## Understand Proportional Relationships

## Think It Through

## What is a proportional relationship?

Suppose you and some friends plan to go to a movie and the tickets cost \$8 each.
You will pay $\$ 8$ for 1 ticket, $\$ 16$ for 2 tickets, $\$ 24$ for 3 tickets, $\$ 32$ for 4 tickets, and so on. The ratios of the total cost of the tickets to the number of tickets are all equivalent.

A group of ratios that are equivalent are in a proportional relationship. When ratios are equivalent, they all have the same unit rate. In a proportional relationship, the unit rate is called the constant of proportionality.

## Think How can you use a table to tell if a relationship is proportional?

The table below shows the total cost of movie tickets based on the number of tickets you buy.

| Total Cost of Tickets (\$) | 8 | 16 | 24 | 32 |
| :--- | :---: | :---: | :---: | :---: |
| Number of Tickets | 1 | 2 | 3 | 4 |

Circle the ratio in the table that shows the constant of proportionality.

The ratios of the total cost of tickets to the number of tickets are equivalent. The ratios all simplify to $\frac{8}{1}$ or 8 , so the ratios are in a proportional relationship.

$$
\frac{8}{1}=8 \quad \frac{16}{2}=8 \quad \frac{24}{3}=8 \quad \frac{32}{4}=8
$$

The unit rate is 8 , so the constant of proportionality is 8 . The equation $c=8 t$, where $c$ is the total cost and $t$ is the number of tickets, represents this relationship. The total cost is always 8 times the number of tickets.

The table below shows the cost to play in the town soccer tournament.

| Total Cost (\$) | 7 | 8 | 9 | 10 |
| :--- | :---: | :---: | :---: | :---: |
| Number of Family Members | 1 | 2 | 3 | 4 |

You can find and simplify the ratios of the total cost to the number of family members.

$$
\frac{7}{1}=7 \quad \frac{8}{2}=4 \quad \frac{9}{3}=3 \quad \frac{10}{4}=2 \frac{1}{2}
$$

The ratios are not equivalent, so the quantities are not in a proportional relationship.

## Think How can you use a graph to tell if a relationship is proportional?

You can use a graph to determine if a relationship is proportional.
The data for the cost of movie tickets and the cost to participate in the soccer tournament can be modeled by the graphs below.



Compare the two graphs. How are they alike? How are they different?

The points on the graphs are on a straight line for both sets of data, but only the data for the cost of movie tickets goes through the origin. This means that only the total cost of the movie tickets compared to the number of tickets is a proportional relationship.

| Proportional Relationship | Non-Proportional Relationship |
| :--- | :--- |
| - The graph can be represented by a | - The graph may or may not be represented by |
| straight line. |  | | a straight line. |
| :--- |
| - The the graph is a straight line, it does not go |
| through the origin. |

## Reflect

1 Look at the graph that compares the total cost to the number of movie tickets you buy. How can you use the graph to find the cost of 5 movie tickets?

