

CUT & GLUE SORT



THE MIDPOINT ON A NUMBER LINE AND IN THE PLANE

Midpoint or Other Endpoint — or Can It Not Be Found?

Number lines and the plane · decide how, don't work it out

FREE

A <i>M</i> is a point on segment <i>JK</i>, with <i>J</i> at -6 and <i>K</i> at 2 on a number line. Where is <i>M</i>?	B <i>M</i> is the midpoint of <i>GH</i>, with <i>G</i> at $(4, -2)$ and <i>H</i> at $(-6, 8)$. Where is <i>M</i>?	C <i>M</i> is the midpoint of <i>AB</i>. On a number line <i>A</i> is at 6 and <i>M</i> is at -1. Where is <i>B</i>?	D <i>R</i> is the midpoint of <i>ST</i>. <i>S</i> is $(0, 5)$, on the <i>y</i>-axis, and <i>T</i> is $(3, -3)$. Where is <i>R</i>?
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1. **Hand out pages 3 and 4**, one of each per student, and scissors and glue.
2. **Say this once:** *“Don't calculate anything. Which two of the three points do you know? Do you know both endpoints, or one endpoint and the midpoint? If it is neither, it cannot be found.”*
3. **Every row gets 4.** A row with more or fewer has a piece in the wrong place. That is how you mark it in ten seconds. *(This is not printed on the student's sheet. If it were, students could finish the last row without deciding anything.)*

Student sheets	pages 3 and 4, one of each per student. The midpoint, the plane and going backwards are on the first as pictures.
Answers	page 5.

What is being sorted. The first two rows are the two directions of the lesson. The first finds the midpoint from both endpoints. The second finds an endpoint from the other endpoint and the midpoint. They are side by side, so students must choose between them. The common mistake on a second-row question is to average the endpoint with the midpoint. So the letters change from piece to piece. M is the midpoint on one piece and an endpoint on another. Elsewhere the midpoint is K, P, Q or R.

The third row is the hard one. The formula needs two of the three points. Each of the four pieces in this row fits more than one place. Each of the other eight pieces fits exactly one place.

A length or an axis does not mean the piece cannot be found. Three pieces that can be found also mention one. It is an axis the point lies on, or a length that is not needed. A student who puts every piece with an extra fact in the last row gets those pieces wrong.



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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Halve it, go past the midpoint, or can it not be found?

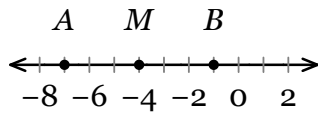
Midpoints

Name _____

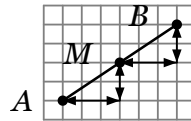
Period _____

Date _____

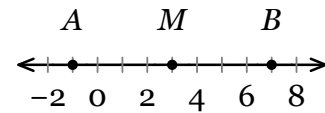
Cut out the twelve pieces on the next page. **Do not work out any answers.** For each piece, decide how you would find the point. Then glue it into that row. **Each piece uses different letters. Check which point is the midpoint before you decide.**



The midpoint
add, then halve: $(-7 + (-1)) \div 2 = -4$



In the plane
 x with x , y with y : the answer is a pair



The other endpoint
the same step again: $2 \times 3 - (-1) = 7$

ADD THE TWO, THEN HALVE : both endpoints are known, and the midpoint is asked for

DOUBLE THE MIDPOINT, TAKE AWAY THE ENDPOINT : one endpoint and the midpoint are known, and the other endpoint is asked for

IT CANNOT BE FOUND : what is given fits more than one place

The twelve pieces

Cut along the dotted lines

A M is a point on segment JK, with J at -6 and K at 2 on a number line. Where is M?	B M is the midpoint of GH, with G at $(4, -2)$ and H at $(-6, 8)$. Where is M?	C M is the midpoint of AB. On a number line A is at 6 and M is at -1. Where is B?	D R is the midpoint of ST. S is $(0, 5)$, on the y-axis, and T is $(3, -3)$. Where is R?
E P is the midpoint of QR, and P is $(2, -3)$. Where is Q?	F Q is the midpoint of PM. On a number line P is at -3 and Q is at 5. Where is M?	G The midpoint of a segment is $(0, -4)$, on the y-axis, and one endpoint is $(3, 2)$. Where is the other endpoint?	H D is the midpoint of EF. On a number line E is at -7 and F is at 3. Where is D?
J B is $(-5, 1)$ and A is somewhere on the x-axis. Where is the midpoint of AB?	K K is the midpoint of MN, with M at $(2, 3)$ and K at $(-1, 5)$. Where is N?	L On a number line A is at 4, and AB is 10 long. Where is the midpoint of AB?	M A segment MN is 14 long, with M at -4 and N at 10 on a number line. Where is its midpoint?



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Cut & Glue Sort — answers

For the teacher

ADD THE TWO, THEN HALVE	B. Both endpoints are known, in the plane.	D. Both endpoints are known. Being on the y-axis changes nothing.	H. Both endpoints are known: $(-7 + 3) \div 2$.	M. Both endpoints are known. Here M is an endpoint, and the length is not needed.
DOUBLE THE MIDPOINT, TAKE AWAY THE ENDPOINT	C. An endpoint and the midpoint are known: $2 \times (-1) - 6$.	F. An endpoint and the midpoint are known: $2 \times 5 - (-3)$.	G. An endpoint and the midpoint are known. Being on the y-axis changes nothing.	K. Here M is an endpoint and K is the midpoint.
IT CANNOT BE FOUND	A. A point on the segment is not always the midpoint. M could be anywhere from -6 to 2.	E. Only the midpoint is known, so Q could be anywhere.	J. A could be anywhere on the x-axis.	L. B could be at 14 or at -6, so the midpoint could be 9 or -1.

If a class finishes early, ask about each piece in the last row: *What one fact would move it up a row?* The answer is the other endpoint, or whether B is to the left or right of A. Then students can find the eight that can be found. To check a second-row answer, average it with the endpoint you had. You should get the midpoint back.

Guessing does not work. A student who puts every piece with only one printed point in the last row, and sorts the rest by what they ask for, gets only eight of the twelve pieces right.