: #3, 5, 7, 9, 11, Math Link
   Extension/Enrichment: #6, 9, 11
   Note: Some students may benefit from completing **BLM 3–10 Section 3.4 Extra Practice**, if they have not already done so.
   Encourage students who work quickly to start the Math Link (p. 119).
   BLM 3–11 Section 3.4 Math Link is available for students who may benefit from scaffolding to get started on the Math Link.
2. The *MathLinks 9 Practice and Homework Book* provides additional problems (Assessment *for* Learning).
3. Literacy Link (Assessment *as* Learning)
4. Math Learning Log (Assessment *as* Learning)

Foldable Entry:
Have students write the page reference and question numbers they had difficulty with in the What I Need to Work On section of their Foldable.

Literacy Link:
Have students work in pairs to complete the lower right leg of the spider map entitled Solving Problems. Have them include all the rules and terms that are associated with solving problems involving powers.

Math Learning Log:
Have students complete the following statements: The part I find most difficult about solving problems that involve exponents is … The part that I find easiest is …

MathLinks 9 Chapter 3, Lesson 10

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Express a given power as a repeated multiplication.
- ☑ Express a given repeated multiplication as a power.
- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
- ☑ Evaluate a given expression by applying the exponent laws.
- ☑ Solve a given problem by applying the order of operations without the use of technology.
- ☑ Solve a given problem by applying the order of operations with the use of technology.
- ☑ Identify the error in applying the order of operations in a given incorrect solution.

Resources/Materials:

- *MathLinks 9*, pp. 120–121
- *MathLinks 9 Practice and Homework Book*, pp. 38–41
- BLM 3–4 Chapter 3 Problems of the Week
- BLM 3–5 Section 3.1 Extra Practice
- BLM 3–7 Section 3.2 Extra Practice
- BLM 3–8 Section 3.3 Extra Practice
- BLM 3–10 Section 3.4 Extra Practice
- calculator
- Foldable

Teacher's Resource:
pp. 162–163

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
Students are now at the chapter review, which serves as a self-assessment tool.

Procedures/Activities/Instruction:
1. Decide how you wish students to approach the Chapter 3 Review. The review is an opportunity for students to verify that they have mastered the concepts and identify any areas of weakness prior to any Assessment *of* Learning. There are a number of approaches that could be used, including:
   - Have students use the notes they made in the What I Need to Work On section of their Foldable to identify any areas of weakness and to help them select review questions.
   - Have students complete at least one related item from each section.
   - Have students review their assignments, identify areas of weakness, and select review questions accordingly.
   - As the teacher, you might select the questions to be completed by the class or individual students.
   - If students have the *MathLinks 9 Practice and Homework Book*, have them complete questions from the relevant sections. Additionally, you might have them complete the Chapter Link and the Vocabulary Link (pp. 38–39) to reinforce their learning. Note that the Chapters 1–3 Review (pp. 40–41) includes questions from Chapters 1 to 3. You may wish to use the Chapters 1–3 Review for review purposes before students write the chapter test. If you decide to include content from earlier chapters in the Chapter 3 Test, have students complete the entire cumulative review before writing the test.
   - You may wish to use questions from **BLM 3–5 Section 3.1 Extra Practice**, **BLM 3–7 Section 3.2 Extra Practice**, **BLM 3–8 Section 3.3 Extra Practice**, and **BLM 3–10 Section 3.4 Extra Practice**.

Assessment:
1. Chapter 3 Review (pp. 120–121) (Assessment *for* Learning). Consider assigning #6–12, 18, 19, and 21, which are the minimum questions that will meet the curriculum outcomes. Assignments should be completed within class time in order for students to get assistance.

Foldable Entry:
Encourage students to use the terminology in their Foldable. As they do the review, they could note what areas in the What I Need to Work On section they now understand. This is a good opportunity for students to note personal growth.

Problems of the Week:
This may be a good time to review students' responses to **BLM 3–4 Chapter 3 Problems of the Week**.

MathLinks 9 Chapter 3, Lesson 11

Time: 40–50 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Express a given power as a repeated multiplication.
- ☑ Express a given repeated multiplication as a power.
- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
- ☑ Evaluate a given expression by applying the exponent laws.
- ☑ Solve a given problem by applying the order of operations without the use of technology.
- ☑ Solve a given problem by applying the order of operations with the use of technology.
- ☑ Identify the error in applying the order of operations in a given incorrect solution.

Resources/Materials:

- *MathLinks 9*, pp. 122–123
- BLM 3–12 Chapter 3 Test
- calculator
- Foldable

Teacher's Resource:

pp. 164–165

***MathLinks 9* Adapted Resource:**

See corresponding chapter for adapted materials to support individual students.

Introduction:
Students are now at the practice test. This could serve as a final self-assessment tool or as a summative tool (Assessment *of* Learning).

Procedures/Activities/Instruction:
1. Before assigning the Chapter 3 Practice Test, have students review their spider map, if they have not already done so. Consider allowing students to use their spider map as a reference for the practice test.
2. Decide how you wish students to approach the practice test. Practice tests are opportunities for students to verify that they have mastered the concepts and identify any areas of weakness prior to Assessment *of* Learning. Provide students with a number of questions they can comfortably do in one class. Choose at least one question for each concept, skill, or process.
3. You may wish to use **BLM 3–12 Chapter 3 Test** or items from the computerized assessment bank (CAB) as a summative assessment.

Assessment:
1. Chapter 3 Practice Test (pp. 122–123) (Assessment *for* Learning). Essential questions to meet the curriculum requirements are #1, 2, 4–6, and 11. Assignments should be completed within class time in order for students to get assistance.
2. **BLM 3–12 Chapter 3 Test** (Assessment *of* Learning)

Foldable Entry:
Encourage students to use their Foldable for terminology and to note areas of personal growth.

MathLinks 9 Chapter 3, Lesson 12

Time: 80–100 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
- ☑ Evaluate a given expression by applying the exponent laws.
- ☑ Solve a given problem by applying the order of operations without the use of technology.
- ☑ Solve a given problem by applying the order of operations with the use of technology.

Resources/Materials:

- *MathLinks 9*, p. 123
- Master 1 Project Rubric
- BLM 3–13 Chapter 3 Math Link: Wrap It Up!
- ruler
- construction paper or other heavy paper
- scissors
- tape and/or glue
- coat hangers, wire, fishing line
- coloured pencils and markers
- other materials for making a mobile
- Foldable

Teacher's Resource:

pp. 166–168

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
Students will complete the chapter problem Math Link: Wrap It Up! (p. 123), which consolidates their work on the Math Links throughout the chapter. You may wish to provide materials in the classroom to help students create their mobile.

Procedures/Activities/Instruction:
1. Decide and communicate how much class time students will have to complete the Math Link: Wrap It Up! and how much needs to be completed at home.
2. Read through the Math Link: Wrap It Up! and clarify any misunderstandings. Clarify that students are to show all of their work, including substitution and proper order of operations. Encourage students to refer to the Math Links that they completed throughout the chapter. Some students may benefit from using **BLM 3–13 Chapter 3 Math Link: Wrap It Up!**, which provides scaffolding.
3. It is important for students to understand how they will be graded. Provide each student with **Master 1 Project Rubric**. Clarify the assessment criteria using the master rubric or the version of the rubric in the Teacher's Resource (p. 168). Work with students to develop the expected outcomes for each level. If using the rubric in the Teacher's Resource, delete the content in the column with the specific question notes and work with students to complete the expected outcomes for each level. Completing specific question notes in this way allows students to identify the key criteria for each level. At the same time, you might emphasize the criteria that differentiate different levels in an effort to encourage students to improve their performance.

Assessment:
1. **Master 1 Project Rubric** (Assessment *of* Learning)

Foldable Entry:
Encourage students to refer to their Foldable as they practise using appropriate mathematical terminology.

MathLinks 9 Chapter 3, Lesson 13

Time: 80–100 min

STRAND/ORGANIZER: Number

General Outcome: Develop number sense.

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.

Achievement Indicators:

- ☑ Demonstrate the differences between the exponent and the base by building models of a given power, such as 2^3 and 3^2.
- ☑ Explain, using repeated multiplication, the difference between two given powers in which the exponent and base are interchanged, e.g., 10^3 and 3^{10}.
- ☑ Express a given power as a repeated multiplication.
- ☑ Express a given repeated multiplication as a power.
- ☑ Explain the role of parentheses in powers by evaluating a given set of powers, e.g., $(-2)^4$, (-2^4) and -2^4.
- ☑ Demonstrate, using patterns, that a^0 is equal to 1 for a given value of a ($a \neq 0$).
- ☑ Evaluate powers with integral bases (excluding base 0) and whole number exponents.
- ☑ Explain, using examples, the exponent laws of powers with integral bases (excluding base 0) and whole number exponents:
  - $(a^m)(a^n) = a^{m+n}$
  - $a^m \div a^n = a^{m-n}$, $m > n$
  - $(a^m)^n = a^{mn}$
  - $(ab)^m = a^m b^m$
  - $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}, b \neq 0.$
- ☑ Evaluate a given expression by applying the exponent laws.
- ☑ Determine the sum of two given powers, e.g., $5^2 + 5^3$, and record the process.

- ☑ Determine the difference of two given powers, e.g., $4^3 - 4^2$, and record the process.
- ☑ Identify the error(s) in a given simplification of an expression involving powers.
- ☑ Solve a given problem by applying the order of operations without the use of technology.
- ☑ Solve a given problem by applying the order of operations with the use of technology.
- ☑ Identify the error in applying the order of operations in a given incorrect solution.

Resources/Materials:

Challenges	
Develop Your Own Online Tournament	**Stopping the Spread of Harmful Bacteria**
MathLinks 9, p. 124 40–50 min • Master 1 Project Rubric • chips or counters (optional) • Foldable	*MathLinks 9,* p. 125 40–50 min • Master 1 Project Rubric • calculator • poster paper • coloured pencils and markers • other materials for creating a poster • word-processing software • presentation software, such as PowerPoint (optional)

Teacher's Resource:
pp. 169–175

***MathLinks 9* Adapted Resource:**
See corresponding chapter for adapted materials to support individual students.

Introduction:
Both Challenges allow students to apply their learning about powers and exponents. In Develop Your Own Online Tournament, students use powers to make a draw for a competition, while in Stopping the Spread of Harmful Bacteria, they research bacterial growth and prepare a presentation.

Procedures/Activities/Instruction:
Develop Your Own Online Tournament

1. Read through the Challenge with students. As you do, direct them to the Literacy Links that explain the terms *draw* and *bye.* You might discuss how teams or players are paired up at each round in a tournament. Have students use a table or tree diagram to illustrate how teams are paired to compete.
2. 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

Some students might find it helpful to use chips or counters to model the draw.

3. If you use the Challenge for Assessment *of* Learning, it is important that students understand how they will be graded. Review **Master 1 Project Rubric** or use the version in the Teacher's Resource (p. 172) and work with students to develop the expected outcomes for each level. If using the version in the Teacher's Resource, delete the content in the column with the specific question notes and work with students to complete the expected outcomes for each level. Completing specific question notes in this way allows students to identify the key criteria for each level. At the same time, you might emphasize the criteria that differentiate different levels (e.g., Level 3 and Level 4), in an effort to encourage students to improve their performance.

Stopping the Spread of Harmful Bacteria

1. Introduce the Challenge by exploring as a class what students know about bacteria. For example, if *E. coli* bacteria are ingested, they can cause gastrointestinal infection (food poisoning) and urinary tract infection. Other bacteria, such as those used in making cheese and yogurt, as well as many that help in digestion, are beneficial to humans.

2. Read through the opening paragraph and then discuss and list methods of finding the time for one bacterium to multiply to 500 000 bacteria.

3. As a class, discuss presentation options.

4. Clarify that the task is to:
- determine how many times a single bacterium needs to double to produce a billion or more bacteria
- determine the time it will take to produce a billion or more bacteria
- use correct mathematical terms to explain the growth
- determine the doubling rate of the bacterium
- list methods to reduce the growth of harmful bacteria
- decide on and implement a presentation format.

5. If you use the Challenge for Assessment *of* Learning, it is important that students understand how they will be graded. Review **Master 1 Project Rubric** or use the version in the Teacher's Resource (p. 175) and work with students to develop the expected outcomes for each level. If using the version in the Teacher's Resource, delete the content in the column with the specific question notes and work with students to complete the expected outcomes for each level. Completing specific question notes in this way allows students to identify the key criteria for each level. At the same time, you might emphasize the criteria that differentiate different levels in an effort to encourage students to improve their performance.

Assessment:

1. You may decide to let students choose either Challenge, depending on the type of assessment you are looking for (Assessment *for* Learning or Assessment *of* Learning).

Foldable Entry:

Encourage students to refer to their Foldable to help them use appropriate mathematical terminology.