Step by step guide: Applications of Indices in Real-Life Situations

Grade 10 Mathematics | 40-Minute Lesson

Before Class Begins

Preparation Checklist:

- Prepare scenario cards for each group (population, bacteria, investment, medicine)
- Write the formula $P = P_0 \times r^n$ on the board (covered until Phase 2)
- Prepare exit tickets for distribution
- Set timer for phase transitions
- Have calculators available for students

PHASE 1: Problem-Solving and Discovery (15 Minutes)

Opening (2 minutes)

[SAY]:

"Good morning/afternoon, class! Today we're going to see how indices—those powers we've been learning about—are used in REAL LIFE! From population growth to bank interest to medicine in your body, indices are everywhere!"

[SAY]:

"Here's our key question: How do we use real numbers in day-to-day activities? Let's explore some real scenarios."

Anchor Activity Introduction (2 minutes)

[DISTRIBUTE scenario cards to groups]:

[SAY]:

"Each group has received a real-life scenario card:
• Group 1: Population Growth
• Group 2: Bacterial Growth

• Group 3: Investment Growth
• Group 4: Medicine Decay"

Group Work Instructions (1 minute)

[SAY - Read slowly and clearly]:

"In your groups, I want you to:
1. Read your scenario carefully
2. Identify the pattern (doubling, tripling, halving?)
3. Count how many times the pattern repeats
4. Try to express the answer using powers/indices
5. Prepare to present your findings

You have 8 minutes. Begin!"

Circulation and Probing (6 minutes)

[DO]: Walk around the room, observing how students analyze the patterns.

[ASK probing questions as you circulate]:

- "What multiplier are you using each time?"
- "How many times does the pattern repeat?"
- "Can you write 2 × 2 × 2 in a shorter way?"
- "What is the starting amount? What is the final amount?"
- "How does the exponent relate to the time given?"

[TIME CHECK]: At 6 minutes, announce: "Two more minutes to prepare your presentations!"

Group Presentations (4 minutes)

[SAY]:

"Time's up! Let's hear from each group. Tell us your scenario, the pattern you found, and your answer."

[CALL each group - about 1 minute each]:

[Expected answers]:

• Group 1: $10{,}000 \times 2^3 = 80{,}000$ people

• Group 2: $100 \times 3^3 = 2{,}700$ bacteria

• Group 3: $5{,}000 \times 2^3 = 40{,}000$ Ksh

• Group 4: $160 \times (1/2)^3 = 20$ mg

[TRANSITION]:

"Excellent work! You've all discovered the same pattern. Let me show you the formal formula."

PHASE 2: Structured Instruction (10 Minutes)

The Exponential Model (5 minutes)

[REVEAL formula on board]:

$$P = P_0 \times r^n$$

[SAY]:

"This is the EXPONENTIAL MODEL. It works for growth AND decay!

P = Final amount (what we want to find)
P_0 = Initial amount (what we start with)
r = Growth factor (the multiplier)
n = Number of time periods (how many times the pattern repeats)"

Common Growth Factors (3 minutes)

[WRITE on board]:

[SAY]:

"Here are the common growth factors:

- *Doubling: $r = 2$*
- *Tripling: $r = 3$*
- *Halving (decay): $r = 1/2$*
- *Compound interest at 5%: $r = 1.05$"*

Finding the Exponent (2 minutes)

[SAY - IMPORTANT]:

"The KEY to solving these problems is finding the exponent n:

n = Total time ÷ Time for one cycle

Example: If population doubles every 10 years, after 30 years:
$n = 30 \div 10 = 3$

COMMON MISTAKE: The exponent is NOT the total time—it's the NUMBER OF CYCLES!"

[TRANSITION]:

"Now let's practice with some real-world problems!"

PHASE 3: Practice and Application (15 Minutes)

Worked Example 1: Population Growth (4 minutes)

[SAY]:

"Let's solve this together: Kakamega town's population doubles every 10 years. If the population today is 50,000 people, what will it be in 30 years?"

[WRITE while explaining]:

"Step 1: Identify the values
- $P_0 = 50{,}000$
- $r = 2$ *(doubles)*
- $n = 30 \div 10 = 3$ *cycles*

Step 2: Apply the formula
$P = 50{,}000 \times 2^3$
$P = 50{,}000 \times 8$
$P = 400{,}000$ *people"*

Worked Example 2: Investment (3 minutes)

[SAY]:

"A STEM club invests Ksh 1,100 at a growth factor of 11/10 per year. What's the value after 3 years?"

"$A = 1{,}100 \times (11/10)^3$
$A = 1{,}100 \times (1331/1000)$
$A = 1{,}464.10$ *Ksh"*

Partner Practice (5 minutes)

[SAY]:

"Work with your partner on this problem:

Bacteria triple every 5 hours. Starting with 1,000 bacteria:
a) How many after 10 hours?
b) How many after 20 hours?"

[GIVE 4 minutes, then review]:

"a) $n = 10 \div 5 = 2$: $1{,}000 \times 3^2 = 9{,}000$ bacteria
b) $n = 20 \div 5 = 4$: $1{,}000 \times 3^4 = 81{,}000$ bacteria"

[TRANSITION]:

"Now I want to see what each of you has learned."

PHASE 4: Assessment / Checkpoint (8 Minutes)

Independent Work (5 minutes)

[DISPLAY questions]:

"1. A principal plants 3 trees in week 1. Each week, the number triples. How many trees by week 5?

2. Upendo Bank: Ksh 50,000 invested at growth factor 1.05 per year. Write the index notation for the amount after 10 years."

[SAY]:

"You have 5 minutes. Begin."

Collection and Closure (2 minutes)

[SAY]:

"Time's up. Please pass your exit tickets forward."

[COLLECT all tickets]

[SAY]:

"Today you learned how indices appear in real life:
- *Population growth (doubling, tripling)*
- *Bacterial growth in science*
- *Compound interest in banking*
- *Medicine decay in healthcare*

The formula $P = P_0 \times r^n$ is your tool for solving all these problems!"

[SAY]:

"Great work today! For homework, complete the remaining assessment problems."

Differentiation Notes

For Struggling Learners:

- Provide formula cards with $P = P_0 \times r^n$
- Use tables to show step-by-step growth
- Start with simple doubling patterns
- Allow calculator use for calculations

For Advanced Learners:

[GIVE these extensions]:

- Medicine reduces to 1/4 every 6 hours. Express amount after 18 hours if initial dose was 200 mg.
- Sound intensity: Jet engine is 10^6 times louder than whisper, conversation is 10^2 times louder. How many times louder is a jet engine than conversation?

Answer Key

Exit Ticket Answers:

1. Trees by week 5: $3 \times 3^4 = 3^5 = 243$ trees

2. Bank investment: $A = 50{,}000 \times (1.05)^{10}$

Additional Assessment Answers:

Bacteria after 10 hours: $1{,}000 \times 3^2 = 9{,}000$

Bacteria after 20 hours: $1{,}000 \times 3^4 = 81{,}000$

Time to reach 243,000 bacteria: 25 hours (5 cycles)

Trees to reach 2,000: Week 7 ($3^7 = 2{,}187$)

Bank amount after 10 years: $50{,}000 \times 1.6289 \approx$ Ksh 81,445

Medicine after 18 hours: $200 \times (1/4)^3 = 3.125$ mg

Jet vs conversation: $10^6 \div 10^2 = 10^4 = 10{,}000$ times louder

Post-Lesson Reflection Prompts

1. What went well? Did students connect indices to real-world applications?

2. What would I change? Were the scenario cards engaging enough?

3. Student Understanding: Did students correctly calculate the exponent from time periods?

4. Next Steps: Which students need more practice with decay problems?