Points Lining Up in the Plane

For GSP5 ACTIVITY NOTES

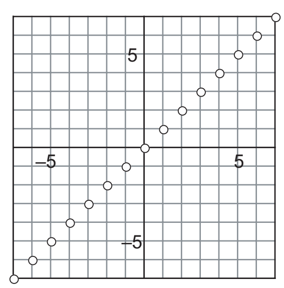
The purpose of this activity is to give students an informal and experiential introduction to the relationship between descriptions of coordinate patterns and graphs in the Cartesian plane. Too often, students don't really get the connection between an equation and its graph. It's important for them to understand that graphs depict the set of points whose coordinates satisfy an equation. This activity helps foster that understanding.

To deepen the experience, conduct a class or group discussion that encourages students to ponder this relationship. Ask, "Why do the points 'line up' in such regular ways? If you could plot not just five, but every point that satisfies the description, what would that look like?"

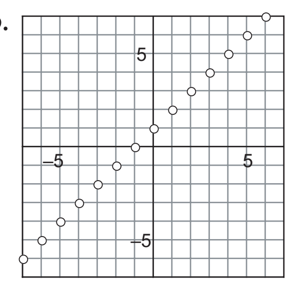
SKETCH AND INVESTIGATE

Q1 In each case, the answer shown depicts all possible answers with integer coordinates on the grid provided. The question asks for five answers, so any five of the points shown is a correct response (not to mention the infinite number of correct responses outside the grid!).

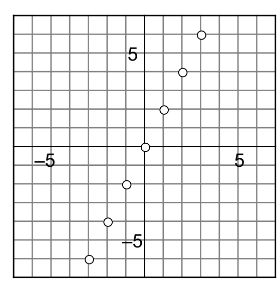
a.



b.



c.



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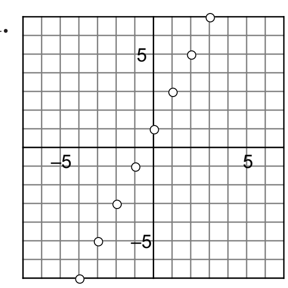

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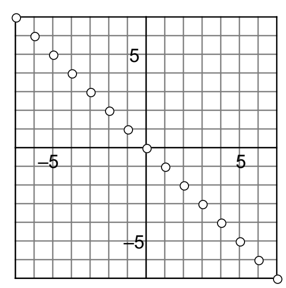
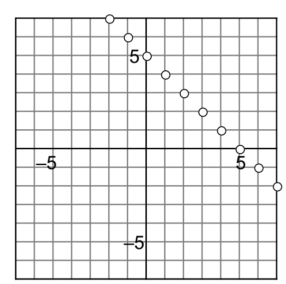


f.



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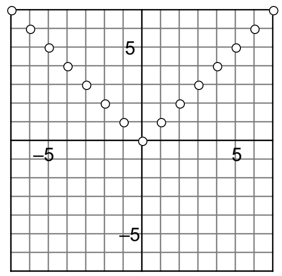
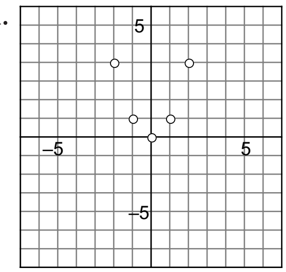
g. 

h. 

Q2 a. The y-coordinate equals the x-coordinate.

b. The y-coordinate is one less than the x-coordinate.

c. The y-coordinate is twice the x-coordinate. (Or, the x-coordinate is one-half the y-coordinate.)

d. The y-coordinate is two less than twice the x-coordinate.

e. The y-coordinate is one-third the x-coordinate. (Or, the x-coordinate is three times the y-coordinate.)

f. The y-coordinate is always -1 (regardless of the value of the x-coordinate).

g. The y-coordinate is the opposite of the absolute value of the x-coordinate. (An acceptable alternate answer for students not familiar with the term *absolute value* might be "The y-coordinate is the 'negative value' of the x-coordinate, regardless of whether the x-coordinate is positive or negative.")

h. The product of the y-coordinate and the x-coordinate is 6.

EXPLORE MORE

Q3 Equations from Q1:

a. $y = x$	b. $y = x + 1$	c. $y = 2x$
d. $y = 2x + 1$	e. $y = -x$	f. $x + y = 5$
g. $y = \lvert x \rvert$	h. $y = x^2$	

Equations from Q2:

a. $y = x$	b. $y = x - 1$	c. $y = 2x$
d. $y = 2x - 2$	e. $y = (1/3)x$ or $x = 3y$	
f. $y = -1$	g. $y = -\lvert x \rvert$	h. $xy = 6$

Q4 Answers will vary.

Here's how to set up the *Movement* button (more detailed instructions are on page 2 of **Points Line Up.gsp**): Plot the eight destination points using the **Plot Points** command. Select all 16 points in the sketch in the following order: point P, point P's destination, point Q, point Q's

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destination, point *R*, point *R*'s destination, . . . , point *W*, point *W*'s destination. Now choose **Edit | Action Buttons | Movement.** Change the speed and label (on the Label panel), and then click OK. Now hide the eight destination points (using **Display | Hide**).

Q5 Answers will vary, but should line up with answers to Q1 and satisfy the rule.

WHOLE-CLASS PRESENTATION

Students connect verbal and graphical representations of points by using a verbal rule about coordinates to position points and by observing a pattern of points to formulate a verbal rule about their coordinates.

Use the sketch **Points Line Up Present.gsp** in conjunction with the Presenter Notes to present this activity to the whole class.

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It's best to have a different student volunteer operate the computer for each rule.

1. Open **Points Line Up Present.gsp.**
2. Drag point *P* so that students can see how the coordinates change. Explain that students will take turns dragging the points to make the coordinates satisfy certain rules.

Encourage students to help each other in figuring out how to move the points and formulate rules.

3. Have the first student volunteer press button *a* to show the first rule, read the rule out loud, and then drag point *P* around until it satisfies the rule.
4. Have the student drag each of the remaining points around until all the points satisfy the rule.

Q1 Ask the class, "How would you describe the pattern these points make?"

Q2 Ask students to record on their paper both the rule and a diagram showing how the points are arranged.

5. Have a second student volunteer come to the computer, press button *b,* and drag the points for the second rule. Have students record on their paper each rule and a diagram of the resulting pattern. Continue for as many of the remaining rules as seems appropriate.
6. Go to page 2 of the sketch, and explain that on this page the points will arrange themselves and that the job of the class is to make up a rule that fits.
7. After students have written rules for all the arrangements on page 2, press the *a* button again to return the points to their initial arrangement.
8. Ask, "What rule did you write down for this arrangement?" After students have responded, ask "Does anyone know how to write this rule as an equation?" Make sure students understand why the answer is $y = x$.
9. Press each of the remaining buttons in turn, and have students give the equation for each pattern.
10. Tell students to go back to their answers for page 1 and write an equation for each of those arrangements.

Finish with a class discussion encouraging students to describe their insights. The discussion might consider questions such as these:

"How many points are there that would satisfy one of these rules?"

"If you could plot all the points that satisfy a rule, what would the result look like?"

"Why is it that the points line up so neatly?"

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