

Here are two strategies to find out.

- Make a table of values.
Use the patterns in the columns.
When we add 1 to the number of nets,
we add \$8 to the amount earned.

The pattern in the number of nets is:
Start at 0. Add 1 each time.
The pattern in the amount earned is:
Start at 25. Add 8 each time.

We can use these patterns to extend the table.
Minowa earned \$97 for repairing 9 nets.

Number of Fishing Nets	Amount Earned (\$)
0	25
1	33
2	41
3	49
4	57
5	65
6	73
7	81
8	89
9	97

- Use a variable in an expression.
Minowa earns \$25 even when there are
no nets to be repaired.
For each net Minowa repairs, she earns \$8.

For 0 nets, she earns: $8 \times 0 + 25 = 25$
For 1 net, she earns: $8 \times 1 + 25 = 33$
For 2 nets, she earns: $8 \times 2 + 25 = 41$
For 3 nets, she earns: $8 \times 3 + 25 = 49$
This pattern continues.

We can use an expression to write the pattern rule.
We use the letter n to represent any number of nets.
Then, the amount earned in dollars for repairing n nets is:
 $8 \times n + 25$, or $8n + 25$

To check that this expression is correct,
substitute $n = 3$.
 $8n + 25 = 8 \times 3 + 25$
 $= 49$

This is the same as the amount earned
for 3 nets in the list above.

To find the amount earned for repairing 9 nets,
substitute $n = 9$ into the expression:
 $8n + 25 = 8 \times 9 + 25$
 $= 72 + 25$
 $= 97$

Minowa earned \$97 for repairing 9 nets.



Sample Solutions

1. a)

Number of Cars	Number of Wheels
1	4
2	8
3	12
4	16
5	20

- b) Multiply the number of cars by 4.
c) Let n represent the number of cars.
d) I can substitute 11 for n in the expression or I can extend the table down to 11 cars.

3. a)

Figure Number	Number of Squares
1	5
2	7
3	9
4	11

- d) I substituted 7 for n : $2 \times 7 + 3 = 17$. I get the same answer when I continue the pattern in the table.

4. a)

Hours Danced	Amount Pledged (\$)
1	12
2	14
3	16
4	18
5	20

For the first example, give students time to look for the patterns in the table. After they examine the patterns within columns, have them focus on the pattern rule that relates the input to the output. Emphasize that there are several ways to describe the same pattern rule. Ask:

- Why might we use an expression with a variable to describe the rule?
(An expression with a variable says exactly what the rule is — for any number. It's quicker than writing out the rule in words. We can then use the rule to solve the problem. It is much easier and faster to use the rule than to extend the table, especially when we have to extend the table by many rows. We could use the other method to check if necessary.)

Work through the second example with students. Draw their attention to the different

numbers (3 and 9) that are substituted for n . Ensure they understand that other numbers could also be substituted for n . Ask:

- Why is 3 substituted for n in the expression?
(To check whether we have found the correct pattern rule)
- Why is 9 substituted for n in the expression?
(To find out how much money Minowa earns for repairing 9 nets)
- How would you find out how much Minowa would earn for repairing 20 nets? (I would substitute $n = 20$ in the expression $8n + 25$.)

As an extension, have students come up with a way to find how many nets Minowa has repaired for a certain amount of money. Ask:

- How would you find out how many nets Minowa repaired when she earned \$137?
(I would subtract 25, then divide by 8: $137 - 25$ is 112, and $112 \div 8$ is 14. Minowa repaired 14 nets.)

b)

Hours Danced	Amount Pledged (\$)
1	$2 \times 1 + 10 = 12$
2	$2 \times 2 + 10 = 14$
3	$2 \times 3 + 10 = 16$
4	$2 \times 4 + 10 = 18$
5	$2 \times 5 + 10 = 20$

Multiply the number of hours by 2, then add 10.

- c) Let h represent the number of hours danced.
 d) I substituted $h = 9$ in the expression: $2 \times 9 + 10 = 28$. Alana pledged \$28.
 e) I worked backward and performed the inverse operations. I subtracted 10 from the output: $34 - 10 = 24$. Then I divided by 2: $24 \div 2 = 12$. Tyson danced for 12 h.
5. a) Multiply the number by 6, then add 5.
 b) Let n represent the number.
 c) Fineen does yard work to earn money. She charges \$5 to bring her own tools and \$6 for each hour she works. One day, Fineen worked for 6 h. How much did she earn? Substitute $n = 6$ into the expression $6n + 5$: $6 \times 6 + 5 = 41$; she earned \$41.

Practice

1. Kilee builds model cars. She needs 4 plastic wheels for each car she builds.
 a) Make a table to show the number of wheels needed for 1, 2, 3, 4, and 5 cars.
 b) Write a pattern rule that relates the number of cars to the number of wheels.
 c) Write an expression to represent the pattern. $4n$
 d) Find the number of wheels needed to build 11 cars. How can you check your answer? 44 wheels



2. For each table of values, write an expression that relates the input to the output.

a)

Input	Output
1	0
2	2
3	4
4	6
5	8

$$2n - 2$$

b)

Input	Output
1	5
2	8
3	11
4	14
5	17

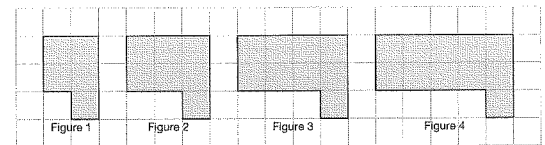
$$3n + 2$$

c)

Input	Output
1	2
2	6
3	10
4	14
5	18

$$4n - 2$$

3. Here is a pattern of squares on grid paper.



- a) Make a table to show the numbers of squares in the first 4 figures.
 b) Write a pattern rule that relates the figure number to the number of squares. Multiply the figure number by 2, then add 3.
 c) Write an expression to represent the pattern. $2n + 3$
 d) Find the number of squares in the 7th figure. 17
 Which strategy did you use?
 Continue the pattern to check your answer.

Practice

For questions 1, 3, 4, and 6, encourage students to use specific phrases to label the two columns of their tables. For example, they could write "Hours Danced" instead of "Input." Remind students that $3n$ is another way of writing $3 \times n$.

Tell students that it doesn't matter which letter variable they use as long as they explain what the variable represents. Usually we choose the first letter of a word or phrase that describes what the variable represents; for example, n for number of students or h for hours danced.

For question 3, provide 1-cm grid paper (PM 23) so students can continue the pattern on a grid to check their answers to part d.

Question 6 is slightly different from the other questions students have seen so far. Instead of adding or subtracting a number after

multiplying, the multiplication term is subtracted from a number. Also, in part e, it is not possible for Skylar to raise exactly \$59. After 19 walks, he will have raised \$57, and after 20 walks, he will have raised \$60.

Assessment Focus: Question 4

For part d, students will either substitute the number of hours in their expression from part c to find the amount Alana pledged or extend their table in part a. Depending on students' abilities, either method is acceptable.

For part e, students may either perform the inverse operations backward to find the number of hours Tyson danced, or extend the table they created in part a. The former method shows a deeper understanding of pattern rules.

Students can complete the Additional Activity *Slithering into Variables* (Master 1.8).

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4. The Grade 6 class held a dance-a-thon to raise money to buy a new computer for the class. Tyson's friend, Alana, pledged \$10, plus \$2 for each hour Tyson danced.
- Make a table to show the amount Alana pledged for 1, 2, 3, 4, and 5 hours danced.
 - Write a pattern rule that relates the amount pledged to the number of hours danced. Show your work.
 - Write an expression to represent the pattern. $2h + 10$
 - Find how much Alana pledged when Tyson danced 9 h. \$28
What strategy did you use?
 - Suppose Alana pledged \$34. How many hours did Tyson dance? How did you find out? 12 h

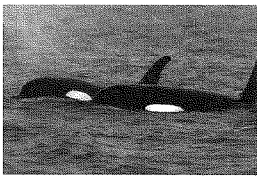
5. The pattern in this table continues.

- Write a pattern rule that relates the number to the amount.
- Write an expression to represent the pattern. $6n + 5$
- Write a story problem you could solve using the pattern.
Solve your problem.

Number	Amount (\$)
0	5
1	11
2	17
3	23
4	29

6. Skylar wants to adopt a whale through the BC Wild Killer Whale Adoption Program. The cost of a 1-year adoption is \$59. Skylar walks his neighbour's dog to raise the money. He gets \$3 for each walk.

- Make a table to show the amount left to raise after 1, 2, 3, 4, and 5 walks.
- Write a pattern rule that relates the number of walks to the amount left to raise.
- Write an expression to represent the pattern.
- Find the amount left to raise after 15 walks.
- After how many walks will Skylar have raised enough money? How do you know? 20 walks



$59 - 3n$
\$14

Reflect

What is one advantage of using a variable to represent a pattern?
How does this help you solve a problem?

ASSESSMENT FOCUS | Question 4

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6. a)

Number of Walks	Amount Left to Raise (\$)
1	56
2	53
3	50
4	47
5	44

- Multiply the number of walks by 3, then subtract from 59.
- Let n represent the number of walks.
- Substitute $n = 15$ into the expression $59 - 3n$:
 $59 - 3(15) = 59 - 45 = 14$
Skylar has \$14 left to raise.
- After 20 walks, Skylar will have raised enough money. I know that after 15 walks, Skylar needed to earn \$14 more. He earns \$15 from 5 walks, so I added 5 more walks to the 15 walks. I checked my answer by substituting 20 for n in the expression.

REFLECT: An expression with a variable tells what the pattern rule is for any number. It is faster to write than a description of the pattern rule in words. To solve a story problem, you can substitute a number for the variable in the expression and find the answer. It is a lot faster to use the expression than to extend a table.

ASSESSMENT FOR LEARNING

What to Look For

Conceptual Understanding

- ✓ Students explain that an expression with a variable can represent a pattern rule.
- ✓ Students explain that a letter variable can represent any input number.

Procedural Knowledge

- ✓ Students can write an expression with a variable to represent a pattern.
- ✓ Students can use pattern rules with variables to solve problems.
- ✓ Students can use an expression to describe the relationship in a table of values.

What to Do If You Don't See It

Check Further

As students work, ask:

- What is the pattern rule that relates the input to the output?
- What letter will you use to represent any input?
- How can you write the rule without using words?

Adjust Instruction

Students who are having difficulty creating an expression to match a pattern rule may benefit from writing out an equation for each input/output pair to see how the output is obtained. (See the example in *Connect*.) Ensure students are able to state a pattern rule clearly in words before they attempt to create an expression with a variable.