

## Operations and Algebraic Thinking

## 5.OA

### Analyze patterns and relationships.

3. Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.

This standard may be one of the most interesting in the Common Core, as it requires students to engage in something rarely done before in the elementary school curriculum: comparing two sequences of numbers, each generated by their own rules. The purpose for this can be elusive, but it is preparing students for some serious mathematics in middle school.

In grade 4, students generate number patterns following a given rule. For example, students may begin at 0 and use the rule “add 6” to generate a sequence. The result is 0, 6, 12, 18, 24, .... Students then look for patterns in the sequence, including those that may not have been apparent when considering the rule itself, such as that all the numbers in the sequence are even.

In grade 5, students now create two number patterns following their own rules. Let’s have one sequence begin at 0 and use the rule “add 2” and another sequence also begin at 0 and follow the rule “add 6.” The results are shown in Table 1. Students may notice the terms in the second sequence are always three times the corresponding terms in the first sequence. That may not have been apparent before the sequences were generated. Using the two sequences to generate ordered pairs, we can graph them on a coordinate plane and look for patterns. One relationship that is evident is the pairs fall on a straight line; this is called a *linear* relationship.

Another thought might be to subtract the corresponding terms. If we take the second value minus the first, the differences increase by 4 each term. Students should be able to reason that if the second value increases by 6 each term, and the first increases by 2, then the difference will increase by 4 each term.

Let’s do another example with the same rules, but start the second sequence at 1. (See Table 2.) The ordered pairs again form a straight line, and the differences again increase by 4 for the same reason as before. However, the terms in the second sequence are not three times the corresponding terms of the first sequence, but are one more than three times.

When creating sequences, questions for consideration may include: Under what conditions are the terms in the second sequence a multiple of those in the first? Is there a way to make two sequences so the difference between the terms will be a specific value? There are myriad things to explore when looking for patterns. Be flexible, be creative, and allow the kids to do the same.

When assessing this standard, provide students with simple rules and starting points that allow them to easily generate the sequences. **The heart of this standard is not in creating the sequences themselves, but to look for patterns and relationships between the two sequences, and to justify why they occur.** Once students can do that, provide them with one sequence and a relationship and ask them to generate the second sequence. Finally, give a pattern or relationship and have students generate two sequences. In all situations, students should plot ordered pairs on the coordinate plane and look for patterns there, as well.

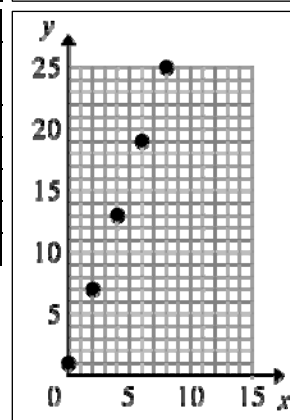
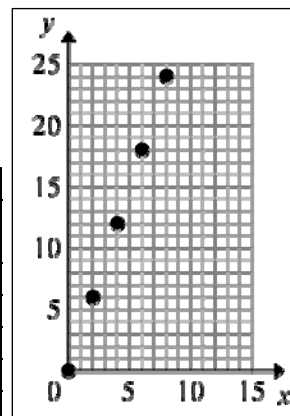
This standard is setting the stage for big things, among them proportional reasoning and the foundation of functions. The key practices here are to have students look for structure and explain their reasoning when describing that structure.

### Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Add	Add	Ordered Pairs	Difference
2	6	(0, 0)	0
0	0	(2, 6)	4
2	6	(4, 12)	8
4	12	(6, 18)	12
6	18	(8, 24)	16

Add	Add	Ordered Pairs	Difference
2	6	(0, 1)	1
0	1	(2, 7)	5
2	7	(4, 13)	9
4	13	(6, 19)	13
6	19	(8, 25)	17



### Connections

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| 2.NBT.2  | 6.EE.9   |
| 3.OA.9   | 7.RP.1–3 |
| 4.OA.4–5 | 8.EE.5–6 |
| 5.G.1–2  | 8.EE.8   |
| 6.RP.1–3 | 8.F.1–5  |
| 6.NS.8   | 8.SP.1–3 |