

CUT & GLUE SORT



CONVERSE OF THE PYTHAGOREAN THEOREM

Acute, Obtuse, or No Triangle at All?

Twelve sets of side lengths · check first, then compare squares

FREE

¹ 11, 3, 12	² 4, 5, 4	³ 6, 10, 5	⁴ 7, 8, 4
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Cut & Glue Sort — how to run it

20–25 minutes, including the cutting

1. **Hand out page 3**, one per student, with scissors and glue. Calculators are allowed for the squares.
2. **Say this once:** *“Put the three numbers in order first. Check that the two smaller ones add to more than the biggest. If they do not, it is not a triangle. If they do, compare $a^2 + b^2$ with c^2 .”*
3. **Check a sheet in ten seconds:** every row gets four pieces.

Student sheet	page 3, one per student. The steps and four small drawings are at the top, the three rows in the middle, and the pieces at the bottom.
Answers	page 4.

The rule. Let c be the longest side and a and b the other two. The three lengths make a triangle only if $a + b$ is more than c . Then $a^2 + b^2$ more than c^2 means acute, equal means right, and less means obtuse. No piece on this sheet is right. Pieces 11 (12, 5, 12) and 5 (14, 5, 12) sit on either side of the right triangle 5, 12, 13, so a student cannot answer them by remembering it. Piece 4 (7, 8, 4) misses right by one: $4^2 + 7^2 = 65$ and $8^2 = 64$.

The last row matters most. In one of its four pieces the two smaller lengths add to exactly the biggest one. A student who skips the triangle check still gets an answer from the squares, and it is always “obtuse”. That student gets eight of the twelve pieces right. That student puts four in the “acute” row, eight in the “obtuse” row and zero in the “not a triangle” row, not four in each. The quick check catches this.

One mistake the quick check does not catch. A student who turns the comparison around swaps the whole acute row with the whole obtuse row. The rows still hold four pieces each, but only four pieces are right. So also check one piece in the acute row.

Partners. Some pieces differ in only one number, like 11, 3, 12 and 7, 12, 3. Two such pieces are never in the same row. If a student has two of them in one row, one of the two is wrong. Guessing does not work: no simple guessing rule gets more than six 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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Acute, obtuse, or not a triangle?

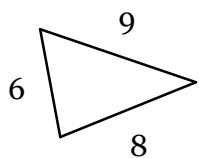
Classifying by side lengths

Name _____

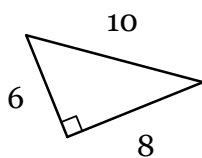
Period _____

Date _____

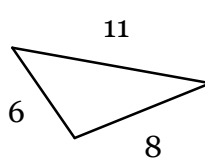
1. Put the three numbers in order. Call the biggest one c , and the other two a and b .
2. Check that $a + b$ is more than c . If it is not, the sides do not make a triangle. Stop there.
3. Compare $a^2 + b^2$ with c^2 . More: **acute**. Equal: **right**. Less: **obtuse**.



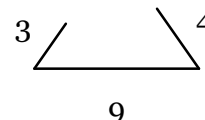
$6^2 + 8^2 = 100$. $9^2 = 81$. 100 is more than 81: **acute**.



$6^2 + 8^2 = 100$. $10^2 = 100$. They are equal: **right**.



$6^2 + 8^2 = 100$. $11^2 = 121$. 100 is less than 121: **obtuse**.



$3 + 4 = 7$. That is less than 9. The sides cannot meet: **not a triangle**.

Cut out the twelve pieces below. Each gives three side lengths. Decide for each: acute, obtuse, or not a triangle. No piece is right. Glue each piece in its row.

Acute. $a^2 + b^2$ is **more** than c^2 .

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Obtuse. $a^2 + b^2$ is **less** than c^2 .

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Not a triangle. $a + b$ is **not more** than c . The sides cannot meet.

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1 11, 3, 12	2 4, 5, 4	3 6, 10, 5	4 7, 8, 4
5 14, 5, 12	6 7, 12, 3	7 9, 5, 10	8 9, 4, 4
9 5, 7, 4	10 5, 14, 9	11 12, 5, 12	12 10, 4, 5



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Cut & Glue Sort — answers

For the teacher

Acute.	2 (4, 5, 4). In order: 4, 4, 5. $4 + 4 = 8$ is more than 5. $4^2 + 4^2 = 32$, and $5^2 = 25$. 32 is more than 25.	4 (7, 8, 4). In order: 4, 7, 8. $4 + 7 = 11$ is more than 8. $4^2 + 7^2 = 65$, and $8^2 = 64$. 65 is more than 64.	7 (9, 5, 10). In order: 5, 9, 10. $5 + 9 = 14$ is more than 10. $5^2 + 9^2 = 106$, and $10^2 = 100$. 106 is more than 100.	11 (12, 5, 12). In order: 5, 12, 12. $5 + 12 = 17$ is more than 12. $5^2 + 12^2 = 169$, and $12^2 = 144$. 169 is more than 144.
Obtuse.	1 (11, 3, 12). In order: 3, 11, 12. $3 + 11 = 14$ is more than 12. $3^2 + 11^2 = 130$, and $12^2 = 144$. 130 is less than 144.	3 (6, 10, 5). In order: 5, 6, 10. $5 + 6 = 11$ is more than 10. $5^2 + 6^2 = 61$, and $10^2 = 100$. 61 is less than 100.	5 (14, 5, 12). In order: 5, 12, 14. $5 + 12 = 17$ is more than 14. $5^2 + 12^2 = 169$, and $14^2 = 196$. 169 is less than 196.	9 (5, 7, 4). In order: 4, 5, 7. $4 + 5 = 9$ is more than 7. $4^2 + 5^2 = 41$, and $7^2 = 49$. 41 is less than 49.
Not a triangle.	6 (7, 12, 3). In order: 3, 7, 12. $3 + 7 = 10$, which is less than 12, so the sides cannot meet.	8 (9, 4, 4). In order: 4, 4, 9. $4 + 4 = 8$, which is less than 9, so the sides cannot meet.	10 (5, 14, 9). In order: 5, 9, 14. $5 + 9 = 14$, which is exactly 14, so the sides cannot meet.	12 (10, 4, 5). In order: 4, 5, 10. $4 + 5 = 9$, which is less than 10, so the sides cannot meet.

Every row holds four pieces. For each piece, put the three lengths in order. If the two smaller ones do not add to more than the biggest, it is not a triangle. Otherwise compare the sum of their squares with the square of the biggest. More: acute. Less: obtuse.

Partner pieces, which differ in one number and sit in different rows: 1 and 6, 2 and 8, 2 and 9, 2 and 12, 3 and 7, 3 and 12, 4 and 9, 5 and 10, 5 and 11, 7 and 10, 7 and 12, 9 and 12.

To check a piece with a student, ask: “Which number is the biggest? Do the other two add to more than it? What are their squares added?”

This sheet counts three lengths whose two shorter sides add to exactly the longest as “not a triangle”. Some textbooks use other definitions, so tell the class which ones this sheet uses.