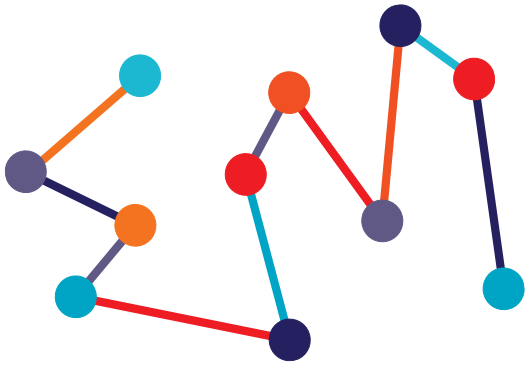
Connect the Dots

Reveal a picture through your skill at working on a coordinate plane.

Typically in a connect-the-dots puzzle, the dots are already given, but not in the National Math Club's version! For this activity students must determine where to place the dots on the coordinate plane before they can connect them and reveal the picture. Students will practice rotations, reflections and translations, writing *x*- and *y*-coordinates of points and using slopes and the slope-intercept form of lines.



MATERIALS NEEDED

- Mathman or Shooting Star Instructions handout (one per student)
- Mathman or Shooting Star handout (one per student)
- Pencils (one per student or per group)
- Colored pencils, markers or crayons (optional)

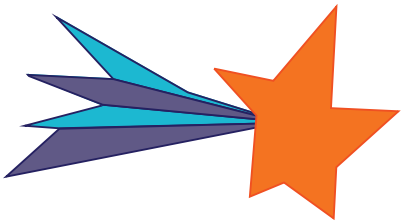
PART 1: INSTRUCTIONS

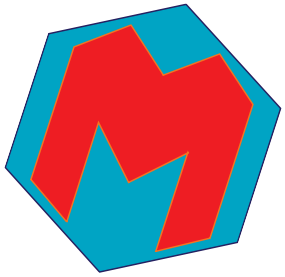
Included in this activity are two connect-the-dots patterns with instructions. The numbers on the left side of the instructions handouts show the order of the points. Beside each number is an instruction for how to find that point. Each instruction is based on the immediately previous point—any movement should start at that previous point. Because of this, if a student has a point incorrect somewhere in the activity, any subsequent points will likely be incorrect as well. If a student gets stuck, check to see where the first wrong point is, correct this answer and let the student try to finish the rest of the points from there. On the right side of the instructions handout is a spot for students to write the *x*- and *y*-coordinates of each point they find. The arrows drawn between the point numbers show which points should be connected by lines. For the Mathman pattern, there are two separate sets of connected points, but for the Shooting Star pattern, there is just one continuous set of connected points.

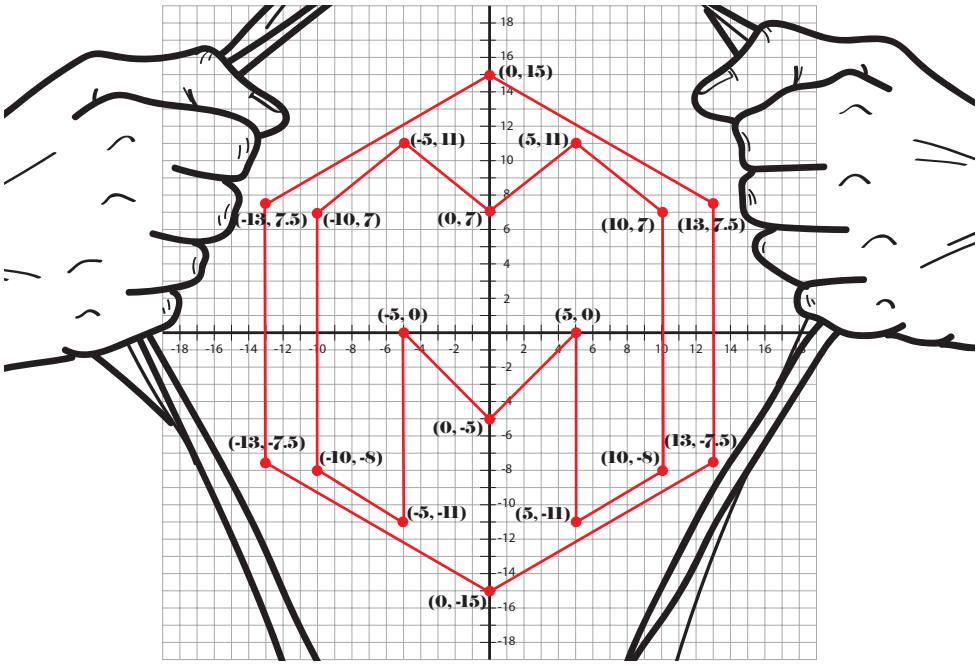
The instructions use knowledge of positive and negative *x* and *y* directions, reflections over an axis, reflections over a line, rotations about a point and moving along a specified slope. You may want to do a refresher on any of these topics with your club. The instructions can also be edited to make them simpler if needed. For example, instead of having a student rotate a point 90 degrees about another point, you can edit the instruction to have students translate the original point a certain number of units in the *x* and *y* directions to get the same result. The Shooting Star instructions require a slightly greater comprehension of these topics.

PART 2: SOLUTIONS

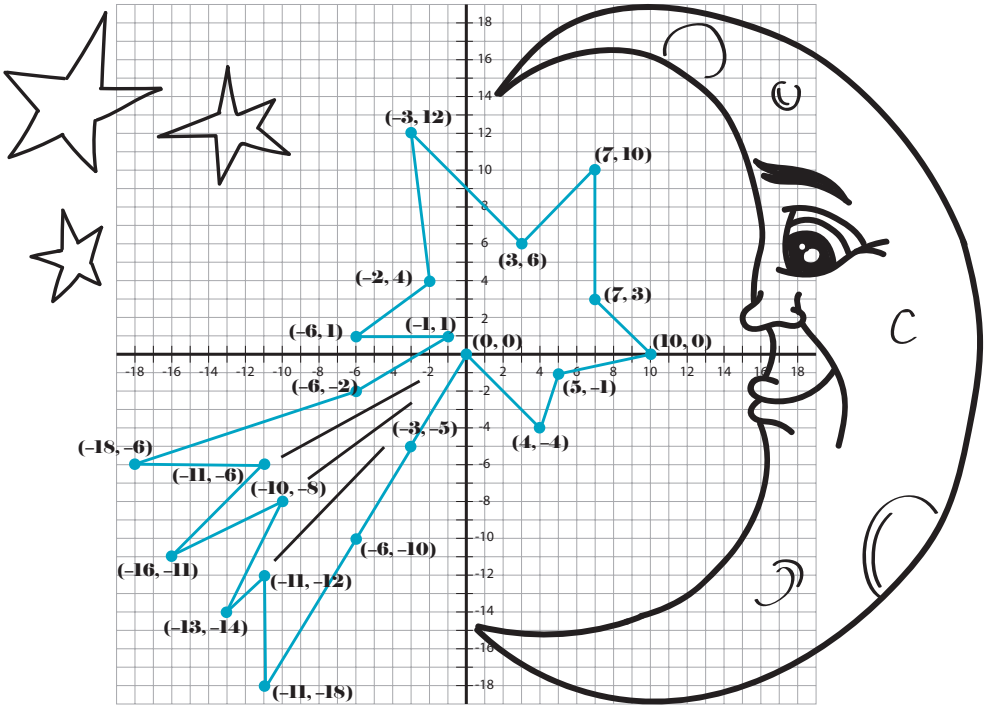
Below are the solutions to both of the connect-the-dots patterns. The solutions are given both as the final drawing on the coordinate plane with points labeled and as an ordered list of the coordinates the student should have filled in on the instructions handout.







1. (0, −5)
2. (5, 0)
3. (5, −11)
4. (10, −8)
5. (10, 7)
6. (5, 11)
7. (0, 7)
8. (−5, 11)
9. (−10, 7)
10. (−10, −8)
11. (−5, −11)
12. (−5, 0)
13. (0, 15)
14. (−13, 7.5)
15. (−13, −7.5)
16. (0, −15)
17. (13, −7.5)
18. (13, 7.5)



1. (0, 0)
2. (4, −4)
3. (5, −1)
4. (10, 0)
5. (7, 3)
6. (7, 10)
7. (3, 6)
8. (−3, 12)
9. (−2, 4)
10. (−6, 1)
11. (−1, 1)
12. (−6, −2)
13. (−18, −6)
14. (−11, −6)
15. (−16, −11)
16. (−10, −8)
17. (−13, −14)
18. (—11, −12)
19. (—11, −18)
20. (−6, −10)
21. (−3, −5)

DO MORE WITH THIS ACTIVITY

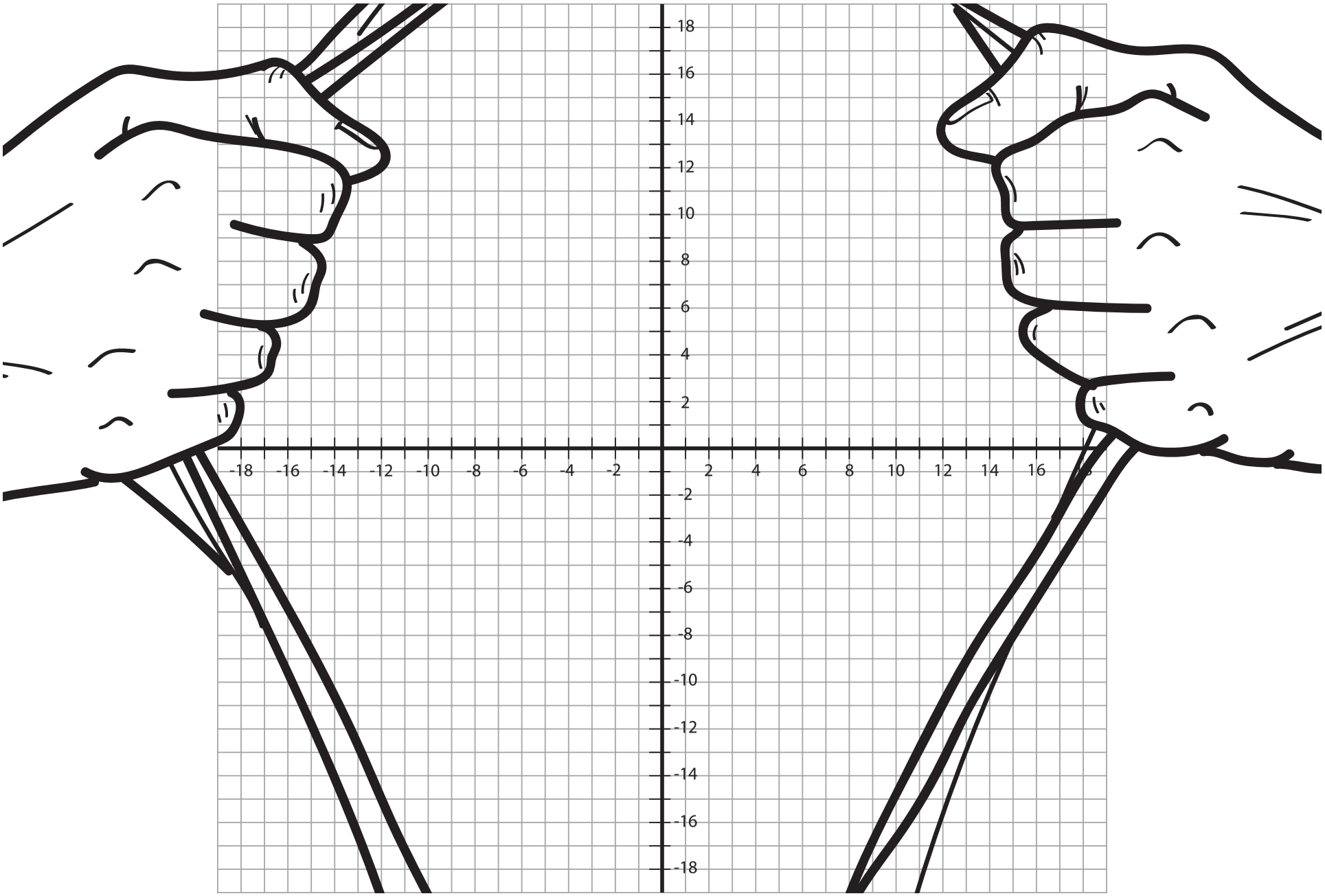
It is really easy to do more with this activity! Here are some ideas:

- Give students blank graph paper, and have them draw their own connect-the-dots patterns and write the instructions to get from point to point. Practice with writing the instructions instead of just following them. This will allow students to gain an even greater understanding of the skills in this activity!
- Find existing connect-the-dots patterns (plenty are available online), put them on a grid and write instructions to move between points. You can focus just on translations, reflections, slopes or whatever students need the most practice with!

Mathman Instructions

Point #	Instruction	Coordinates
1.	Starting at the origin, move 5 units in the negative y direction.	(___ , ___)
2.	Follow a line through this point, with slope $m = 1$, to the intersection on the x-axis.	(___ , ___)
3.	Move 11 units in the negative y direction.	(___ , ___)
4.	Move 5 units in the positive x direction and 3 units in the positive y direction.	(___ , ___)
5.	Reflect this point over the x-axis, and then move 1 unit in the negative y direction.	(___ , ___)
6.	Move 5 units in the negative x direction and 4 units in the positive y direction.	(___ , ___)
7.	Follow a line through this point, with a slope of $m = 4/5$, to the intersection on the y-axis.	(___ , ___)
8.	Move 5 units in the negative x direction and 4 units in the positive y direction.	(___ , ___)
9.	Move 5 units in the negative x direction and 4 units in the negative y direction.	(___ , ___)
10.	Reflect this point over the x-axis, and then move 1 unit in the negative y direction.	(___ , ___)
11.	Move 5 units in the positive x direction and 3 units in the negative y direction.	(___ , ___)
12.	Follow a line through this point, parallel to the y-axis, to the line's intersection with the x-axis.	(___ , ___)
13.	Starting at the origin, move 15 units in the positive y direction.	(___ , ___)
14.	Move 13 units in the negative x direction and 7.5 units in the negative y direction.	(___ , ___)
15.	Reflect this point over the x-axis.	(___ , ___)
16.	Move 13 units in the positive x direction and 7.5 units in the negative y direction.	(___ , ___)
17.	Move 13 units in the positive x direction and 7.5 units in the positive y direction.	(___ , ___)
18.	Reflect this point over the x-axis.	(___ , ___)

Mathman


18
16
14
12
10
8
6
4
2
-18 -16 -14 -12 -10 -8 -6 -4 -2
2 4 6 8 10 12 14 16
-2
-4
-6
-8
-10
-12
-14
-16
-18

Shooting Star Instructions

Point #	Instruction	Coordinates
1.	Place your first point at the origin.	(___ , ___)
2.	Reflect over the line $y = x - 4$.	(___ , ___)
3.	Move 1 unit in the positive x direction and 3 units in the positive y direction.	(___ , ___)
4.	Follow a slope of $m = 1/5$ to the intersection with the x-axis.	(___ , ___)
5.	Rotate 90 degrees counterclockwise around the point (7, 0).	(___ , ___)
6.	Reflect over the line $y = 13/2$.	(___ , ___)
7.	Rotate 90 degrees counterclockwise around the point (7, 6).	(___ , ___)
8.	Reflect over the line $y = x + 9$.	(___ , ___)
9.	Move 1 unit in the positive x direction and 8 units in the negative y direction.	(___ , ___)
10.	Rotate 90 degrees counterclockwise around the point (–2, 1) and then move 1 unit in the negative x direction.	(___ , ___)
11.	Reflect over the line $x = -7/2$.	(___ , ___)
12.	Move 5 units in the negative x direction and 3 units in the negative y direction.	(___ , ___)
13.	Multiply the x- and y-coordinates by 3.	(___ , ___)
14.	Reflect over the line $x = -29/2$.	(___ , ___)
15.	Rotate 90 degrees counterclockwise around the point (–11, –11).	(___ , ___)
16.	Follow a slope of $m = 1/2$ to the intersection with the line $y = -8$.	(___ , ___)
17.	Move 3 units in the negative x direction and 6 units in the negative y direction.	(___ , ___)
18.	Rotate 90 degrees clockwise around the point (–11, –14).	(___ , ___)
19.	Reflect over the line $y = -15$.	(___ , ___)
20.	Move 5 units in the positive x direction and 8 units in the positive y direction.	(___ , ___)
21.	Divide the x- and y-coordinates by 2.	(___ , ___)

Shooting Star