

## What's My Rule?

### Purpose

The purpose is to learn to spot patterns in number series. When you are looking for a pattern that uncovers a hidden operation, you look at what number you started with and what number you ended with and try to figure out what happened to the numbers in between. This is one thing scientists and mathematicians do when they discover new "formulas." A game that exercises this skill is What's My Rule?

### Activity

To play, think of a simple operation such as  $+ 2$ . The student gives you a number and you add two to it and say the new number back. For example, if she says, "one," you say "three." She says, "five" and you say, "seven." The number she gives you is called the independent variable, or the number In. The number you say back is called the dependent variable, or the number Out.

Record the information on a chart like this:

IN	OUT
1	3
5	7
9	?

What's My Rule?  $+2$

When a student thinks she knows the rule, let her predict the number out loud. Finally, when everyone can predict successfully, let someone formulate the rule of plus 2. Students love to make these up for each other using easy addition, subtraction, multiplication, and division operations.

Play this game regularly. It's a good rainy day and in-the-car game.

One teacher called this activity Black Box and made a symbolic black box out of a milk carton decorated with gears and levers with a slide inside that flipped a card upside down. A card would be put in the slot in the top of the box and come out so the number written on the back of the card came out a bottom slot. The students then guessed the rule. When the box appeared, the students' minds focused to discover the relationship between the In and Out number of the day.

### Worksheet

What's My Rule? - Blank page to copy is on the following page.

Sample games:

IN	OUT
2	4
6	8
9	---
20	---

What's My Rule? \_\_\_\_\_

IN	OUT
7	4
3	0
10	7
8	---
20	---

What's My Rule? \_\_\_\_\_

\*Answers : 9 11 11 8 5  
 Rule: Add 2 20 22 20 17  
 Rule: Subtract 3

# What's My Rule?

Date \_\_\_\_\_

IN	OUT
2	4
6	8
9	_____
20	_____

What's My Rule? \_\_\_\_\_

IN	OUT
7	4
3	0
10	7
8	_____
20	_____

What's My Rule? \_\_\_\_\_

IN	OUT
10	5
8	4
6	_____
4	_____
100	_____
12	_____

What's My Rule? \_\_\_\_\_

IN	OUT
0	0
1	2
2	4
3	_____
8	_____

What's My Rule? \_\_\_\_\_

Make your own.

IN	OUT
2	12
3	13
10	20
7	_____
40	_____

What's My Rule? \_\_\_\_\_

IN	OUT
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

What's My Rule? \_\_\_\_\_

## Graphing Number Patterns

**Purpose** The purpose of this lesson is to connect number patterns to coordinate graphing. Showing a pattern on a graph makes a ‘picture’ of the pattern and allows us to easily find the rule or function being shown by the pattern.

**Teacher Background** Study Huts and Flags - Worksheet 3. It is easy to see what the rule of this pattern is. The number of flags is equal to two times the number of houses. When a student is first introduced to this idea, he builds the patterns with blocks, then finds the answers by counting the blocks. The numbers are recorded on a chart called a T chart. When he notices a pattern or a rule, he can figure out how many flags would be needed for ten houses without having to build ten houses.

T charts are used to list the  $x$  and  $y$  pairs. The T shape is more obvious on Worksheet 4. It has an  $x$  and a  $y$  above a horizontal line and a vertical line between the  $x$  and the  $y$  to form a T. Using the number pairs on the T chart for  $x$  and  $y$ , we create an ordered pair that can be placed as a point on a graph. We then can put a picture of this pattern on a graph. What is fun is that the number pattern  $y = 2x$  will create a geometric pattern on the graph. All the points will be in a straight line. This delights most students.

In algebra, the rule of a pattern is called the function. We choose the value of ‘ $x$ .’ Because we choose what ‘ $x$ ’ is, this variable is called the independent variable. We choose the number of houses we are going to look at. The value of the ‘ $y$ ’ is dependent on what the value of  $x$  is and by the function or the rule. The number of flags is dependent on the number of houses. The rule says take the number of houses and multiply it by two because every house has two flags. In algebra, we would write this pattern as a function like this:  $y = 2x$ . This means take the number of houses you have and multiply it by two to find out how many flags there will be. Knowing the function of a pattern allows us to calculate the  $n$ th value of the pattern. What is meant by the  $n$ th value is the ‘ $y$ ’ value of any ‘ $x$ ’ without having to count them. How many flags would you need for 101 houses? You could choose any number of houses and figure out how many flags you would need.

Mathematicians and scientists use this to figure out how the world works, using scientific formulas such as distance is equal to rate (how fast you are going) times how long you go. This is written as  $d = rt$ . Mastery of this concept of graphing functions and finding rules will take many years. It is one of our most important algebraic tools.

**Prerequisites** Sums and Differences - What’s My Rule, and Coordinate Graphing

**Materials** Graphing Number Patterns - Worksheets 1 - 8, pages 32 - 39  
Ruler  
Pattern blocks and tiles or cubes

**Warm Up** Review ordered pairs or play Treasure Hunt.

## Lesson

Begin with Graphing Number Patterns - Worksheet 1. Start the student on building a few houses and chimneys. When he has built three, ask, **“How many chimneys will ten huts have?”** “Ten.”

**“How do you know that? You only built three.”** “I can tell because there is only one chimney on each hut, so ten huts will need ten chimneys.”

Have him fill in the chart.

Turn to Graphing Number Patterns - Worksheet 2. Have him write ‘Huts and Chimneys’ on the line where it says ‘Graph Title.’ Above the X on the T chart on the right hand side of Graphing Number Patterns - Worksheet 2, write the word Huts.

**“Number downward under the X, one through ten.”**

Above the Y on the T chart, write the word Chimneys.

Huts	Chimneys
X	Y
1	1
2	2
3	3
4	4
5	5

Huts	Chimneys
1	<u>1</u>
2	<u>2</u>
3	<u>3</u>
4	<u>4</u>
5	<u>5</u>
6	<u>6</u>
7	<u>7</u>
8	<u>8</u>
9	<u>9</u>
10	<u>10</u>

**“How many chimneys does one hut have?”** “One.”

**“Write 1 in the Chimney column just to the right of the 1 in the Huts column.”**

Repeat with all the other number pairs for huts and chimneys. You are recopying the chart on Graphing Number Patterns - Worksheet 1 onto a more generic form.

Circle the first pair of numbers 1, 1 on the T chart.

**“Do you remember what an ordered pair of (1, 1) tells you to do on a graph?”** “Go over one and up one and put a point.”

Huts	Chimneys
X	Y
1	1
2	2
3	3
4	4
5	5

**“Put a point on the graph at (1, 1).”** We have to label what each part of the ordered pair means.

**“Where does the first one come from?”**

“The number of huts.”

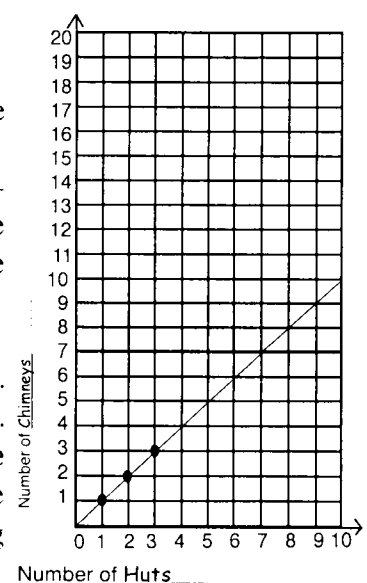
On the x axis (the horizontal line at the bottom of the graph), have him write the words ‘Number of Huts.’

**“Where does the second one come from?”** “The number of chimneys on the hut.” On the vertical y axis, have him write, ‘Number of Chimneys.’ Have him turn the paper sideways to do this.

Repeat this process for two more points, (2, 2) and (3, 3). Remember (2, 2) means two houses have two chimneys.

**“Do you see a pattern in the way the points go on the graph?”** “They line up in a line.” If he does not see the pattern, have him connect the points with a line using the ruler.

Graph Title Huts and Chimneys



**“Put your ruler on the page so that each dot just shows above the ruler. Connect the dots. Extend the line down to (0, 0) right at the corner of the graph.”**

**Note** This location (0, 0) is called the origin.

**“This is how you draw a ‘picture’ of a pattern on a graph.”**

Check the Answer Key to be sure you have done the work correctly.

End the lesson here.

On Graphing Number Patterns - Worksheet 3, page 34, Huts and Flags, and Worksheet 5, page 36, Stars and Points, the pattern of instruction is repeated.

**Worksheets** Graphing Number Patterns - Worksheets 3 - 8, pages 34 - 39

**Test for Understanding** What we want to see at this point in his work is that he can look at a pattern and extend it. Can he identify the rule? Can he put the  $x$ ,  $y$  points on a graph and connect the points?

Use Graphing Number Patterns - Worksheets 7 and 8 as a Test for Understanding. Observe him working. Do not assist him. Watch to see what he can do and what he can not do.

You can give him more practice on patterns you make up, or you can let this one rest until next year. This topic will come up every year in his study of mathematics all the way through Algebra II and beyond. This is just the beginning.

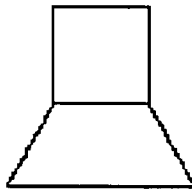
**Graphing Number Patterns - Worksheet 1**

Date \_\_\_\_\_

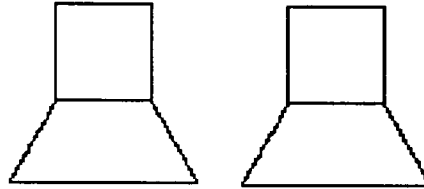
**Huts and Chimneys**

Build with pattern blocks.

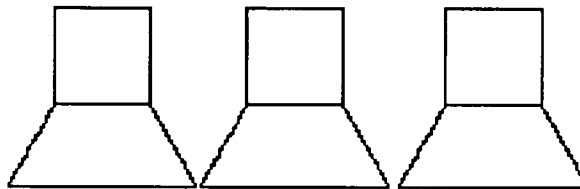
One hut has one chimney.



Two huts have two chimneys.



Three huts have \_\_\_\_ chimneys.



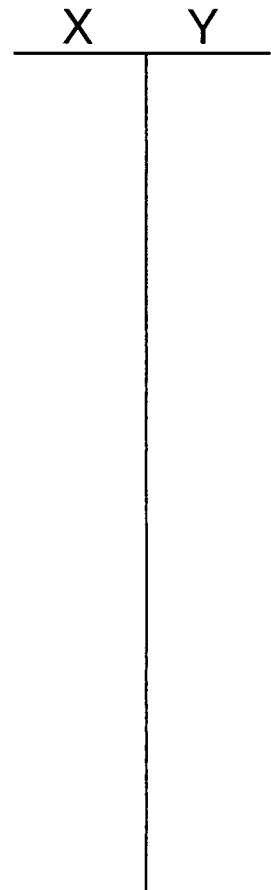
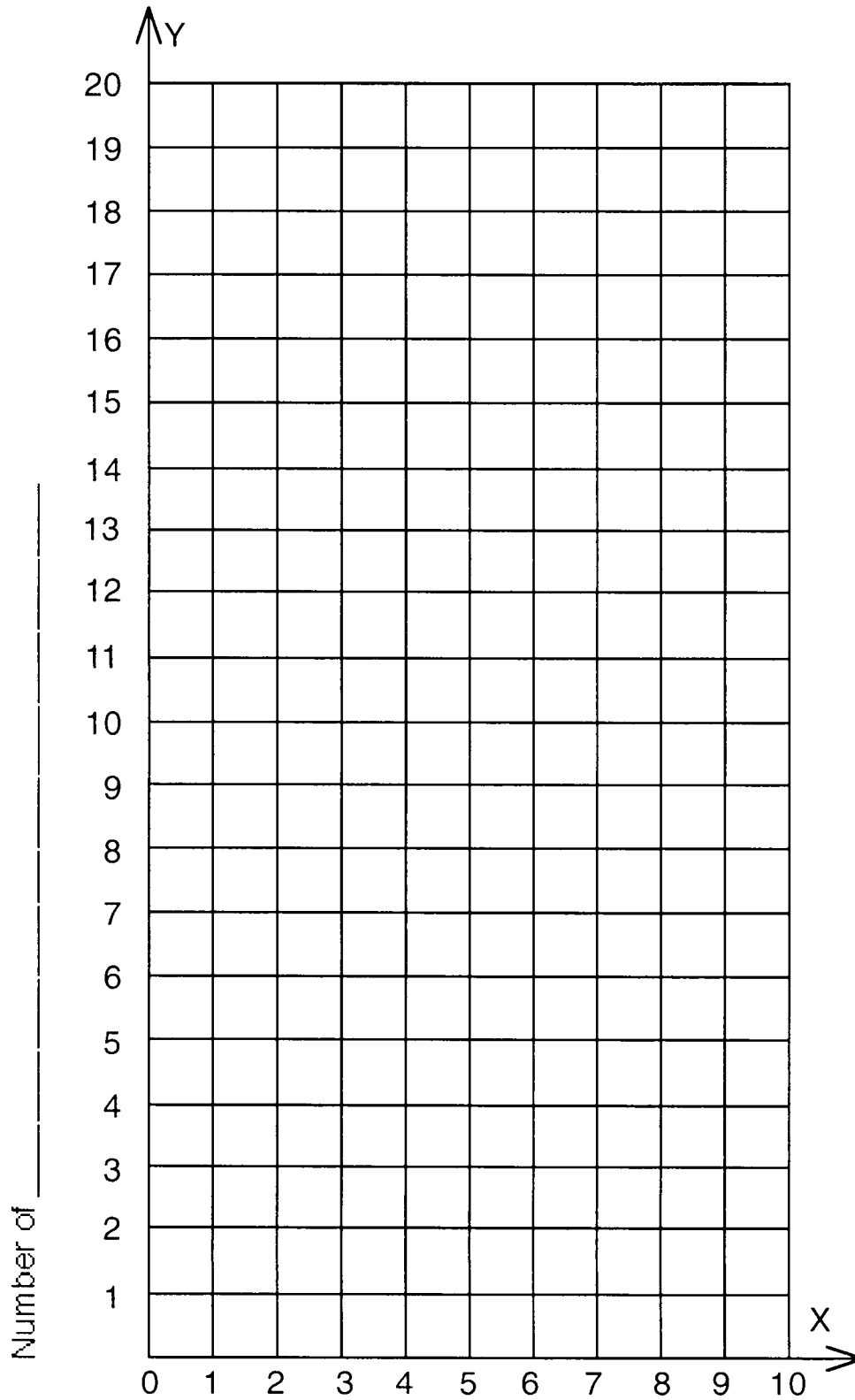
How many chimneys will 10 huts have? \_\_\_\_\_

Guess first \_\_\_\_\_

How do you know?  
What's the rule?

Huts	Chimneys
1	_____
2	_____
3	_____
4	_____
5	_____
6	_____
7	_____
8	_____
9	_____
10	_____

Graph title \_\_\_\_\_



Number of \_\_\_\_\_

### What's My Rule

IN	OUT
2	4
6	8
9	11
20	22

What's My Rule? +2  
in plus 2 equals out

IN	OUT
10	5
8	4
6	3
4	2
100	50
12	6

What's My Rule? ÷2  
or  $\frac{1}{2}$  of in equals out

IN	OUT
2	12
3	13
10	20
7	17
40	50

What's My Rule? +10

IN	OUT
7	4
3	0
10	7
8	5
20	17

What's My Rule? -3  
in - 3 = out

IN	OUT
0	0
1	2
2	4
3	6
8	16

What's My Rule? X2

Make your own.

IN	OUT
---	---
---	---
---	---
---	---
---	---

What's My Rule? AWV

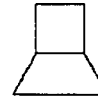
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### Graphing Number Patterns -Worksheet 1

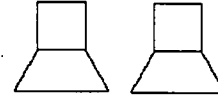
#### Huts and Chimneys

Build with pattern blocks.

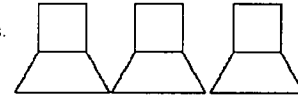
One hut has one chimney.



Two huts have two chimneys.



Three huts have 3 chimneys.



How many chimneys will 10 huts have? 10

Guess first \_\_\_\_\_

How do you know?  
What's the rule?

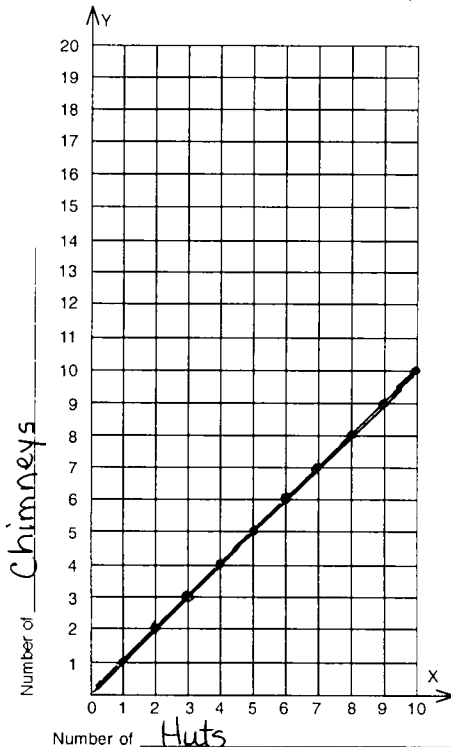
huts = chimneys  
or  $C = H$   
There is one chimney  
on each hut.

Huts	Chimneys
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

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### Graphing Number Patterns -Worksheet 2

Graph title Huts and Chimneys



X	Y
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

33

### Graphing Number Patterns -Worksheet 3

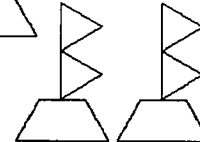
#### Huts and Flags

Build with pattern blocks.

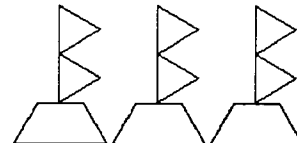
One hut has two flags.



Two huts have four flags.



Three huts have 6 flags.



How many flags will 10 huts have? 20

Guess first \_\_\_\_\_

How do you know?  
What's the rule?

huts x 2 = flags  
or  
 $F = 2H$

Huts	Flags
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18
10	20

34