

# Grade 4 - Number and Shape Patterns - Lesson

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A number pattern follows a rule, such as start at 1 and add 3. Use the rule to make each term: 1, 4, 7, 10, 13. Then look for features the rule does not state, such as terms that alternate odd and even. An input-output table shows the same rule as pairs of numbers.

Grade 4 · Common Core State Standards: **4.OA.C.5**

## Key facts

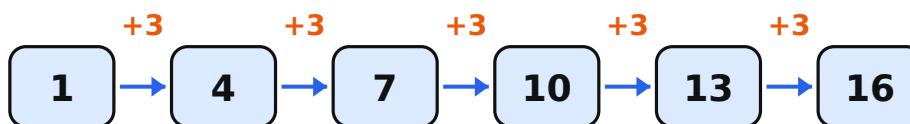
- A pattern rule gives a starting number and an operation to repeat.
- Each number in a pattern is called a term.
- Adding an odd number makes terms alternate odd and even; adding an even number keeps them all odd or all even.
- In an input-output table, the same rule turns every input into its output.
- Shape patterns grow by adding the same number of pieces at each step.

## What is a pattern rule?

A **pattern** is a list of numbers or shapes that follows a rule. The rule tells you where to start and what to do each time. Each number in the list is called a **term**.

## Pattern rule

Example: *Start at 1. Add 3 each time.* The terms are 1, 4, 7, 10, 13, 16, and the pattern keeps going.



Each arrow adds 3.

## How do you make a pattern from a rule?

1. Write the starting number.

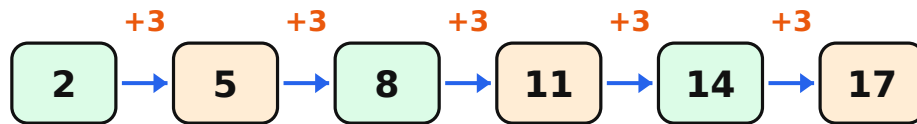
2. Do the operation in the rule to get the next term.
3. Do the same operation on that new term.
4. Keep going until you have enough terms.

**Example:** Start at 3 and multiply by 2. Terms: 3,  $3 \times 2 = 6$ ,  $6 \times 2 = 12$ ,  $12 \times 2 = 24$ ,  $24 \times 2 = 48$ .

### What features can you find that the rule does not say?

Look for odd and even numbers, last digits and other number patterns. The rule *Start at 2, add 3* never says anything about odd or even. But the terms 2, 5, 8, 11, 14, 17 alternate: even, odd, even, odd. That happens because adding an odd number flips odd to even and even to odd.

Adding an even number does not change odd or even. The rule *Start at 1, add 4* gives 1, 5, 9, 13, 17, and every term is odd.



Orange boxes are odd and green boxes are even. They take turns.

### What is an input-output table?

An input-output table pairs each input with the output that the rule makes. The rule *add 6* works the same way for every input. To find a rule, compare one input with its output and then check it on the other columns.

**Rule: add 6**

| Input  | 1 | 2 | 3 | 4  | 5  |
|--------|---|---|---|----|----|
| Output | 7 | 8 | 9 | 10 | 11 |

Every output is the input plus 6.

### How do shape patterns grow?

Count the pieces in each step and look for what is added. A row of toothpick squares needs 4 toothpicks for 1 square. Each new square shares a side, so it adds only 3 more toothpicks: 4, 7, 10, 13.



1 square: 4

2 squares: 7

3 squares: 10

Each new square adds 3 toothpicks.

## Questions about number and shape patterns

### What is a number pattern?

A number pattern is a list of numbers that follows a rule. The rule tells the starting number and what to do each time, such as add 5 or multiply by 2.

### How do you find the rule of a pattern?

Compare each term with the next one. Find what was added, subtracted or multiplied, and check that it works for every pair. For 7, 12, 17, 22 the rule is add 5.

### What does it mean to find a feature of a pattern that the rule does not say?

It means noticing something extra, such as every term being even or the terms alternating odd and even. You can explain it using what you know about odd and even numbers.

### Why do some patterns stay odd the whole time?

Adding an even number to an odd number always gives an odd number. So the rule start at 1, add 4 gives only odd numbers: 1, 5, 9, 13, 17.

### How do you use an input-output table?

Apply the rule to each input to get its output. If the rule is unknown, test one input-output pair to guess the rule, then check it on the other pairs.