Lesson: Talking About Distance, Rate and Time

Standards: Standards: 6NS1.2, 6AF2.3, 6MS2.4, 7MG1.3, 7AF1.3, AF4.2, 7MR2.5, Alg.15.0

Warm-up or Activity:

Distance/Rate/Time Chart

The chart can be completed as a whole class activity, partner Think-Pair-Share, or as a group categorization activity. Put up a few relevant sentence starters that help students while categorizing. For example, "I know this goes in the *rate* category because…" If groups categorize the examples the whole class needs to review the Example Chart (overhead or Elmo) to verify that examples are in the correct category. The teacher can model some of the sentences in the debrief/ review time

Note to teacher: Many of the activities in this lesson correspond to the listening, speaking, writing and reading components for English Language Development in core content classrooms.

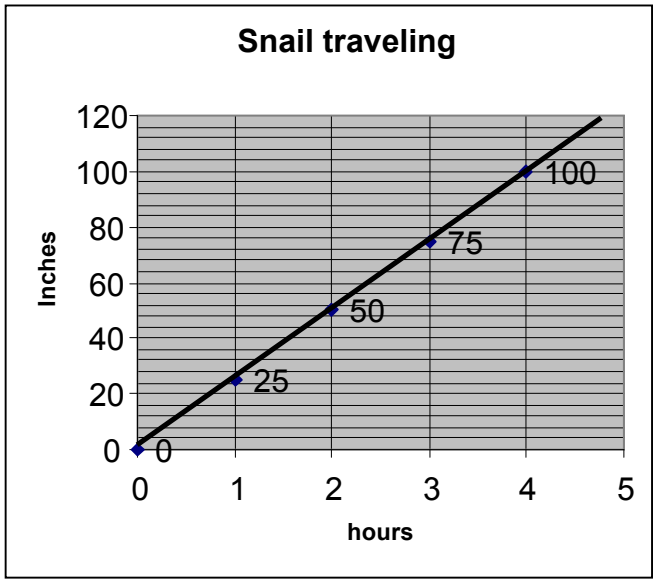
Lesson:

Each example has a graph and two methods to solve. The lesson is meant for two to three days. The graphs can be constructed by students if they are given a function table or they can derive the table from the problem. Otherwise the graph can be distributed for student discussion and interpretation before the problem is read or attempted. The graphs are meant for student discussion and access into the concepts and not necessarily for finding the solution.

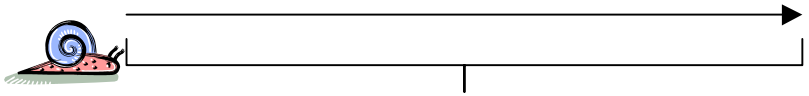
Distance	***Rate***	***Time***
How far?	**How fast? (speed)**	**How long?**
Inches Feet Centimeters Yards Meters Miles Kilometers Knot (nautical mile = 1.15 miles)	Feet per second, $\frac{ft.}{sec.}$ Yards per minute Miles per hour, $\frac{miles}{hr.}$ Kilometers per hour, $\frac{km.}{hr.}$ Knots per hour	Seconds Minutes Hours Days Weeks Months Years
Example	**Example**	**Example**
A car **traveled 20 miles.**	A car traveled 20 miles at an **average rate of 60 miles per hour.**	A car traveled 20 miles at an average rate of 60 miles per hour **for 3 hours**.
A runner **traveled 15 kilometers.**	A runner traveled 15 kilometers at a **speed of 5 kilometers per hour.**	A person ran for 15 kilometers at a speed of 5 kilometers per hour for **2 hours**.
Question	**Question**	**Question**
How far did the car travel?	**How fast** was the car traveling?	For **how long** did the car travel? **How long** did it take for the car to get there?

Example 1: A snail travels at a speed of 25 inches per hour. How far can a snail travel in four hours?

Interpret a graph

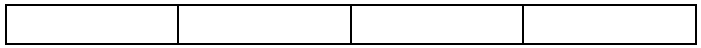


"Draw a diagram"

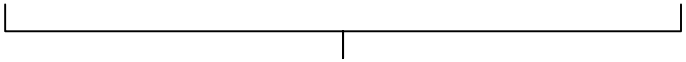


4 hours

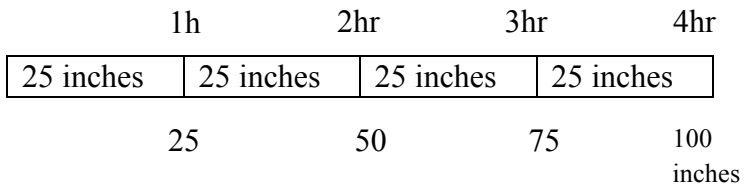
Distance Traveled



"Draw a bar model"



4 hours



"Write a sentence"

The snail traveled 100 inches in four hours.

Traditional Method:

Distance = (rate) (time)

$d = rt$

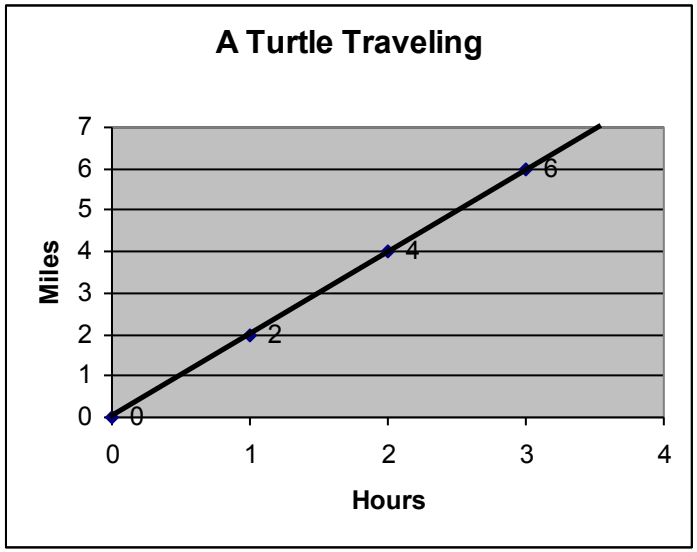
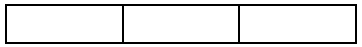
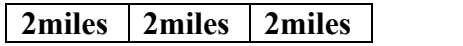
$d = \left(\frac{25\ in.}{1hr.}\right)(4hr.)$

$d = \left(\frac{25\ in.}{1\cancel{hr.}}\right)(4\cancel{hr.})$

$d = (25\ in.)(4)$

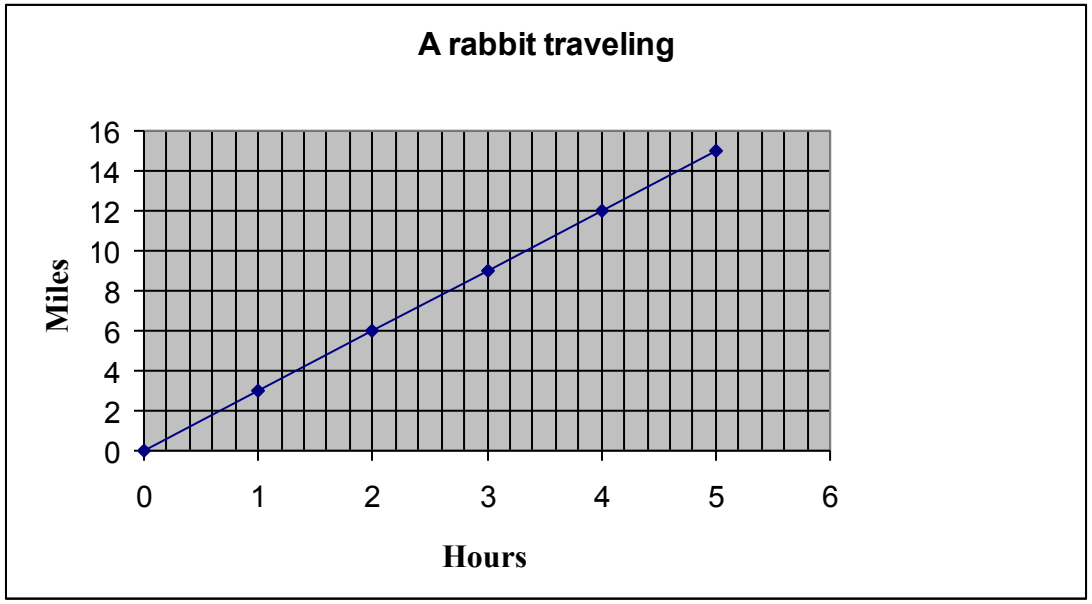
$d = 100\ inches$

Example 2: **A turtle travels 2 miles in one hour. How far does it travel in 3 hours?**

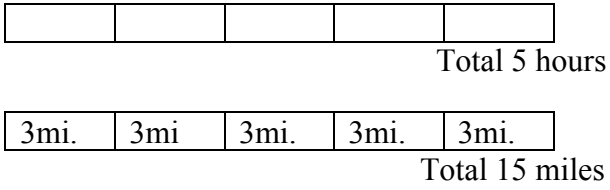
Interpreting a Graph	Bar Model	Traditional Method
		$d = rt$
	3 hours	$d = \left(\frac{2\ miles}{1hr.}\right)(3hrs.)$
		$d = (2\ miles)(3)$
	2miles 2miles 2miles	$d = 6\ miles$
	2 4 6 miles	The turtle traveled six miles in three hours.
	The turtle traveled six miles in three hours.	

You Try: A rabbit hops and jumps at a speed of 3 miles per hour. How far did the rabbit travel in five hours?

Interpreting a graph:



Bar Model



Traditional:

$d = rt$

$d = \left(\frac{3mi.}{1hr.}\right)(5hrs.)$

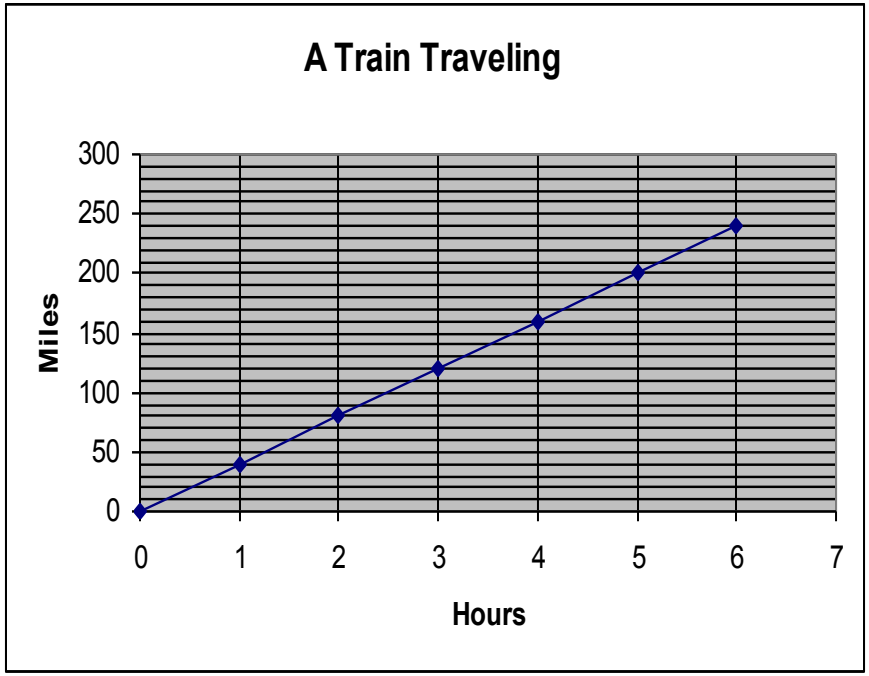
$d = (3mi.)(5)$

$d = 15\ miles$

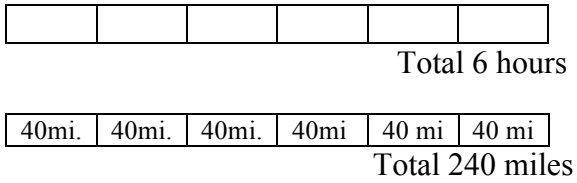
The rabbit traveled 15 miles in five hours.

<u>Example 3</u>: A passenger train left the train station in Sacramento and traveled at an average speed of 40 miles per hour. In six hours it reached its destination. How far did it travel?

Graph Interpretation



Bar Model



The train traveled 240 miles in six hours.

Traditional Method

$$d = rt$$

$$d = \left(\frac{40miles}{1hr.}\right)(6hrs.)$$

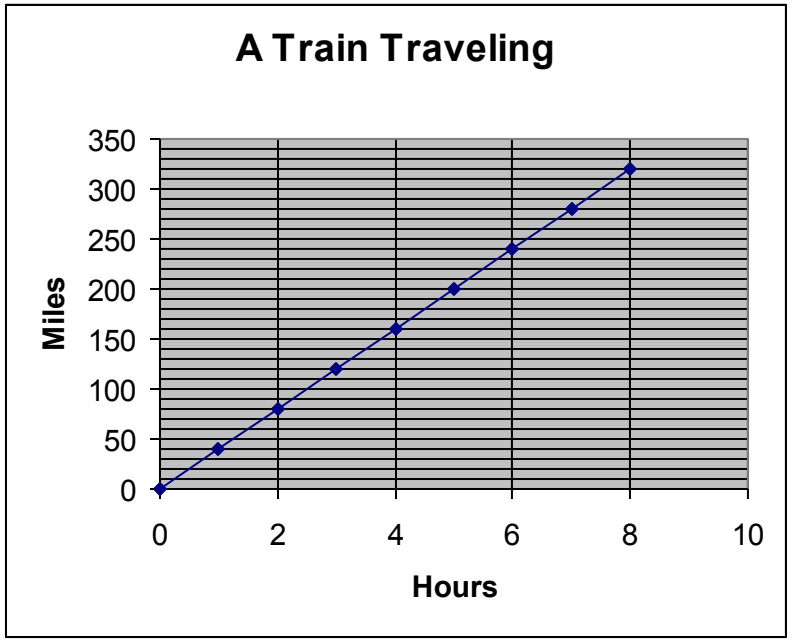
$$d = (40miles)(6)$$

$$d = 240\ miles$$

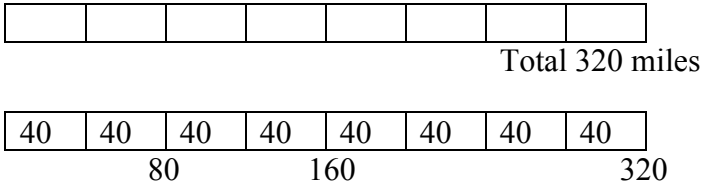
The train traveled 240 miles in six hours.

<u>Example 4</u>: What if we knew that a train traveled 320 miles in eight hours, what was the average speed of the train?

Graph Interpretation



Bar Model



<u>Note</u>: the bar can be divided in half to yield 160; then in half to yield 80 and in half again to yield 40 for each segment in the bar.

Traditional $d = rt$

$$320\ miles = (rate)(8hrs.)$$

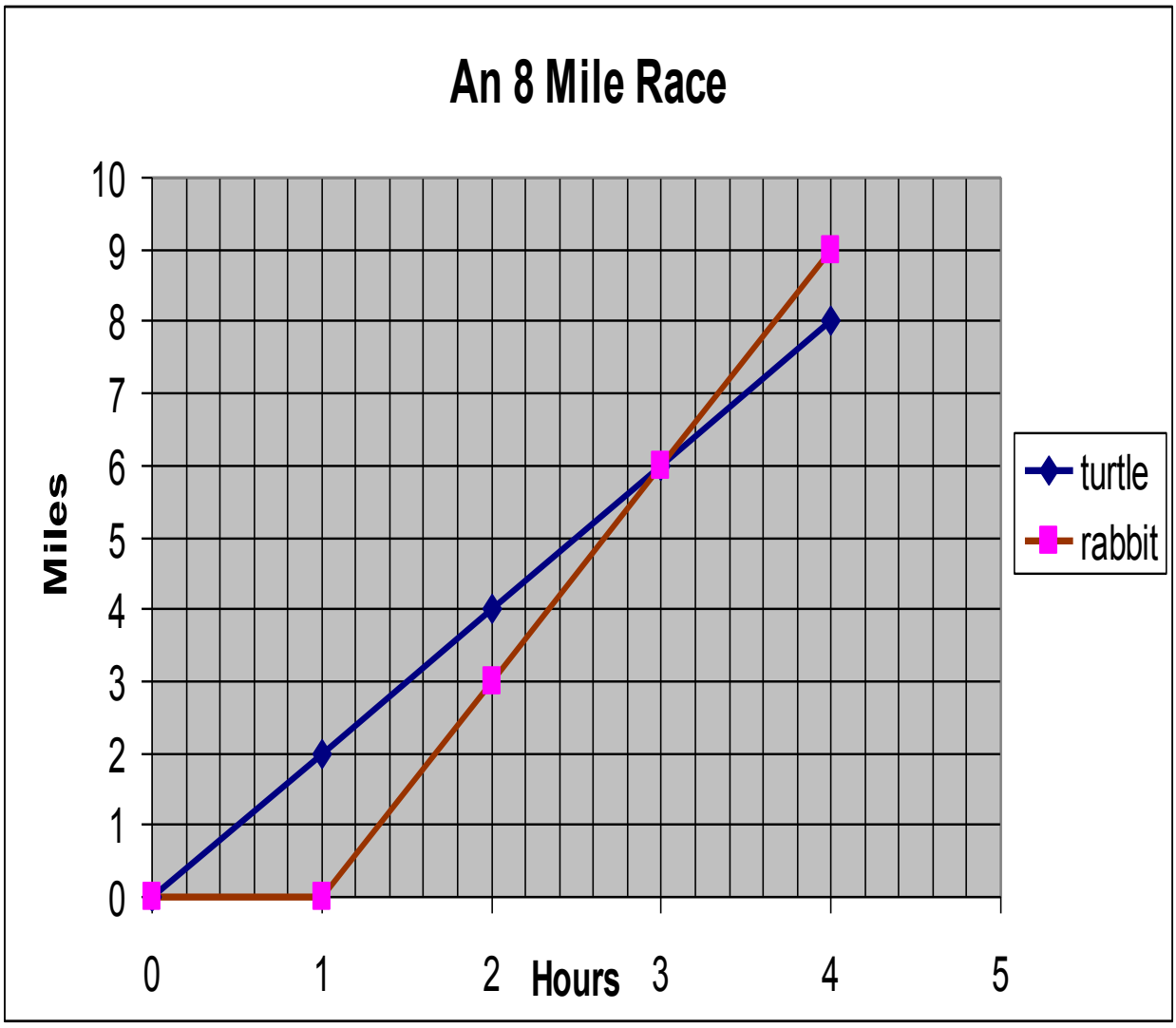
$$\left(\frac{320\ miles}{8hrs}\right) = \left(\frac{(r)(8hrs)}{8hrs}\right)$$

$$\left(\frac{320\ miles}{8hrs}\right) = \left(\frac{(r)(8hrs)}{8hrs}\right)$$

$$\frac{40\ miles}{hr} = r$$

The average speed of the train was 40 miles per hour.

Graphs can be used to show a story. Here is a graph that represents a race between a turtle and a rabbit. From the information in the graph write a story.



The graph interpretation can be done as a Think-Pair-Share or as a group activity. After 5 minutes encourage students to share out their analysis.

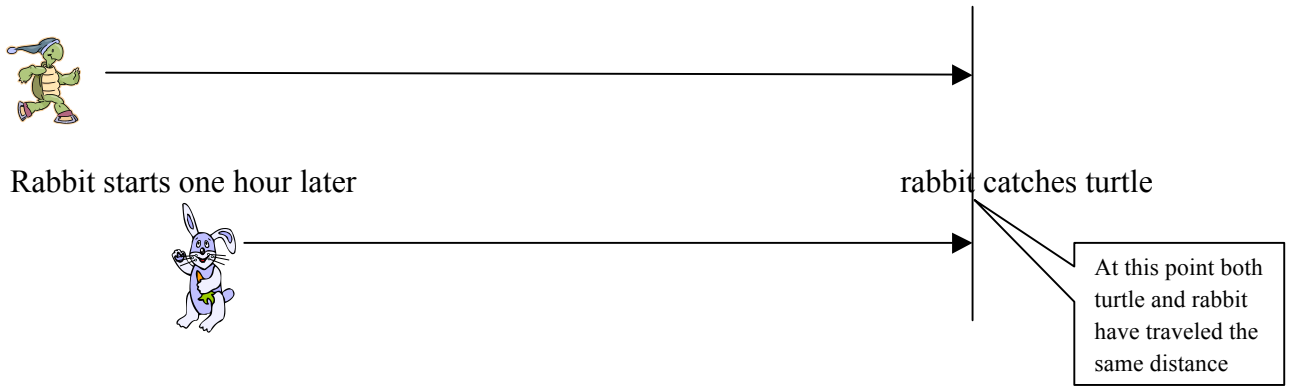
Note: If students leave out the following details be sure to include through questioning.

Which one left first? How do you know?

Who won the race? What does the point of intersection mean? How far have both gone at that point?

Example 5: In a race between a turtle and a rabbit, the turtle travels at average rate of 2 miles per hour. The rabbit knew it was going to win so it gave the turtle a chance by starting one hour later, and it traveled at an average rate of 3 miles per hour. How long did it take the rabbit to catch the turtle?

Draw a picture:



Traditional:

Note: Since the distance is the same for both we can write:

$(rt)_{\text{turtle}} = (rt)_{rabbit}$

let x = *time it takes the rabbit to catch turtle*

let $x+1$ = *the time the turtle will travel until overtaken*

$$\left(\frac{2\ miles}{hr}\right)(x+1) = \frac{3\ miles}{hr}(x)$$

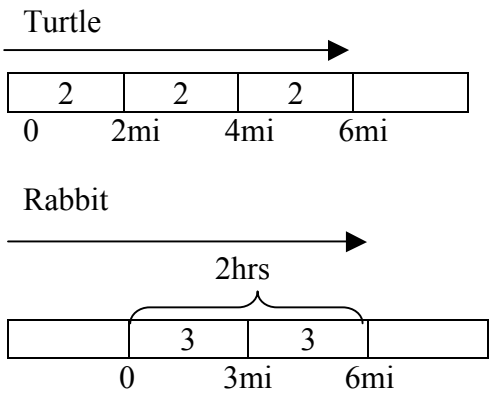
$$(2)(x) + (2) = (3)(x)$$

$$(2x) + (2) - (2x) = (3x) - (2x)$$

$$(2) = (x)$$

$$2 = x$$

Bar Model

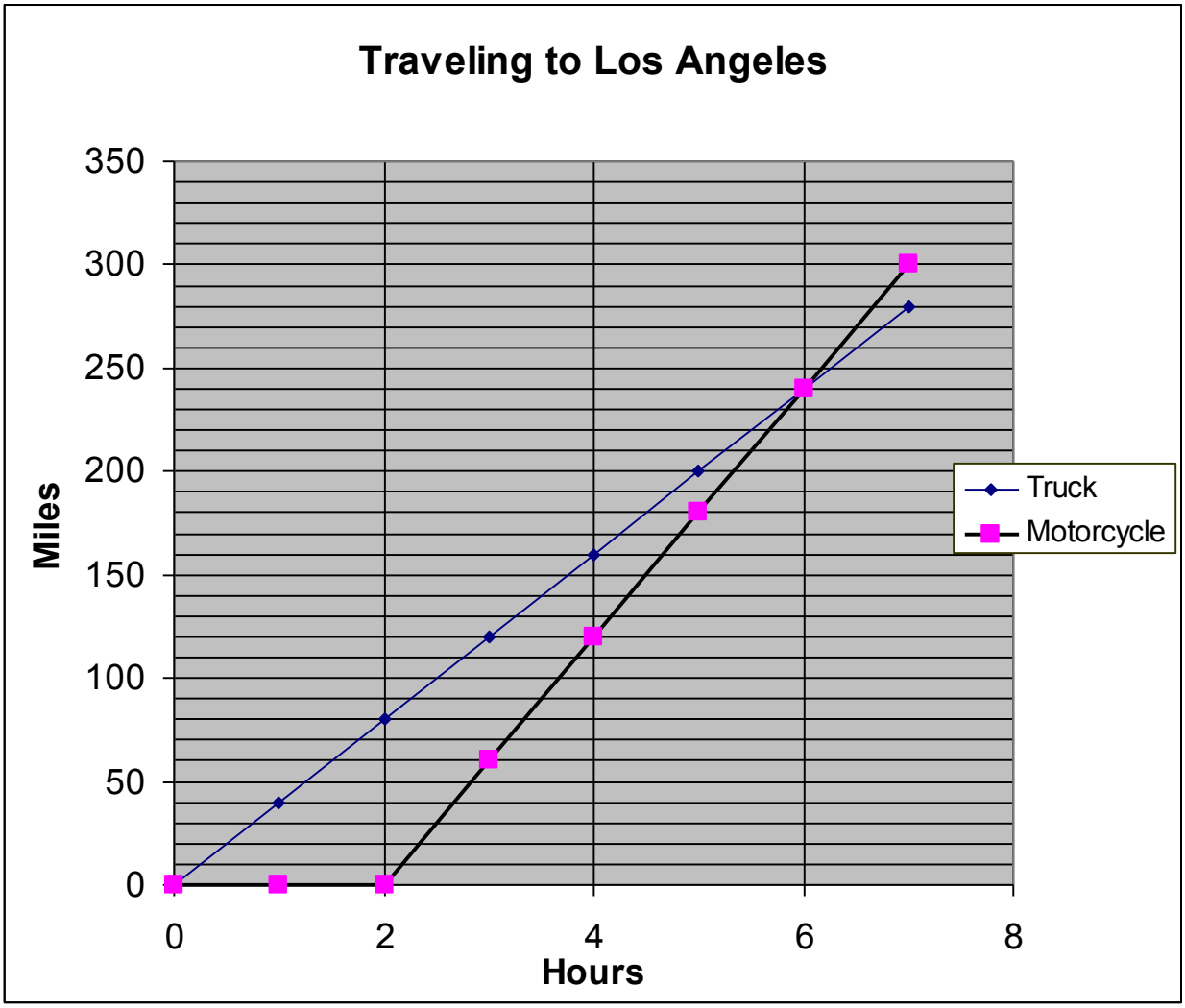


Note: the turtle and rabbit traveled the same distance but it took the rabbit 2 hours to reach that distance.

It took the rabbit 2 hours to catch the turtle.

Enhanced question: How long did the turtle go before being overtaken by the rabbit?

Here is a graph that is titled "Traveling to Los Angles". From the information in the graph write a detailed story (assume both vehicles are traveling on the same road).



The graph interpretation can be done as a Think-Pair-Share or as a group activity. After 5 minutes encourage students to share out their analysis.

<u>Note</u>: If students leave out the following details be sure to include through questioning.

- **"How do you know that the motorcycle left later?" How much later?**
- **"Who reached 300 miles first?"**
- **"What information does the point of intersection tell us (assuming they traveled the same road)?" "How far have both gone at that point?"**
- **"What does the slope of each line tell us?"**

Using POST –ITs for the Bar Model:

A truck leaves San Jose for Los Angeles traveling at an average of 40 mph. Two hours later a motorcycle leaves the same place in San Jose for Los Angeles at 60 miles per hour. How long will it be before the motorcycle overtakes the truck?

Truck		Motorcycle	
6	240 mi	4	240 mi
40		**60**	
5	200	3	180
40		**60**	
4	160	2	120
40		**60**	
3	120	1	60
40		**60**	
2	80	0	0
40		**0**	
1hr	40mi	0	0 mi
40		**0**	
0hr	0mi	0hr	0mi

Place each post-it one at a time and label each one as you go. Start with the truck and then do the motorcycle. Notice that the motorcycle has two Post-Its with zero hours and miles. Those represent leaving two hours later. Each post-it represents one hour and the rate will remain the same. Label the top left hand corner for each hour. This means an increase by one hour for each post it.The top right hand corner will total the miles and when both vehicles have reached the same distance; the time it takes the motorcycle to overtake the truck is on the top left corner of the post-it. The example can be done from bottom to top, top to bottom or on its side. **NOTE: Because students do not know the number of Post-Its needed you can place 5 or 7 for the truck and let students experiment until they find the number of post its until the distance is equal.**

Traditional:

$$40(x+2) = 60x$$

$$40x + 80 = 60x$$

$$40x + 80 - 40x = 60x - 40x$$

$$80 = 20x$$

$$\frac{80}{20} = \frac{20x}{20}$$

$$4 = x$$

∴ The time it takes the motorcycle to overtake the truck is 4 hours.