

**Title: Raising the Power!**

**Grade level/content area: 8th Grade Algebra**

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**Date lesson will be taught: March 6<sup>th</sup>/7<sup>th</sup>**

**Source of the lesson:**

Teacher modified from school's CLT Plans

**CONCEPT STATEMENT**

In this lesson, students will explore numerical patterns to uncover the fundamental laws of exponents, including products and quotients of bases. Through guided discovery, they will derive these rules and apply them to simplify multivariable expressions and ratios of monomials with integer exponents. Robert Recorde, a 16th-century mathematician known for introducing the equals sign (=), contributed to the foundation of modern algebra, including exponent notation. By recognizing and applying these exponent properties, students will strengthen their algebraic reasoning and problem-solving skills.

**Important Vocabulary:**

Exponent – The number that indicates how many times the base is multiplied by itself.

Base – The number being raised to a power.

Power – An expression that represents repeated multiplication of the same factor.

Product of Powers Property – The rule stating that when multiplying like bases, add the exponents.

Quotient of Powers Property – The rule stating that when dividing like bases, subtract the exponents.

Monomial – A single term consisting of a coefficient, variables, and exponents.

**LESSON OBJECTIVES**

**Students will be able to...** define the different laws of exponents, including the product and quotient rules, through pattern exploration and apply these laws to simplify expressions with integer exponents, including multivariable expressions and ratios of monomials.

**VIRGINIA SOL OBJECTIVE(s) ADDRESSED**

A.EO.3 The student will derive and apply the laws of exponents.

**MATERIALS NEEDED (Resources, supplies, and handouts)**

Highlighter, Pencils, Chromebook, glue sticks, and notebook

'Mathematician of the Unit: Robert Recorde' Slides

'Laws of Exponents Exploration' notes and 'Exponents and Radicals' note bundle

'Laws of Exponents' and 'Dividing Monomials' videos by The Math Dude

'Discovering the Laws of Exponents' Desmos

'HW 1: Product Rule' worksheet and 'HW 3: Quotient Rule' worksheet

**SAFETY CONSIDERATIONS**

*Students will be instructed to use all materials for their intended use.*

<b>ENGAGEMENT</b>		<b>Estimated Time: 10 minutes</b>
<b>Teacher and Student Activity</b>	<b>Probing Questions</b>	
Students will glue in 'Laws of Exponents Exploration' notes and 'Exponents and Radicals' note bundle.		
Teacher will display the 'Mathematician of the Unit: Robert Recorde' slides on to the smartboard. Teacher will go over the slides, explain that Recorde wanted to allow those that were not highly educated to easily relate to math concepts.		
Students will work in their pods and discuss the 3 questions presented on the board. After about 5 mins, a representative of each group will share with the class on what the group discussed.	<ul style="list-style-type: none"> <li>• Why do you think mathematicians create shortcuts or rules like the laws of exponents?</li> <li>• How would math be different if we had no symbols or simplifications?</li> <li>• Can you think of a real-world example where simplifying a process makes things more efficient?</li> </ul>	
Teacher will introduce today's topic of Laws of Exponents and hand out highlights for exploration.		

<b>EXPLORATION</b>		<b>Estimated Time: 15 minutes</b>
<b>Teacher and Student Activity</b>	<b>Probing Questions</b>	
For 10 minutes and in their pods, students will work together to complete the Product Rule and Quotient Rule pages of their 'Laws of Exponents Explore' notes. Students will use the highlighter to color in the circles that they create for the various examples that they see.		
After 10 mins or when most of the pods have finished their work, students will share what pattern have they noticed when looking at the first column and the last column of both pages.	<ul style="list-style-type: none"> <li>• What operations do we see involved in using exponents?</li> <li>• What other operations involve repeating a different operation?</li> </ul>	

<b>EXPLANATION</b>		<b>Estimated Time: 30 minutes</b>
<b>Teacher and Student Activity</b>	<b>Probing Questions</b>	
Teacher will play 'Laws of Exponents' video by The Math Dude. After the video, teacher will ask students 'What did you notice and what did you wonder?' Students will be chosen at random to give their response.		
Teacher will then have the students turn to the first page of their 'Exponents and Radicals' notes. Teacher will define what a monomial is.	<ul style="list-style-type: none"> <li>• What is an example of a monomial?</li> </ul>	

Teacher will explain that when multiplying monomials, one must add the exponents. Teacher will fill in the first example. Then together with the students, they will work on simplifying problems 17, 18, and 19.	<ul style="list-style-type: none"> <li>• Why do we add exponents when multiplying monomials instead of multiplying them?</li> <li>• How does the product rule relate to the idea of repeated multiplication?</li> <li>• What would happen if we accidentally multiplied the exponents instead of adding them? Can you give an example?</li> </ul>
Teacher will remind students that if there are coefficients, then one must multiply the coefficients and then simplify the variables using the product rule to the exponents. Together, Teacher and students will go over example problems 20, 23, 24, 26, 27, 32 and 34.	<ul style="list-style-type: none"> <li>• How does multiplying coefficients differ from working with exponents? Why don't we add coefficients like we do exponents?</li> <li>• Can you explain why the product rule only applies when the bases are the same? What happens if the bases are different?</li> </ul>
Teacher will then play 'Dividing Monomials' video by The Math Dude. Again teacher will ask students 'What did the notice and what did they wonder?' A few random students will be chosen to give their responses.	
Teacher will tell students to turn to page 2 in their 'Exponent and Radicals' note bundle, and teacher will explain that when dividing monomials, one must subtract the exponents. Teacher will fill in the first example. Then together with the students, they will work on simplifying problems 1, 3, 4, and 6.	<ul style="list-style-type: none"> <li>• Why do you think we subtract exponents instead of dividing them when working with the quotient rule?</li> <li>• How is dividing monomials like multiplying monomials? How is it different?</li> <li>• What would happen if we added the exponents instead of subtracting them when dividing?</li> </ul>
Just like the product rule, teacher will remind students that if there are coefficients, then one must divide the coefficients and then simplify the variables using the quotient rule to the exponents. Together, Teacher and students will go over example problems 7, 9, 10, and 11.	<ul style="list-style-type: none"> <li>• Why does the coefficient follow normal division rules, while the exponents follow the quotient rule?</li> </ul>
Teacher will then instruct students to take out their Chromebook, where students will get to review what we have just talked about, how it applies to the real world and an introduction to the power rule of exponents.	

ELABORATION	Estimated Time: 15 minutes
Teacher and Student Activity	Probing Questions
On their Chromebooks, students will work to start the 'Discovering the Laws of Exponents'	

Desmos. Students will be given 10 mins to work on their Desmos.	
Teacher will observe students' progress on the Desmos teacher app. If a student seems like they are struggling, then the teacher will have a few moments of one-on-one help to clarify any misconceptions.	
After 10 mins, teacher will ask students questions based on what they read about in the Desmos.	<ul style="list-style-type: none"> <li>• What did we observe about the applications of the laws of exponents?</li> <li>• What other examples could you use the product and quotient rules in someone's everyday life?</li> <li>• What differences and similarities did you notice about the product rule and the power rule?</li> </ul>

<b>EVALUATION</b>	<b>Estimated Time: 10 minutes</b>
<b>Teacher and Student Activity</b>	<b>Probing Questions</b>
Teacher will then hand out homework assignments: 'HW 1: Product Rule' and 'HW 3: Quotient Rule'. Students will have 8 mins to work on problems 16 and 19 from HW1, and problems 1 and 7 from HW 3.	
Once student is done, student will check in with the teacher and receive feedback on their work. Any additional time, student will begin working on the odds from the two HW sheets, starting at problem 13 for HW 1, or work on completing the Desmos.	

## **DIFFERENTIAL STRATEGIES**

By using the videos, students with learning disabilities will have a fun visual way to connect to the product and quotient rule. This also supplies an audio for students with hearing impairments. Using the Desmos, all the teacher to have some one-on-one instruction time with students that is struggling with the content.

## **ASSESSMENT**

To determine the student's understanding of the material, teacher will check the 4 problems from the HW pages. In addition, teacher will also view the students' progress on their Desmos activity. Any unfinished work will be assigned for homework, giving the Desmos 4 days to complete.

**Attach any SUPPLEMENTARY MATERIALS** (handouts, worksheets, data collection tables, assessments, etc.) as part of your lesson plan.

Important Links:

'Laws of Exponents' YouTube video by Math Dude

[https://www.youtube.com/watch?v=ktX\\_MCUEaFU](https://www.youtube.com/watch?v=ktX_MCUEaFU)

'Dividing Exponents' YouTube video by Math Dude

<https://www.youtube.com/watch?v=Ny4KOqCDock&t=189s>

'Discovering the Laws of Exponent' Desmos Activity

<https://teacher.desmos.com/activitybuilder/custom/620d41600fc07e5e63fb6ef2?collections=60244aefcc9000424a7b3223>

'Mathematician of the Unit: Robert Recorde' google slides

[https://docs.google.com/presentation/d/1lnz7Q7xDCDVEGszfpmV\\_1pyjS-4tQeHpKJy4H3Sa3uE/edit?usp=sharing](https://docs.google.com/presentation/d/1lnz7Q7xDCDVEGszfpmV_1pyjS-4tQeHpKJy4H3Sa3uE/edit?usp=sharing)