Ratio Rescue: Scaling Up to Find Missing Values

Teacher		**Class**	Year 6
Subject	Maths	**Topic**	Ratio problems
Date		**Room**	
Lesson length	60 minutes	**Country**	United Kingdom

Pupils learn to find missing values in 2-part ratios. They build and scale a colour mix using times-table facts.

Curriculum links

- solve problems involving the relative sizes of 2 quantities where missing values can be found by using integer multiplication and division facts [1]

Learning objectives

- Students will find missing values in 2-part ratios using integer multiplication and division.
- Students will scale both parts of a ratio equally to keep relative sizes unchanged.

Success criteria

- I can write a ratio as a:b and find the scale factor.
- I can multiply both parts equally to find a missing value.
- I can check my answer by dividing back to the base ratio.

What students already know

2-minute chant and whiteboard check of x3 and x4 facts: ask 3 x 4, 2 x 6, 12 divided by 3.

Key words

ratio	a comparison that shows how much of one thing there is for every bit of another [8]
for every	linking words that tell how many of a second amount go with a first amount [1]
scale factor	the whole number you multiply both sides by to make a larger matching pair [4]
equivalent ratio	two pairs that show the same comparison, though the numbers are bigger or smaller [4]

Materials

- red cubes
- blue cubes
- small cups
- recording sheets
- whiteboards and pens
- times-table grids
- Slides 1-5, 7, 10, 12 on display
- Worksheet Task B printed

Before the lesson

- Load Slides 1-5, 7, 10, 12 and check they display clearly
- Count out trays of red cubes, blue cubes and small cups for each pair
- Print recording sheets with space for base ratio and scaled ratio
- Print Worksheet Task B for pairs and times-table grids for support

Lesson outline

0–10 min **Starter** 10 min · Whole class

To recall multiplication facts and introduce ratio as for every.

YOU DO

1. Show Slides 1-2: Ratio Rescue: Finding Missing Values with Use times tables to solve ratio puzzles.
2. Hold up one tiny cup and say the hook: this recipe makes one tiny pot of purple paint, but we need enough for the whole class.
3. Teach Slide 2 fact: Ratio just means for every. 4:2 means for every 4 of one thing, there are 2 of the other.
4. Quick-fire x3 and x4 facts on whiteboards to warm up for finding scale factors.

STUDENTS DO

1. Chant x3 and x4 facts and show answers on whiteboards.
2. Repeat for every sentences with a partner using fingers to show 4 to 2.
3. Predict how we could make more purple without changing the colour.

Say: Today we rescue mixtures with maths. Ratio just tells us for every how many of one thing go with the other. You will use the times tables you know to grow both sides together and find what is missing.

Ask: What does 4:2 mean? (For every 4 of one thing, there are 2 of the other.) · What does a ratio show us? (The relative sizes of 2 or more values [8], how much of one compared to another.) · If 3 x 4 = 12, what is 12 divided by 3? (4, the matching division fact we use to find the multiplier.)

Check understanding: Whiteboards up for 3 x 5, 4 x 3 and 12 divided by 3; reteach with a times-table grid if many are unsure.

Support: Give a times-table grid so pupils read off x3 and x4 facts instead of recalling. **Stretch:** Ask what integer could turn 3 into 30 and 2 into 20, to spot x10 early.

Use: Slides 1-2

10–20 min **Teaching** 10 min · Whole class

To model finding a missing value by dividing then multiplying.

YOU DO

1. Show Slides 3-5 and point out a ratio can be written in the form a:b [4].
2. Present the photo problem in its exact words: A batch has 4 chocolate for every 2 strawberry. What if there were 24 chocolate?
3. Model the solver: 24 divided by 4 = 6 to find the multiplier, then 2 x 6 = 12, because to scale up a ratio, you have to multiply both numbers by the same factor [4].
4. Repeat with Slide 5 mystery in its exact words: For every 3 blue spoons there are 2 red spoons. 18 blue are used. How many red?

STUDENTS DO

1. Copy 4:2 = 24:12 and say the two calculations aloud.
2. Solve the blue spoons problem with the teacher: 18 ÷ 3 = 6, so 2 x 6 = 12.
3. Choral repeat: both sides get the same multiplier.

Say: First write the two parts as a:b. Find what one side was multiplied by using division. Then multiply the other side by that same whole number, so the comparison stays the same.

Worked example: 4 chocolate : 2 strawberry. Scale chocolate to 24. Step 1: 24 ÷ 4 = 6. Step 2: 2 × 6 = 12. New pair is 24:12. Check: 24 ÷ 6 = 4 and 12 ÷ 6 = 2, back to base.

Ask: How do we find how many times 4 grew to 24? (Divide: 24 ÷ 4 = 6 [4].) · Why must we do 2 x 6 as well? (To scale up a ratio, you have to multiply both numbers by the same factor [4].) · How do 3 blue spoons become 18 blue spoons? (3 x 6 = 18 so 2 x 6 = 12.)

Check understanding: Thumbs up if 24:12 keeps the same for every rule; if not, rebuild with cubes for 4:2 repeated 6 times.

Support: Label the starting numbers on the board and cover the second step until 24 ÷ 4 = 6 is secure.
Stretch: Ask pupils to prove 12 red is right by dividing 18 ÷ 6 and 12 ÷ 6.

Use: Slides 3-5

20–40 min **Main activity** 20 min · Pairs

To scale the 3:2 colour mix to find missing amounts.

YOU DO

1. Show Slides 7 solver steps and give each pair 3 red cubes, 2 blue cubes, cups and a recording sheet.
2. Direct pairs to build the base mix of 3 red cubes to 2 blue cubes and write 3:2.
3. Set the challenge: 12 red cubes are needed, find the blue cubes by 12 ÷ 3 = 4, then 2 × 4 = 8, because division and multiplication can be used to solve ratio problems [8].
4. Circulate, ask pairs to read out both calculations and check by dividing back.

STUDENTS DO

1. Build 3 red cubes to 2 blue cubes in a cup and record 3:2.
2. Find the scale factor with division and make the scaled cup with 12 red and 8 blue.
3. Record both ratios and write 12 ÷ 3 = 4 and 2 × 4 = 8 underneath.

Say: Build 3 red to 2 blue. That is your for every rule. If the red side grows to 12, divide to find the grower, then grow the blue side by the same grower. Write both calculations under your ratios.

Worked example: Base 3 red : 2 blue. Need 12 red. 12 ÷ 3 = 4, so the scale factor is 4. Blue = 2 × 4 = 8. Scaled mix is 12:8, same colour because both sides were multiplied by 4.

Ask: What division finds our multiplier for 12 red cubes? (12 ÷ 3 = 4.) · How many blue cubes keep the same purple? (8, because 2 × 4 = 8.) · How can a table help here? (A table can be used to collect the information needed to solve the problem [8].)

Check understanding: Pairs hold up cups and sheets showing 12:8 with both facts; rebuild base mix if a pair has unequal multipliers.

Support: Give a pre-built base mix and a times-table grid so pupils only find x3 and x4 facts. **Stretch:** Ask pupils to scale the same mix to 30 red cubes and then to explain the method in two sentences.

Use: Slides 7

40–52 min **Practice** 12 min · Pairs

To solve four missing-value puzzles in pairs using tables.

YOU DO

1. Show Slides 10 cards and hand out Worksheet Task B.
2. Model one card: 3 apples to 2 oranges. 9 apples, how many oranges? 9 ÷ 3 = 3, so 2 × 3 = 6.
3. Send pairs to complete Task B: Practice questions: Scale both parts by the same number, using two-column tables.
4. Stop after 9 minutes to compare answers and stress that a bar model may help to clarify the structure of the problem [3].

STUDENTS DO

1. Solve the pencil card: 3 blue to 2 red. 18 blue, how many red?
2. Solve the fruit card: 3 apples to 2 oranges. 9 apples, how many oranges?
3. Complete Worksheet Task B tables, writing ÷ then × beside each arrow.

Say: Write the ratio as two columns. Find what one side was multiplied by. Multiply the other side the same. Draw quick bars or dots if it helps you see the equal groups.

Worked example: 3 apples : 2 oranges with 9 apples. 9 ÷ 3 = 3. Oranges = 2 × 3 = 6. Table shows 3→9 and 2→6 with ×3 arrows on both columns.

Ask: 3 blue pencils grew to 18, what is the multiplier? (6, because 18 ÷ 3 = 6, so red is 2 × 6 = 12.) · 9 apples came from 3 apples, what happens to oranges? (Multiply by 3 as well: 2 × 3 = 6.)

Check understanding: Check tables for matching × arrows on both columns; pull a small group to redo one puzzle with cubes if arrows differ.

Support: Highlight the scale-factor arrow in the known column so pupils see the division first. **Stretch:** Leave both cells blank for 30 apples and ask pupils to show two different routes to the answer.

Use: Slides 10, Worksheet Task B

52–60 min **Plenary** 8 min · Whole class

To check pupils can find missing values and explain the method.

YOU DO

1. Show Slides 12 quiz and cover answers for think time.
2. Take answers on whiteboards for all three: 4:2 to 12, 3:2 to 9, 2:1 to 10.
3. Ask pupils to say the division then multiplication each time and vote which tool helped most.
4. Link back to success criteria and set homework.

STUDENTS DO

1. Show whiteboard answers with both calculations for each quiz question.
2. Explain to a partner why both sides use the same multiplier.
3. Self-check against the three I can statements with fingers 1 to 3.

Say: No guessing, prove it. Tell me the division that found the grower and the multiplication that grew the other side. Then tell your partner which tool, bars, tables or times-table facts, helped you most.

Ask: Ratio 4:2. If 4 is 12, what is 2? (6, because x3, so 2 x 3.) · Ratio 3:2. If 3 is 9, what is 2? (6, because x3, so 2 x 3.) · Ratio 2:1. If 2 is 10, what is 1? (5, because x5, so 1 x 5.)

Check understanding: Count whiteboards showing correct multiplier and missing value; reteach one error by rebuilding 3:2 to 9:6 with cubes tomorrow if needed.

Support: Let pupils answer with the times-table grid open and point to the ÷ then × steps. **Stretch:** Ask pupils to write the check by division for 9:6 back to 3:2.

Use: Slides 12

Common mistakes

Mistake	How to spot it	How to fix it
Adding the same number to both parts instead of multiplying, for example turning 3:2 into 9:8 by adding 6.	See +6 on both sides or mismatched arrows in the table.	Cover and show that to scale up a ratio, you have to multiply both numbers by the same factor [4]; test 3:2 with cubes repeated 3 times.
Multiplying only one side, for example 3:2 becomes 9:2.	One column has a ×3 arrow and the other has none.	Ask what happened to the other side and insist both columns get the same arrow, then check by dividing back to base [8].

Support

- Give a pre-built base mix of 3 red cubes to 2 blue cubes with a times-table grid for x3 and x4 facts
- Highlight the known-column arrow and label bar pictures so pupils find the division step first

Stretch

- Challenge pupils to scale the same mix to 30 red cubes and explain the method in two sentences
- Ask pupils to work backwards by dividing to return to the base ratio and prove the check

For the LSE or teaching assistant

Stay with two focus pairs in the main activity: keep the 3:2 mix built, prompt 12 ÷ 3 first, then 2 × 4, and scribe calculations if needed.

Check for understanding

Question	Answer

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Ratio 4:2. If 4 is 12, what is 2?	6, because x3, so 2 x 3
Ratio 3:2. If 3 is 9, what is 2?	6, because x3, so 2 x 3
Ratio 2:1. If 2 is 10, what is 1?	5, because x5, so 1 x 5

Homework

Practise x3 and x4 facts for 5 minutes and write one 3:2 puzzle for your partner to solve.

Sources

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