

LESSON ORGANIZER

40–50 min

Curriculum Focus: Explore the pattern within each column of a table of values. (6PR1)

Teacher Materials

- calculator (optional)

Student Materials

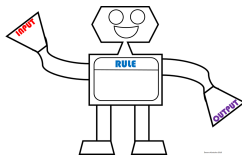
- 2-column charts (PM 19)
 - calculators
- Optional*
- Step-by-Step 1 (Master 1.11)
 - Extra Practice 1 (Master 1.21)

Vocabulary: Input/Output machine, input, output, operation, growing pattern

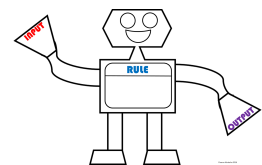
Assessment: Master 1.2 Ongoing Observations: Patterns and Equations

Key Math Learnings

1. A pattern rule can be illustrated with an Input/Output machine.
2. The input and output can be recorded in a table. The input and output can be described using pattern rules. There is a relationship between corresponding input numbers and output numbers.



Input/Output Machine



-Any number you put in a machine will have one or more rules to follow to get to a new number.

The input is the starting number.

The output is the final number that is calculated after all the math operations have been applied to it.

Operation mean to add, subtract, multiply or divide

Let's see an example



What does this machine do to the input?

Ans: multiply input by 3

Use the above machine to fill in the blank

a) When the input is 5 the output is 15.

$$5 \times 3$$

b) When the input is 9 the output is 27.

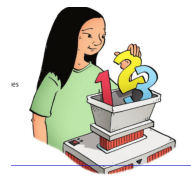
$$\downarrow$$
$$9 \times 3$$

You try

Draw your own input/output table

- a) Choose some input numbers
- b) Choose an operation you want to apply to each input
- c) Complete the output

Thinking



A pattern rule tells us 3 things

- i) how the input is related to the output.
- ii) The pattern in the input column
- iii) The pattern in the outcome pattern

$$\boxed{\times 8}$$

Input	Output
1	8
2	16
3	24
4	32
5	40

Show work

$$\begin{aligned} 1 \times 8 \\ 2 \times 8 \\ 3 \times 8 \\ 4 \times 8 \\ 5 \times 8 \end{aligned}$$

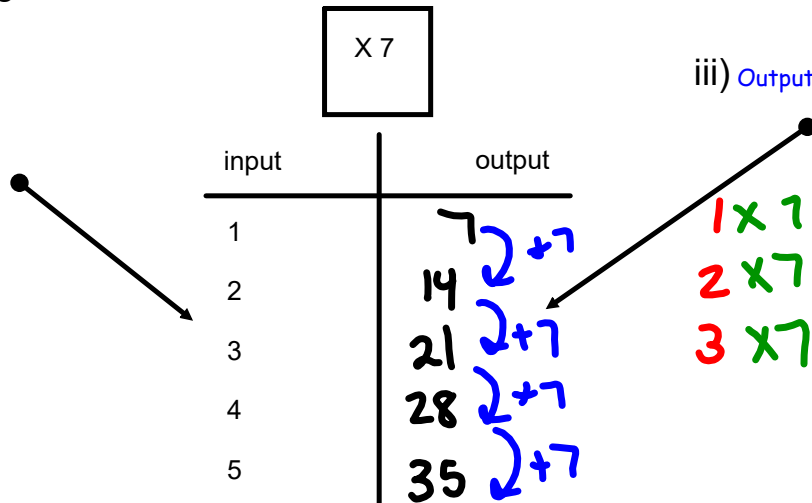
My example is on the next page.

My example

i) Each input is

ii) Input is

iii) Output is



A pattern rule

i) how the input is related to the output.

ii) The pattern in the input column

iii) The pattern in the outcome pattern

i) Multiply input by 7 to get the output

ii) The input starts at 1 and increases by 1

iii) The output starts at 7 and increase by 7.

Connect

We can use an Input/Output machine to make a growing pattern.

- This machine add 8 to each input to get the output.



The pattern rule that relates the input to the output is: add 8 to each input to get output.

When each input increases by 1, the output add 8.

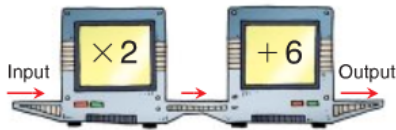
The pattern rule for the input is: Start at 1 add 1 each time.

The pattern rule for the output is: Start at 9 add 8 each time.

Input	Output
1	9
2	10
3	11
4	12

Handwritten notes: Blue arrows show +1 between inputs. Blue arrows show +1 between outputs.

- This Input/Output machine doubles each input, then adds 6.



The pattern rule that relates the input to the output is: Multiply the input by 2, then add 6.

Show work if more than one operation and do it in order that the machine has

Input	Output
2	10
4	14
6	18
8	22

Handwritten notes: Red arrows show +2 between inputs. Red arrows show +4 between outputs.

The pattern rule for the input is: Start at 2 each time.
The pattern rule for the output is: Start at 10 each time.



Input of 2

2 $\times 2$ +6 = 4 +6 = 10

Input of 4

4 $\times 2$ +6 = 8 +6 = 14

Input of 6

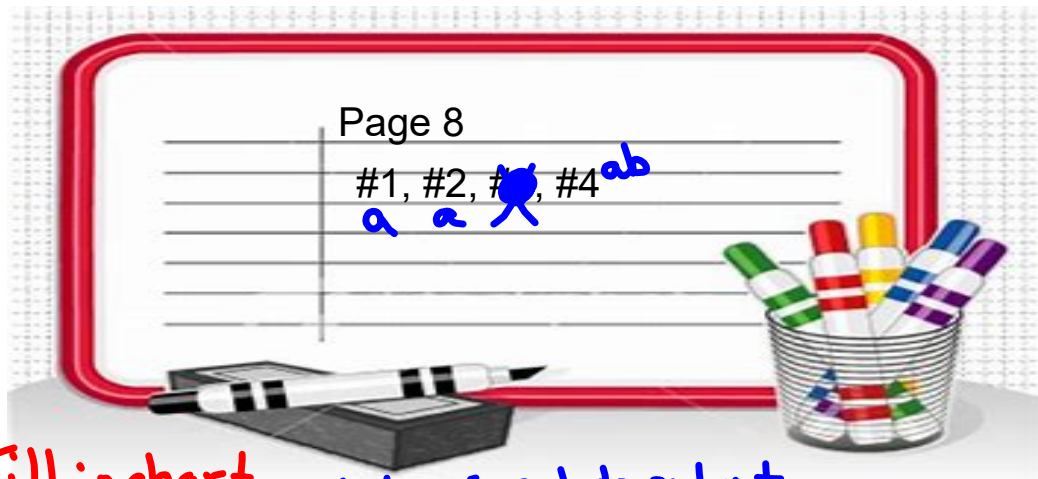
6 $\times 2$ +6 = 12 +6 = 18

→ pattern rule input is Start at 2 and add 2 each time.

→ pattern Rule for output is Start at 10 and 4 each time.

Oct. 4

Class/Homework



Fill in chart
Pattern rule that relates input to output
• multiply input by 9 to get output

Pattern for input
→ Start input at 1 then increase by 1 each time
patter rule output
→ Start at then

Practice

Class/homework

- 1 For each Input/Output machine:
- Copy and complete the table.
 - Write the pattern rule that relates the input to the output.
 - Write the pattern rule for the input.
 - Write the pattern rule for the output.

Input	Output
1	
2	
3	
4	
5	

a)



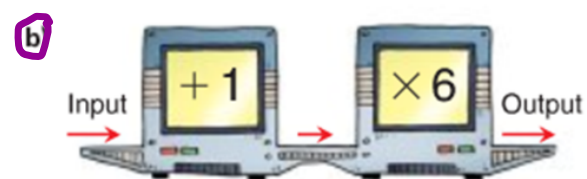
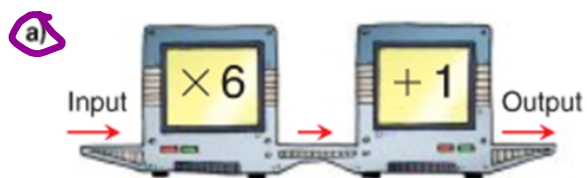
b)



2. For each Input/Output machine:

- Copy and complete the table.
- Write the pattern rule that relates the input to the output.
- Write the pattern rule for the input.
- Write the pattern rule for the output.

Input	Output
2	
4	
6	
8	
10	



3. Look at question 2 and your tables.
 - a) How are the Input/Output machines the same?
How are they different?
 - b) How do the output numbers from the two machines compare? Explain.
 - c) Is it possible to get more than one output number
for each input? How do you know?

4. Copy and complete this table.
The pattern rule that relates the input to the output is:
Divide the input by 6.
a) Write the pattern rule for the input.
b) Write the pattern rule for the output.

Input	Output
36	
42	
48	
54	
60	

5. Copy and complete this table.
The pattern rule that relates the input to the output is:
Divide the input by 3, then subtract 2.
- a) Write the pattern rule for the input.
 - b) Write the pattern rule for the output.

Input	Output
30	
60	
90	
120	
150	

6. The pattern rule that relates the input to the output is:
Add 4 to the input. Then divide by 2.
Check the data in the Input/Output table.
Identify any output numbers that are incorrect.
How do you know they are incorrect?
Show your work.

Input	Output
4	2
8	4
16	10
26	15
30	19



7) The pattern rule that relates the input to the output is:

Divide the input by 6, then add 5.

a) Check the data in the Input/Output table.

Identify any output numbers that are incorrect. How do you know they are incorrect?

b) Correct the table.

c) Write 3 more input and output numbers for this pattern rule.

Show your work.

Input	Output
6	6
12	7
30	10
42	2
54	15

8. The pattern rule that relates the input to the output is:
Multiply the input by 4. Then subtract 3.
Find the missing numbers in the table.
How can you check your answers?

Input	Output
3	9
6	?
9	?
12	45
15	?



9. The pattern rule that relates the input to the output is:
Add 5 to the input. Then multiply by 3.
Find the missing numbers in the table.
What strategies did you use?



Input	Output
2	21
5	?
?	39
11	?
?	57
?	66

10. a) Draw an Input/Output machine with two operations.
Choose two numbers and two operations for your machine.
- b) Choose 5 input numbers.
Find the output numbers.
- c) Erase 2 input numbers and 2 output numbers.
Each row must have at least one number.
Trade tables with a classmate.
Trade pattern rules that relate the input to the output.
Find your classmate's missing numbers.

Reflect

Suppose you want to make an Input/Output machine to convert millimetres to metres.
Describe what your machine would look like.

ASSESSMENT FOR LEARNING	
What to Look For	What to Do If You Don't See It
<p>Conceptual Understanding</p> <ul style="list-style-type: none">✓ Students explain that an Input/Output machine is used to create a pattern.	<p>Check Further</p> <p>As students work, ask:</p> <ul style="list-style-type: none">• What are the differences in consecutive input numbers?• What are the differences in consecutive output numbers?• How can you use these differences to write pattern rules for the input and output numbers?• How can you use the pattern rules to extend the table?
<p>Procedural Knowledge</p> <ul style="list-style-type: none">✓ Students can identify, extend, and create patterns with Input/Output machines.✓ Students can identify erroneous data in a table of input and output numbers.✓ Students can describe the pattern within each column of a table of values.✓ Students can generate values in one column of a table of values given values in the other column and a pattern rule.	<p>Adjust Instruction</p> <p>Students who have difficulty identifying number patterns may benefit from creating their own patterns. Have students work independently to create and extend different types of number patterns. They can trade patterns with a classmate, and identify each other's patterns.</p>