LESSON 1: EXPLORE BEATS PER MINUTE

EXERCISES

- Review your Unit Assessment from the previous unit.
- Write your wonderings about rate.
- Write a goal stating what you plan to accomplish in this unit.
- Based on your previous work, write three things you will do differently during this unit to increase your success.

LESSON 2: PRICE AS A RATE

EXERCISES

EXERCISES

For problems 1–4, use the following information: peaches cost $1.25 per pound.

1. What is the cost of 5 pounds of peaches?

2. What is the cost of $\frac{1}{2}$ pound of peaches?

3. What is the cost of 4.2 pounds of peaches?

4. What is the cost of 1 peach if 4 peaches weigh 1 pound and each peach weighs the same?

5. Brittany bought 2 pounds of peas for $5.00.
   a. What is the price of 1 pound of peas?
   b. Brittany needs 5.5 pounds of peas to prepare a community meal. What is the cost of 5.5 pounds of peas?

6. Suppose that 8 pints of strawberries cost $6.00.
   a. Complete the table to show the cost of strawberries for the given numbers of pints.

Amount (pt)	1	2	3	4	5	6
Cost ($)						

Amount (pt)	7	8	9	10	11	12
Cost ($)		$6.00				$9.00

   b. How much do 6.5 pints of strawberries cost? Explain how you know.
   c. Organic strawberries cost 3 times as much as regular strawberries. Add another row to the table you completed for problem 6a, giving the cost of different quantities of organic strawberries.

LESSON 2: PRICE AS A RATE

EXERCISES

7. Eggs cost $3.00 per dozen. Elijah has $0.32.
   a. How many eggs can Elijah buy?
   b. Elijah needs to buy 3 eggs to make a cake. How much more money does Elijah need to buy 3 eggs?

Challenge Problem

8. A new car model has a curb weight of 3,291 pounds and a list price of $21,300. What is the cost per pound of the car? Use this unit cost to determine the price of one of the car's wheels, if it weighs 20 pounds. Does it make sense to price a car's pieces by weight? Explain.

LESSON 3: FUEL EFFICIENCY AS A RATE

EXERCISES

EXERCISES

For problems 1–4, use the following information: Lisa's car has a range of 300 miles. Her gas tank can hold 15 gallons.

1. How many gallons of gas will Lisa need to go 450 miles?

2. How many gallons of gas will Lisa need to go 185 miles?

3. How far can Lisa drive if she has 8 gallons of gas?

4. How far can Lisa drive if she has one-quarter tank of gas?

For problems 5 and 6, use the following information: Brent's truck can hold 22 gallons of gas, and he can drive 275 miles on a single tank of gas.

5. a. Complete the following table to determine how far Brent can drive for the given amounts of gas:

Distance (mi)						275		
Gas (gal)	1	2	6	10	16	22	28	34

   b. What is the fuel efficiency of Brent's truck in miles per gallon? Explain where you can find this unit rate in the table you completed for problem 5a.

   c. How many miles can Brent drive if he has half a tank of gas?

6. a. Complete the following table to determine how many gallons of gas Brent needs to drive for the given distances:

Gas (gal)							22	
Distance (mi)	12.5	25	50	100	150	200	275	350

   b. What is the fuel efficiency of Brent's truck in gallons per mile? Explain where you can find this unit rate in the table you completed for problem 6a.

   c. How much gas does Brent need to drive a distance of 112 miles?

LESSON 3: FUEL EFFICIENCY AS A RATE

EXERCISES

7. Compare the unit rates you worked with in problems 5 and 6, and discuss any problem scenarios in which one of these inverse rates might be more useful than the other. Is there one unit of fuel efficiency you prefer to use? Explain.

Challenge Problem

8. Find the rate of dollars per mile for Lisa's car (from problems 1–4) if gas costs $4.00 per gallon. Remember, Lisa's car can go 300 miles on 15 gallons of gas.

LESSON 4: POPULATION DENSITY AS A RATE

EXERCISES

EXERCISES

For problems 1–3, use the following table:

City	Population—2010 Census	Area (sq mi)	Population Density (to nearest tenth)
Chicago	2,695,598	227.6	
San Francisco	805,235	46.9	

1. Complete the table by calculating the population density of each of the cities.

2. Which city is more crowded? How do you know?

3. What units did you use for the population density in problem 1? Are there any other units you could use instead? Explain.

For problems 4–7, use the following table:

State	Population—2000 Census	Area (sq mi)	Population Density (to nearest tenth)
California	37,593,222	163,695	
Georgia	8,186,453	59,425	
Montana	902,195	147,042	
New Jersey	8,414,350	8,722	

Source: www.enchantedlearning.com

4. Complete the table by calculating the population density of each state.

5. Which state is the most crowded? Least crowded? Explain.

6. Would the population density of a state increase or decrease if the state's area were to shrink?

7. Would the population density of a state increase or decrease if the state's population were to shrink?

LESSON 4: POPULATION DENSITY AS A RATE

EXERCISES

Challenge Problem

8. What is the population density of your classroom? How does this rate compare to those of the states and cities you considered in the previous problems? Explain.

LESSON 5: WHAT IS A RATE?

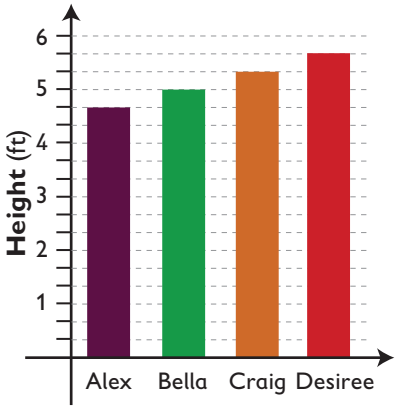
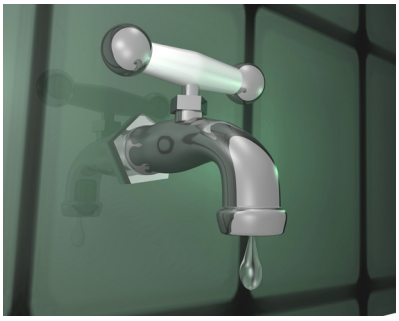
EXERCISES

EXERCISES

1. Define *rate* in your own words.

For problems 2–8, complete the table in the following way:

- Decide whether or not each situation describes a rate, and place a check mark in the appropriate column.
- Explain why each situation does or does not represent a rate.

Situation	Rate	Not a Rate	Reason
2. Emma earns $6.50 per hour for babysitting.			
3. 			
4.  30 drops per minute			
5. Denzel read 3 books this week to gather information for his science project.			

LESSON 5: WHAT IS A RATE?

EXERCISES

Situation	Rate	Not a Rate	Reason
6.  1 quart (0.946 liter)			
7. The distance between where you live and your school.			
8. Tickets to a play cost $9.00 for children and $12.00 for adults.			

Challenge Problem

9. Find at least three other rates not represented in the table for problems 2–8, and explain what real-world scenarios you could use the rates to measure.

LESSON 6: SPEED AS RATE

EXERCISES

EXERCISES

1. It took Mina 30 seconds to walk the length of the school hall. What is Mina's speed if the school hall is 60 meters long?

For problems 2–5, use the following information: Rosa can run 4 laps around the school track in 8 minutes. Each lap is one-quarter mile long.

2. What is Rosa's average speed? Write your answer using the following units:
   a. Miles per minute
   b. Miles per hour
   c. Laps per minute
   d. Feet per second (1 mile = 5,280 feet)

3. How long will it take Rosa to run 5 laps if she is able to continue running at the same pace?

4. How long will it take Rosa to run 3 miles if she is able to continue running at the same pace?

5. Write the following formulas:
   a. The time, t, (measured in minutes) it takes Rosa to complete n laps around the track
   b. The number of laps, n, Rosa can complete in t minutes

For problems 6 and 7, use the following information: Denzel bikes 12 miles to school every day. It takes him 48 minutes to bike to school.

6. a. Complete the following double number line:

   b. What is Denzel's speed in miles per minute? Explain how you could find his speed in miles per hour, a more conventional rate of speed.

   c. How many miles can Denzel bike in 72 minutes?

LESSON 6: SPEED AS RATE

EXERCISES

7. a. Complete the following table:

Time (min)					48		
Distance (mi)	1	2	3	6	12	15	25

b. What is Denzel's speed in minutes per mile? Explain how you could find his speed in hours per mile. Does this unit rate make sense in the context of this problem?

c. How long will it take Denzel to bike 23 miles?

Challenge Problem

9. Sportscasters often speak of the "4-minute mile." Express this rate in miles per minute. Why would someone speak of a 4-minute mile rather than report the speed in miles per minute? Explain.

LESSON 7: CONVERSION FACTORS

EXERCISES

EXERCISES

For problems 1–4, use the fact that there are 2.54 centimeters in 1 inch.

1. How many centimeters are in 3 inches?

2. How many centimeters are in 13 inches?

3. How many inches are in 42 centimeters?

4. How many inches are in 1 meter?

5. Suppose you accidentally leave a water hose running outside for 12 hours. How many gallons of water are lost if water flows through the hose at a rate of 6.5 gallons per minute?

6. Explain how you could find the number of miles in 1 kilometer, given that 1.61 kilometers are in 1 mile.

7. A rectangular field has an area of 2.4 acres and a width of 297 feet. There are 43,560 square feet in 1 acre.
   a. Draw a diagram of the field. What is its area in square feet?
   b. Find the length of the field.

8. A truck has a carrying capacity of 2.5 tons. There are 2,000 pounds in 1 ton.
   a. How many gallon containers of water can the truck carry if 1 gallon of water weighs 8.34 pounds?
   b. How much space does the quantity of water you calculated in problem 8a take up? Use the fact that 1 gallon takes up 268.8 cubic inches. Round to the nearest cubic inch.
   c. Write your answer to problem 8b in cubic feet. There are 1,728 cubic inches in 1 cubic foot. Round to the nearest cubic foot.

Challenge Problem

9. Discuss why you think a conversion factor is considered a rate.

LESSON 8: RATES AND UNITS

EXERCISES

EXERCISES

1. Rosa walked 3 blocks in 6 minutes.
   a. How many blocks did she walk per minute?
   b. How many minutes did it take her to walk 1 block?

For problems 2 and 3, use the following information: Suraj and his brother each biked 80 miles in 5 hours.

2. After their ride, Suraj makes the following calculation: $80 \div 5 = 16$. What does this calculation tell you about their ride? How do you know?

3. After their ride, Suraj's brother makes the following calculation: $5 \div 80 = 0.0625$. What does this calculation tell you about their ride? How do you know?

For problems 4 and 5, use the following information: Scott and Fernando rode the Acela Express train from Washington, D.C., to Boston, Massachusetts. The 442-mile trip took 6.5 hours.

4. After their trip, Scott makes the following calculation: $442 \div 6.5 = 68$. Write this equation with the appropriate units. What does the value 68 tell you about their trip? Explain.

5. After their trip, Fernando makes the following calculation: $6.5 \div 442 \approx 0.0147$. Write this equation with the appropriate units. What does the value 0.0147 tell you about their trip? Explain.

For problems 6–8, use the following information: Ms. Endo drove 250 miles in 5 hours. She used 12.5 gallons of gas for the trip.

6. Find Ms. Endo's average fuel consumption in miles per gallon.

7. Find Ms. Endo's average fuel consumption in gallons per mile.

8. Find Ms. Endo's average fuel consumption in gallons per hour.

Challenge Problem

9. Suppose you have a problem that multiplies $\frac{\text{dollars}}{\text{day}} \times \frac{\text{days}}{\text{year}} \times \text{years}$. What would the units of your answer be? Explain.

LESSON 9: PUTTING IT TOGETHER 1

EXERCISES

- Read through your Self Check and think about your work in this lesson.
- Write down what you have learned during the lesson.
- What would you do differently if you were starting Self Check task now?
- Which method would you prefer to use if you were doing the task again? Why?
- Compare the new approaches you learned about with your original method.
- Record your ideas— keep track of problem-solving strategies.
- Complete any exercises from this unit you have not finished.

LESSON 13: RATES AND GRAPHS

EXERCISES

EXERCISES

For problems 1 and 2, use the following information:

- Three trains travel from Fort Collins to Junction City, a distance of 525 miles.
- Train A completes the whole trip in 7.5 hours.
- Train B travels $\frac{6}{7}$ times as fast as train A.
- Train C travels at an average speed of 55 miles per hour.

1. Find each train's average speed in miles per hour. Which train is fastest? Which train is slowest?

2. Draw a graph of each train's speed on the same coordinate plane. Which train produces the steepest line?

For problems 3–6, use the following information: Caroline and Aiko qualified for the finals of the 440-yard dash at their school's track meet. Caroline completed the race in 1 minute and 4 seconds, and Aiko completed the race in 1 minute flat.

3. Suppose each runner runs at a constant pace. Find each runner's average speed in yards per second.

4. Sketch a graph of each runner's race on the same coordinate plane.

5. Now suppose the two runners were tied for the first half of the race, but Aiko then got tired and was only able to run at three-quarters of Caroline's pace. Sketch a graph of each runner's race on the same coordinate plane if Caroline finished the race in 1 minute flat.

6. Now suppose that Aiko (as she did in problem 4) ran at a constant speed, finishing the race in 1 minute flat. This time Caroline ran 1.5 times as fast as Aiko for the first half of the race but then tripped and was not able to finish the race. Sketch a graph of each runner's race on the same coordinate plane.

Challenge Problem

7. Choose one of the graphs you drew for problems 4–6. How does your graph change if you graph average speed versus distance? Time versus average speed? Explain.

LESSON 14: RATES AND FORMULAS

EXERCISES

EXERCISES

For problems 1–4, write a formula to describe the given situation. Define and give the units for each variable.

1. John walks at a rate of 3 miles per hour.

2. Allan buys artichokes at the price of 2 for $3.00.

3. It takes Michael 3 hours to ride his bike 21 miles.

4. Jason's car gets about 25 miles per gallon.

For problems 5–7, use the following information: a high-speed office photocopier can copy 125 pages per minute.

5. Calculate two rates to express the photocopier's output in pages per second and in seconds per page.

6. Write formulas giving the number of pages, p, that can be copied in any number of minutes, m, and in any number of seconds, s.

7. Write one formula giving the number of minutes, m, and another formula giving the number of seconds, s, it would take to copy any number of pages, p.

Challenge Problem

8. Time yourself doing some activity, such as reading a book, riding a bike, running, or swimming, and use your data to find a rate. Time a friend doing the same activity, and compare the two rates. Write a formula for each rate.

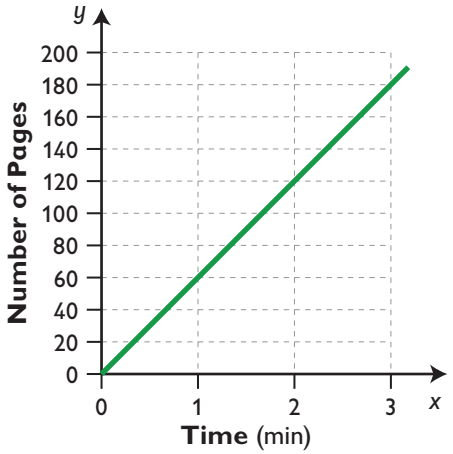
LESSON 15: REPRESENTATIONS OF RATES

EXERCISES

EXERCISES

PrintStar Printing Services sells three different printers for home, office, and publication purposes.

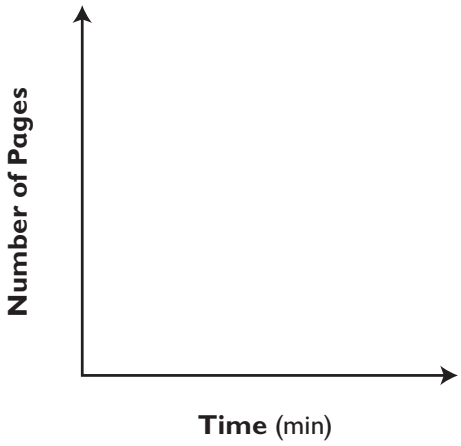
1. The following graph represents the printing rate for PrintStar's office printer:



   Explain how you can tell that the rate is 60 pages per minute.

2. Explain why the relationship between the number of pages, p, and time, t, can be expressed as $p = 60t$.

3. PrintStar's home printer prints at a constant rate of 30 pages per minute. Draw a graph representing this rate on the following coordinate plane:

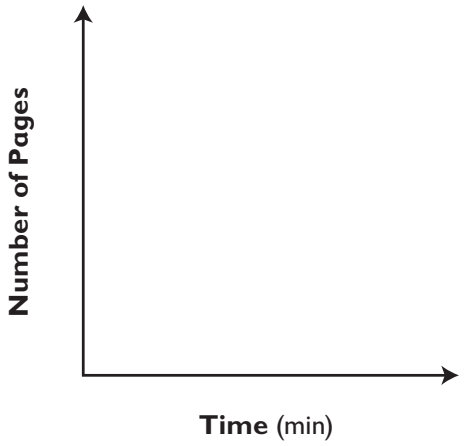


4. Write a formula describing the relationship between the number of pages, p, and the time, t, for PrintStar's home printer.

LESSON 15: REPRESENTATIONS OF RATES

EXERCISES

5. PrintStar's publication printer can print at a constant rate of 120 pages per minute. Draw a graph representing this rate on the following coordinate plane:



6. Write a formula describing the relationship between the number of pages, p, and the time, t, for PrintStar's publication printer.

Challenge Problem

7. Compare the three graphs and their corresponding formulas. What do you notice? Explain.

LESSON 16: PUTTING IT TOGETHER 2

EXERCISES

- Read through your Self Check and think about your work in this lesson.
- Write down what you have learned during the lesson.
- What would you do differently if you were starting Self Check task now?
- Which method would you prefer to use if you were doing the task again? Why?
- Compare the new approaches you learned about with your original method.
- Record your ideas— keep track of problem-solving strategies.
- Complete any exercises from this unit you have not finished.