

CUT & GLUE SORT

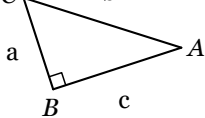
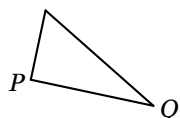
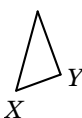


PROVING THE PYTHAGOREAN THEOREM

May the Theorem Be Used?

Twelve lettered triangles · no numbers · three rows

FREE

 $a^2 + b^2 = c^2$	 PQ is perpendicular to PR. $PQ^2 + PR^2 = QR^2$	 $XY^2 + YZ^2 = XZ^2$
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Row 1. Correct: the theorem gives this equation.

Row 2. Wrong: a right angle is known, but the wrong side stands alone.

Row 3. Not allowed: nothing says an angle is right, so the theorem may not be used.

1. **Hand out pages 3 and 4**, one of each per student, with scissors and glue. Nothing else is needed.
2. **Say this once:** *“First ask: is a right angle known, from a mark or from the words? If not, the theorem may not be used. If yes, the side across from the right angle must stand alone.”*
3. **Check a sheet in ten seconds:** every row gets four pieces.

Student sheets	pages 3 and 4, one of each per student. Page 3 has the rule and the three rows. Page 4 has the pieces.
Answers	page 5.

Each piece is a triangle with letters and an equation. There are no numbers. The student decides whether the Pythagorean theorem gives that equation. A right angle can be known in three ways on these pieces: a right-angle mark in the angle, or words such as “PQ is perpendicular to PR”, or words such as “Angle U is a right angle”. Then the side across from the right angle must stand alone on one side of the equation.

Row 2 tests the letters. The right angle is known, but the equation puts another side alone. Of these four pieces, one puts c alone, as if c were always the long side, one starts from a corner that is not the right angle and two write the sides in alphabet order. Alphabet order means that the side named by the first and the last letter, here SU , always stands alone, as in $ST^2 + TU^2 = SU^2$ for triangle STU , wherever the right angle is. The side that stands alone is always the one across from the right angle, whatever its letter.

Row 3 is the most important. In each of its four pieces the angle is drawn exactly right and the equation is the one it would give, so the piece looks correct. But nothing on the piece says the angle is right. In one of them there is no mark at all. In one of them the words say that two sides have the same length. In one of them there is a right-angle mark, but at a different point. In one of them there is an arc in the angle, with no right-angle mark. The theorem may only be used when the angle is known to be right.

A student who only checks that the longest side stands alone places eight pieces correctly. A student who only checks for a right angle places eight. Guessing rules place at most six pieces correctly.

This sort practises when the theorem may be used. It does not practise the proof itself. The lesson has the proof.



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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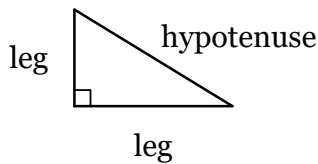
Cut & Glue Sort — may the theorem be used?

The Pythagorean theorem

Name _____

Period _____

Date _____



The Pythagorean theorem: if an angle of a triangle is **known** to be a right angle, then $\text{leg}^2 + \text{leg}^2 = \text{hypotenuse}^2$. The hypotenuse is the side across from the right angle.
Known means a right-angle mark in that angle, or words that say it. A drawing that only looks right is not enough.

Each piece on the next page shows a triangle and an equation. First ask: is a right angle **known**? If yes, ask: is the side across from it alone? **Decide which row the piece belongs in, and glue it there.**

Row 1. Correct: the theorem gives this equation.

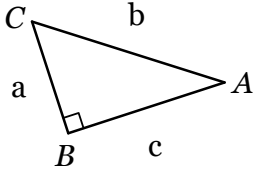
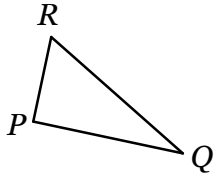
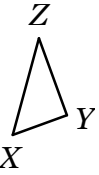
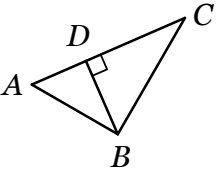
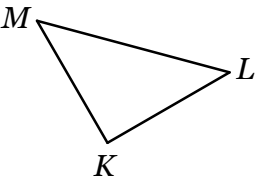
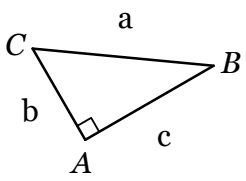
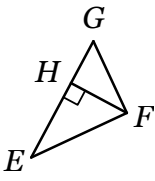
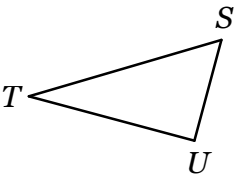
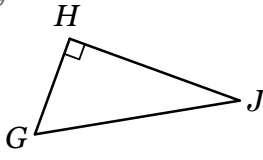
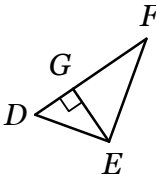
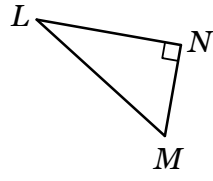
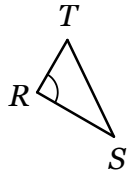
Row 2. Wrong: a right angle is known, but the wrong side stands alone.

Row 3. Not allowed: nothing says an angle is right, so the theorem may not be used.

Cut & Glue Sort — the pieces

Cut along the dashed lines

Cut out the twelve pieces. Glue each one in its row on the other sheet.

1  $a^2 + b^2 = c^2$	2  <i>PQ is perpendicular to PR.</i> $PQ^2 + PR^2 = QR^2$	3  $XY^2 + YZ^2 = XZ^2$	4  $BD^2 + BC^2 = CD^2$
5  <i>KL and KM have the same length.</i> $KL^2 + KM^2 = LM^2$	6  $a^2 = b^2 + c^2$	7  $EH^2 + FH^2 = EF^2$	8  Angle U is a right angle. $ST^2 + TU^2 = SU^2$
9  $GH^2 + HJ^2 = GJ^2$	10  $DE^2 + EF^2 = DF^2$	11  $LN^2 = LM^2 + MN^2$	12  $RS^2 + RT^2 = ST^2$



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Each row holds four pieces. Every piece is listed here with the reason.

1 **Correct: the theorem gives this equation.**

- 2. Triangle PQR. PQ is perpendicular to PR. $PQ^2 + PR^2 = QR^2$. *Why:* The words say that PQ is perpendicular to PR, so angle P is right. The side across from P is QR, and it stands alone. So the theorem gives this equation.
- 6. Triangle ABC. $a^2 = b^2 + c^2$. *Why:* The right-angle mark at A shows that angle A is right. The side across from A is a, and it stands alone. So the theorem gives this equation.
- 7. Triangle EFH. $EH^2 + FH^2 = EF^2$. *Why:* The right-angle mark at H shows that angle EHF is right. The side across from H is EF, and it stands alone. So the theorem gives this equation.
- 9. Triangle GHJ. $GH^2 + HJ^2 = GJ^2$. *Why:* The right-angle mark at H shows that angle H is right. The side across from H is GJ, and it stands alone. So the theorem gives this equation.

2 **Wrong: a right angle is known, but the wrong side stands alone.**

- 1. Triangle ABC. $a^2 + b^2 = c^2$. *Why:* The right-angle mark at B shows that angle B is right. So b, the side across from B, must stand alone. This equation puts c alone instead.
- 4. Triangle BCD. $BD^2 + BC^2 = CD^2$. *Why:* The right-angle mark at D shows that angle CDB is right. So BC, the side across from D, must stand alone. This equation puts CD alone instead.
- 8. Triangle STU. Angle U is a right angle. $ST^2 + TU^2 = SU^2$. *Why:* The words say that angle U is a right angle. So ST, the side across from U, must stand alone. This equation puts SU alone instead.
- 11. Triangle LMN. $LN^2 = LM^2 + MN^2$. *Why:* The right-angle mark at N shows that angle N is right. So LM, the side across from N, must stand alone. This equation puts LN alone instead.

3 **Not allowed: nothing says an angle is right, so the theorem may not be used.**

- 3. Triangle XYZ. $XY^2 + YZ^2 = XZ^2$. *Why:* Angle Y looks right, but no mark and no words say so. A drawing that only looks right is not enough, so the theorem may not be used.
- 5. Triangle KLM. KL and KM have the same length. $KL^2 + KM^2 = LM^2$. *Why:* The words say that KL and KM have the same length. That says nothing about angle K. Angle K only looks right, so the theorem may not be used.
- 10. Triangle DEF. $DE^2 + EF^2 = DF^2$. *Why:* The right-angle mark is at G. It shows that angle DGE is right. Nothing says that angle E is right, so the theorem may not be used for triangle DEF.
- 12. Triangle RST. $RS^2 + RT^2 = ST^2$. *Why:* The arc only shows which angle is meant. It does not say that angle R is right, so the theorem may not be used.

To check a piece with a student, ask two questions. First: what says that an angle of this triangle is right, a mark in that angle or the words? If nothing does, it goes in row 3. If something does, ask: is the side across from that angle the one standing alone? If yes, it goes in row 1. If no, it goes in row 2.