

Grade 8 Mathematics

Patterns, Relations, and Functions : Lesson 3

Read aloud to the students the material that is printed in **boldface type** inside the boxes. Information in regular type inside the boxes and all information outside the boxes should **not** be read to students. Possible student responses are included in parentheses after the questions.

NOTE: The directions read to students may depend on the available materials. Read only those parts of the lesson that apply to the materials you are using.

Any directions that ask you to do something, such as to turn to a page or to hand out materials to students, will have an arrow symbol (\Rightarrow) by them.

Purpose of Lesson 3:

- In this lesson, the tutor and the students will
 - ✓ given a function table, predict output from input;
 - ✓ generalize pattern rules; and
 - ✓ match a pattern rule to a given input/output table.

Equipment/Materials Needed:

- One calculator of any kind. If you can get one with a large display, that would be great.
- Paper and pencils
- Copies of Student Sheets 61 and 62

Preparations before beginning Lesson 3:

- Locate a calculator.
- Have paper and pencils available.
- Run off one copy of Student Sheets 61 and 62 for each student.

Lesson 3: Patterns, Functions, and Relations

⇒ Get the calculator and place it in front of you. Enter $0 + 2 =$ into the calculator. You should see only the **2** on the display. Do not let the students see you enter these numbers. You are going to use a feature on the calculator called the constant key. Once you have entered a rule, such as $0 + 2 =$, if you continue to press $=$, the calculator will add just keep adding 2 to the amount in the display. Zero is the starting point and 2 is the number that will be added over and over again. Two is the constant. You are going to add 2 constantly over and over. You can change either number to get different rules. Turn the calculator so that it faces the students.

Say:

We are going to play a game. It is called “What’s my Rule?” I have put a rule into my calculator. I am going to press the = key on the calculator over and over. I want you to look at the number in the display. What is it now? (2)

⇒ Press the equal key.

Say:

What number is on the display now? (4) I want you to write down 2 and 4. As I press the = key, write the numbers that appear on the display. When you think you know the rule in the calculator, raise your hand. Continue pressing the $=$ key. The students should have written 2 and 4 on their paper. The next number will be 6, the next 8, and so on. If students say that the rule is even numbers, say: **That rule is a correct one, but not the one I put into the calculator. My rule tells the calculator how many to add each time. Does anyone know my rule? (Add 2.) If I put 20 into the calculator, what number would show? (22)** Simply press $20 =$. Do not clear the calculator at any point or press the $+$ sign after you first enter $0 + 2$. Either command will mess up the pattern.

⇒ Turn the calculator away from the students. Enter $0 + 6 =$. Turn the calculator around to face the students.

Say:

What number is on the display? (6) As I press the equal key, write the numbers that appear on the display. Press = (12 will show.) Press = (18 will show.) **What is my rule? (Add 6.) If I press the = key again, what number will appear? (24)** You may want to do a few more of these problems. Use $0 +$ some number. This activity is a great way to practice skip counting and multiplication facts.

⇒ Turn the calculator away from the students. This time you will do a subtraction rule. Enter $18 - 3 =$. Turn the calculator around to face the students.

Say:

What number is on the display? (15) As I press the equal key, write the numbers that appear on the display. Press = (12 will show.) Press = (9 will show.) Press = (6 will show.) **What is my rule? (Subtract 3.) If I press the = key again, what number will appear? (3).**

⇒ Turn the calculator away from the students. Enter $20 - 5 =$. Turn the calculator around to face the students.

Say:

What number is on the display? (15) As I press the equal key, write the numbers that appear on the display. Press = (10 will show.) Press = (5 will show.) Press = (0 will show.) **What is my rule? (Subtract 5.) If I press the = key again, what number will appear? (-5).** You may want to give a few more subtraction problems.

⇒ Turn the calculator away from the students. This time you will do an addition rule, but start with a number other than 0. Enter $1 + 4 =$. Turn the calculator around to face the students.

Say:

What number is on the display? (5) As I press the equal key, write the numbers that appear on the display. Press = (9 will show.) Press = (13 will show.) Press = (17 will show.) **What is my rule? (Add 4.) If I press the = key again, what number will appear? (21).** It is absolutely necessary that the students write these numbers down.

⇒ Turn the calculator away from the students. Enter $100 - 10 =$. Turn the calculator around to face the students.

Say:

What number is on the display? (90) As I press the equal key, write the numbers that appear on the display. Press = (80 will show.) Press = (70 will show.) Press = (60 will show.) What is my rule? (Subtract 10.) If I press the = key again, what number will appear? (50)

⇒ Put the calculator away. Give Student Sheet 61 to the students.

Say:

Let's play the "What's My Rule?" game in a different way. We are going to pretend that I am putting numbers into the calculator. I will call out a number and tell you what the calculator would have done. To help you see patterns, we are going to put the numbers in a table. This type of table has many names. It is called an *in/out table*, an *input/output table*, a *function table*, or a *T table*. On your sheet, you have 3 blank tables. We are going to use these tables to see whether we can find rules.

Say:

Let's start with Table 1. The number that I put in is one (1); 7 comes out. You would write the one in the column called *in* and write the 7 in the column called *out*. I have done this for you. As I call out numbers, write them in the table until you see a rule. I put in 2; out comes 8. I put in 3; out comes 9. I put in 7; out comes 13. What's my rule? (Add 6, or add 6 to the *in* number to get the *out* number.) If you need a few more examples, use 4, 10; 5, 11; 6, 12; 8, 14. It is important to get students to see that to get the *out* number, they do something to the *in* number.

Say:

Let's go to Table 2. The first number that I put in is one (1); 50 comes out. Write these numbers in the table. As I call out other numbers, write them in the table until you see a rule. I put in 2; out comes 100. I put in 3; out comes 150. I put in 10; out comes 500. What's my rule? (Multiply by 50, or multiply the *in* number by 50 to get the *out* number.) If you need a few more examples, use 4, 200; 5, 250; 6, 300; 7, 350.

Say:

Let's go to Table 3. The first number that I put in is one (1); 3 comes out. Write these numbers in the table. As I call out other numbers, write them in the table until you see a rule. I put in 2; out comes 5. I put in 3; out comes 7. I put in 4; out comes 9. I put in 10; out comes 21. What's my rule? (This one is a little more difficult. They have to double the *in* number and add one.) If you need a few more examples, use 5, 11; 6, 13; 7, 15; 8, 17.

Say:

Let's look at Part B, problems 4–6. On these problems, you are given a table, and you have to choose the rule. Take a few minutes to do these problems and then we will discuss them. Allow about 5 minutes. **Which rule matches the table in #4? (C) How did you figure out the rule?** (Some will say that they tried each one. Some will say that they looked for a pattern. If they chose D, they are not seeing that the numbers in B are related to the numbers in A. If we add 6 to the last number in B, we do get the next number in B, but not if we add 6 to the numbers in A.) **What rule matches Table 5? (B.)** Again, if they chose D they are not seeing that each number in D is simply 8 plus each number in C. **What rule matches Table 6? (B)**

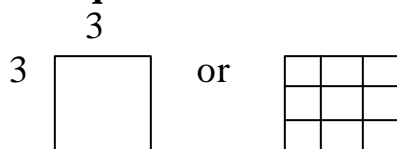
⇒ Give Student Sheet 62 to the students.

Say:

Would someone read the first problem. Allow one student to read. **How do you think we could find out how much Nicole makes on the different number of bottles? What is the pattern or rule?** (multiply the number of bottles times 5¢) **So how much does she earn on 5, 6, and 100 bottles?** (25¢, 30¢ and 500¢ or \$5)

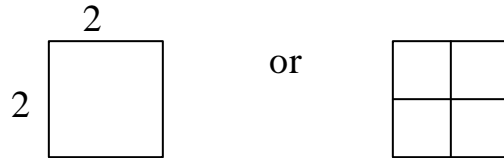
Say:

Look at Problem 2. How would you find the perimeter for any square? (add all the sides or multiply one side by 4) **What is the perimeter for squares 5, 6, and 100?** (20 units, 24 units, and 400 units) **Draw a picture of what you think square #3 would look like.**



Say:

Look at problem 3. How would you find the area of any square? (multiply side \times side, or s^2 , or multiply length \times width) **What is the area of squares 5, 6, and 20?** (25, 36, and 400) **Draw a picture of what you think square 2 would look like.**



\Rightarrow Have one student summarize today's lesson. Seeing relationships and generalizing patterns is one of the most important concepts in algebra.

Student Sheet 61 (Patterns: Lesson 3)

Part A In/Out Tables

1.

In	Out
1	7

2.

In	Out

3.

In	Out

Part B

Choose the rules below that match the patterns in the tables.

4.

A	B
1	6
2	12
3	18
4	24

- To get the numbers in column B,
- A. Multiply the numbers in column A by 2
 - B. Add 5 to the numbers in column A
 - C. Multiply the numbers in column A by 6
 - D. Add 6 to the numbers in column A

5.

C	D
3	11
4	12
5	13
6	14

- To get the numbers in column D,
- A. Multiply the numbers in column C by 3
 - B. Add 8 to the numbers in column C
 - C. Multiply the numbers in column C by 3.3
 - D. Add 1 to the numbers in column C

6.

E	F
1	1
2	3
3	5
4	7

- To get the numbers in column F,
- A. Add 0 to the numbers in column E
 - B. Double the numbers in column E and subtract 1
 - C. Add 1 to the numbers in column E
 - D. Add 2 to the numbers in column E

Student Sheet 62 (Patterns: Lesson 3)

1. Nicole earns 5¢ on each bottle that she takes to the recycling center. If the pattern continues, how much would she make on 5 bottles, 6 bottles, and 100 bottles?

Number of bottles	Amount earned
1	5¢
2	10¢
3	15¢
4	20¢
5	
6	
100	

2. The table below shows the perimeter for certain sized squares. If the pattern continues, what will be the perimeter for squares 5, 6, and 100?

Square Number	Perimeter
1	4 units
2	8 units
3	12 units
4	16 units
5	
6	
100	

3. The table below shows the area for certain sized squares. If the pattern continues, what will be the area for squares 5, 6, and 20?

Square Number	Area
1	1
2	4
3	9
4	16
5	
6	
20	