

MYSTERY PICTURE



PROVING THE PYTHAGOREAN THEOREM

Does the Theorem Give It?

25 lettered triangles · no numbers · a picture appears

FREE

1 $AB^2 + BC^2 = AC^2$	2 $LM^2 + LN^2 = MN^2$	3 Angle Q is a right angle. $PQ^2 + QR^2 = PR^2$	4 $JK^2 = JM^2 + KM^2$	5 $XY^2 + XZ^2 = YZ^2$
6 DE is perpendicular to EF. $DE^2 + EF^2 = DF^2$	7 $JK^2 + KL^2 = JL^2$	8 $GH^2 + GJ^2 = HJ^2$	9 $RS^2 + ST^2 = RT^2$	10 $AB^2 + BC^2 = AC^2$
11 $KL^2 = KM^2 + LM^2$	12 $QR^2 = PQ^2 + PR^2$	13 Angle F is a right angle. $EF^2 + FG^2 = EG^2$	14 $QS^2 + RS^2 = QR^2$	15 Angle Z is a right angle. $XY^2 + YZ^2 = XZ^2$
16 $GJ^2 = GH^2 + HJ^2$	17 $KL^2 + LM^2 = KM^2$	18 $BD^2 + BC^2 = CD^2$	19 $SU^2 = ST^2 + TU^2$	20 MN is perpendicular to NP. $MN^2 + MP^2 = NP^2$
21 $RS^2 + ST^2 = RT^2$	22 AC is perpendicular to BC. $AC^2 + BC^2 = AB^2$	23 $DF^2 = DE^2 + EF^2$	24 $BD^2 + CD^2 = BC^2$	25 $XY^2 + XZ^2 = YZ^2$

1. **Give each student page 3** and a pencil.
2. **Say this once:** *“In each square, ask: is a right angle known, from a mark or from the words? Is the side across from it alone? If both are yes, fill the square with slanted lines. If not, leave it white.”*
3. **Let them work.** The picture shows when they are right. Nothing else is needed.

Student sheet page 3, one per student. A box at the top states the theorem with a small drawing.
Answers pages 4–5, for you.

Each square is a triangle with letters and an equation. There are no numbers. The theorem gives the equation only when two things are true. First, an angle of that triangle is known to be right: a right-angle mark stands in that angle, or the words say so. Second, the side across from that right angle stands alone on one side of the equation. Fifteen squares are filled, and the finished picture is **the letter E**.

Five white squares put the wrong side alone. The right angle is known, but the equation puts another side alone. Of these five squares, three write the sides in alphabet order and two start from a corner that is not the right angle. Alphabet order means that the side named by the first and the last letter, here JL, always stands alone, as in $JK^2 + KL^2 = JL^2$ for triangle JKL, wherever the right angle is. The side that stands alone is always the one across from the right angle, whatever its letter.

Five white squares only look right. The angle is drawn exactly right, and the equation is the one it would give. But nothing says the angle is right. In two of them there is no mark at all. 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. In one of them there are equal-length marks on two sides.

If part of a student’s picture looks wrong, the mistake is in that square. Ask: *“What tells you this angle is right? Which side is across from it?”* Guessing does not work. Every simple guessing rule, such as filling every square with a right-angle mark, gets at least eight squares wrong.

This picture 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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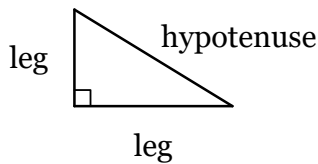
Mystery Picture — does the theorem give it?

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 square shows a triangle and an equation. **Does the Pythagorean theorem give this equation? If yes, fill the square with slanted lines. If no, leave it white.** A picture appears. If part of it is missing, or one square does not fit, check that square again.

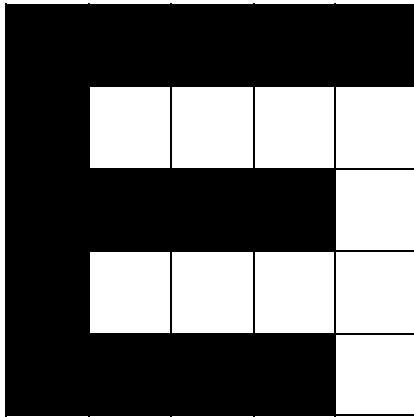
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Mystery Picture — answers

For the teacher



The finished picture is **the letter E**. Fifteen squares are filled.

To check a square, ask two questions. What says that an angle of this triangle is right? Then: is the side across from that angle the one standing alone? The table gives the reason for every square. It goes on over the page.

	The square	Answer	Why
1	Triangle ABC. $AB^2 + BC^2 = AC^2$	fill	The right-angle mark at B shows that angle B is right. The side across from B is AC, and it stands alone. So the theorem gives this equation.
2	Triangle LMN. $LM^2 + LN^2 = MN^2$	fill	The right-angle mark at L shows that angle L is right. The side across from L is MN, and it stands alone. So the theorem gives this equation.
3	Triangle PQR. Angle Q is a right angle. $PQ^2 + QR^2 = PR^2$	fill	The words say that angle Q is a right angle. The side across from Q is PR, and it stands alone. So the theorem gives this equation.
4	Triangle JKM. $JK^2 = JM^2 + KM^2$	fill	The right-angle mark at M shows that angle JMK is right. The side across from M is JK, and it stands alone. So the theorem gives this equation.
5	Triangle XYZ. $XY^2 + XZ^2 = YZ^2$	fill	The right-angle mark at X shows that angle X is right. The side across from X is YZ, and it stands alone. So the theorem gives this equation.
6	Triangle DEF. DE is perpendicular to EF. $DE^2 + EF^2 = DF^2$	fill	The words say that DE is perpendicular to EF, so angle E is right. The side across from E is DF, and it stands alone. So the theorem gives this equation.
7	Triangle JKL. $JK^2 + KL^2 = JL^2$	white	The right-angle mark at J shows that angle J is right. So KL, the side across from J, must stand alone. This equation puts JL alone instead.
8	Triangle GHJ. $GH^2 + GJ^2 = HJ^2$	white	Angle G 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.
9	Triangle RST. $RS^2 + ST^2 = RT^2$	white	The right-angle mark at T shows that angle T is right. So RS, the side across from T, must stand alone. This equation puts RT alone instead.
10	Triangle ABC. $AB^2 + BC^2 = AC^2$	white	The right-angle mark is at D. It shows that angle ADB is right. Nothing says that angle B is right, so the theorem may not be used for triangle ABC.
11	Triangle KLM. $KL^2 = KM^2 + LM^2$	fill	The right-angle mark at M shows that angle M is right. The side across from M is KL, and it stands alone. So the theorem gives this equation.
12	Triangle PQR. $QR^2 = PQ^2 + PR^2$	fill	The right-angle mark at P shows that angle P is right. The side across from P is QR, and it stands alone. So the theorem gives this equation.

Mystery Picture — answers, squares 13 to 25

For the teacher

	The square	Answer	Why
13	Triangle EFG. Angle F is a right angle. $EF^2 + FG^2 = EG^2$	fill	The words say that angle F is a right angle. The side across from F is EG, and it stands alone. So the theorem gives this equation.
14	Triangle QRS. $QS^2 + RS^2 = QR^2$	fill	The right-angle mark at S shows that angle RSQ is right. The side across from S is QR, and it stands alone. So the theorem gives this equation.
15	Triangle XYZ. Angle Z is a right angle. $XY^2 + YZ^2 = XZ^2$	white	The words say that angle Z is a right angle. So XY, the side across from Z, must stand alone. This equation puts XZ alone instead.
16	Triangle GHJ. $GJ^2 = GH^2 + HJ^2$	fill	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.
17	Triangle KLM. $KL^2 + LM^2 = KM^2$	white	The arc only shows which angle is meant. It does not say that angle L is right, so the theorem may not be used.
18	Triangle BCD. $BD^2 + BC^2 = CD^2$	white	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.
19	Triangle STU. $SU^2 = ST^2 + TU^2$	white	Angle T 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.
20	Triangle MNP. MN is perpendicular to NP. $MN^2 + MP^2 = NP^2$	white	The words say that MN is perpendicular to NP, so angle N is right. So MP, the side across from N, must stand alone. This equation puts NP alone instead.
21	Triangle RST. $RS^2 + ST^2 = RT^2$	fill	The right-angle mark at S shows that angle S is right. The side across from S is RT, and it stands alone. So the theorem gives this equation.
22	Triangle ABC. AC is perpendicular to BC. $AC^2 + BC^2 = AB^2$	fill	The words say that AC is perpendicular to BC, so angle C is right. The side across from C is AB, and it stands alone. So the theorem gives this equation.
23	Triangle DEF. $DF^2 = DE^2 + EF^2$	fill	The right-angle mark at E shows that angle E is right. The side across from E is DF, and it stands alone. So the theorem gives this equation.
24	Triangle BCD. $BD^2 + CD^2 = BC^2$	fill	The right-angle mark at D shows that angle D is right. The side across from D is BC, and it stands alone. So the theorem gives this equation.
25	Triangle XYZ. $XY^2 + XZ^2 = YZ^2$	white	The marks show that XY and XZ have the same length. That says nothing about angle X. Angle X only looks right, so the theorem may not be used.