## Multiplying and Dividing Rational Expressions

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Length of lesson: 52 minutes
Grade/Level: $8^{\text {th }}$ grade, Honors Algebra I
Source of the lesson: Holt Algebra I Florida Teacher's Edition textbook, 2004, Lesson 11.4 Appropriateness for Middle School Students: Students are interested in finding simpler ways to evaluate problems. To discover this, students will attempt problems on their own then share answers in front of the class. This offers students time to figure it out on their own, then gives students an alternate way they could have solved the problem. They hear and see the problem being worked out by a fellow student.
Concepts: Students will examine how multiple fractions with rational expressions in then can be solved with different operations. This will allow students to simplify the fractions through comparing similar expressions but still noticing the restrictions in equation.
Students will be able to:

- Simplify rational expressions
- Interpret rational expressions and solve the equation
- Understand the difference between multiplying and dividing different rational expressions
Sunshine State Standards Addressed:

| MA.912.A.5.1 | Simplify algebraic ratios. |
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| MA.912.A.5.2 | Rational expressions and equations - simplify rational expressions and solve rational equations <br> using what has been learned about factoring polynomials. |
| MA.912.A.5.4 | Solve algebraic proportions. |
| MA.912.A.5.5 | Solve rational equations. |

Safety: There are no significant concerns.
Materials List and Advanced Preparations:

- Each student needs notebook paper and pencil
- A copy of the post-test for each student (30 copies)
- A whiteboard marker/chalk for written examples

| Engagement | Time: 10 minutes |  |
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| What the Teacher Will Do | Probing/Eliciting Questions | Student Responses <br> Potential Misconceptions |
| Write five problems on the board for <br> students to individually evaluate on <br> paper. This will serve as their warm- <br> up and their Pre-test. | $\frac{7}{12} \cdot \frac{1}{2}=\frac{7}{24}$ | Students may think they need to find <br> a common denominator. |


| After allowing students five minutes to solve the problems we will go over the answers aloud as a class. | $\begin{array}{r} \frac{3}{8} \cdot \frac{2}{3}=\frac{1}{4} \\ \frac{2}{3} \cdot \frac{1}{2}=\frac{1}{3} \\ \frac{2}{5} \cdot \frac{5}{6} \cdot \frac{4}{5}=\frac{4}{15} \end{array}$ |  |
| :---: | :---: | :---: |
| Now write elaborate problem on the board and explain that it is a race to be the first to solve the problem correctly. $\left(\frac{3}{8}\right) \cdot\left(\frac{4}{9}\right) \cdot\left(\frac{1}{2}\right) \cdot\left(\frac{8}{9}\right) \cdot\left(\frac{6}{4}\right) \cdot\left(\frac{3}{2}\right)=\frac{1}{6}$ | Okay, so what are some helpful techniques that we could use? | Students may not recognize that reducing simplifies the problem. <br> Students may not be aware that they do not need a common denominator when multiplying. |
| Exploration |  | Time: 7 minutes |
| What the Teacher Will Do | Probing/Eliciting Questions | Student Responses Potential Misconceptions |
| Explain to the students that they will now simplify a different set of problems which are similar to the ones in their warm-up, just a little more complicated. Teacher will write a problem on the board one at a time and have the students work out the problem individually on paper. The teacher will walk around viewing the students work. Then write the next problem on the board, then the next. | $\frac{x+4}{x-7} \cdot \frac{x-7}{x-3}=\frac{x-4}{x-3}$ $\begin{gathered} \frac{3}{x-1} \cdot \frac{6}{x}=\frac{18}{x(x-1)} \\ \frac{x+5}{4 x^{2}} \cdot \frac{x-3}{x+5} \cdot \frac{2 x}{3}=\frac{x-3}{6 x} \end{gathered}$ | Students may not check restrictions at beginning and end of problem. |
| Explanation |  | Time: 15 minutes |
| What the Teacher Will Do | Probing/Eliciting Questions | Student Responses Potential Misconceptions |
| By reviewing the three previous problems as a class, explain the concept of multiplying the rational expressions. Point out how we multiplied across and then simplified in the warm-up problems. Now write the rational expression on the board, first explain why we need to state any restrictions (what's not included in the domain). Then check if anything can be simplified (divide to one). Now multiply across and then check the restrictions once more. Now introduce using division, pointing out that the only difference is to invert the divisor and multiply. This is done because division by a fraction is equivalent to multiplication by the reciprocal of | $\begin{aligned} & \frac{x+4}{x-7} \cdot \frac{x-7}{x-3}=\frac{x-4}{x-3} \\ & \frac{3}{x-1} \cdot \frac{6}{x}=\frac{18}{x(x-1)} \\ & \frac{x+5}{4 x^{2}} \cdot \frac{x-3}{x+5} \cdot \frac{2 x}{3}=\frac{x-3}{6 x} \\ & \frac{x-4}{x} \div \frac{x-4}{x+5}=\frac{x+5}{x} \end{aligned}$ <br> *point out that the x terms do not divide to one in the answer. | Students may not understand the inverting of the divisor. <br> Students may want a common denominator. |


| the fraction. <br> *Be sure to catch all restrictions in numerator and denominator, $x \neq 4$ because the divisor $\frac{x-4}{x+5}$ is zero when $x=2$. | $\frac{6}{p} \div \frac{3}{p^{2}}=2 p$ |  |
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| Elaboration |  | Time: 10 minutes |
| What the Teacher Will Do | Probing/Eliciting Questions | Student Responses Potential Misconceptions |
| Write four problems on board and have students work individually on paper, then choose four students to solve it on the board. | *Might want to factor if it helps to simplify. $\begin{aligned} & \frac{x+y}{5 x} \cdot \frac{3 x}{x^{2}-y^{2}}=\frac{3}{5(x-y)} \\ & \frac{n+4}{16} \cdot \frac{12}{n^{2}-16}=\frac{3}{4(n-16)} \\ & \frac{t^{2}-9}{6} \div \frac{3-t}{9}=\frac{-3(t+3)}{2} \\ & \frac{x-1}{x-3} \div \frac{x^{2}-x}{x^{2}-9}=\frac{x+3}{x} \end{aligned}$ | Students may not recognize the factoring opportunities. |
| Evaluation |  | Time: 10 minutes |
| What the Teacher Will Do | Probing/Eliciting Questions | Student Responses Potential Misconceptions |
| Pass out quiz (post-evaluation) **Quiz is posted below |  |  |

## Practice with Rational Expressions

Name

Simplify the following expressions and state any restrictions.
1.) $\frac{x-2}{x+3} \cdot \frac{x+3}{x-5}=$
restriction(s):
answer:
2.) $\frac{x}{x+5} \cdot \frac{x^{2}-25}{2 x}=$
restriction(s):
answer:
3.) $\frac{3 m^{5}}{4 n^{2}} \cdot \frac{12 n}{15 m^{2}}=$
restriction(s):
answer:
4.) $\frac{x-9}{x-3} \div \frac{x+3}{x-3}=$
restriction(s):
answer:
5.) $\frac{x+5}{x-3} \div \frac{1}{(x-3)}=$
restriction(s):
answer:
6.) $\frac{18 p^{3}}{5 q^{2}} \div \frac{9 p}{q^{3}}=$
restriction(s):
answer:

