

Ages 11–14 · Maths

LESSON SLIDES

Ratio and Proportion

Maths · Simplifying, sharing, unit rates, direct proportion and scale

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Ratio and Proportion

SPEAKER NOTES

Show two glasses of squash, one with 1 part juice to 4 parts water and one with 2 parts juice to 8 parts water. Ask: which one is stronger? Collect votes. Tell students that by the end of the lesson they will be able to prove that the two drinks taste the same.

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By the end of this lesson you can

- 🎯 Write and simplify ratios
- 🎯 Explain how a ratio differs from a fraction
- 🎯 Share an amount in a given ratio
- 🎯 Use unit rates and direct proportion
- 🎯 Use scales on drawings and maps

By the end of this lesson you can

SPEAKER NOTES

Read the objectives aloud. Tell students there is a five-question quiz at the end, and that one method, finding the value of one part, solves most problems in the lesson.

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What is a ratio?

- A ratio compares the sizes of quantities
- 12 red beads and 8 blue beads: red to blue is 12 : 8
- Order matters: blue to red is 8 : 12
- A ratio can have three or more parts, such as 1 : 3 : 5

What is a ratio?

SPEAKER NOTES

Ask students to write the ratio of students wearing glasses to students not wearing glasses in the room. Stress that the order of the words gives the order of the numbers. A common mistake is writing the parts the wrong way round.

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 Example

Simplifying ratios

- 1 Divide every part by the highest common factor
- 2 $12 : 8 \rightarrow$ divide by 4 $\rightarrow 3 : 2$
- 3 Same units first: $40 \text{ cm} : 2 \text{ m} = 40 : 200 = 1 : 5$
- 4 Clear decimals: $1.5 : 2 \rightarrow$ multiply by 2 $\rightarrow 3 : 4$

Simplifying ratios

SPEAKER NOTES

Link back to the starter: $2 : 8$ simplifies to $1 : 4$, so both drinks are the same strength. Ask: what is $15 : 25$ in its simplest form? $3 : 5$. Students often divide by a common factor that is not the highest, such as $6 : 4$ from $12 : 8$; ask them to keep going until no factor is left.

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Ratio vs fraction

Ratio: part to part

- Red : blue = 3 : 2
- Compares one part with another
- 3 red beads for every 2 blue

Fraction: part of the whole

- Red = $\frac{3}{5}$ of the beads
- Compares one part with the total
- $3 + 2 = 5$ parts in the whole

Ratio vs fraction

SPEAKER NOTES

Many students write the ratio 3 : 2 as the fraction $\frac{3}{2}$. Ask: if there are 3 red and 2 blue beads, what fraction is blue? $\frac{2}{5}$, because the total is 5. Adding the parts of a ratio always gives the denominator.

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 Example

Sharing in a ratio

- 1 Share EUR 350 in the ratio 2 : 5
- 2 Total parts: $2 + 5 = 7$
- 3 One part: $350 \div 7 = \text{EUR } 50$
- 4 Shares: $2 \times 50 = \text{EUR } 100$ and $5 \times 50 = \text{EUR } 250$
- 5 Check: $100 + 250 = 350$

Sharing in a ratio

SPEAKER NOTES

Draw a bar model with 7 equal boxes, 2 for the first person and 5 for the second. The most common mistake is dividing by 2 and by 5 instead of by the total 7. Always finish by checking that the shares add back to the amount.

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 Example

Three parts, or one share known

- 1 Share 72 kg in the ratio 1 : 3 : 5
- 2 9 parts, so one part = $72 \div 9 = 8$ kg
- 3 Shares: 8 kg, 24 kg and 40 kg
- 4 Boys : girls = 4 : 5 and there are 20 boys
- 5 One part = $20 \div 4 = 5$, so 25 girls

Three parts, or one share known

SPEAKER NOTES

The second problem gives one share, not the total, so we find one part from the share we know. Ask: how many children are in the club altogether? $9 \text{ parts} \times 5 = 45$. Students who divide 20 by 9 have treated 20 as the total.

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Unit rates: how much for one?

- A unit rate is an amount per one unit
- 150 km in 2.5 hours: $150 \div 2.5 = 60$ km/h
- USD 132 for 8 hours: $132 \div 8 = \text{USD } 16.50$ per hour
- Divide by the quantity you want one of

Unit rates: how much for one?

SPEAKER NOTES

Ask students for unit rates they see in daily life: price per kilogram, kilometres per hour, pay per hour. Ask: what is the cost per litre if 5 litres of paint cost EUR 42? EUR 8.40. Watch for students who divide the wrong way, such as $2.5 \div 150$.

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 Example

Best buy: compare unit prices

- 1 500 g of rice for GBP 2.40, or 750 g for GBP 3.45?
- 2 Per 100 g: $2.40 \div 5 = \text{GBP } 0.48$
- 3 Per 100 g: $3.45 \div 7.5 = \text{GBP } 0.46$
- 4 The 750 g bag is better value

Best buy: compare unit prices

SPEAKER NOTES

Point out that we compare the same amount (100 g) of each. Ask: is the cheapest bag always the best value? No: the small bag costs less in total but more per 100 g. Also mention that a bigger bag is only better value if you use it all.

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Direct proportion

- Both quantities change by the same factor
- Double one and the other doubles
- The ratio between them never changes
- Equation: $y = kx$, where k is the unit rate
- Graph: a straight line through $(0, 0)$

Direct proportion

SPEAKER NOTES

Sketch a graph of cost against number of notebooks at USD 1.50 each: the points lie on a straight line through the origin, and $k = 1.50$. Ask: what does the point $(0, 0)$ mean here? Zero notebooks cost nothing.

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 Example

The unitary method

- 1 250 g of flour makes 10 biscuits
- 2 How much flour for 18 biscuits?
- 3 One biscuit: $250 \div 10 = 25$ g
- 4 18 biscuits: $25 \times 18 = 450$ g
- 5 Or scale up: $18 \div 10 = 1.8$, and $250 \times 1.8 = 450$ g

The unitary method

SPEAKER NOTES

Show both routes and let students choose. The unitary method always works; the scale factor is quicker when the numbers are friendly. A common error is additive thinking: 8 more biscuits so 8 more grams, giving 258 g.

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Proportional or not?

Proportional

- 3 notebooks cost USD 4.50
- 5 notebooks cost USD 7.50
- USD 1.50 each both times

Not proportional

- Taxi: EUR 3 fixed charge plus EUR 2 per km
- 1 km costs EUR 5, 2 km cost EUR 7
- Double the distance, but not double the fare

Proportional or not?

SPEAKER NOTES

Ask students to divide cost by quantity for each pair. The notebooks give 1.50 every time; the taxi gives 5 and then 3.50. The fixed charge means the taxi graph is a straight line that does not pass through the origin.

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 Example

Scale drawings and maps

- 1 Scale 1 : 50 means 1 cm on the plan is 50 cm in real life
- 2 A 3.5 m wall: $350 \text{ cm} \div 50 = 7 \text{ cm}$ on the plan
- 3 Map scale 1 : 25,000: $4 \text{ cm} \times 25,000 = 100,000 \text{ cm}$
- 4 $100,000 \text{ cm} = 1,000 \text{ m} = 1 \text{ km}$

Scale drawings and maps

SPEAKER NOTES

Remind students that a scale has no units: both parts are in the same unit.

Converting at the end is where most errors happen, so write the chain $\text{cm} \rightarrow \text{m} \rightarrow \text{km}$ on the board. Ask: how long would a 2 km road be on that map? 8 cm.

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Common mistakes to avoid

- Writing the parts in the wrong order
- Dividing by one part instead of the total parts
- Mixing units, such as cm with m
- Adding instead of multiplying: $2 : 3$ is not $4 : 5$

Common mistakes to avoid

SPEAKER NOTES

Show one worked example of each mistake and ask students to find the error. The last one is the most important: equivalent ratios come from multiplying both parts by the same number, so $2 : 3$ becomes $4 : 6$, not $4 : 5$.

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 Quick check

Ana and Ben share USD 45 in the ratio 4 : 5. How much does Ben get?

A USD 25

B USD 20

C USD 9

D USD 36

Quick check

SPEAKER NOTES

Answer: A, USD 25. There are 9 parts, one part is $45 \div 9 = \text{USD } 5$, so Ben gets $5 \times 5 = \text{USD } 25$ and Ana gets USD 20. USD 20 is Ana's share, USD 9 is the number of parts, and USD 36 comes from working out four-fifths of 45.

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Key takeaways

- ✓ Simplify a ratio by dividing by the highest common factor
- ✓ Ratio is part to part; fraction is part to whole
- ✓ Sharing: total parts, one part, then multiply
- ✓ Unit rate = amount for one; compare unit prices
- ✓ Direct proportion: same factor, straight line through (0, 0)

Key takeaways

SPEAKER NOTES

Recap one example for each bullet aloud, including the scale example from the previous slides. Then move to the five-question quiz on the page and set the worksheet for practice.