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**Algebra 2**

**Unit Plan: Rational Expressions**

Introduction

**Overview:**

* This unit, Rational Expressions, is designed as a part of an Algebra II (non-regents) course and will provide students with an understanding as to how they can perform various operations with rational expressions and apply them to real life situations. Through this unit, students will gain a more in depth understanding of a topic previously discussed in both Algebra I and possibly middle school mathematics. Consisting of four different lessons, this unit will cover: simplifying rational expressions, adding and subtracting rational expressions, multiplying rational expressions, and dividing rational expressions. Throughout this unit, students will also learn how the calculator can be used to assist them in checking their work with rational expressions.
* Beginning with the first lesson, simplifying rational expressions, students will learn methods for simplifying rational expressions including looking for the greatest common factor among the terms and factoring so that the expression is in simplest terms. The skills the students learn in this lesson will be carried through and applied in each lesson after. With this knowledge, students will go on to the second lesson, multiplying rational expressions, students will discuss the importance of simplifying before multiplying and review how exponents can be multiplied. Moving on to the third lesson, dividing rational expressions, students will compare the multiplication and division of rational expressions and review how exponents can be divided. Finally, with the fourth lesson, adding and subtracting rational expressions, students will discuss distributing the negative throughout the sets of parentheses, combining like terms separately with the numerator and the denominator, and the role of common denominators. Throughout each lesson, comparisons will be made between how these operations (simplifying, adding and subtracting, multiplying, and dividing) can be performed with fractions. Most of the skills taught throughout this unit will become extremely helpful in further units when working with rational equations where students must solve for a specific variable and radical expressions.
* Throughout this unit, real life applications will be used to reinforce the operations performed on the rational expressions. Real life applications in this unit will include the role of rational expressions in athletics, design, and economics. Following their completion of this unit, students will have gained a more in depth understanding of rational expressions, including; simplifying, adding and subtracting, multiplying, and dividing, as well as the role they play in everyday life.

**Rationale:**

* This unit, Rational Expressions, will help to engage students in the subject of mathematics, specifically the topic of rational expressions. Experiences such as real life applications in athletics, design, and economics will motivate students and help them to gain an appreciation of the topic of rational expressions as well as of math as a subject. Through its connections to the real world, this unit will help students to understand the role mathematics plays in life as well as the role it can play in their future.
* This unit creates multiple opportunities for students to work together. Through their collaboration, the students will gain a better understanding of rational expressions. Through each lesson students will be asked to work with their peers to develop a better understanding of the current topic. These peer discussions occur most prevalently when students are given application problems. With these problems students will work cooperatively to understand the role of rational expressions as well as the role they play in the real world.
* This unit is aligned with both national and state standards. At the state level, this unit covers common core standards in the high school algebra section including ideas such as interpreting the structure of expressions, performing arithmetic operations on polynomials, and rewriting rational expressions. Also at the state level, this unit covers all eight mathematical practices. At the national level, this unit covers standards in both the number and operations standard and the algebra standard for grades nice through twelve; including ideas such as understanding meanings of operations and how they relate to one another; computing fluently and making reasonable estimates; understanding patterns, relations, and functions; representing and analyzing mathematical situations and structures using algebraic symbols; and using mathematical models to represent and understand quantitative relationships. Also at the national level, this unit covers process standards including problem solving, communication, connections, and representation.

Learning Goals

* Students will learn to perform various operations on rational expressions and apply this skill to rational expressions in real life situations

* Students will understand the role rational expressions play in everyday life, including the connection between rational expressions and real life situations.
* Students will gain an appreciation for mathematics, specifically rational expressions, including the role it plays in everyday life.

Standards

* **2010 NYS Common Core Standards**

Content Standards:

High School Algebra

Seeing Structure in Expressions (A-SSE)

*Interpret the structure of expressions*

1. Interpret expressions that represent a quantity in terms of its context.­

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

2. Use the structure of an expression to identify ways to rewrite it.

Arithmetic with Polynomials & Rational Expressions (A-APR)

*Perform arithmetic operations on polynomials.*

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

*Rewrite rational expressions.*

6. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

7. (+) 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.

Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

* **NCTM Standards**

Content Standards:

Number and Operations Standard, Grades 9-12

*Understand meanings of operations and how they relate to one another*

Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities;

*Compute fluently and make reasonable estimates*

Judge the reasonableness of numerical computations and their results.

Algebra Standard, Grades 9-12

*Understand patterns, relations, and functions*

Understand relations and functions and select, convert flexibly among, and use various representations for them;

Understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more-complicated symbolic expressions;

*Represent and analyze mathematical situations and structures using algebraic symbols*

Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations

Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency- mentally or with paper and pencil in simple cases and using technology in all cases

*Use mathematical models to represent and understand quantitative relationships*

Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts;

Process Standards:

*Problem Solving*

Build new mathematical knowledge through problem solving

Solve problems that arise in mathematics and in other contexts

Apply and adapt a variety of appropriate strategies to solve problems

Monitor and reflect on the process of mathematical problem solving

*Communication*

Organize and consolidate their mathematical thinking through communication

Communicate their mathematical thinking coherently and clearly to peers, teachers, and others

Use the language of mathematics to express mathematical ideas precisely

*Connections*

Recognize and use connections among mathematical ideas

Understand how mathematical ideas interconnect and build on one another to produce a coherent whole

*Representation*

Create and use representations to organize, record, and communicate mathematical ideas

Select, apply, and translate among mathematical representations to solve problems

Objectives

* Lesson 1: Simplifying Rational Expressions
  + Given 10 rational expressions, students will simplify each, making sure it is in simplest form, with 80% accuracy.
  + Given 2 real life situations, students will create a rational expression for each, making sure they are in simplest form, with 100% accuracy.
* Lesson 2: Multiplying Rational Expressions
  + Given 7 rational expressions, students will solve each by performing the requested operation (multiplication), making sure that it is in simplest form, with 80% accuracy
  + Given 2 real life situations, students will use multiplication to create a rational expression, making sure that it is in simplest form, with 100% accuracy.
* Lesson 3: Dividing Rational Expressions
  + Given 10 rational expressions students will solve each by performing the requested operation (division), making sure that it is in simplest form, with 80% accuracy.
  + Given 2 real life situations, students will use division to create a rational expression, making sure that it is in simplest form, with 100% accuracy.

* Lesson 4: Adding and Subtracting Rational Expressions
  + Given 10 rational expressions, students will add or subtract each, making sure that it is in simplest form as well, with 80% accuracy.
  + Given 2 real life situations, students will use adding and subtracting to create a rational expression, making sure that it is in simplest form, with 100% accuracy.

Subject Matter Outline

* **Lesson 1: Simplifying rational expressions**

Key Terms (6):

* Constant- A term or expression with no variables
* Coefficient- The number multiplied by the other variables in the term
* Term- Parts of an expression or equation that are separated by (+) or (-) signs
* Lowest terms/Simplest form- The point at which there are no common factors in the numerator and the denominator
* Rational expression- A fraction with a polynomial in the numerator and a nonzero polynomial in the denominator
* Rational equation- An equation containing one or more rational expressions.

Strategies:

* Analysis of vocabulary
* Using the greatest common factor to put a rational expression in simplest form
* Using factoring strategies (e.g., difference of perfect squares, box method) to put a rational expression in simplest form

Key Skills:

* Vocabulary
* Ability to determine the simplest form of a rational expression using the greatest common factor
* Ability to determine the simplest form of a rational expression using factoring strategies

Real World Applications:

* How can simplifying a rational expression help you to determine an expression to represent the area a landscaper must cover?
* **Lesson 2: Multiplying rational expressions**

Key Terms (1):

* Distributive Property- A property which states that the term on the exterior of a set of parenthesis multiplied by the sum of the interior terms is equal to the sum of the exterior term multiplied separately by each of the interior terms

Strategies:

* Analysis of Vocabulary
* Using the distributive property to multiply rational expressions

Key Skills:

* Vocabulary
* Ability to multiply rational expressions by using the distributive property

Real World Applications:

* How can you use multiplying rational expressions to determine an expression for the number of people who need to purchase an item in order to make a profit?
* **Lesson 3: Dividing rational expressions**

Key Terms (2):

* Keep-change-flip- the process of keeping the first expression, changing the sign from () to (), and switching the numerator and denominator of the second expression when dividing rational expressions
* Multiplicative inverse- the reciprocal of a given term, the value that when multiplied by the original is equal to 1

Strategies:

* Analysis of vocabulary
* Using the keep-change-flip method to divide rational expressions
* Using the multiplicative inverse to divide rational expressions

Key Skills:

* Vocabulary
* Ability to divide rational expressions using the keep-change-flip method
* Ability to divide rational expressions using the multiplicative inverse

Real World Applications:

* How can you use dividing rational expressions to determine an expression to represent the ratio of money spent on a specific item out of a total given budget
* **Lesson 4: Adding and subtracting rational expressions**

Key Terms (2):

* Least common multiple (LCM)- The smallest positive integer into which two or more integers divide evenly
* Least common denominator (LCD)- The smallest whole number that can be used as a denominator for two or more fractions (will be the least common multiple of the original denominators)

Strategies:

* Analysis of vocabulary
* Using the least common denominator (or least common multiple of the denominators) to add and/or subtract rational expressions
* Using the distributive property to add and/or subtract rational expressions

Key Skills:

* Vocabulary
* Ability to add and/or subtract rational expressions using the least common denominator (or least common multiple of the denominators)
* Ability to use the distributive property to add and/or subtract rational expressions

Real World Applications:

* How can you use adding and subtracting rational expressions to determine the an expression to represent the number of people in a certain age group given the number in two specific populations

Possible Methods of Starting the Unit

**Unit Opener #1**

To begin my unit on rational expressions I would have students complete a Frayer model diagram. This unit is taught as a part of an Algebra II course, but contains ideas that students have previously been exposed to through their Algebra I course. Knowing that students already have experience with this topic, I feel that a semantic map would be the best strategy to open this unit. This diagram would help to activate the students’ prior knowledge of rational expressions; helping them to remember the most important characteristics and information among them.

I would begin this activity by handing the students a blank copy of the Frayer model diagram. I would use a projected copy on the SMARTboard to show the students what to write in the center concept box. After doing this I will have the students read the directions, ask if anyone has any questions, and then set the students off to complete the diagram. As the students are completing the diagram I will walk around the classroom, making sure that everyone is completing their work. I will not answer the students’ questions at this time; I want to see what everyone comes up with on their own first. After the students have been given around 15 minutes to complete this worksheet I will call the attention to the front of the room where once again the Frayer model diagram will be projected on the SMARTboard. At this time I will ask the class to tell me some of the items they listed on their worksheets; together we will create a class copy of the Frayer model diagram. This class copy will include everything the students know about quadratics functions. This diagram will benefit the students by giving them a sheet with the definition, main characteristics, examples, and nonexamples, which could come in useful in the future. This diagram will help me as the teacher by showing me how much review is necessary and where I need to begin my unit.

Unit: Rational Expressions

**Directions**: Use your knowledge of rational expressions to fill in the chart below. Fill in each box by responding to the heading inside.

**Definition (in your own words) Facts/Characteristics**

**Examples**

**Non-examples**

**Unit Opener #2**

To begin my unit on rational expressions I would have students complete a semantic map. This unit is taught as part of an algebra II course but is something that the students have previously been exposed to. Knowing that the students already have experience with this topic, I feel that a semantic map would be a great strategy to open this unit. This semantic map would help to activate the students prior knowledge of rational expressions; helping them to remember the most important characteristics and information among them.

I would begin this activity by handing the students a blank copy of the semantic map organizer. I would use a projected copy on the SMARTboard to show students what to write in the major concept box and the four category boxes. After doing this I will have the students read the directions, ask if anyone has any questions, and then set the students off to complete the map. As the students are completing the map I will walk around the classroom, making sure that everyone is completing their work. There will be no need to answer questions at this time; there are no wrong answers on this worksheet. After the students have been given around 20 minutes to complete this worksheet I will call the attention to the front of the room where once again the semantic map will be projected on the SMARTboard. At this time I will ask the class to tell me some of the items they listed on their worksheets; together we will create master list. This master semantic map will include everything that the students know about rational expressions; it will help me to see how much review is necessary and where I need to begin my unit.

Unit: Rational Expressions

**Directions**: Use your knowledge of rational expressions to fill in the chart below. Under each category write any words, steps, or ideas associated with the category.

Dividing

Multiplying

Subtracting

Adding

**Unit Opener #3**

To begin my unit on rational expressions I would have students complete a concept definition map. This unit is taught as a part of an Algebra II course, but it is also something that the students have been previously exposed to through their Algebra I course. Knowing that the students already have experience with this topic, I feel that the concept definition map would be a great strategy to open this unit. This concept definition map would help to activate the students prior knowledge of rational expressions; helping them to remember what they are, some of their properties, some examples, and some similar concepts.

I would begin this activity by handing the students a blank copy of the concept definition map. I would use a projected copy on the SMARTboard to show students what to write in the center concept box. After doing this I will have the students read the directions, ask if anyone has any questions, and then set the students off to complete the map. As the students are completing the map I will walk around the classroom, making sure that everyone is completing their work. I will not be answering the students’ questions at this time; I would like to see what they remember and any misconceptions they may have before I have taught. After the students have been given around 20 minutes to complete this worksheet I will call the attention to the front of the room where once again the concept definition map will be projected on the SMARTboard. At this time I will ask the class to help me fill in the chart by asking their responses to each question on the chart. Together we will create a master chart containing the best responses to each question, all in student friendly (but mathematical) terms. This concept definition map will provide students with some of the most important ideas in the unit; students will be able to look back on this sheet throughout the unit. This will also help me to see how much review is necessary and where I need to begin my unit.

Unit: Rational Expressions

**Directions:** Use your knowledge of rational expressions to fill in the chart below. Under each category, fill in the space by answering the questions.

What are they?

What are some comparisons?

What are some properties?

What are some examples?

Lesson Plans

Lesson Plan #1: Simplifying Rational Expressions

**Goal:**

* Students will learn to perform various operations on rational expressions and apply these expressions to real life situations.

**Performance Objectives:**

* Given 10 rational expressions students will simplify each, making sure it is in simplest form, with 80% accuracy.

**Standards:**

* **2010 NYS Common Core Standards**

Content Standards:

High School Algebra

Seeing Structure in Expressions (A-SSE)

*Interpret the structure of expressions*

1. Interpret expressions that represent a quantity in terms of its context.­

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

2. Use the structure of an expression to identify ways to rewrite it.

Arithmetic with Polynomials & Rational Expressions (A-APR)

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*Rewrite rational expressions.*

6. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

7. (+) 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.

Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
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Content Standards:

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*Understand meanings of operations and how they relate to one another*

Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities;

*Compute fluently and make reasonable estimates*

Judge the reasonableness of numerical computations and their results.

Algebra Standard, Grades 9-12

*Understand patterns, relations, and functions*

Understand relations and functions and select, convert flexibly among, and use various representations for them;

Understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more-complicated symbolic expressions;

*Represent and analyze mathematical situations and structures using algebraic symbols*

Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations

Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency- mentally or with paper and pencil in simple cases and using technology in all cases

*Use mathematical models to represent and understand quantitative relationships*

Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts;

Process Standards:

*Problem Solving*

Build new mathematical knowledge through problem solving

Solve problems that arise in mathematics and in other contexts

Apply and adapt a variety of appropriate strategies to solve problems

Monitor and reflect on the process of mathematical problem solving

*Communication*

Organize and consolidate their mathematical thinking through communication

Communicate their mathematical thinking coherently and clearly to peers, teachers, and others

Use the language of mathematics to express mathematical ideas precisely

*Connections*

Recognize and use connections among mathematical ideas

Understand how mathematical ideas interconnect and build on one another to produce a coherent whole

*Representation*

Create and use representations to organize, record, and communicate mathematical ideas

Select, apply, and translate among mathematical representations to solve problems

**Materials and Resources:**

* White board
* SMARTboard
* Markers
* PowerPoint presentation
* Notes sheet
* Class examples (complete with answers)
* Guided practice examples (complete with answers)
* Independent practice examples

**Use of Electronic Technology:**

* The **SMARTboard** will be used to present the notes for the lesson. The students will also be able to use the SMARTboard throughout the lesson, putting answers up and interacting with the board throughout the presentation.
* Students will also have the option of using **graphing calculators** to compute and check their work.

**Introduction:**

* After welcoming the students into the classroom, getting them settled down, and ensuring that they are ready to begin the day, present them with the daily do now. This do now will help to activate their prior knowledge, causing them to think about previously learned materials and possibly hypothesize about how about how the day’s lesson will relate. The daily do now will be written on the white board. The students will complete the following do now on a clean piece of paper or as a part of their notes:

Factor the following:

As the students are completing this do now walk around the room to ensure they are all working. At this time offer the students assistance and answer any questions they may have. Students will be allowed to work on their own or with the person they are sitting next to. After about 5 minutes, or sooner depending on how the students are progressing, call the students attention back to the front of the room. At this time go over the do now assignment, going over both problems. To begin, ask the students how they would go about factoring the first problem. Ask for the students’ assistance in completing the problems. Since the students have recently reviewed these types of problems have them walk you through the problem step by step. Once you have gotten an answer for each problem, ask the students if they have any other questions. At this time explain to the students that the day’s topic will be simplifying rational expressions and that in the future this will make dealing with these kinds of problems (rational expressions) simpler.

**Development:**

* Begin by introducing the day’s topic of simplifying rational expressions. At this time explain to the students that simplifying will be extremely helpful when it comes to performing other operations, such as addition, subtraction, multiplication, and division, on rational expressions. To introduce the idea of simplifying rational expressions and avoid confusing the students, begin completing example problems that show the students each important idea they must remember. These important ideas include:

1. Looking for the greatest common factor among the terms
2. Factoring so that your expression is in simplest terms
3. Making sure to get rid of negative squared terms

To illustrate these important ideas simplify the following expressions with the class (using the previously prepared SMARTboard presentation):

For each problem walk the students through it step by step, questioning them as you go as to what they believe the next step could be. Using question 1 as an example the questioning and completion process could look something like this:

\*Beginning with , ask the students if there is anything that both the numerator (top) and denominator (bottom) of the expression have in common.

\*Possible answers could include: 2, 3, 6, 9, 18, and *c*

\*Although all these answers are correct, explain to the students that just like when you are reducing fractions you are looking for the largest number that goes into both pieces, the greatest common factor.

\*At this time ask the students for the largest number and/or variable that they could factor out of each term.

\*After receiving the answer “*18c*”, ask the students what will be left over in the numerator and denominator once this has been factored out.

\*Lastly, explain to the students that because “*18c*” is connected to the other terms by multiplication and because there is an “*18c*” in both the numerator and the denominator it can simply be cancelled out from both pieces.

\*This will leave you with a final answer of.

When you are sure that the students fully understand this problem walk them through the next two in a similar fashion, this time pointing out that for question two the best method to simplify will be to work first with the numerator. In the numerator have the students first get rid of the negative in the squared term and then factor the numerator (by Un-FOILing or using the box method). Moving on to the denominator have the students factor the quadratic (by Un-FOILing or using the box method). As you are going through the example problems with the students, stress that it is important to be writing down each example that you are putting on the board. After going through these two problems as well as any other notes, the students will have all the information they need to simplify expressions.

**Guided Practice:**

* Guided practice will be given to the students in the form of a worksheet to work on during class. This classwork will consist of the following problems:

These problems will be written on the board, underneath each problem there will be room for the solution. To complete this assignment, have the students work either on their own or in small groups with the other students sitting next to them. These groups will allow the students to talk through each of the questions and their peers may be able to clear up any misunderstandings they have. As the groups are all working, walk around the classroom observing the students’ interactions. At this time, assist and correct the students as necessary. Instead of giving the students answers to the questions, ask them questions and give hints that will help lead them to the correct answers. These hints would involve directing them to one of the previously completed examples that has some of the same issues. When students ask if they have the correct answer, respond yes if it is correct and provide the step in which they first erred if it is not correct. As the students are completing this classwork some errors that will be common are, simple calculation mistakes, students not factoring out the negative from the squared term, and students not factoring out the GCF. When observing students making any of these common mistakes make sure to point them out immediately (students do not want to get into the habit of making these mistakes). To help remind students of these common errors, write the following statements on the board:

\*Don’t forget your calculator, always check your work\*

\*Don’t forget to get rid of the negative from the squared term\*

\*Finding a GCF first will make the rest of the problem easier\*

Putting these hints up on the board will ensure that the ideas are fresh in the students mind. These hints will help to reinforce the correct procedures. If at any time during their classwork students are struggling they can look up at the board and see if these are any of their problems. During this time also stress to the students that you are there to assist them whenever they need it. There is no reason for a student to be struggling, they can always ask for help. As you are walking the class checking the students’ progress, choose four students to come up to the board and answer a question, this should be done as they are still completing the assignment. When it appears that most of the students have completed the assigned problems, call the class’s attention back to the front of the room. At this time have the student that put the question on the board explain how the steps and procedures they used to arrive at their answer. Once this is done ask students again if they have any questions, comments, or confusions and deal with them at this time.

**Accommodations and Modifications:**

* *Early Mastery Learners*

To accommodate early mastery learners, offer the students **more advanced example** problems. A more advanced example problem would include:

1. Simplify the following:

Early mastery learners would also be offered the option to **tutor their peers**. This peer tutoring would help the mastery learners to really understand the material, if they are able to teach it, it is an indication that they truly know it.

* *ELL and Students with Communication Disorders*

To accommodate ELL students and students with communication disorders **simplified and reworded directions** will be offered. These instructions will be said aloud directly following the distribution of the classwork or homework assignments. An example of a specific simplified/reworded set of directions is:

Written: Simplify the following expression.

Spoken: Factor the given expressions and see what you can eliminate so that the expression will be in simplest form

If necessary, write these simplified/reworded directions on the board or on the specific student’s paper.

* *Reading, Writing, and Behavior Problems*

To accommodate students with reading, writing, and behavior problems **simplified directions** like those above will once again be used. Students with trouble reading will be offered **readers** to assist them in reading the specific questions. Students with trouble writing will be offered **scribes** to assist them in writing notes and problems. **Visualizing** will also be used to assist these students. These visualizations could include breaking down an expression by writing each variable as a multiplied version of its simplest forms. This could mean instead of writing the student could write. Specifically, for students with behavioral problems that are interfering with the lesson, you should work with the students and (if needed) the parents to create a student-teacher **contract**. With this contract you will sit down and create a written agreement stating what the student needs to do (or the way they must act) in order to receive a specific desired reward. When creating this contract assist the student in choosing an appropriate reward.

**Closure:**

* To conclude this lesson, have the students complete the closing activity worksheet. This worksheet will help to assess the students overall understanding of the day’s topic. This worksheet will ask students to simplify the given expression as well as give themselves a rating based on their overall understanding of the topic. A copy of the problem is shown below:

Simplify the following:

Students will give themselves a 1 if they feel that they do not understand or only slightly understand the topic, a 2 if they feel that they understand the topic of but could use a little more practice, or a 3 if they completely understand the topic. After about five minutes, or sooner depending on how quickly the students are progressing, call the class’s attention back to the front of the room. At this time, work with the class to answer the question. Call on several students to walk you through the completion of the problem. As they are completing them, check that they are factoring out the greatest common factor and following the rules of factoring quadratics. When the problem has been reviewed go over any of the students’ questions or concerns then collect the worksheet. Lastly, connect this material to ideas that will be covered later on in the unit by explaining to the students that they will be moving on to multiplying and dividing rational expressions which are much simpler when you have simplified first.

**Independent Practice:**

* The students’ independent practice will consist of the eight remaining questions on the guided practice worksheet, a copy of the worksheet is attached.
* Specific Independent Practice Examples (homework assignment): #2, 3, 4, 5, 6, 8, 10, 12 (8 problems total)

**Evaluation:**

* *Diagnostic*

Prior to beginning the unit, students were given a **pretest** to assess their understanding of simplifying, adding, subtracting, multiplying, and dividing rational expressions. This pretest will serve as a form of diagnostic evaluation to assess each student’s knowledge prior to beginning the unit. Prior to beginning the lesson, at the beginning of class, students will be given a **do now** assignment. This do now will active their prior knowledge, bringing up the ideas of performing various operations on rational expressions.

* *Formative*

During the lesson, students will complete several forms of assessment that will be used to assess their progress through the topic. Through the use of **in class example problems** and a **classwork assignment** (guided practice), the students will be assessed in two ways. Firstly they will be assessed through the direct observations from the teacher. As students are completing this assignment, look for any issues they may be having and assess their progress and understanding of the current topic. Out of class, students will be assessed through the use of a **homework assignment** (independent practice). Using this assignment, students will be assessed when it has been collected the next day.

* *Summative*

A unit test will be given to assess the students overall understanding of performing various operations rational expressions. This test will contain problems that involve simplifying, adding, subtracting, multiplying, and dividing rational expressions.

A copy of the test questions is shown below

**Algebra 2- Unit 2 Test: Rational Expressions**

**Directions:** Answer all questions in the space provided. An incorrect answer with sufficient work may receive partial credit; a correct answer with insufficient work may only receive partial credit.

Simplify the following:

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Multiply the following:

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Divide the following

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Add the following

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Subtract the following:

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Lesson Plan #2: Multiplying Rational Expressions

**Goal:**

* Students will learn to perform various operations on rational expressions and apply these expressions to real life situations.

**Performance Objectives:**

* Given 7 rational expressions, students will solve each by performing the requested operation (multiplication), making sure that it is in simplest form, with 80% accuracy.

**Standards:**

* **2010 NYS Common Core Standards**

Content Standards:

High School Algebra

Seeing Structure in Expressions (A-SSE)

*Interpret the structure of expressions*

1. Interpret expressions that represent a quantity in terms of its context.­

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

2. Use the structure of an expression to identify ways to rewrite it.

Arithmetic with Polynomials & Rational Expressions (A-APR)

*Perform arithmetic operations on polynomials.*

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

*Rewrite rational expressions.*

6. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

7. (+) 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.

Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

* **NCTM Standards**

Content Standards:

Number and Operations Standard, Grades 9-12

*Understand meanings of operations and how they relate to one another*

Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities;

*Compute fluently and make reasonable estimates*

Judge the reasonableness of numerical computations and their results.

Algebra Standard, Grades 9-12

*Understand patterns, relations, and functions*

Understand relations and functions and select, convert flexibly among, and use various representations for them;

Understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more-complicated symbolic expressions;

*Represent and analyze mathematical situations and structures using algebraic symbols*

Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations

Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency- mentally or with paper and pencil in simple cases and using technology in all cases

*Use mathematical models to represent and understand quantitative relationships*

Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts;

Process Standards:

*Problem Solving*

Build new mathematical knowledge through problem solving

Solve problems that arise in mathematics and in other contexts

Apply and adapt a variety of appropriate strategies to solve problems

Monitor and reflect on the process of mathematical problem solving

*Communication*

Organize and consolidate their mathematical thinking through communication

Communicate their mathematical thinking coherently and clearly to peers, teachers, and others

Use the language of mathematics to express mathematical ideas precisely

*Connections*

Recognize and use connections among mathematical ideas

Understand how mathematical ideas interconnect and build on one another to produce a coherent whole

*Representation*

Create and use representations to organize, record, and communicate mathematical ideas

Select, apply, and translate among mathematical representations to solve problems

**Materials and Resources:**

* White board
* SMARTboard
* Markers
* PowerPoint presentation
* Notes sheet
* Class examples (complete with answers)
* Guided practice examples (complete with answers)
* Independent practice examples

**Use of Electronic Technology:**

* The **SMARTboard** will be used to present the notes for the lesson. The students will also be able to use the SMARTboard throughout the lesson, putting answers up and interacting with the board throughout the presentation.
* Students will also have the option of using **graphing calculators** to compute and check their work.

**Introduction:**

* After welcoming the students into the classroom, getting them settled down, and ensuring that they are ready to begin the day, present them with the daily do now. This do now will help to activate their prior knowledge, causing them to think about previously learned materials and possibly hypothesize about how about how the day’s lesson will relate. The daily do now will be written on the white board. The students will complete the following do now on a clean piece of paper or as a part of their notes:

Multiply the following:

As the students are completing this do now walk around the room to ensure they are all working. At this time offer the students assistance and answer any questions they may have. Students will be allowed to work on their own or with the person they are sitting next to. After about 5 minutes, or sooner depending on how the students are progressing, call the students attention back to the front of the room. At this time go over the do now assignment, going over both problems. To begin, ask the students how they would go about multiplying the first problem. Ask for the students’ assistance in completing the problems. Since the students have recently completed a unit that featured these types of problems have them walk you through their process step by step. Expect to hear words like “FOIL” and “distribute” throughout the completion of the problems. Once you have gotten an answer for each problem, ask the students if they have any other questions. At this time explain to the students that the day’s topic will be multiplying rational expressions and that this will combine the previous day’s topic of simplifying rational expressions with some other previously discussed topics.

**Development:**

* Begin by introducing the day’s topic of multiplying rational expressions. At this time explain to the students that multiplying will combine the day’s previous topic of simplifying and will also be extremely helpful when it comes to the next topics of division, addition, and subtraction. To introduce the idea of multiplying rational expressions and avoid confusing the students, begin completing example problems that show the students the important ideas they must remember. These important ideas include:

1. Simplifying the expressions first, cancelling out to begin with
2. Multiplying numerator by numerator, and denominator by denominator (distribute and/or FOIL)

To illustrate these important ideas multiply the following expressions with the class:

For each problem walk the students through each problem step by step, questioning them as you go as to what they believe the next step should be. Using question 1 as an example the questioning and completion process could look something like this:

\*Beginning with , ask the students if there is anything that can be factored from the numerator or the denominator. Remind the students that terms can only be cancelled from numerator to denominator (up and down) or from the numerator of one expression and the denominator of the other (diagonal),

\*Once receiving the answer “*4x*” from the numerator and the denominator of the first expression, move on to the cancelling step.

\*Point out to the students that there is now a common “*4x*” between the numerator and the denominator of the first expression, as well as an “*x+2*” between the numerator of the first expression and the denominator of the second expression, knowing this ask the students what they can do next\*

\*Once receiving the answer “cancel them from each expression”, move on to the final step. At this point remind the students that whenever you cancel a term you are left with a “*1*” in its place

\*Lastly have the students multiply the remaining numerators and the remaining denominators by distributing the remaining terms left in each

\*This will leave you with an answer of “”

When you are sure that the students fully understand this problem, walk them through the next problem in a similar fashion. Again with this problem stress that it is important remember to simplify each expression first and then multiply by either distributing and/or FOILing. As you are going through the example problems with the students, stress that it is important to be writing down each example that you are putting on the board. After going through these two problems as well as any other notes, the students will have all the information they need to multiply expressions.

**Guided Practice:**

* Guided practice will be given to the students in the form of a worksheet to work on during class. This classwork will consist of seven problems from the guided practice worksheet (the classwork), specifically #2, 4, 6, 8, 10, 12, and 14. These problems will be written on the board, underneath each problem there will be room for the solution. To complete this assignment, have the students work either on their own or in small groups with the other students sitting next to them. These groups will allow the students to talk through each of the questions and their peers may be able to clear up any misunderstandings they have. As the groups are all working, walk around the classroom observing the students interactions. At this time, assist and correct the students as necessary. Instead of giving the students answers to the questions, ask them questions and give hints that will help lead them to the correct answers. These hints would involve directing them to one of the previously completed examples that has some of the same issues. When students ask if they have the correct answer, respond yes if it is correct and provide the step in which they first erred if it is not correct. As the students are completing this classwork, some errors that will be common are, students incorrectly cancelling out terms, simple calculation mistakes, and distribution/FOILing issues. When observing students making any of these common mistakes make sure to point them out immediately (students do not want to get into the habit of making these mistakes). To help remind students of these common errors, write the following statements on the board:

\*You can only cancel when there is something in common between all the terms or the terms are connected by multiplication \*

\*You can only cancel up and down, or diagonally\*

\*Don’t forget your calculator, always check your work\*

\*Check your distributing and FOILing, don’t forget to distribute the negative to EVERYTHING in the second expression\*

Putting these hints up on the board will ensure that the ideas are fresh in the students mind. These hints will help to reinforce the correct procedures. If at any time during their classwork students are struggling they can look up at the board and see if these are any of their problems. During this time also stress to the students that you are there to assist them whenever they need it. There is no reason for a student to be struggling, they can always ask for help. As you are walking the class checking the students’ progress, choose four students to come up to the board and answer a question, this should be done as they are still completing the assignment. When it appears that most of the students have completed the assigned problems, call the class’s attention back to the front of the room. At this time have the student that put the question on the board explain how the steps and procedures they used to arrive at their answer. Once this is done ask students again if they have any questions, comments, or confusions and deal with them at this time.

**Accommodations and Modifications:**

* *Early Mastery Learners*

To accommodate early mastery learners, offer the students **more advanced example** problems. A more advanced example problem would include:

Multiply the following:

Early mastery learners would also be offered the option to **tutor their peers**. This peer tutoring would help the mastery learners to really understand the material, if they are able to teach it, it is an indication that they truly know it.

* *ELL and Students with Communication Disorders*

To accommodate ELL students and students with communication disorders **simplified and reworded directions** will be offered. These instructions will be said aloud directly following the distribution of the classwork or homework assignments. An example of a specific simplified/reworded set of directions is:

Written: Multiply the following

Spoken: Simplify the expression, cancel out any like terms, and then multiply the numerator by the numerator and the denominator by the denominator for the expressions.

If necessary, write these simplified/reworded directions on the board or on the specific student’s paper.

* *Reading, Writing, and Behavior Problems*

To accommodate students with reading, writing, and behavior problems **simplified directions** like those above will once again be used. Students with trouble reading will be offered **readers** to assist them in reading the specific questions. Students with trouble writing will be offered **scribes** to assist them in writing notes and problems. **Visualizing** will also be used to assist these students. These visualizations could include breaking down an expression by writing each variable as a multiplied version of its simplest forms. This could mean instead of writing the student could write. Specifically, for students with behavioral problems that are interfering with the lesson, you should work with the students and (if needed) the parents to create a student-teacher **contract**. With this contract you will sit down and create a written agreement stating what the student needs to do (or the way they must act) in order to receive a specific desired reward. When creating this contract assist the student in choosing an appropriate reward.

**Closure:**

* To conclude this lesson, have the students complete the closing activity worksheet. This worksheet will help to assess the students overall understanding of the day’s topic. This worksheet will ask students to multiply the given expression as well as give themselves a rating based on their overall understanding of the topic. A copy of the problem is shown below:

Multiply the following:

Students will give themselves a 1 if they feel that they do not understand or only slightly understand the topic, a 2 if they feel that they understand the topic of but could use a little more practice, or a 3 if they completely understand the topic. After about five minutes, or sooner depending on how quickly the students are progressing, call the class’s attention back to the front of the room. At this time, work with the class to answer the question. Call on several students to walk you through the completion of the problem. As they are completing this problem, check that they are simplifying first, and then multiplying the numerator by the numerator and the denominator by the denominator. When the problem has been reviewed go over any of the students’ questions or concerns then collect the worksheet. Lastly, connect this topic to the next topic of dividing rational expressions. Explain to the students that when you are dividing rational expressions you are really still multiplying just with a twist (something you will be discussing in the next lesson).

**Independent Practice:**

* The students’ independent practice will consist of the remaining seven questions on the guided practice worksheet, a copy of the worksheet is attached.
* Specific Independent Practice Examples (homework assignment): #1, 3, 5, 7, 9, 11, 13 (7 problems total)

**Evaluation:**

* *Diagnostic*

Prior to beginning the unit, students were given a **pretest** to assess their understanding of simplifying, adding, subtracting, multiplying, and dividing rational expressions. This pretest will serve as a form of diagnostic evaluation to assess each student’s knowledge prior to beginning the unit. Prior to beginning the lesson, at the beginning of class, students will be given a **do now** assignment. This do now will active their prior knowledge, bringing up the ideas of performing various operations on rational expressions.

* *Formative*

During the lesson, students will complete several forms of assessment that will be used to assess their progress through the topic. Through the use of **in class example problems** and a **classwork assignment** (guided practice), the students will be assessed in two ways. Firstly they will be assessed through the direct observations from the teacher. as students are completing this assignment, look for an issues they may be having and assess their progress and understanding of the current topic. Out of class, students will be assessed through the use of a **homework assignment** (independent practice). Using this assignment, students will be assessed when it has been collected the next day.

* *Summative*

A unit test will be given to assess the students overall understanding of performing various operations rational expressions. This test will contain problems that involve simplifying, adding, subtracting, multiplying, and dividing rational expressions.

A copy of the test questions is shown below:

**Algebra 2- Unit 2 Test: Rational Expressions**

**Directions:** Answer all questions in the space provided. An incorrect answer with sufficient work may receive partial credit; a correct answer with insufficient work may only receive partial credit.

Simplify the following:

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Multiply the following:

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Divide the following

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Add the following

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Subtract the following:

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Lesson Plan #3: Dividing Rational Expressions

**Goal:**

* Students will learn to perform various operations on rational expressions and apply these expressions to real life situations.

**Performance Objectives:**

* Given 10 rational expressions, students will solve each by performing the requested operation (division), making sure that it is in simplest form, with 80% accuracy.

**Standards:**

* **2010 NYS Common Core Standards**

Content Standards:

High School Algebra

Seeing Structure in Expressions (A-SSE)

*Interpret the structure of expressions*

1. Interpret expressions that represent a quantity in terms of its context.­

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

2. Use the structure of an expression to identify ways to rewrite it.

Arithmetic with Polynomials & Rational Expressions (A-APR)

*Perform arithmetic operations on polynomials.*

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

*Rewrite rational expressions.*

6. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

7. (+) 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.

Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

* **NCTM Standards**

Content Standards:

Number and Operations Standard, Grades 9-12

*Understand meanings of operations and how they relate to one another*

Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities;

*Compute fluently and make reasonable estimates*

Judge the reasonableness of numerical computations and their results.

Algebra Standard, Grades 9-12

*Understand patterns, relations, and functions*

Understand relations and functions and select, convert flexibly among, and use various representations for them;

Understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more-complicated symbolic expressions;

*Represent and analyze mathematical situations and structures using algebraic symbols*

Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations

Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency- mentally or with paper and pencil in simple cases and using technology in all cases

*Use mathematical models to represent and understand quantitative relationships*

Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts;

Process Standards:

*Problem Solving*

Build new mathematical knowledge through problem solving

Solve problems that arise in mathematics and in other contexts

Apply and adapt a variety of appropriate strategies to solve problems

Monitor and reflect on the process of mathematical problem solving

*Communication*

Organize and consolidate their mathematical thinking through communication

Communicate their mathematical thinking coherently and clearly to peers, teachers, and others

Use the language of mathematics to express mathematical ideas precisely

*Connections*

Recognize and use connections among mathematical ideas

Understand how mathematical ideas interconnect and build on one another to produce a coherent whole

*Representation*

Create and use representations to organize, record, and communicate mathematical ideas

Select, apply, and translate among mathematical representations to solve problems

**Materials and Resources:**

* White board
* SMARTboard
* Markers
* Class examples (complete with answers)
* Guided practice examples (complete with answers)
* Independent practice examples

**Use of Electronic Technology:**

* The **SMARTboard** will be used to present the notes for the lesson. The students will also be able to use the SMARTboard throughout the lesson, putting answers up and interacting with the board throughout the presentation.
* Students will also have the option of using **graphing calculators** to compute and check their work.

**Introduction:**

* After welcoming the students into the classroom, getting them settled down, and ensuring that they are ready to begin the day, present them with the daily do now. This do now will help to activate their prior knowledge, causing them to think about previously learned materials and possibly hypothesize about how about how the day’s lesson will relate. The daily do now will be written on the white board. The students will complete the following do now on a clean piece of paper or as a part of their notes:

Divide the following:

Multiply the following:

As the students are completing this do now walk around the room to ensure they are all working. At this time offer the students assistance and answer any questions they may have. Students will be allowed to work on their own or with the person they are sitting next to. After about 5 minutes, or sooner depending on how the students are progressing, call the students attention back to the front of the room. At this time go over the do now assignment, going over both problems. To begin, ask the students how they would go about dividing (or simplifying) the first problem. Since the students have recently studied simplifying rational expressions have them walk you through their process step by step. Expect to hear words like “factor” and “cancel” throughout the completion of the problems. Once you have gotten an answer for this question, move on to the second. Once again, ask the students how they would go about multiplying the second problem. Since the students have recently reviewed multiplying expressions, have them walk you through their process step by step. Expect to hear words like “distribute” and “combine like terms” throughout the completion of the problems. Once you have gotten an answer for each problem, ask the students if they have any other questions. At this time explain to the students that the day’s topic will be dividing rational expressions and that this will be very similar to the previous day’s topic of multiplying rational expressions.

**Development:**

* Begin by introducing the day’s topic of dividing rational expressions. At this time explain to the students that dividing will be very similar to the previous day’s topic of multiplying. Explain to the students that the only difference between multiplying and dividing rational expressions is a method called Keep-Change-Flip. To introduce the idea of dividing rational expressions and avoid confusing the students, begin completing example problems that show the students the important ideas they must remember. These important ideas include:

1. Keep (the first fraction)-Change (the sign to multiplication)-Flip (the second fraction)
2. Simplifying the expressions first, cancelling out to begin with
3. Multiplying the new numerator by numerator, and the new denominator by denominator (distribute and/or FOIL)

To illustrate these important ideas divide the following examples with the class:

For each problem walk the students through each problem step by step, questioning them as you go as to what they believe the next step should be. Using question 1 as an example, the questioning and completion process should look something like this:

\*Beginning with , have the students use the Keep-Change-Flip method to rearrange the expression.

\*Once receiving the answer “”, move on to the next step of simplifying

\*Ask the students if there is anything that can be factored from the numerator or the denominator. Remind the students that terms can only be cancelled from numerator to denominator (up and down) or from the numerator of one expression and the denominator of the other (diagonal)

\*Once receiving the answer “*4x*” from the numerator and the denominator of the first expression, move on to the cancelling step.

\*Point out to the students that there is now a common “*4x*” between the numerator and the denominator of the first expression, as well as an “*x+2*” between the numerator of the first expression and the denominator of the second expression, know this ask the students what they can do next\*

\*Once receiving the answer “cancel them from each expression” move on to the final step. At this point remind the students that whenever you cancel a term you are left with a “*1*” in its place

\*Lastly have the students multiply the remaining numerators and the remaining denominators by distributing the remaining terms left in each

\*This will leave you with an answer of “”

When you are sure that the students fully understand this problem, walk them through the next problem in a similar fashion. Again with this problem stress that it is important to first use the Keep-Change-Flip method and then remember to simplify each expression first and then multiply by either distributing and/or FOILing. As you are going through the example problems with the students, stress that it is important to be writing down each example that you are putting on the board. After going through these two problems as well as any other notes, the students will have all the information they need to divide expressions.

**Guided Practice:**

* Guided practice will be given to the students in the form of a worksheet to work on during class. This classwork will consist of seven problems from the guided practice worksheet (the classwork), specifically #2, 4, 6, 8, 10, 12, and 14. These problems will be written on the board, underneath each problem there will be room for the solution. To complete this assignment, have the students work either on their own or in small groups with the other students sitting next to them. These groups will allow the students to talk through each of the questions and their peers may be able to clear up any misunderstandings they have. As the groups are all working, walk around the classroom observing the students interactions. At this time, assist and correct the students as necessary. Instead of giving the students answers to the questions, ask them questions and give hints that will help lead them to the correct answers. These hints would involve directing them to one of the previously completed examples that has some of the same issues. When students ask if they have the correct answer, respond yes if it is correct and provide the step in which they first erred if it is not correct. Dividing rational expressions and multiplying rational expressions are extremely similar therefore students are likely to make some of the same common mistakes as during the previous day’s lesson. As the students are completing this classwork, some errors that will be common are, students incorrectly cancelling out terms, simple calculation mistakes, distribution/FOILing issues, and improperly using the Keep-Change-Flip method. When observing students making any of these common mistakes make sure to point them out immediately (students do not want to get into the habit of making these mistakes). To help remind students of these common errors, write the following statements on the board:

\*You can only cancel when there is something in common between all the terms or the terms are connected by multiplication \*

\*You can only cancel up and down, or diagonally\*

\*Don’t forget your calculator, always check your work\*

\*Check your distributing and FOILing, don’t forget to distribute the negative to EVERYTHING in the second expression\*

\*Don’t forget to…KEEP-CHANGE-FLIP\*

Putting these hints up on the board will ensure that the ideas are fresh in the students mind. These hints will help to reinforce the correct procedures. If at any time during their classwork students are struggling they can look up at the board and see if these are any of their problems. During this time also stress to the students that you are there to assist them whenever they need it. There is no reason for a student to be struggling, they can always ask for help. As you are walking the class checking the students’ progress, choose four students to come up to the board and answer a question, this should be done as they are still completing the assignment. When it appears that most of the students have completed the assigned problems, call the class’s attention back to the front of the room. At this time have the student that put the question on the board explain how the steps and procedures they used to arrive at their answer. Once this is done ask students again if they have any questions, comments, or confusions and deal with them at this time.

**Accommodations and Modifications:**

* *Early Mastery Learners*

To accommodate early mastery learners, offer the students **more advanced example** problems. A more advanced example problem would include:

1. Divide the following:

Early mastery learners would also be offered the option to **tutor their peers**. This peer tutoring would help the mastery learners to really understand the material, if they are able to teach it, it is an indication that they truly know it.

* *ELL and Students with Communication Disorders*

To accommodate ELL students and students with communication disorders **simplified and reworded directions** will be offered. These instructions will be said aloud directly following the distribution of the classwork or homework assignments. An example of a specific simplified/reworded set of directions is:

Written: Divide the following expression

Spoken: Use the Keep-Change-Flip method to change the division to multiplication then multiply the numerators and the denominators

If necessary, write these simplified/reworded directions on the board or on the specific student’s paper.

* *Reading, Writing, and Behavior Problems*

To accommodate students with reading, writing, and behavior problems **simplified directions** like those above will once again be used. Students with trouble reading will be offered **readers** to assist them in reading the specific questions. Students with trouble writing will be offered **scribes** to assist them in writing notes and problems. **Visualizing** will also be used to assist these students. These visualizations could include breaking down an expression by writing each variable as a multiplied version of its simplest forms. This could mean instead of writing the student could write. Specifically, for students with behavioral problems that are interfering with the lesson, you should work with the students and (if needed) the parents to create a student-teacher **contract**. With this contract you will sit down and create a written agreement stating what the student needs to do (or the way they must act) in order to receive a specific desired reward. When creating this contract assist the student in choosing an appropriate reward.

**Closure:**

* To conclude this lesson, have the students complete the closing activity worksheet. This worksheet will help to assess the students overall understanding of the day’s topic. This worksheet will ask students to divide the given expression as well as give themselves a rating based on their overall understanding of the topic. A copy of the problem is shown below:

Divide the following:

Students will give themselves a 1 if they feel that they do not understand or only slightly understand the topic, a 2 if they feel that they understand the topic of but could use a little more practice, or a 3 if they completely understand the topic. After about five minutes, or sooner depending on how quickly the students are progressing, call the class’s attention back to the front of the room. At this time, work with the class to answer the question. Call on several students to walk you through the completion of the problem. As they are completing this problem, check that they are using the Keep-Change-Flip method and then simplifying and cancelling common terms. Once this has been done the students are to

**Independent Practice:**

* The students’ independent practice will consist of the remaining seven questions on the guided practice worksheet, a copy of the worksheet is attached.
* Specific Independent Practice Examples (homework assignment): #1, 3, 5, 7, 9, 11, 13 (7 problems total)

**Evaluation:**

* *Diagnostic*

Prior to beginning the unit, students were given a **pretest** to assess their understanding of simplifying, adding, subtracting, multiplying, and dividing rational expressions. This pretest will serve as a form of diagnostic evaluation to assess each student’s knowledge prior to beginning the unit. Prior to beginning the lesson, at the beginning of class, students will be given a **do now** assignment. This do now will active their prior knowledge, bringing up the ideas of performing various operations on rational expressions.

* *Formative*

During the lesson, students will complete several forms of assessment that will be used to assess their progress through the topic. Through the use of **in class example problems** and a **classwork assignment** (guided practice), the students will be assessed in two ways. Firstly they will be assessed through the direct observations from the teacher. as students are completing this assignment, look for an issues they may be having and assess their progress and understanding of the current topic. Out of class, students will be assessed through the use of a **homework assignment** (independent practice). Using this assignment, students will be assessed when it has been collected the next day.

* *Summative*

A unit test will be given to assess the students overall understanding of performing various operations rational expressions. This test will contain problems that involve simplifying, adding, subtracting, multiplying, and dividing rational expressions.

A copy of the test questions is shown below

**Algebra 2- Unit 2 Test: Rational Expressions**

**Directions:** Answer all questions in the space provided. An incorrect answer with sufficient work may receive partial credit; a correct answer with insufficient work may only receive partial credit.

Simplify the following:

|  |
| --- |
|  |
|  |
|  |

Multiply the following:

|  |
| --- |
|  |
|  |
|  |

Divide the following

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| --- |
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|  |

Add the following

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| --- |
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|  |

Subtract the following:

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| --- |
|  |
|  |
|  |

Lesson Plan #4: Adding and Subtracting Rational Expressions

**Goal:**

* Students will learn to perform various operations on rational expressions and apply these expressions to real life situations.

**Performance Objectives:**

* Given 10 rational expressions, students will add or subtract each, making sure that it is in simplest form as well, with 80% accuracy.

**Standards:**

* **2010 NYS Common Core Standards**

Content Standards:

High School Algebra

Seeing Structure in Expressions (A-SSE)

*Interpret the structure of expressions*

1. Interpret expressions that represent a quantity in terms of its context.­

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

2. Use the structure of an expression to identify ways to rewrite it.

Arithmetic with Polynomials & Rational Expressions (A-APR)

*Perform arithmetic operations on polynomials.*

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

*Rewrite rational expressions.*

6. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

7. (+) 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.

Mathematical Practices:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

* **NCTM Standards**

Content Standards:

Number and Operations Standard, Grades 9-12

*Understand meanings of operations and how they relate to one another*

Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities;

*Compute fluently and make reasonable estimates*

Judge the reasonableness of numerical computations and their results.

Algebra Standard, Grades 9-12

*Understand patterns, relations, and functions*

Understand relations and functions and select, convert flexibly among, and use various representations for them;

Understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more-complicated symbolic expressions;

*Represent and analyze mathematical situations and structures using algebraic symbols*

Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations

Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency- mentally or with paper and pencil in simple cases and using technology in all cases

*Use mathematical models to represent and understand quantitative relationships*

Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts;

Process Standards:

*Problem Solving*

Build new mathematical knowledge through problem solving

Solve problems that arise in mathematics and in other contexts

Apply and adapt a variety of appropriate strategies to solve problems

Monitor and reflect on the process of mathematical problem solving

*Communication*

Organize and consolidate their mathematical thinking through communication

Communicate their mathematical thinking coherently and clearly to peers, teachers, and others

Use the language of mathematics to express mathematical ideas precisely

*Connections*

Recognize and use connections among mathematical ideas

Understand how mathematical ideas interconnect and build on one another to produce a coherent whole

*Representation*

Create and use representations to organize, record, and communicate mathematical ideas

Select, apply, and translate among mathematical representations to solve problems

**Materials and Resources:**

* White board
* SMARTboard
* Markers
* Class examples (complete with answers)
* Guided practice examples (complete with answers)
* Independent practice examples

**Use of Electronic Technology:**

* The **SMARTboard** will be used to present the notes for the lesson. The students will also be able to use the SMARTboard throughout the lesson, putting answers up and interacting with the board throughout the presentation.
* Students will also have the option of using **graphing calculators** to compute and check their work.

**Introduction:**

* After welcoming the students into the classroom, getting them settled down, and ensuring that they are ready to begin the day, present them with the daily do now. This do now will help to activate their prior knowledge, causing them to think about previously learned materials and possibly hypothesize about how the day’s lesson will relate. The daily do now will be written on the white board. The students will complete the following do now on a clean piece of paper or as a part of their notes:

Add the following:

Subtract the following:

As the students are completing this do now walk around the room to ensure they are all working. At this time offer the students assistance and answer any questions they may have. Students will be allowed to work on their own or with the person they are sitting next to. After about 5 minutes, or sooner depending on how the students are progressing, call the students attention back to the front of the room. At this time go over the do now assignment, going over both problems. To begin, ask the students how they would go about adding the first problem. Ask for the students’ assistance in completing the problem. Since the students have recently reviewed these ideas, through the previous unit, they should be able to walk you through the process step by step. Once you have gotten an answer for the first problem, move on to the second. Complete this problem in a similar manner to how you completed the addition problem. Once you have gotten an answer for each problem, ask the students if they have any other questions. At this time explain to the students that the day’s topic will be adding and subtracting rational expressions, an idea similar to ones previously discussed in the last unit and in earlier math courses.

**Development:**

* Begin by introducing the day’s topic of adding and subtracting rational expressions. At this time explain to the students that this will involve concepts discussed earlier in the unit like multiplying and simplifying rational expressions. This will also be very similar to the idea of adding and subtracting fractions. To introduce the idea of adding and subtracting rational expressions provide students with a quick review on adding and subtracting fractions. Remind the students about the importance of finding a common denominator as well as making sure that whatever you do to the numerator you do to the denominator as well. Following this quick fraction review provide the students with these important ideas about adding and subtracting rational expressions:

When Adding…

1. Make sure there is a common denominator
2. Combine like terms

When Subtracting…

1. Make sure there is a common denominator
2. Distribute the negative
3. Combine like terms

To clarify these ideas for the students begin completing example problems that help to illustrate each important idea, add or subtract the following example problems:

For each problem walk the students through it step by step, questioning them as you as to what they believe the next step should be. Using question 1 as an example, the questioning and completion process could look something like this:

\*Beginning with , ask the students if both expressions have a common denominator

\*The students should answer “yes”

\*Tell the students that at this point they are going to merge the fractions, writing both expressions with only one denominator looking something like this:

\*At this time ask the students for the next step on their list of important ideas

\*The students should answer “combine like terms”

\*At this point have the students help you to combine like terms in the expression, this should look something like this:

\*Stress to the students that they are NOT done yet, their last step with be to simplify, checking if there are any common factors between the terms

\*The students should answer “yes, an *x* can be factored out”

\*After factoring out the final *x* the problem is complete, this will leave you with a final answer of *x+6*

When you are sure that the students fully understand this problem walk them through the next in a similar fashion this time pointing out that a common denominator must be reached before they can combine like terms. Allow the students to complete the third example on their own, asking a student to give an answer in about 3 minutes. Moving on to the subtraction problems, complete a similar question and answer process with the students. When doing this make sure to stress to the students the importance of distributing the negative to all terms in the numerator of the second expression, other than this, the problem should progress in a very similar manner to the first three addition problems. After walking the students through the first subtraction problem, allow them to complete the last two example problems on their own. After about 5 minutes check back in and call on a student to give you the answer. After going through each example problem as well as the accompanying notes, ask the students if they have any more questions or comments on what they have just learned or something related. At this time the students have all the information they need to add and subtract expressions.

**Guided Practice:**

* Guided practice will be given to the students in the form of a worksheet to work on during class. This classwork will consist of seven problems from the guided practice worksheet (the classwork), specifically #2, 4, 6, 8, 10, 12, and 14. These problems will be written on the board, underneath each problem there will be room for the solution. To complete this assignment, have the students work either on their own or in small groups with the other students sitting next to them. These groups will allow the students to talk through each of the questions and their peers may be able to clear up any misunderstandings they have. As the groups are all working, walk around the classroom observing the students interactions. At this time, assist and correct the students as necessary. Instead of giving the students answers to the questions, ask them questions and give hints that will help lead them to the correct answers. These hints would involve directing them to one of the previously completed examples that has some of the same issues. When students ask if they have the correct answer, respond yes if it is correct and provide the step in which they first erred if it is not correct. As the students are completing this classwork some errors that will be common are students incorrectly cancelling out terms, simple calculation mistakes, and distribution/FOILing issues. When observing students making any of these common mistakes make sure to point them out immediately (students do not want to get into the habit of making these mistakes). To help remind students of these common errors, write the following statements on the board:

\*You can only cancel when there is something in common between all the terms or the terms are connected by multiplication \*

\*Don’t forget your calculator, always check your work\*

\*Check your distributing and FOILing, don’t forget to distribute the negative to EVERYTHING in the second expression\*

Putting these hints up on the board will ensure that the ideas are fresh in the students mind. These hints will help to reinforce the correct procedures. If at any time during their classwork students are struggling they can look up at the board and see if these are any of their problems. During this time also stress to the students that you are there to assist them whenever they need it. There is no reason for a student to be struggling, they can always ask for help. As you are walking the class checking the students’ progress, choose four students to come up to the board and answer a question, this should be done as they are still completing the assignment. When it appears that most of the students have completed the assigned problems, call the class’s attention back to the front of the room. At this time have the student that put the question on the board explain how the steps and procedures they used to arrive at their answer. Once this is done ask students again if they have any questions, comments, or confusions and deal with them at this time.

**Accommodations and Modifications:**

* *Early Mastery Learners*

To accommodate early mastery learners, offer the students **more advanced example** problems. A more advanced example problem would include:

Subtract the following:

Add the following

Early mastery learners would also be offered the option to **tutor their peers**. This peer tutoring would help the mastery learners to really understand the material, if they are able to teach it, it is an indication that they truly know it.

* *ELL and Students with Communication Disorders*

To accommodate ELL students and students with communication disorders **simplified and reworded directions** will be offered. These instructions will be said aloud directly following the distribution of the classwork or homework assignments. An example of a specific simplified/reworded set of directions is:

Written: Subtract the following expression.

Spoken: Find a common denominator, distribute the negative, and combine like terms so that the expression will be in simplest form

If necessary, write these simplified/reworded directions on the board or on the specific student’s paper.

* *Reading, Writing, and Behavior Problems*

To accommodate students with reading, writing, and behavior problems **simplified directions** like those above will once again be used. Students with trouble reading will be offered **readers** to assist them in reading the specific questions. Students with trouble writing will be offered **scribes** to assist them in writing notes and problems. **Visualizing** will also be used to assist these students. These visualizations could include breaking down an expression by writing each variable as a multiplied version of its simplest forms. This could mean instead of writing the student could write. Specifically, for students with behavioral problems that are interfering with the lesson, you should work with the students and (if needed) the parents to create a student-teacher **contract**. With this contract you will sit down and create a written agreement stating what the student needs to do (or the way they must act) in order to receive a specific desired reward. When creating this contract assist the student in choosing an appropriate reward.

**Closure:**

* To conclude this lesson, have the students complete the closing activity worksheet. This worksheet will help to assess the students overall understanding of the day’s topic. This worksheet will ask students to add or subtract the given expression as well as give themselves a rating based on their overall understanding of the topic. A copy of the problem is shown below:

Add the following:

Subtract the following:

Students will give themselves a 1 if they feel that they do not understand or only slightly understand the topic, a 2 if they feel that they understand the topic of but could use a little more practice, or a 3 if they completely understand the topic. After about five minutes, or sooner depending on how quickly the students are progressing, call the class’s attention back to the front of the room. At this time, work with the class to answer the question. Call on several students to walk you through the completion of the problem. As they are completing these problems, check that they are getting a common denominator and distributing the negative. When the problem has been reviewed go over any of the students’ questions or concerns then collect the worksheet. Lastly, as this is the last topic of the unit, connect this to ideas that will be discussed in their next unit on radicals. Discuss the similarities between adding and subtracting rational expressions and adding and subtracting rational expressions that include radicals.

**Independent Practice:**

* The students’ independent practice will consist of the remaining seven questions on the guided practice worksheet, a copy of the worksheet is attached.
* Specific Independent Practice Examples (homework assignment): #1, 3, 5, 7, 9, 11, 13 (7 problems total)

**Evaluation:**

* *Diagnostic*

Prior to beginning the unit, students were given a **pretest** to assess their understanding of simplifying, adding, subtracting, multiplying, and dividing rational expressions. This pretest will serve as a form of diagnostic evaluation to assess each student’s knowledge prior to beginning the unit. Prior to beginning the lesson, at the beginning of class, students will be given a **do now** assignment. This do now will active their prior knowledge, bringing up the ideas of performing various operations on rational expressions.

* *Formative*

During the lesson, students will complete several forms of assessment that will be used to assess their progress through the topic. Through the use of **in class example problems** and a **classwork assignment** (guided practice), the students will be assessed in two ways. Firstly they will be assessed through the direct observations from the teacher. as students are completing this assignment, look for an issues they may be having and assess their progress and understanding of the current topic. Out of class, students will be assessed through the use of a **homework assignment** (independent practice). Using this assignment, students will be assessed when it has been collected the next day.

* *Summative*

A unit test will be given to assess the students overall understanding of performing various operations rational expressions. This test will contain problems that involve simplifying, adding, subtracting, multiplying, and dividing rational expressions.

A copy of the test questions is shown below

**Algebra 2- Unit 2 Test: Rational Expressions**

**Directions:** Answer all questions in the space provided. An incorrect answer with sufficient work may receive partial credit; a correct answer with insufficient work may only receive partial credit.

Simplify the following:

|  |
| --- |
|  |
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|  |

Multiply the following:

|  |
| --- |
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|  |

Divide the following

|  |
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Add the following

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Subtract the following:

|  |
| --- |
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|  |

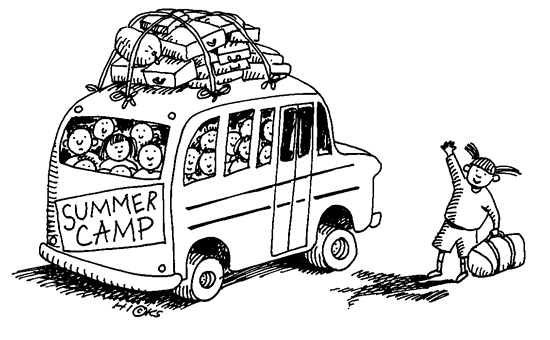
Culminating Project

* This task will assess the goals of the unit, meaning the students understanding of rational expressions, including their role in the real world. Students will be asked to complete several assignments including a poster, essay, and presentation to assess their overall understanding.
* The goal of this unit is for the students to understand how simplifying, multiplying, dividing, and adding and subtracting rational expressions can be applied to real life situations. This task will require students to use their understanding of performing these operations on rational expressions to create a finished poster. This poster will require students to create several rational expressions and perform various operations to represent the given information. By completing each piece of this project students will demonstrate their overall understanding of rational expressions. After completing the poster, students will be asked to complete a short essay (1 page or less) briefly explaining the steps they took to create each expression and a brief presentation to explain their poster. This task will relate to the standards covered in the unit.

* Through this task students will begin by answering each question listed on the assignment page. This includes answering five short questions by creating a specific expression related to each. Following this the students will create a poster displaying all their work and their answers to each question. These posters should be both neat and fun.

Along with the poster, the students will be required to complete a short paper. In this paper, students will explain the steps they took to create each expression. The students will also be required to give a short five minute presentation explaining their poster and the steps they took to arrive at their expressions.

* This will be an individual task; each student will be required to complete their own poster. If the students wish they may work with one other student. However, in the end, each student must turn in their own poster and essay, as well as put together their own presentation. When the project is turned in, each student should identify who they worked with, if anybody. To complete this project each student will need the following materials; poster board, scrap paper (for calculations), pencil or pen, markers, and a calculator. Students will also need their notes and other worksheets from the unit to aid them in completing this project. Throughout this task the teacher will be observing the students’ progress and stepping in when needed. If the students do need assistance during this task, the teacher will ask them questions that will lead them to a correct answer. While completing this project, students will be allowed to use any materials they have accumulated through class. This could include notes, worksheets, and old tests or quizzes. Students may also use their calculators or any other form of technology they deem necessary when completing this project. Students will be given one class period to complete this project, any work that they have not completed at the end of this period they will have to finish on their own time. Students will be scored on the following criteria; poster, overall mathematical content, essay, and presentation. There will be a possible sixteen total points that students can earn when completing this project.

**Summer Employment Project:**

**Due Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

For two straight months this past summer you spent your days working at the local town summer camp. As you spent your days flipping burgers in the hot snack bar and chasing campers in the hot sun, you earned a total of $7.25 an hour. After a long and tiring summer you are curious as to how much money you have made. (Not knowing how many hours you worked this summer, use the variable *h* to represent “*hours worked*”). After completing the problems below, create a poster displaying all your work (and answers to the questions), an essay explaining the steps you took in creating each expression (no longer than a page), and a short presentation explaining your poster to the class.

Complete the following problems. Make sure that all expressions are in simplest form and all terms are written as fractions.

1. Write an expression to determine the total amount of money (the gross pay) you made this summer.
2. While you though you made a lot of money this summer, you forgot that money was taken out of each paycheck for Federal taxes, New York State taxes, and Social Security (FICA). The rates for each of these are listed below:

Federal taxes 🡪 NYS taxes 🡪 Social Security (FICA) 🡪

Use these rates to create an expression to represent the amount you made this summer after deductions (the net pay).

1. Knowing that you worked for a total of 8 weeks this summer, write an expression to determine your paycheck for each week (assuming you worked the same number of hours each week) after the deductions?
2. Your friend worked at the same town camp but instead for 8.00 an hour. Write an expression to determine her gross pay, net pay, and her net pay per week. Write an expression to determine the difference between your friends net pay per week and your net pay per week?
3. You and your friend have decided to splurge and go on an end of summer camping trip. To pay for this trip you are both spending your entire last paycheck on camping supplies, write an expression to show the amount you would be putting into the trip if you were to add both your last weekly paychecks.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |  |
| Poster | The poster contains little to none of the required components. | The poster contains most required components. | The poster contains all required components. | The poster contains all required components, and ideas are displayed in a neat and creative manner. |  |
| Mathematical Content | More than one expression is missing or many mistakes were made when performing each operation. | Most expressions are correct and the operations are performed correctly or with few mistakes. | All expression are correct and the operations are performed with few mistakes. | All expressions are correct and operations are performed correctly including simplifying, multiplying, dividing, and adding and subtracting. |  |
| Essay | The essay contains little to none of the required components with several to many grammatical errors. | The essay contains most required components with several grammatical errors. | The essay contains all required components with few grammatical errors. | The essay contains all required components and is written with good grammar and style. |  |
| Presentation | The poster is not presented in a professional manner; many aspects of the poster are not explained. | The poster is not presented in a professional manner; some aspects of the poster are not explained. | The poster is presented in a professional manner where most aspects of the project are explained. | The poster is presented in a professional (speaking calmly and clearly) manner where all aspects of the project are explained clearly. |  |
|  |  |  |  | Total: |  |

Suggested Methods of Evaluation

Pre-Assessment

**Algebra 2- Rational Expressions Unit**

**Factor the following:**

|  |  |
| --- | --- |
|  |  |
| **Simplify the following:** | **Factor and Simplify the following:** |

**Add the following:**

|  |  |
| --- | --- |
|  |  |

**Subtract the following:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | |  | |
| **Multiply the following:** | **Divide the following:** | |

Do Now Assignments

* Lesson 1: Simplifying Rational Expressions

Factor the following:

* Lesson 2: Multiplying Rational Expressions

Multiply the following:

* Lesson 3: Dividing Rational Expressions

Divide the following:

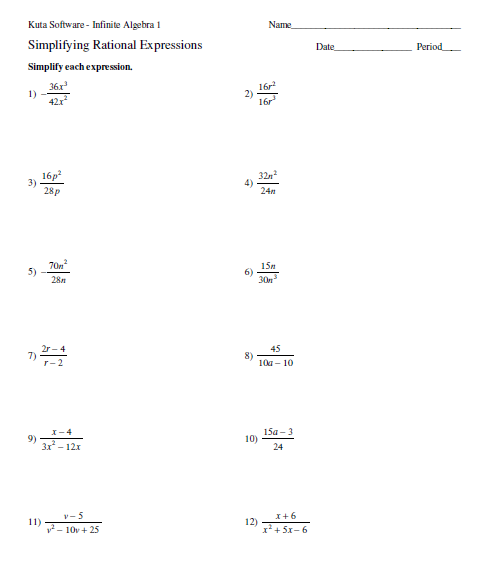
Multiply the following:

* Lesson 4: Adding and Subtracting Rational Expressions

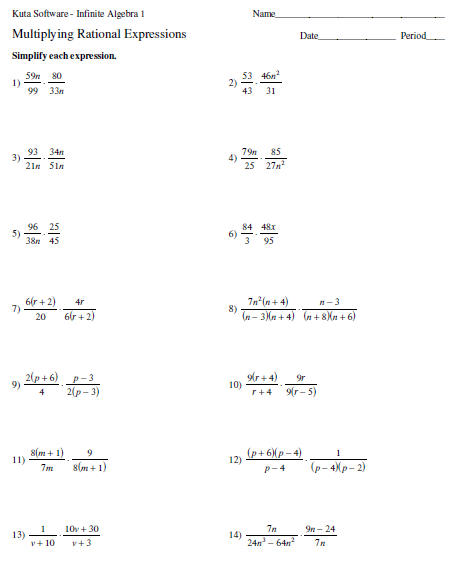
Add the following:

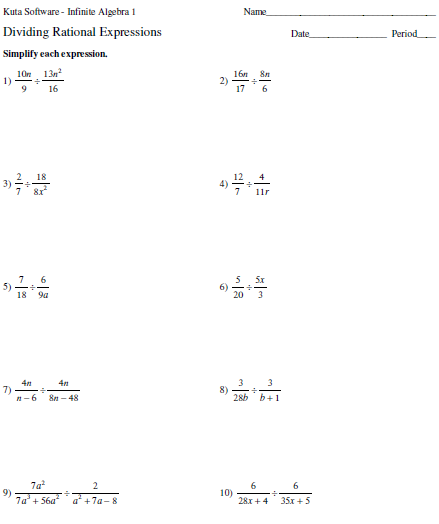
Subtract the following:

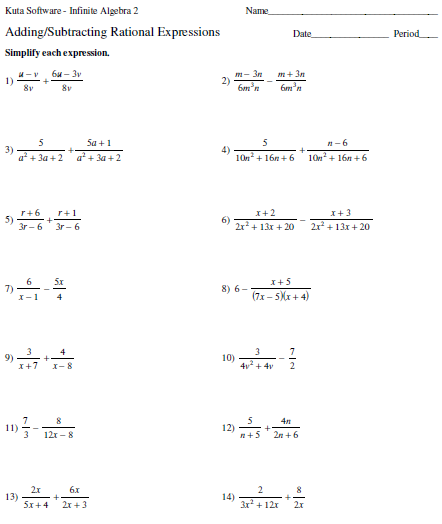
Worksheets:

Simplifying Worksheet:

Multiplying Worksheet:



Dividing Worksheet:

Adding/Subtracting Worksheet:

Extra Practice Worksheets:

**Simplifying Rational Expressions**

1. 6.
2. 7.
3. 8.
4. 9.
5. 10.

Adding and Subtracting Rational Expressions

|  |  |
| --- | --- |
| Add the following: | Subtract the following: |
|  | 7. |
|  | 8. |
|  | 9. |
|  | 10. |
|  | 11. |
|  | 12. |

Classwork Assignments (Guided Practice)

* Lesson 1: Simplifying Rational Expressions

Simplifying Worksheet- #1, 7, 9, 11

* Lesson 2: Multiplying Rational Expressions

Multiplying Worksheet- All Evens

* Lesson 3: Dividing Rational Expressions

Dividing Worksheet- All Evens

* Lesson 4: Adding and Subtracting Rational Expressions

Adding and Subtracting Worksheet- All Evens

Homework Assignments (Independent Practice)

* Lesson 1: Simplifying Rational Expressions

Simplifying Worksheet- #2, 3, 4, 5, 6, 8, 10, 12

* Lesson 2: Multiplying Rational Expressions

Multiplying Worksheet- All Odds

* Lesson 3: Dividing Rational Expressions

Dividing Worksheet- All Odds

* Lesson 4: Adding and Subtracting Rational Expressions

Adding and Subtracting Worksheet- All Odds

Closing Activities

* Lesson 1: Simplifying Rational Expressions

Simplify the following:

* Lesson 2: Multiplying Rational Expressions

Multiply the following:

* Lesson 3: Dividing Rational Expressions

Divide the following:

* Lesson 4: Adding and Subtracting Rational Expressions

Add the following:

Subtract the following:

Unit Test/Post-Assessment

* Students post-assessment scores will be calculated by grading the following problems from the pre-assessment: #1, #4, #10,#13 and #14, as well as the following new problems: #2, #5, #7, #8, #11 The successful completion of these problems will demonstrate the students overall understanding of the unit on rational expressions.

**Algebra 2- Unit 2 Test: Rational Expressions**

**Directions:** Answer all questions in the space provided. An incorrect answer with sufficient work may receive partial credit; a correct answer with insufficient work may only receive partial credit.

Simplify the following:

|  |
| --- |
|  |
|  |
|  |

Multiply the following:

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| --- |
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Divide the following

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Add the following

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Subtract the following:

|  |
| --- |
|  |
|  |
|  |

Resources

**References:**

* Barton, M. L., & Heidema, C. (2002). *Teaching Reading in Mathematics.* Alexandria: ASCD.
* Vivian, M. L., & Thomas, M. (2003). *Algebra, Grades 5-8 (The 100+ Series).* Columbus: Instructional Fair.
* Gantert, A. X. (2009). *Algebra 2 and Trigonometry .* NYC: Amsco School Publications, Inc..
* *Rational (Fractional) Expressions* . (2012). Retrieved September 2013, from Regents Exam Prep Center: http://www.regentsprep.org/Regents/math/algtrig/ATO2/indexATO2.htm

**General Resources:**

* Graphing Calculator Application
* Kuta Software Worksheets (attached)

**Technology Resources:**

* SMARTboard
* Graphing Calculator Application