# 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?