

CUT & GLUE SORT

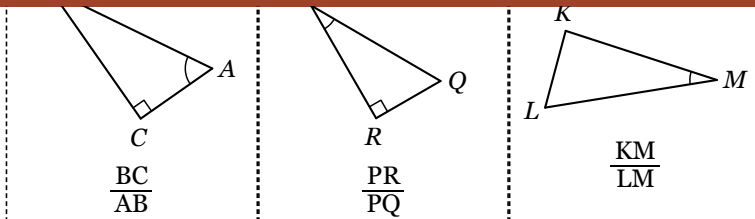


SINE, COSINE AND TANGENT RATIOS

Sine, Cosine, or Not a Right Triangle?

Twelve lettered triangles · find the arc · three rows

FREE



Row 1. The fraction is the sine of the angle with the arc: the opposite leg over the hypotenuse.

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Row 2. The fraction is the cosine of the angle with the arc: the adjacent leg over the hypotenuse.

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Row 3. No right angle is marked. It may not be a right triangle, so sine and cosine cannot be used.

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Cut & Glue Sort — how to run it

25 minutes, including the cutting

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 look for the right-angle square. No square means row 3. Then find the arc. Does the top of the fraction touch the angle with the arc? Opposite does not touch it. Adjacent touches it.”*
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 three rows. Page 4 has the pieces and the three definitions, with the same triangle drawn twice.

Answers page 5.

Each piece is a lettered triangle with an arc at one angle and a fraction of two sides. There are no numbers. The fraction always has the longest side on the bottom, so the student must decide between sine (opposite leg $\div$ hypotenuse) and cosine (adjacent leg $\div$ hypotenuse). The leg opposite the angle does not touch it. The adjacent leg touches it. A student who swaps the two puts a row-1 piece in row 2, or the reverse. This can happen with any of the eight pieces that have a square. Every triangle is turned: a student who calls the more upright leg “opposite” places only four of the twelve pieces correctly.

Row 3 is the most important. Sine and cosine are defined only in a right triangle: the hypotenuse is the side across from the right angle. The four row-3 triangles have no square. They look right-angled, but their corners are 87° , 93° , 88° and 92° . Ask: *“Which mark tells you this angle is 90° ?”* Guessing rules that do not use the square place at most six pieces correctly.



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 — sine or cosine?

Trigonometric ratios

Name _____

Period _____

Date _____

Each piece on the next page shows a triangle with an arc and a fraction of two of its sides. **First look for the right-angle square. Then find the arc. Decide which row the piece belongs in, and glue it there.** Use the marks and the letters, not how the drawing looks.

Row 1. The fraction is the sine of the angle with the arc: the opposite leg over the hypotenuse.

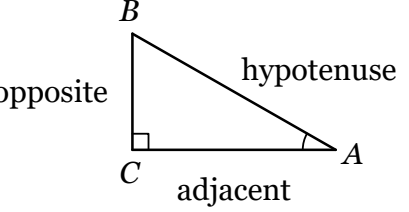
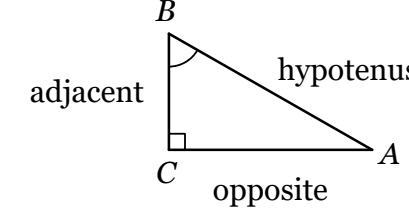
Row 2. The fraction is the cosine of the angle with the arc: the adjacent leg over the hypotenuse.

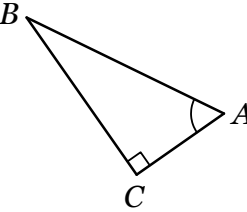
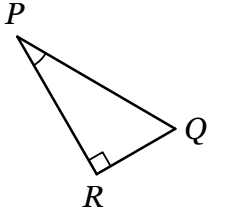
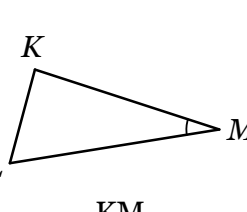
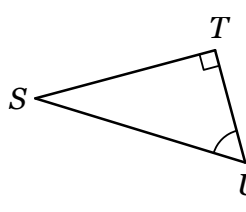
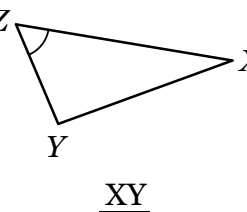
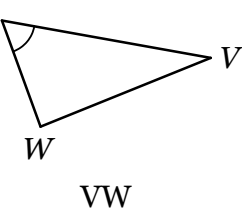
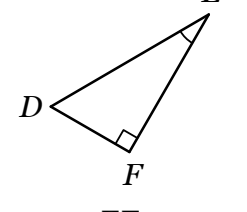
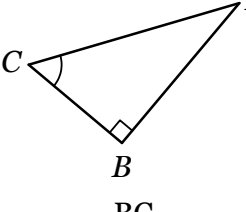
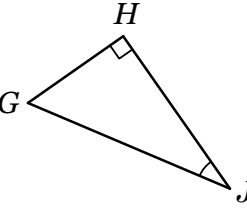
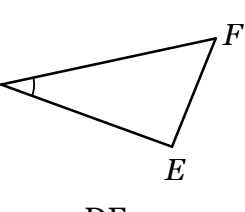
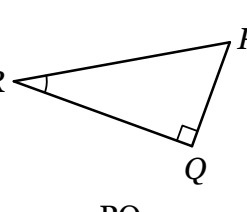
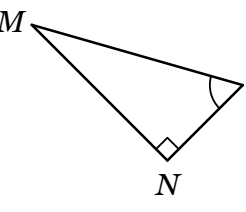
Row 3. No right angle is marked. It may not be a right triangle, so sine and cosine cannot be used.

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.

 The arc marks angle A. The hypotenuse is across from the right angle. The leg opposite an angle does not touch it. The leg adjacent to an angle touches it. The hypotenuse touches the angle too, but it is never the adjacent leg. When the angle moves, opposite and adjacent change places.	 The arc marks angle B.	$\sin A = \frac{\text{leg opposite A}}{\text{hypotenuse}}$ $\cos A = \frac{\text{leg adjacent to A}}{\text{hypotenuse}}$ $\tan A = \frac{\text{leg opposite A}}{\text{leg adjacent to A}}$
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1  $\frac{BC}{AB}$	2  $\frac{PR}{PQ}$	3  $\frac{KM}{LM}$	4  $\frac{ST}{SU}$
5  $\frac{XY}{XZ}$	6  $\frac{VW}{UV}$	7  $\frac{EF}{DE}$	8  $\frac{BC}{AC}$
9  $\frac{GH}{GJ}$	10  $\frac{DE}{DF}$	11  $\frac{PQ}{PR}$	12  $\frac{NP}{MP}$



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Each row holds four pieces. Every piece is described again here, with the reason.

- 1 **The fraction is the sine of the angle with the arc: the opposite leg over the hypotenuse.**
 1. Arc at A, fraction BC/AB . *Why:* Right angle at C. BC is the leg opposite A (it does not touch the arc), and AB is the hypotenuse. So BC/AB is $\sin A$.
 4. Arc at U, fraction ST/SU . *Why:* Right angle at T. ST is the leg opposite U (it does not touch the arc), and SU is the hypotenuse. So ST/SU is $\sin U$.
 9. Arc at J, fraction GH/GJ . *Why:* Right angle at H. GH is the leg opposite J (it does not touch the arc), and GJ is the hypotenuse. So GH/GJ is $\sin J$.
 11. Arc at R, fraction PQ/PR . *Why:* Right angle at Q. PQ is the leg opposite R (it does not touch the arc), and PR is the hypotenuse. So PQ/PR is $\sin R$.
- 2 **The fraction is the cosine of the angle with the arc: the adjacent leg over the hypotenuse.**
 2. Arc at P, fraction PR/PQ . *Why:* Right angle at R. PR is the leg adjacent to P (it touches the arc), and PQ is the hypotenuse. So PR/PQ is $\cos P$.
 7. Arc at E, fraction EF/DE . *Why:* Right angle at F. EF is the leg adjacent to E (it touches the arc), and DE is the hypotenuse. So EF/DE is $\cos E$.
 8. Arc at C, fraction BC/AC . *Why:* Right angle at B. BC is the leg adjacent to C (it touches the arc), and AC is the hypotenuse. So BC/AC is $\cos C$.
 12. Arc at P, fraction NP/MP . *Why:* Right angle at N. NP is the leg adjacent to P (it touches the arc), and MP is the hypotenuse. So NP/MP is $\cos P$.
- 3 **No right angle is marked. It may not be a right triangle, so sine and cosine cannot be used.**
 3. Arc at M, fraction KM/LM . *Why:* There is no square at K. The corner is 87° , not 90° , but only the mark could tell. Without it, LM is not known to be a hypotenuse.
 5. Arc at Z, fraction XY/XZ . *Why:* There is no square at Y. The corner is 93° , not 90° , but only the mark could tell. Without it, XZ is not known to be a hypotenuse.
 6. Arc at U, fraction VW/UV . *Why:* There is no square at W. The corner is 88° , not 90° , but only the mark could tell. Without it, UV is not known to be a hypotenuse.
 10. Arc at D, fraction DE/DF . *Why:* There is no square at E. The corner is 92° , not 90° , but only the mark could tell. Without it, DF is not known to be a hypotenuse.

To check a piece with a student, ask three questions. Is there a square at a corner? If not, the piece goes in row 3. Which corner has the arc? Does the top side of the fraction touch that corner? If it does not, it is the opposite leg and the piece goes in row 1. If it does, it is the adjacent leg and the piece goes in row 2.

This sheet uses these definitions: $\sin = \text{opposite leg} \div \text{hypotenuse}$ and $\cos = \text{adjacent leg} \div \text{hypotenuse}$, in a right triangle. Some textbooks use other definitions, so tell the class which ones this sheet uses.