Summer 2016

UTM High School STEM Workshop

**Workshop Facilitator**: Dr. Chris Caldwell

**Subject/Grade**: Re-write rational expressions. High school algebra

**Estimated time**: ½ hour

**Standard(s)**: Tennessee Math Standards

High School, **A2.A.APR.C.4, M3.A.APR.C.4** Rewrite rational expressions in different forms.

**P.N.NE.A.5** Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

**Objective**: Be the first team to simplify a rational expression, with each team member completing only one step per turn.

* I can simplify a rational expression.

**Assessment**: Determine the first team to correctly simplify the expression.

**Motivating Students/Anticipatory SET**: Consider watching the first 2.5 minutes of the YouTube video of Usain Bolt setting the 200m world record. <https://www.youtube.com/watch?v=_vlVvxypZJ4>.

Usain Bolt set the world record in the 200 meter sprint in 2009 with a time of 19.19 seconds. His average speed, or rate, is the distance he ran divided by the time ( $\frac{200 m}{19.19 s}≈10.4$ meters per second). A quantity that we get by dividing like this is called a ratio. When variables are involved, we refer to a *rational expression*. Let’s race to see who can simplify rational expressions the fastest.

**Instructional procedures**:

* Separate students into four or more groups.
* Appoint one student as score keeper and provide a pencil and chart with columns labeled Team 1, Team 2, etc.
* Divide a white board (chalk board) into a number of side by side regions equaling the number of groups.
* Seat each group of students approximately the same distance from a white board, OR mark a start line for each group and have students stand behind the start line.
* Demonstrate a safe but fast walk from a group or the start line to the board (it is probably not safe to have students run in the classroom).
* Have students count off, sit in a line, or stand in a line to know what order they are in.
* Hand the first student in each line a card with the first problem (the same problem for each group).
* Explain that the first student will move quickly to the board, write the problem, and the return with the marker to the group. The first student will pass the marker to the second student. The second student will move to the board, complete one step of the problem, the return to the group, passing the marker to the third student. Each student in turn will take the marker, move to the board, complete one step, then pass the marker to the next student. The last student in line can pass the marker to the first student, if necessary to continue work on the problem.
* Discuss rules[[1]](#endnote-1).
	+ *Simplify* means write as a single fraction[[2]](#endnote-2) so that the numerator and denominator have no common factor except 1.
	+ Each student should complete ONE step. This means applying a single arithmetic operation (to both sides), or forming the reciprocal on both sides, or factoring the numerator and denominator and eliminating a common factor, but not more than one of these (this is a team effort).
	+ Students waiting in line may coach the student on deck about the next step.
* When a player believes that the problem is completed, he or she returns to the group. When the group agrees that the problem is finished, they all raise their hands (in the “touchdown” sign) to signal that they are finished.
* When a team announces “finished,” other teams should continue working. The teacher will quickly indicate “correct” or “incorrect.” If the finished team’s solution is correct, they earn one point and play ends. If the finished team’s solution is not correct, then they earn zero points.[[3]](#endnote-3) The first of the remaining teams to agree that they are done will raise their hands in the “touchdown” sign to signal that they are finished. Again, the teacher will announce “correct” or “incorrect” and play will cease or continue. Proceed until a team correctly solves the problem or all teams have presented an incorrect solution.
* Erase the board and resume play with a new card.
* Continue until all cards are used or until approximately 10 minutes remain in the allotted time.
* Return the room to the appropriate configuration, moving tables/desks or removing tape from the floor.
* Have the scorekeeper announce the winning team. Present a prize to the team members.
* Having watched the team’s work, consider demonstrating / discussing a few “favorite mistakes.” Reproduce what was done. Ask students as a whole group to explain why it is wrong. Ask the whole group to describe a correct step that could have been done instead.
* Ask several of the Questioning/Thinking/Problem Solving problems below.

**Materials and Resources**: A copy of Dr. Caldwell’s notes “Racing for the Answer.” One copy of each problem card per group. A copy of the answer sheet for the teacher. White board (chalk board). A pencil and scorecard (just a piece of paper labeled Team 1, Team 2, etc). A marker (piece of chalk) per group. If desired, masking tape to mark starting lines. If desired, a piece of paper with the problem for each group; rather than going to the board, the group sits and passes the paper from student to student.

**Questioning/Thinking/Problem Solving**:

* What do we call the expression in the numerator or denominator of a rational expression?
* What is the first step in adding two rational expressions or subtracting one from another?
* What do we have to remember about the order of operations?
* Look at problem 5 (or any other problem). Are there values of the variable for which this expression is undefined?

**Grouping**:

Approximately 4 equal (or nearly equal) size groups. Group size is not as important as the number of groups. Each group must have a place to line up. Each group must have a safe route to and from the board. Each group must have a dedicated portion of the board on which to work.

**Accomodations/Adaptations**:

Ensure students with mobility issues have clear access to the board. Consider a portable whiteboard on an easel at an appropriate height for students who cannot stand at the board. Each member of a team would need to use this board for a step by step solution. For visually impaired students, allow a teammate to read each step of the problem. Allow the classmate to accompany the visually impaired student to the board to continue to read/scribe as required.

**Closure:** Remind students that a RATIOnal expression is a RATIO that we get when we divide one polynomial by another. Expressions like these can represent speed, density, pressure, or other familiar quantities.

**Teacher Reflection:** To be completed after conducting the lesson.

1. Each class may modify the rules, of course, but these are some of the issues that require clarification. [↑](#endnote-ref-1)
2. There is a possible variant for problem 13. See the answer sheet. [↑](#endnote-ref-2)
3. Consider subtracting a point or half a point for an incorrect solution. [↑](#endnote-ref-3)