

1.6

Graphing Relations

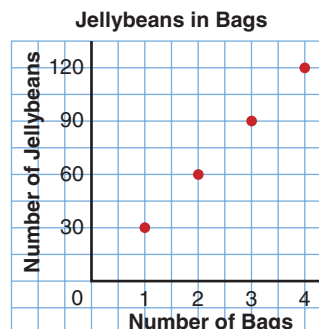
Focus Create a table of values, then graph.

We can use a graph to show the relationship between two quantities.

What does this graph show?

How many jellybeans are in each bag?

Write a relation for the total number of jellybeans in n bags.



Explore



You will need grid paper.

The cost of n CDs, in dollars, is $12n$.

- What is the cost of one CD?
- Copy and complete this table.
- Graph the data.

Use the graph to answer these questions:

- What is the cost of 5 CDs?
- How many CDs could you buy with \$72?

Number of CDs n	Cost (\$) $12n$
0	
2	
4	
6	
8	
10	



Reflect & Share

Describe the patterns in the table. How are these patterns shown in the graph?

If you had \$50, how many CDs could you buy?

Connect

This table shows how $4n + 2$ relates to n , where n is a whole number.

We could have chosen any Input numbers, but to see patterns it helps to use consecutive numbers.

These data are plotted on a graph.

The input is plotted on the horizontal axis.

The output is plotted on the vertical axis.

On the vertical axis, the scale is 1 square for every 2 units.

The graph also shows how $4n + 2$ relates to n .

When we place a ruler along the points, we see the graph is a set of points that lie on a straight line.

When points lie on a straight line, we say the relation is a **linear relation**.

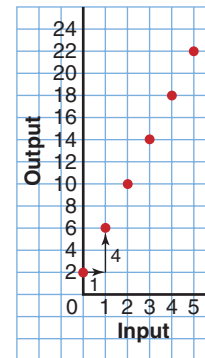
Since no numbers lie between the Input values in the table, it is not meaningful to join the points with a solid line.

The graph shows that each time the input increases by 1, the output increases by 4.

Input n	Output $4n + 2$
0	$4(0) + 2 = 2$
1	$4(1) + 2 = 6$
2	$4(2) + 2 = 10$
3	$4(3) + 2 = 14$
4	$4(4) + 2 = 18$
5	$4(5) + 2 = 22$

Red arrows on the left indicate an increase of +1 in the input for each row. Red arrows on the right indicate an increase of +4 in the output for each row.

Graph of $4n + 2$ against n



Example

Mr. Beach has 25 granola bars.

He gives 3 granola bars to each student who stays after school to help prepare for the school concert.

- Write a relation to show how the number of granola bars that remain is related to the number of helpers.
- Make a table to show this relation.
- Graph the data. Describe the graph.
- Use the graph to answer these questions:
 - How many granola bars remain when 7 students help?
 - When will Mr. Beach not have enough granola bars?



A Solution

- a) Let n represent the number of helpers. b) Substitute each value of n into $25 - 3n$.

Each helper is given 3 granola bars.
So, the number of granola bars given to n helpers is $3n$.

There are 25 granola bars.

The number of granola bars that remain is $25 - 3n$.

So, n is related to $25 - 3n$.

- c) On the vertical axis, use a scale of 1 square for every 2 units.

The points lie on a line so the graph represents a linear relation.

When the input increases by 1, the output decreases by 3.

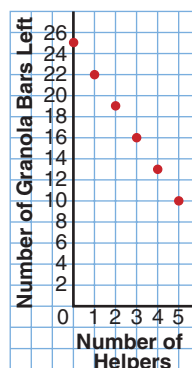
The graph goes down to the right.

This is because the number of granola bars that remain decreases as the number of helpers increases.

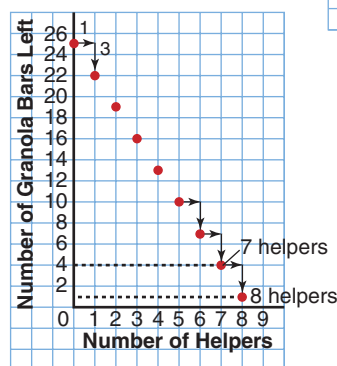
- d) i) To find the number of granola bars that remain, extend the graph. The points lie on a straight line. Extend the graph to 7 helpers. There are 4 granola bars left.
- ii) Continue to extend the graph. 25 granola bars are enough for 8 helpers, but not for 9 helpers. Mr. Beach will not have enough granola bars for 9 or more helpers.

Number of Helpers n	Number of Granola Bars Left $25 - 3n$
0	$25 - 3(0) = 25$
1	$25 - 3(1) = 22$
2	$25 - 3(2) = 19$
3	$25 - 3(3) = 16$
4	$25 - 3(4) = 13$
5	$25 - 3(5) = 10$

Granola Bars Left



Granola Bars Left



To graph a relation, follow these steps:

- Select appropriate Input numbers. Make a table of values.
- Choose scales for the horizontal and vertical axes.
- Use a ruler to draw the axes on grid paper. Use numbers to indicate the scale.
- Label the axes. Give the graph a title.
- Plot the data in the table.

Another Strategy

We could have solved part d) of the *Example* by extending the table.

Practice

1. Copy and complete this Input/Output table for each relation.

- $4n$ is related to n .
- $x + 3$ is related to x .
- $4c + 6$ is related to c .

Input n	Output
1	
2	
3	
4	
5	

2. Graph each relation in question 1.
Suggest a real-life situation it could represent.

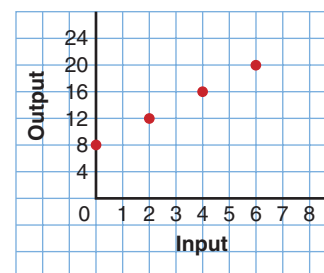
3. a) Copy and complete this Input/Output table to show how $6a - 4$ is related to a .

- Graph the relation.
What scale did you use on the vertical axis?
How did you make your choice.
- Explain how the graph illustrates the relation.

Input a	Output
2	
4	
6	
8	
10	

4. Look at the graph on the right.

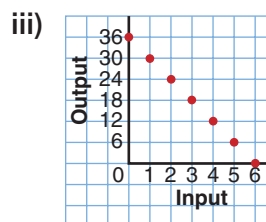
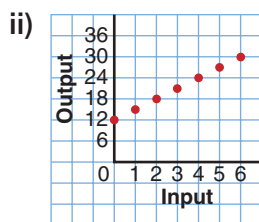
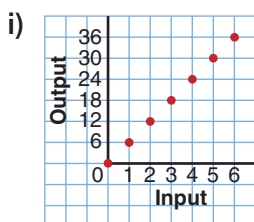
- What is the output when the input is 1?
- Which input gives the output 18?
- Extend the graph. What is the output when the input is 8?
- Suggest a real-life situation this graph could represent.



5. Admission to Fun Place is \$5.
Each go-cart ride costs an additional \$3.
- Write a relation to show how the total cost is related to the number of go-cart rides.
 - Copy and complete this table.
 - Draw a graph to show the relation.
Describe the graph.
 - Use the graph to answer these questions:
 - Erik goes on 6 go-cart rides.
What is his total cost?
 - Before entering the park, Lydia has \$30.
How many go-cart rides can she afford?

Number of Go-Cart Rides	Total Cost (\$)
0	
1	
2	
3	
4	
5	

6. Match each graph to its relation.
- The number of seashells collected is related to the number of students who collected. There are 12 seashells to start. Each student collects 3 seashells.
 - The number of counters on the teacher's desk is related to the number of students who remove counters. There are 36 counters to start. Each student removes 6 counters.
 - The money earned baby-sitting is related to the number of hours worked. The baby-sitter earns \$6/h.



7. Akuti borrows \$75 from her mother to buy a new lacrosse stick. She promises to pay her mother \$5 each week until her debt is paid off.
- Write a relation to show how the amount Akuti owes is related to the number of weeks.
 - Make a table for the amount owing after 2, 4, 6, 8, and 10 weeks.
 - Draw a graph to show the relation. Describe the graph.
 - Use the graph to answer these questions:
 - How much does Akuti owe her mother after 13 weeks?
 - When will Akuti finish paying off her debt?

8. **Assessment Focus** Use the relation: $5n + 6$ is related to n
- Describe a real-life situation that could be represented by this relation.
 - Make a table of values using appropriate Input numbers.
 - Graph the relation. Describe the graph.
 - Write 2 questions you could answer using the graph. Answer the questions.

Reflect

How can the graph of a relation help you answer questions about the relation? Use an example to show your thinking.