

## I. Lesson Overview

<b>Lesson Title:</b>	Expressing Numbers in Index Form
<b>Strand:</b>	Numbers and Algebra
<b>Sub-Strand:</b>	Indices and Logarithms
<b>Grade Level:</b>	10
<b>Estimated Duration:</b>	40 minutes

### Key Inquiry Question

*How do we use real numbers in day-to-day activities?*

## II. Learning Objectives & Standards

### Learning Objectives

Upon completion of this lesson, students will be able to:

1. **Know (Conceptual Understanding):** Understand the meaning of index notation, including the concepts of base and exponent (index/power).
2. **Do (Procedural Skill):** Express numbers in index form by identifying the base and counting the number of times it is multiplied.
3. **Apply (Application/Problem-Solving):** Apply index notation to represent real-world situations involving repeated multiplication.

### Curriculum Alignment

<b>Strand:</b>	Indices and Logarithms
<b>Sub-Strand:</b>	Indices
<b>Specific Learning Outcome:</b>	Expressing numbers in index form.

## III. Materials & Resources

<b>Textbooks:</b>	<a href="#">CBC Grade 10 Mathematics Learner's Book</a> <a href="#">CBC Grade 10 Mathematics Teacher's Book</a>
<b>Materials:</b>	A4 sheets of paper (one per student for the anchor activity)

## IV. Lesson Procedure

### Phase 1: Problem-Solving and Discovery / Engage & Explore (15 minutes)

**Objective:** To activate prior knowledge about multiplication and introduce the concept of repeated multiplication through a hands-on activity.

**Materials Required:** One A4 sheet of paper per student (approximately 0.1 mm thick).

#### Anchor Activity: Paper Folding Exploration

Group Formation:

- Form groups of 2-3 students.

First Fold:

- Take a piece of paper and fold it in half once. Count the number of layers (2 layers).

Second Fold:

- Fold it in half again and count the number of layers (4 layers).

Continue Folding:

- Continue folding and record your observations in a table.

Record Data:

- Create a table with columns for "Number of Folds" and "Number of Layers".

Express in Index Form:

- Express the number of layers using index notation (powers of 2).

#### Expected Observations:

Number of Folds	Number of Layers	Index Form
1	2	$2^1$
2	4	$2^2$
3	8	$2^3$
4	16	$2^4$
5	32	$2^5$

**Teacher's Role:** The teacher circulates among the groups, observing how students count layers and record data. The teacher asks probing questions (e.g., "What pattern do you see?", "How does the number of layers relate to the number of folds?", "Can you predict the number of layers after 6 folds?"). The teacher uses student discoveries to bridge to formal instruction on index notation.

### Phase 2: Structured Instruction / Explain (10 minutes)

**Objective:** To formalize the concept of index notation and connect it to the paper folding activity.

#### Key Takeaways & Teacher Connection:

### Index Notation:

When writing index notation, we represent it as:  $a^n$

Where:

- $a$  is the base (the number being multiplied)
- $n$  is the exponent/index/power (the number of times the base is multiplied by itself)

### Connecting to the Paper Folding Activity:

*"In your paper folding activity, you discovered that the number of layers doubles with each fold. This is repeated multiplication by 2. We can write this using index notation!"*

- 2 layers =  $2 \times 1 = 2^1$
- 4 layers =  $2 \times 2 = 2^2$
- 8 layers =  $2 \times 2 \times 2 = 2^3$
- 16 layers =  $2 \times 2 \times 2 \times 2 = 2^4$

**General Rule:** When a number is multiplied by itself  $n$  times, we write it as base <sup>$n$</sup> .

### Examples:

- $a \times a = a^2$  (a squared)
- $8 = 2 \times 2 \times 2 = 2^3$  (2 cubed or 2 to the power of 3)
- $625 = 5 \times 5 \times 5 \times 5 = 5^4$  (5 to the power of 4)
- $1000 = 10 \times 10 \times 10 = 10^3$

**Addressing Misconceptions:** "Remember: The exponent tells us how many times the base is multiplied, not added. For example,  $2^3 = 2 \times 2 \times 2 = 8$ , NOT  $2 + 2 + 2 = 6$ ."

### Phase 3: Practice and Application / Elaborate (15 minutes)

**Objective:** To apply index notation to express various numbers and solve problems.

### Varied Problems:

#### 1. Express in Index Form:

- $a \times a = a^2$
- $8 = 2 \times 2 \times 2 = 2^3$
- $625 = 5 \times 5 \times 5 \times 5 = 5^4$
- $81 = 3 \times 3 \times 3 \times 3 = 3^4$
- $64 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^6$  OR  $4 \times 4 \times 4 = 4^3$
- $1000000 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^6$

## 2. Finding the Base and Exponent:

Express 729 in index form.

Solution:  $729 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 3^6$

(Or  $729 = 9 \times 9 \times 9 = 9^3$ , since  $9 = 3^2$ )

**Teacher's Role:** The teacher monitors students as they work, helping them identify the base by finding prime factors when necessary.

### Phase 4: Assessment / Evaluate (Exit Ticket)

**Objective:** To formatively assess individual student understanding.

#### Exit Ticket Questions:

1. Write the number 729 in index form. (Your answer should be written as  $a^b$ )
2. A school has a computer storage server that saves student work in blocks. Each block holds repeated copies of the same unit file. One unit file has a size of 3 MB. After processing, the total saved size is 243 MB. Write 243 in index form using base 3.

#### Answer Key:

1.  $729 = 3^6$  (since  $3 \times 3 \times 3 \times 3 \times 3 \times 3 = 729$ )

Alternative:  $729 = 9^3$  (since  $9 \times 9 \times 9 = 729$ )

Alternative:  $729 = 27^2$  (since  $27 \times 27 = 729$ )

2.  $243 = 3^5$  (since  $3 \times 3 \times 3 \times 3 \times 3 = 243$ )

This means the server saved  $3^5 = 243$  copies of the 1 MB unit file.

## V. Differentiation

Student Group	Strategy & Activity
Struggling Learners (Support)	Scaffolding: Provide a multiplication chart to help identify repeated factors. Start with small bases (2, 3, 5) and small exponents. Use visual aids showing the paper folding pattern. Allow use of calculators to verify answers.
On-Level Learners (Core)	The core lesson activities as described above.
Advanced Learners (Challenge)	Extension Activity: Explore numbers that can be expressed in multiple index forms (e.g., $64 = 2^6 = 4^3 = 8^2$ ). Investigate: If you could fold a

	paper 50 times, how thick would it be? (Hint: $2^{50} \times 0.1$ mm). Research real-world applications of exponential growth.
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## VI. Assessment

Type	Method	Purpose
<b>Formative (During Lesson)</b>	<ul style="list-style-type: none"> <li>- Observation during paper folding</li> <li>- Questioning to check understanding</li> <li>- Exit Ticket</li> </ul>	To monitor progress and adjust instruction.
<b>Summative (After Lesson)</b>	<ul style="list-style-type: none"> <li>- Homework assignment</li> <li>- Future quiz/test questions</li> </ul>	To evaluate mastery of learning objectives.

**Teacher's Role:** Collect and review the exit tickets to gauge student understanding and identify any common misconceptions that need to be addressed in the next lesson.

## VII. Teacher Reflection

*To be completed after the lesson.*

1. What went well?
2. What would I change?
3. Student Understanding: What did the exit tickets reveal?
4. Next Steps: Based on assessment data, what is the plan for the next lesson?