1.7 CONSTANT RATE OF CHANGE

**Objective:** To identify rates of change using tables and graphs
VOCABULARY

- **rate of change** - a rate that describes how one quantity changes in relation to another. A rate of change is usually expressed as a unit rate.

- **constant rate of change** - the rate of change in a linear relationship.
WHEN DO WE USE THIS?

Real-World Link

A computer programmer charges customers per line of code written. Fill in the blanks with the amount of change between consecutive numbers.

<table>
<thead>
<tr>
<th>Lines of Code</th>
<th>50</th>
<th>100</th>
<th>150</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost ($)</td>
<td>1,000</td>
<td>2,000</td>
<td>3,000</td>
<td>4,000</td>
</tr>
</tbody>
</table>

+50  +50  +50
+1000 +1000 +1000

Label the diagram below with the terms change in lines, change in dollars, and constant rate of change.

\[
\text{Change in Dollars} = \frac{\text{\$1,000}}{50 \text{ lines}}
\]

\[
\text{Change in lines} = \frac{\text{\$20}}{1 \text{ line}} \text{ unit rate}
\]

The constant rate of change is $20 per line of programming code.
HOW TO FIND THE CONSTANT RATE OF CHANGE

Examples:
• a)

The table shows the number of miles a plane traveled while in flight. Use the information to find the approximate constant rate of change in miles per minute.

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>30</th>
<th>60</th>
<th>90</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (mi)</td>
<td>290</td>
<td>580</td>
<td>870</td>
<td>1,160</td>
</tr>
</tbody>
</table>
ANSWER

• About 10 miles per minute
  9.66
  ≈10
The table shows the number of students that buses can transport. Use the table to find the constant rate of change in students per school bus.

<table>
<thead>
<tr>
<th>Number of Buses</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Students</td>
<td>144</td>
<td>216</td>
<td>288</td>
<td>360</td>
</tr>
</tbody>
</table>
ANSWER

• 72 students per school bus
  72/1
2. The graph represents the distance traveled while driving on a highway. Find the constant rate of change.

To find the rate of change, pick any two points on the line, such as (0, 0) and (1, 60).

\[
\frac{\text{change in miles}}{\text{change in hours}} = \frac{(60 - 0) \text{ miles}}{(1 - 0) \text{ hours}}
\]

\[= \frac{60 \text{ miles}}{1 \text{ hour}}\]
RISE OVER RUN

Y

X

Y

X

Rise = 2

Run = 3

Slope = \frac{\text{Rise}}{\text{Run}} = \frac{2}{3}
USE A GRAPH TO FIND A CONSTANT RATE OF CHANGE.

**Got It?** Do these problems to find out.

c. Use the graph to find the constant rate of change in miles per hour while driving in the city.

d. On the lines below, explain what the points (0, 0) and (1, 30) represent.
• 30 miles per hour
  • 30/1

• The point (0,0) represents traveling zero miles in zero hours.
• The point (1,30) represents traveling 30 miles in 1 hour.
4. The table and graph below show the hourly charge to rent a bicycle at two different stores. Which store charges more per bicycle? Explain.

<table>
<thead>
<tr>
<th>Pedals Rentals</th>
<th>Time (hour)</th>
<th>Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>48</td>
</tr>
</tbody>
</table>

The cost at Pedals Rentals increases by $12 every hour. The cost at Super Cycles increases by $8 every hour.

So, Pedals Rentals charges more per hour to rent a bicycle.
1. The table and graph below show the amount of money Mi-Ling and Daniel save each week. Who saves more each week? Explain. (Examples 1, 2, and 4)

<table>
<thead>
<tr>
<th>Time (weeks)</th>
<th>Mi-Ling’s Savings ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>$30</td>
</tr>
<tr>
<td>3</td>
<td>$45</td>
</tr>
<tr>
<td>4</td>
<td>$60</td>
</tr>
</tbody>
</table>

The unit rate for Mi Ling’s savings is $15 per wk

The unit rate for Daniel’s savings is $10 per wk

2. Refer to the graph in Exercise 1. Explain what the points (0, 0) and (1, 10) represent. (Example 3)

(0,0) represents zero dollars saved by Daniel in zero wks

(1,10) represents 10 dollars saved in one wk

3. **Building on the Essential Question** How can you find the unit rate on a graph that goes through the origin? Use the y-coordinate of the point where the x-coordinate is 1.