01 / STUDENT ACTIVITY

How many tiles make a border?

Suggested MYP Years 1-3 | 35 minutes | Patterns and algebra

Name: _____ Class: _____ Date: _____

Inquiry question

How can you count the one-tile-wide border of any square grid without counting each tile?

Draw square grids with side lengths 3, 4 and 5 tiles. Shade only the outside border. A corner tile counts once. Investigate whole-number side lengths n of at least 3.

You need: Squared paper; two colours

1. Choose a way to count border tiles and organise your results. Investigate more sizes if helpful.

2. Describe the relationship and write a rule for the border count B in terms of n.

3. Predict the count for a 12 by 12 grid; check it by another method.

4. Explain why your rule works for every permitted n. Compare two different counting methods.

Record your investigation

Use the space below and extra paper for diagrams, tables, calculations and your conclusion.

Exit response: What did you revise, and what evidence changed your mind?

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01 / TEACHER NOTES

How many tiles make a border?

Suggested MYP Years 1-3 | 35 minutes | Patterns and algebra

Teaching purpose

The same picture supports several valid expressions, giving students a reason to explain equivalence rather than simply simplify algebra.

Expected findings / checked solution

Counts for n = 3, 4, 5 are 8, 12, 16. B = 4n - 4: four sides count each corner twice, so subtract four. Alternatively B = n^2 - (n - 2)^2. For n = 12, B = 44. The stated domain is whole numbers n >= 3.

Neutral teacher prompt

Which tiles does each part of your expression count?

Support

Allow physical counters and a partially drawn grid.

Extension

Generalise to an a by b rectangle with a, b >= 3, then to a border two tiles wide.

Suggested lesson rhythm

Launch for 5 minutes; explore for 20 minutes; compare approaches for 7 minutes; finish with a 3-minute exit response.

Formative evidence

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02 / STUDENT ACTIVITY

Does the order of discounts matter?

Suggested MYP Years 1-3 | 30 minutes | Percentages

Name: _____ Class: _____ Date: _____

Inquiry question

Is a 20% discount followed by a 10% discount the same as 30% off?

A fictional shop sells an item for 80 currency units. Offer A gives 20% off, then a further 10% off the reduced price. Offer B gives 30% off the original price. There are no taxes or extra fees.

You need: Calculator; paper

1. Predict which offer is better and explain your initial reasoning.

2. Calculate the final price under each offer; represent the changes with a diagram or multipliers.

3. Test other starting prices. Does your conclusion depend on the original price?

4. Reverse the two successive discounts. Explain what changes and what stays the same.

Record your investigation

Use the space below and extra paper for diagrams, tables, calculations and your conclusion.

Exit response: What did you revise, and what evidence changed your mind?

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Does the order of discounts matter?

Suggested MYP Years 1-3 | 30 minutes | Percentages

Teaching purpose

A familiar shopping claim exposes additive reasoning and creates a useful bridge to multiplicative models.

Expected findings / checked solution

Offer A: 80 x 0.8 x 0.9 = 57.60. Offer B: 80 x 0.7 = 56. Offer B costs 1.60 less. The successive discount is 28%, since 0.8 x 0.9 = 0.72. Reversing percentage discounts gives the same final price when both apply to the current price and there are no intermediate rounding rules.

Neutral teacher prompt

What quantity is the second percentage calculated from?

Support

Use a 100-unit starting price before returning to 80.

Extension

For discounts a% and b%, derive the effective discount a + b - ab/100 percent.

Suggested lesson rhythm

Launch for 5 minutes; explore for 15 minutes; compare approaches for 7 minutes; finish with a 3-minute exit response.

Formative evidence

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03 / STUDENT ACTIVITY

Can a spinner game be fair?

Suggested MYP Years 1-3 | 40 minutes | Probability

Name: _____ Class: _____ Date: _____

Inquiry question

Can you redesign a spinner so neither player has an advantage?

A spinner has eight equally likely sectors: five blue and three gold. Blue awards Player A one point; gold awards Player B one point. Each spin is independent. You may simulate by drawing one of eight labelled slips and replacing it each time.

You need: Paper; pencil; optional spinner

1. Predict the scores after 80 spins and explain the assumptions.

2. Run 40 trials and record both frequencies. Compare the results with your prediction.

3. Redesign the sector colours to make equal one-point rewards fair.

4. Keep five blue and three gold sectors. Can you change the points per colour so expected scores are equal?

Record your investigation

Use the space below and extra paper for diagrams, tables, calculations and your conclusion.

Exit response: What did you revise, and what evidence changed your mind?

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Can a spinner game be fair?

Suggested MYP Years 1-3 | 40 minutes | Probability

Teaching purpose

Students distinguish observed results from a probability model and discover that fairness needs a precise definition.

Expected findings / checked solution

Expected scores after 80 spins are 50 for A and 30 for B, not guaranteed outcomes. With one point per win, four sectors of each colour is fair. With the original sectors, award A 3 points per blue and B 5 per gold: both expected scores per spin are 15/8. Experimental differences alone do not establish unfairness.

Neutral teacher prompt

Do you mean equal chances of scoring, equal expected points, or equal chances of winning a whole match?

Support

List all eight equally likely outcomes and begin with the colour redesign.

Extension

Explain why equal expected points need not give equal probabilities of winning a fixed-length match.

Suggested lesson rhythm

Launch for 5 minutes; explore for 25 minutes; compare approaches for 7 minutes; finish with a 3-minute exit response.

Formative evidence

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04 / STUDENT ACTIVITY

Which rectangle gives the most space?

Suggested MYP Years 1-3 | 35 minutes | Area and optimisation

Name: _____ Class: _____ Date: _____

Inquiry question

If every rectangle has the same perimeter, must it have the same area?

You have 24 units of fencing to enclose a rectangle. Use positive whole-number side lengths. All four sides need fencing; no gates or shared walls are included.

You need: Squared paper; ruler

1. Find every different rectangle you can make; rotating a rectangle does not make a new case.

2. Compare areas and choose a representation that reveals a pattern.

3. Identify the largest area and explain why your list is complete.

4. Describe what happens to the area as the side lengths become more alike.

Record your investigation

Use the space below and extra paper for diagrams, tables, calculations and your conclusion.

Exit response: What did you revise, and what evidence changed your mind?

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Which rectangle gives the most space?

Suggested MYP Years 1-3 | 35 minutes | Area and optimisation

Teaching purpose

A small set of accessible trials opens into a general argument and a discussion of domain restrictions.

Expected findings / checked solution

Possible pairs are (1,11), (2,10), (3,9), (4,8), (5,7), (6,6). Areas are 11, 20, 27, 32, 35, 36 square units. With side lengths x and 12 - x, area is $x(12 - x) = 36 - (x - 6)^2$, so the square maximises area even if positive non-integer lengths are permitted.

Neutral teacher prompt

How will you know you have found every distinct rectangle?

Support

Provide 24 unit strips and allow trial constructions.

Extension

Generalise to perimeter P: show the maximum area is $P^2/16$ for positive real side lengths.

Suggested lesson rhythm

Launch for 5 minutes; explore for 20 minutes; compare approaches for 7 minutes; finish with a 3-minute exit response.

Formative evidence

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05 / STUDENT ACTIVITY

When should you switch plans?

Suggested MYP Years 2-4 | 40 minutes | Linear models

Name: _____ Class: _____ Date: _____

Inquiry question

Which hire plan is cheaper, and when does the answer change?

A fictional bicycle hire service offers Plan A at 6 currency units plus 2 per hour, or Plan B at 15 plus 0.5 per hour. Time t is measured continuously for 0 <= t <= 8 hours. There are no extra charges or rounding rules.

You need: Calculator; graph paper

1. Choose useful hire times and compare both costs.

2. Represent the relationship with equations and a graph, defining your variables and units.

3. Find the break-even time and justify your recommendation for shorter and longer hires.

4. Consider a service that instead charges for each started hour. Explain how the model would change.

Record your investigation

Use the space below and extra paper for diagrams, tables, calculations and your conclusion.

Exit response: What did you revise, and what evidence changed your mind?

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When should you switch plans?

Suggested MYP Years 2-4 | 40 minutes | Linear models

Teaching purpose

The recommendation must depend on the model and its domain, giving equations and graphs a practical purpose.

Expected findings / checked solution

A(t) = 6 + 2t and B(t) = 15 + 0.5t. Equality occurs at t = 6 hours, costing 18. A is cheaper for 0 <= t < 6; B for 6 < t <= 8. If both services charge each started hour, replace t with the ceiling of t (at t = 0 use zero); equality holds for 5 < t <= 6, and costs are step functions.

Neutral teacher prompt

What do the intercept and gradient mean in this situation?

Support

Start with a table at 0, 2, 4, 6 and 8 hours.

Extension

Design a third plan that is cheapest for some, but not all, times in the domain.

Suggested lesson rhythm

Launch for 5 minutes; explore for 25 minutes; compare approaches for 7 minutes; finish with a 3-minute exit response.

Formative evidence

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06 / STUDENT ACTIVITY

Can an average hide the story?

Suggested MYP Years 2-4 | 30 minutes | Statistics

Name: _____ Class: _____ Date: _____

Inquiry question

Which average best describes a typical journey when one result is unusually large?

These are fictional journey times in minutes for seven students: 8, 9, 10, 10, 11, 12, 45. Use only the supplied data; you do not need to collect personal information.

You need: Calculator; paper

1. Calculate the mean and median. Decide which better communicates a typical journey and justify your choice.

2. Represent the data on a number line and explain why the two averages differ.

3. Replace 45 with 15, then with 90. Track which statistics change.

4. Write an honest two-sentence summary that includes both typicality and the unusual journey.

Record your investigation

Use the space below and extra paper for diagrams, tables, calculations and your conclusion.

Exit response: What did you revise, and what evidence changed your mind?

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Can an average hide the story?

Suggested MYP Years 2-4 | 30 minutes | Statistics

Teaching purpose

Students must make and defend a statistical choice, rather than treat every average as an interchangeable calculation.

Expected findings / checked solution

The original total is 105, so the mean is 15 minutes and the median is 10. Replacing 45 with 15 gives a mean of 75/7, about 10.71; replacing it with 90 gives 150/7, about 21.43. In both cases the median remains 10. The median describes the centre of this skewed sample usefully, but the long journey is relevant and should not simply be deleted.

Neutral teacher prompt

What question does your chosen average answer, and what information does it conceal?

Support

Order the data physically using number cards.

Extension

Investigate the effect on mean and median of adding the same value to every observation.

Suggested lesson rhythm

Launch for 5 minutes; explore for 15 minutes; compare approaches for 7 minutes; finish with a 3-minute exit response.

Formative evidence

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07 / STUDENT ACTIVITY

Does doubling length double everything?

Suggested MYP Years 2-4 | 40 minutes | Similarity and measurement

Name: _____ Class: _____ Date: _____

Inquiry question

When a design is enlarged, what happens to perimeter and area?

A rectangular logo is 3 cm wide and 2 cm high. Create similar copies using scale factors 2, 3 and 4. Every length is multiplied by the same factor.

You need: Squared paper; ruler

1. Predict the new perimeters and areas before calculating.

2. Draw or tabulate the copies and compare length, perimeter and area ratios.

3. State and explain general rules for positive scale factor k.

4. A client wants twice the area. Find the scale factor and justify why doubling the lengths would not work.

Record your investigation

Use the space below and extra paper for diagrams, tables, calculations and your conclusion.

Exit response: What did you revise, and what evidence changed your mind?

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Does doubling length double everything?

Suggested MYP Years 2-4 | 40 minutes | Similarity and measurement

Teaching purpose

A concrete enlargement makes it possible to confront a common misconception using both diagrams and algebra.

Expected findings / checked solution

The original perimeter is 10 cm and area is 6 cm². At k = 2, 3, 4 the perimeters are 20, 30, 40 cm and areas are 24, 54, 96 cm². Perimeter scales by k; area by k². Twice the area needs k = square root of 2, about 1.414, giving dimensions about 4.243 cm by 2.828 cm.

Neutral teacher prompt

Can your diagram explain why there are two factors of k in the area?

Support

Use unit squares at k = 2 before making a table.

Extension

For similar boxes, compare volume and surface-area scale factors and discuss packaging material.

Suggested lesson rhythm

Launch for 5 minutes; explore for 25 minutes; compare approaches for 7 minutes; finish with a 3-minute exit response.

Formative evidence

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08 / STUDENT ACTIVITY

Which dice total should you choose?

Suggested MYP Years 2-4 | 40 minutes | Sample spaces

Name: _____ Class: _____ Date: _____

Inquiry question

If you win when two dice add to your chosen total, is every total equally good?

Two independent fair six-sided dice are rolled. You choose one integer total from 2 to 12 before rolling and score one point whenever that total occurs. All successful totals pay the same reward.

You need: Two fair six-sided dice; paper

1. Choose a total and justify your initial strategy.

2. Run 30 trials with a partner and compare frequencies. Keep a tally of every total.

3. Construct a complete sample space that distinguishes the first die from the second.

4. Recommend a total using theoretical probability, then explain why your short experiment may show a different winner.

Record your investigation

Use the space below and extra paper for diagrams, tables, calculations and your conclusion.

Exit response: What did you revise, and what evidence changed your mind?

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Which dice total should you choose?

Suggested MYP Years 2-4 | 40 minutes | Sample spaces

Teaching purpose

Comparing simulation with an explicit sample space makes the source of probability claims visible.

Expected findings / checked solution

There are 36 equally likely ordered outcomes. Counts for sums 2 through 12 are 1, 2, 3, 4, 5, 6, 5, 4, 3, 2, 1. Total 7 has probability 6/36 = 1/6 and maximises expected points. The expected number of sevens in 30 trials is 5; it is not a guaranteed count. Totals are not equally likely even though individual ordered die outcomes are.

Neutral teacher prompt

What are the equally likely outcomes: totals, individual faces, or ordered pairs?

Support

Provide an empty 6 by 6 grid with die values as row and column headings.

Extension

Choose rewards that give equal expected points for totals 2 and 7; compare risk as well as expectation.

Suggested lesson rhythm

Launch for 5 minutes; explore for 25 minutes; compare approaches for 7 minutes; finish with a 3-minute exit response.

Formative evidence

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09 / STUDENT ACTIVITY

How large can an open box be?

Suggested MYP Years 4-5 | 50 minutes | Quadratic area and cubic volume

Name: _____ Class: _____ Date: _____

Inquiry question

Which corner cut makes the largest open box from a fixed sheet?

A sheet measures 20 cm by 30 cm. Cut equal squares of side x cm from all four corners and fold up the sides to form an open box. Ignore material thickness and tabs. First restrict x to whole centimetres with 1 <= x <= 9.

You need: Paper; ruler; scissors optional; calculator

1. Sketch the net and express the box dimensions in terms of x.

2. Choose a systematic method to compare all permitted cuts.

3. Find the best whole-centimetre cut and check your volume independently.

4. Allow any real cut with 0 < x < 10. Use a graph or numerical search to refine the best cut; distinguish a numerical estimate from a proof.

Record your investigation

Use the space below and extra paper for diagrams, tables, calculations and your conclusion.

Exit response: What did you revise, and what evidence changed your mind?

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09 / TEACHER NOTES

How large can an open box be?

Suggested MYP Years 4-5 | 50 minutes | Quadratic area and cubic volume

Teaching purpose

A simple net connects spatial reasoning to functions, constraints and the precision of a recommendation.

Expected findings / checked solution

$V = x(20 - 2x)(30 - 2x)$ cm³. For $x = 1$ through 9, volumes are 504, 832, 1008, 1056, 1000, 864, 672, 448, 216. The integer maximum is 1056 at $x = 4$. Numerical optimisation on the continuous domain gives x about 3.924 cm and V about 1056.31 cm³. Zero and 10 are excluded because the box degenerates.

Neutral teacher prompt

How do you know your proposed maximum is the largest across the domain you are using?

Support

Build the $x = 2$ net and label each dimension before writing a formula.

Extension

Compare the integer optimum with the continuous optimum and evaluate the practical significance of the difference.

Suggested lesson rhythm

Launch for 5 minutes; explore for 35 minutes; compare approaches for 7 minutes; finish with a 3-minute exit response.

Formative evidence

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Which savings plan wins over time?

Suggested MYP Years 4-5 | 45 minutes | Linear and exponential models

Name: _____ Class: _____ Date: _____

Inquiry question

Does a plan that grows by a fixed amount always beat one that grows by a fixed percentage?

Two fictional accounts start with 100 currency units at year 0. Account A adds a fixed bonus of 20 at each year end. Account B grows by 15% at each year end. There are no deposits, withdrawals, taxes or fees; keep full precision until reporting.

You need: Calculator; optional spreadsheet

1. Compare balances for whole years 0 through 8. Predict when one plan overtakes the other.

2. Write expressions for both balances after n years and identify the domain.

3. Find the first whole year when B exceeds A and check the years immediately before and after.

4. Explain why this fictional comparison is insufficient for choosing a real savings account.

Record your investigation

Use the space below and extra paper for diagrams, tables, calculations and your conclusion.

Exit response: What did you revise, and what evidence changed your mind?

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Which savings plan wins over time?

Suggested MYP Years 4-5 | 45 minutes | Linear and exponential models

Teaching purpose

Students compare two kinds of growth and must report a result that matches a discrete time model.

Expected findings / checked solution

A(n) = 100 + 20n and B(n) = 100(1.15)^n for whole n >= 0. They are equal at n = 0. At n = 4, A = 180 and B = 174.900625. At n = 5, A = 200 and B = 201.13571875. B first exceeds A at year 5. Compare years 1-3 as well to establish that it is the first crossing in the discrete domain. Real choices also depend on rates, fees, risk and terms.

Neutral teacher prompt

What is the percentage applied to each year, and why does that change the size of the increase?

Support

Build the first three years by repeated addition and multiplication.

Extension

Change the fixed bonus and percentage, then investigate which assumptions control the crossing year.

Suggested lesson rhythm

Launch for 5 minutes; explore for 30 minutes; compare approaches for 7 minutes; finish with a 3-minute exit response.

Formative evidence

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