

MYSTERY PICTURE



ALGEBRAIC PROOF

Algebraic Proof: Is That the Right Reason?

25 steps, each with a reason · right name, fill the square · a picture appears

FREE

¹ If $JK = 12$, then $JK + 5 = 17$. Reason: Addition Property of Equality	² If $7 = y$, then $y = 7$. Reason: Symmetric Property of Equality	³ If $3x + 5 = 20$, then $3x = 15$. Reason: Subtraction Property of Equality	⁴ If $5x - 2x + 1 = 7$, then $3x + 1 = 7$. Reason: Simplify	⁵ If $m\angle A = m\angle B$ and $m\angle B = m\angle C$, then $m\angle A = m\angle C$. Reason: Transitive Property of Equality
⁶ If $3(x - 2) = 12$, then $3x - 6 = 12$. Reason: Multiplication Property of Equality	⁷ If $x - 9 = 4$, then $x = 13$. Reason: Subtraction Property of Equality	⁸ $AB = AB$ Reason: Symmetric Property of Equality	⁹ If $\frac{x}{4} + 1 = 6$, then $\frac{x}{4} = 5$. Reason: Division Property of Equality	¹⁰ If $x = 4$, then $3x = 12$. Reason: Multiplication Property of Equality
¹¹ If $y + 6 = 10$, then $y = 4$. Reason: Addition Property of Equality	¹² If $x + 3 = 10$, then $10 = x + 3$. Reason: Reflexive Property of Equality	¹³ If $PQ = RS$ and $RS = TU$, then $PQ = TU$. Reason: Symmetric Property of Equality	¹⁴ If $4x = 28$, then $x = 7$. Reason: Division Property of Equality	¹⁵ If $5x = 35$, then $x = 7$. Reason: Multiplication Property of Equality
¹⁶ If $2x + 8 = 20$, then $x + 4 = 10$. Reason: Subtraction Property of Equality	¹⁷ If $m\angle 1 = m\angle 2$, then $m\angle 2 = m\angle 1$. Reason: Transitive Property of Equality	¹⁸ If $y = 3$ and $T = y + 8$, then $T = 3 + 8$. Reason: Substitution	¹⁹ If $\frac{x}{3} = 5$, then $x = 15$. Reason: Division Property of Equality	²⁰ If $x + 7 = 10$, then $x = 3$. Reason: Simplify
²¹ If $x = 7$ and $P = 2x + 3$, then $P = 2(7) + 3$. Reason: Transitive Property of Equality	²² If $2(x + 5) = 18$, then $x + 5 = 9$. Reason: Distributive Property	²³ If $2(x + 4) = 9$, then $2x + 8 = 9$. Reason: Distributive Property	²⁴ If $4x + 3x = 21$, then $7x = 21$. Reason: Addition Property of Equality	²⁵ If $n = 5$, then $n + 4 = 9$. Reason: Substitution

Mystery Picture — how to run it

25–35 minutes

1. **Give each student page 3** and a pencil.
2. **Say this once:** *“Every step is correct math. Only the reason can be wrong. If the reason is the right name, fill the square with slanted lines. If not, leave it white.”*
3. **Let them work.** Nothing else is needed. The picture checks the answers.

Student sheet page 3, one per student. It carries the list of reasons.
Answers page 4 — yours.

Nine of the 25 reasons are right. When those squares are filled, the number 7 appears. A wrong square leaves a gap in the picture or adds a square that does not belong. The student's sheet tells them to check that square again.

Every step on the sheet is correct algebra. So a student cannot find the white squares by looking for bad algebra. Each white square prints a reason that students often confuse with the right one. The most common mistake is naming a step for the sign that goes away. For example, a step that adds 9 to both sides is called “Subtraction” because a minus sign goes away. Other white squares call the Distributive Property the Multiplication Property, or call putting like terms together the Addition Property. Some mix up Symmetric, Transitive and Reflexive, or call Substitution the Transitive Property.

Guessing does not work. Nine of the ten names are right in one square and wrong in another, and every simple guessing rule gets at least seven squares wrong.



This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.
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Mystery Picture — is that the right reason?

A reason for every line

Name _____

Period _____

Date _____

Each square has one step and a reason. **Every step is correct math. Only the reason can be wrong.** Is the reason the right name for the step? If yes, fill the square with slanted lines. If no, leave it white. A picture will appear. If part of it is missing, or one square does not fit, check that square again.

Properties of equality <i>that do the same thing to both sides</i> Addition Property of Equality: If $a = b$, then $a + c = b + c$. Subtraction Property of Equality: If $a = b$, then $a - c = b - c$. Multiplication Property of Equality: If $a = b$, then $a \cdot c = b \cdot c$. Division Property of Equality: If $a = b$ and c is not 0, then $a \div c = b \div c$.	Other properties of equality Reflexive Property of Equality: $a = a$. Symmetric Property of Equality: If $a = b$, then $b = a$. Transitive Property of Equality: If $a = b$ and $b = c$, then $a = c$. Substitution: If $a = b$, then b can take the place of a in a line. Not properties of equality (<i>they change only how one side is written</i>) Distributive Property: $a(b + c) = ab + ac$. Simplify: put like terms together, as in $5x - 2x = 3x$.
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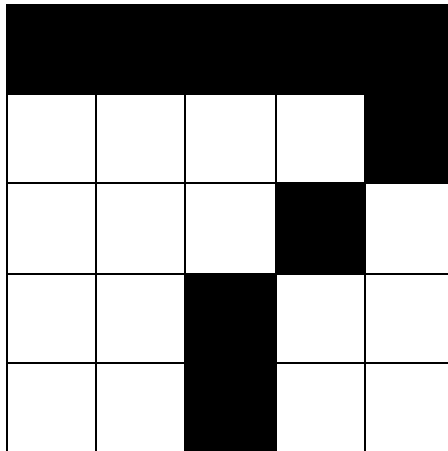
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Mystery Picture — answers

For the teacher



The number 7. Nine squares filled.

Square	The reason printed	Is it right?
1 fill	Addition Property of Equality	Right.
2 fill	Symmetric Property of Equality	Right.
3 fill	Subtraction Property of Equality	Right.
4 fill	Simplify	Right.
5 fill	Transitive Property of Equality	Right.
6 white	Multiplication Property of Equality	Wrong. It is Distributive Property: only the left side is rewritten.
7 white	Subtraction Property of Equality	Wrong. It is Addition Property of Equality: 9 is added to both sides.
8 white	Symmetric Property of Equality	Wrong. It is Reflexive Property of Equality: one thing equals itself.
9 white	Division Property of Equality	Wrong. It is Subtraction Property of Equality: 1 is taken from both sides.
10 fill	Multiplication Property of Equality	Right.
11 white	Addition Property of Equality	Wrong. It is Subtraction Property of Equality: 6 is taken from both sides.
12 white	Reflexive Property of Equality	Wrong. It is Symmetric Property of Equality: the two sides swap.
13 white	Symmetric Property of Equality	Wrong. It is Transitive Property of Equality or Substitution: the two given equations share a side.
14 fill	Division Property of Equality	Right.
15 white	Multiplication Property of Equality	Wrong. It is Division Property of Equality: both sides are divided by 5.
16 white	Subtraction Property of Equality	Wrong. It is Division Property of Equality: both sides are divided by 2.
17 white	Transitive Property of Equality	Wrong. It is Symmetric Property of Equality: the two sides swap.
18 fill	Substitution	Right.
19 white	Division Property of Equality	Wrong. It is Multiplication Property of Equality: both sides are multiplied by 3.
20 white	Simplify	Wrong. It is Subtraction Property of Equality: 7 is taken from both sides.
21 white	Transitive Property of Equality	Wrong. It is Substitution: 7 takes the place of x inside a longer line.
22 white	Distributive Property	Wrong. It is Division Property of Equality: both sides are divided by 2, and the bracket stays.
23 fill	Distributive Property	Right.
24 white	Addition Property of Equality	Wrong. It is Simplify: only the left side is rewritten.
25 white	Substitution	Wrong. It is Addition Property of Equality: 4 is added to both sides.