

CUT & GLUE SORT



ALGEBRAIC PROOF

Algebraic Proof: Both Sides, One Side, or Not Allowed?

12 steps · does it change both sides, only how one side is written, or neither?

FREE

A If $3(x - 2) = 12$, then $3x - 6 = 12$.	B If $3x + 5 = 20$, then $3x = 15$.	C If $4x = 7x$, then $4 = 7$.	D If $2(x + 4) = 9$, then $2x + 4 = 9$.
E If $4x + 2x = 18$, then $6x = 18$.	F If $x = 5$, then $x + 3 = 8$.	G If $2(x + 4) = 10$, then $x + 4 = 5$.	H If $3x + 5 = 20$, then $3x = 25$.
J If $10 = 2(x + 1)$, then $10 = 2x + 2$.	K If $\frac{x}{2} = 7$, then $x = 14$.	L If $x + 9 - 4 = 12$, then $x + 5 = 12$.	M If $3x + 4 = 19$, then $7x = 19$.

Cut & Glue Sort — how to run it

25 minutes, 8 of them cutting

1. **Give each student pages 3 and 4**, scissors and glue.
2. **Say this once:** *“Look at what each step does. Does it do the same thing to both sides? Does it change only how one side is written? Or does the new line not follow at all?”*
3. **Let them cut, sort and glue.** Nothing else is needed.

Rows	page 3, one per student. It carries the list of reasons.
Pieces	page 4, one per student. The student cuts.
Answers	page 5 — yours.

Every row gets four pieces. That is how to mark a sheet in ten seconds. It is printed on your page only. A student who knew it could fill the last row by counting instead of thinking.

The first two rows test a difference that few students notice. Some steps change both sides of the equation. These use a property of equality. Other steps change only the way one side is written. These use the Distributive Property or Simplify. That is why the list on the student's sheet puts the Distributive Property apart from the properties of equality.

The third row holds steps that no reason allows. Its pieces show common mistakes. The 2 multiplies only the first term in the bracket. Each side gets a different change. Unlike terms are put together. Both sides are divided by x when x could be 0. The Division Property on the student's list says c is not 0, and many students do not read that part.

A student cannot sort by how a piece looks. A bracket appears in all three rows. Every simple guessing rule gets at most eight of the twelve pieces right.



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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Cut & Glue Sort — what does the step do?

A reason for every line

Name _____

Period _____

Date _____

Each piece shows one step of algebra. Decide what the step does. Then glue the piece in the row that says so. Use the list of reasons to help you.

Properties of equality *that do the same thing to both sides*

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 *(they change only how one side is written)*

Distributive Property: $a(b + c) = ab + ac$.

Simplify: put like terms together, as in $5x - 2x = 3x$.

Correct: it does the same thing to both sides. *A property of equality allows it.*

Correct: it changes only how one side is written. *The Distributive Property or Simplify allows it.*

Wrong: the new line does not follow. *No reason on the list allows it.*

Cut & Glue Sort — the pieces

Cut along the dashed lines

Cut out the twelve pieces. Read each step. Glue it in one row of the other page.

A If $3(x - 2) = 12$, then $3x - 6 = 12$.	B If $3x + 5 = 20$, then $3x = 15$.	C If $4x = 7x$, then $4 = 7$.	D If $2(x + 4) = 9$, then $2x + 4 = 9$.
E If $4x + 2x = 18$, then $6x = 18$.	F If $x = 5$, then $x + 3 = 8$.	G If $2(x + 4) = 10$, then $x + 4 = 5$.	H If $3x + 5 = 20$, then $3x = 25$.
J If $10 = 2(x + 1)$, then $10 = 2x + 2$.	K If $\frac{x}{2} = 7$, then $x = 14$.	L If $x + 9 - 4 = 12$, then $x + 5 = 12$.	M If $3x + 4 = 19$, then $7x = 19$.



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Cut & Glue Sort — answers

For the teacher

Every row gets four pieces: B F G K / A E J L / C D H M.

Correct: it does the same thing to both sides.

B: If $3x + 5 = 20$, then $3x = 15$. *Subtraction Property of Equality*

F: If $x = 5$, then $x + 3 = 8$. *Addition Property of Equality*

G: If $2(x + 4) = 10$, then $x + 4 = 5$. *Division Property of Equality*

K: If $\frac{x}{2} = 7$, then $x = 14$. *Multiplication Property of Equality*

Correct: it changes only how one side is written.

A: If $3(x - 2) = 12$, then $3x - 6 = 12$. *Distributive Property*

E: If $4x + 2x = 18$, then $6x = 18$. *Simplify*

J: If $10 = 2(x + 1)$, then $10 = 2x + 2$. *Distributive Property*

L: If $x + 9 - 4 = 12$, then $x + 5 = 12$. *Simplify*

Wrong: the new line does not follow.

C: If $4x = 7x$, then $4 = 7$. *Both sides are divided by x , and x could be 0 (here it is 0).*

D: If $2(x + 4) = 9$, then $2x + 4 = 9$. *The 2 multiplies only the x , not the 4.*

H: If $3x + 5 = 20$, then $3x = 25$. *5 is added on the right but taken away on the left.*

M: If $3x + 4 = 19$, then $7x = 19$. *$3x$ and 4 are not like terms.*