Systems in the Real World

Students model two-fact stories as systems of equations (count and value) and two-limit stories as systems of inequalities (feasible region), solve or shade, and read answers back into the story, including discrete plans as whole-number points.

TIME	45 minutes (one student with a parent or tutor, or a small group)
WHO	Math 1 (algebra readiness), about age 12. Follows Unit 6, Lessons 1 to 5.
MATERIALS	Student worksheet (PDF), the Deep Dive 5 interactive page for this lesson, pencil, graph paper, colored pencils
PRIOR KNOWLEDGE	Substitution and elimination (Lessons 2 and 3). Systems of inequalities (Lesson 5). Constraints and discrete versus continuous (Unit 5, Lesson 4).
STANDARDS	NC Math 1 NC.M1.A-CED.3 (represent constraints by systems of equations or inequalities and interpret solutions), A-REI.6, A-REI.12.
KEEP OUT	Optimization (best plan). Here, feasible plans only.

Learning goals

1. Translate a two-fact story into two equations (count and value), choose a fitting method, solve, and read the answer back with a check.
2. Translate two limits into two inequalities, shade the feasible region, and test plans in both.
3. Explain when the plans are whole-number points only, and find and interpret one feasible plan.

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
Count and value	two facts	Two equations.
Constraint	a limit	An inequality; two make a system.
Feasible region	the overlap	Every plan that obeys both.
Read it back	story words with units	And check.

> THE ONE SENTENCE TO SAY OUT LOUD
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> Name the unknowns. Two facts, two equations; solve and read it back. Two limits, two inequalities; shade both and keep the overlap. It has to satisfy every one.

Lesson timeline (45 minutes)

0:00 to 0:05	Warm-up: two facts. 40 tickets, $8 and $5, $260. Ask what two things the story tells you. Count and money. Write them as equations.
0:05 to 0:16	Mini-lesson: solve and read back. Substitution on the tickets; elimination on the coins (cents!). Read each answer back and check it against the story. Then the five steps.
0:16 to 0:27	Two limits. Bracelets and keychains: write the money and time constraints, simplify the time one, shade both, find the overlap, test (5, 8) and (7, 5). Ask the Unit 2 question and mark the dots. Find one plan and say what it means.
0:27 to 0:40	Practice. The practice problems or Worksheet Parts A and B. Same buttons: Hint, Show next step, Reveal answer, Hide help. Every answer read back with units.
0:40 to 0:45	Exit ticket. Worksheet Part C, item 4. Success looks like the system, 10 adults and 20 kids, and the check.

Misconceptions to listen for

- **One equation for two facts.** Each fact is its own equation.
- **Mixed units.** Dollars with cents, or hours with minutes, break the value equation.
- **Numbers without the story.** Read back: what does 20 mean?
- **A plan that obeys one limit.** Both, or it is not feasible.
- **Fractions of a bracelet.** Whole things: dots.

Support and stretch

Support

Give the count-and-value template on a card. Convert all money to one unit before writing. Shade the two constraints in two colors and circle the dots.

Stretch

Ask which feasible plan makes the most money at the fair if bracelets sell for $6 and keychains for $3 (a preview of optimization). Ask for a two-fact story whose system has no solution and what that would mean.

Where this goes next

Unit 7: Introduction to Exponential Functions. A brand-new family of graphs. Open with the family-of-graphs frame: lines were the first family, and they add; the exponential family multiplies.

> THE HABIT TO BUILD
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> Two facts or two limits. Every answer read back into the story and checked against every fact or limit.