

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 $2 \times 2 \times 2$ 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)

P₀ = 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:

$$n = \text{Total time} \div \text{Time for one cycle}$$

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

$$P = 50,000 \times 2^3$$

$$P = 50,000 \times 8$$

$$P = 400,000 \text{ people"}$$

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?"

$$A = 1,100 \times (11/10)^3$$

$$A = 1,100 \times (1331/1000)$$

$$A = 1,464.10 \text{ Ksh"}$$

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: $50,000 \times 1.6289 \approx \text{Ksh } 81,445$

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?