Fractions, Division, and Unit Rates

Objective Compute unit rates involving ratios of fractions.	**Materials** Fraction tiles, fraction strips

In preparation for high school algebra, students must develop fluency with proportional thinking and transforming expressions. To teach unit rates involving fractions, connect to students' previous knowledge of whole-number division, the inverse relationship between multiplication and division, fractions as equal parts of a whole, least common denominators, and the definition of a unit rate.

Be aware of possible errors in students' thinking about division with fractions. Many students who struggle with this skill are confused by algorithms for dividing fractions, such as "invert and multiply."

This activity guides students to use proportional thinking to find unit rates, which develops a more solid understanding of division with fractions.

## Step by Step   20–30 minutes

1 Present a rate problem.

- Present a problem that uses division of a fraction by a fraction to find a unit rate. For example: Daria can type $\frac{2}{3}$ of a page in $\frac{1}{6}$ of an hour. What is her unit rate for typing in pages per hour?
- Help the student write the rate as a ratio using a colon. $(\frac{2}{3} : \frac{1}{6})$
- Ask the student to think about what operation *pages per hour* suggests. (division)

2 Develop a strategy based on whole-number division.

- Ask the student to think about an easier division problem first. If the problem was 8 ÷ 4, you could think of it as the following: "How many groups of 4 are in 8?" For $\frac{2}{3} \div \frac{1}{6}$, you can think of it as: "How many groups of $\frac{1}{6}$ are in $\frac{2}{3}$?"

3 Model $\frac{2}{3} \div \frac{1}{6}$ with fraction tiles or strips.

- Help the student represent the problem with manipulatives.
- Each bar represents one whole.
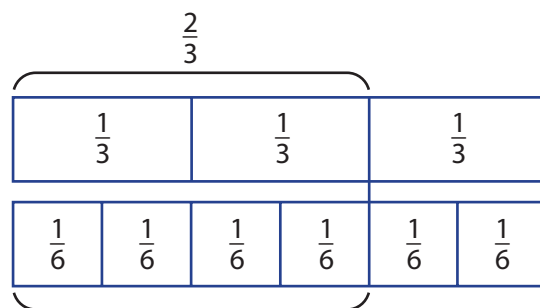
4 Solve the problem.

- Remind the student that she is looking for how many groups of $\frac{1}{6}$ are in $\frac{2}{3}$. (Four groups of $\frac{1}{6}$ are in $\frac{2}{3}$.)
- Relate the quotient to the context of the original problem. Daria's unit typing rate is 4 pages per hour.

5 Repeat with similar problems.

- Use the process in Steps 3 and 4 to work through other problems. For example, if Daria can type $\frac{2}{3}$ page in $\frac{1}{3}$ hour, what is her new unit rate for typing? (2 groups of $\frac{1}{3}$ in $\frac{2}{3}$. 2 pages per hour)
- As the student becomes more comfortable working with these problems, you can let her take more responsibility for making the model and finding groups.

Check for Understanding

Ask the student to solve the following problem: Kai can mow $\frac{5}{6}$ acre in $\frac{1}{3}$ of an hour. What is his unit rate mowing in acres per hour? Have the student draw a model and show her work. ($\frac{5}{2}$ or $2\frac{1}{2}$ acre per hour)

For the student who struggles, use the chart below to help pinpoint where extra help may be needed.

If you observe…	the student may…	Then try…
the student answers that Kai mows $\frac{5}{18}$ acre per hour	have found the unit rate of mowing $\frac{5}{6}$ in three hours	using fraction tiles or strips to represent the problem.
the student answers that Kai mows $\frac{2}{5}$ acre per hour	have divided $\frac{1}{3} \div \frac{5}{6}$	having the student use informal reasoning to examine why this answer does not make sense.
the student answers that Kai mows $\frac{1}{15}$ acres per hour	not understand the relationship of acres to hours or may not understand this problem as a rate.	providing an example using simpler numbers. For example, suppose Kai mowed 4 acres in 2 hours. What would be the rate of acres per hour? Ask the student what operation she used to determine this rate. Have the student write the rate as a ratio and then as a division problem.