Growth and Decay

Students learn that b decides growth (above 1) or decay (between 0 and 1), why b = 1 is flat and b must be positive, and convert between percent change and factor in both directions, reading a and b in stories.

TIME	40 minutes (one student with a parent or tutor, or a small group)
WHO	Math 1 (algebra readiness), about age 12. Follows Unit 7, Lesson 2.
MATERIALS	Student worksheet (PDF), the Deep Dive 5 interactive page for this lesson, pencil, calculator optional
PRIOR KNOWLEDGE	y = a · b^x and the two jobs (Lesson 2). Percents as decimals (middle school). The multiplicative identity (Unit 1).
STANDARDS	NC Math 1 NC.M1.F-LE.1 and F-LE.5 (interpret parameters in context), NC.M1.F-IF.8 (interpret expressions for exponential growth and decay in context).
KEEP OUT	Compound interest formulas (Unit 8). Asymptotes and end behavior (Lesson 4).

Learning goals

1. Explain why b above 1 grows, b between 0 and 1 decays, and b = 1 is flat, using multiplying by more or less than 1.
2. Convert a percent change to a factor (start from 100%) and a factor to a percent rate (measure from 100%), both ways.
3. Sort equations and stories into growth and decay.
4. Say what a and b mean in a story.

Vocabulary: say both, every time

The rule for the whole lesson: whenever the adult or the student says a math word, they follow it with the plain-English version. Proper term first, plain English second, until the student does it without being asked.

TERM	LOOKS LIKE	PLAIN ENGLISH
Growth, decay	b above 1, b below 1	Bigger each step, smaller each step.
Factor	b	What you multiply by.
Rate	the percent	How far b is from 1.
Start from 100%	add or take away	Then write as a decimal.

> THE ONE SENTENCE TO SAY OUT LOUD
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> Above 1 grows, below 1 decays, 1 does nothing. Start from 100%: add the percent for growth, take it away for decay.

Lesson timeline (40 minutes)

0:00 to 0:05	**Warm-up: three factors.** Multiply 100 by 1.5 three times, by 0.5 three times, by 1 three times. Ask what each list does.
0:05 to 0:15	**Mini-lesson: what b decides.** The three cases with the why. Run the explorer past b = 1 and watch the switch. Say b must be positive, and why.
0:15 to 0:26	**Percents.** Grows 10%: 100% plus 10%, 1.10. Loses 25%: 100% minus 25%, 0.75. Then factor to percent: 1.05 and 0.85. The medicine story: say what a and b mean out loud.
0:26 to 0:36	**Sort and practice.** The growth-or-decay sort, then the practice problems or Worksheet Parts A to D. Same buttons: Hint, Show next step, Reveal answer, Hide help.
0:36 to 0:40	**Exit ticket.** Worksheet Part F. Success looks like 1.07 and 0.70; growth 25% and decay 40%.

Misconceptions to listen for

- **10% growth means b = 0.10.** Start from 100%: 1.10.
- **Losing 25% means b = 1.25 or 0.25.** Keep 75%: 0.75.
- **b = 0.85 loses 85%.** It keeps 85% and loses 15%.
- **b = 1 is growth.** Multiplying by 1 changes nothing: flat.
- **Bigger b always means bigger output.** Only for the same a and same x. b sets the speed, a sets the start.

Support and stretch

Support

Keep a percent-to-decimal strip (100% = 1.00) on the desk. Do conversions with 100 as the starting amount first so the numbers are visible.

Stretch

Ask what factor gives growth of 100% (2) and decay of 100% (0, everything gone in one step, and why that is not exponential either). Ask how many years at 10% growth it takes to double (a table: about 7).

Where this goes next

Lesson 4: reading the graph. The y-intercept, domain, range, the horizontal asymptote at y = 0, end behavior, and matching an equation to its graph by elimination.

> THE HABIT TO BUILD
>
> Start from 100%. Add for growth, take away for decay, then write the factor as a decimal.