High School Math 2 Unit 1 Extending the Number System

Approximate Time Frame: 2 – 3 Weeks

Connections to Previous Learning:

Properties of integer exponents learned in Math I will be extended to rational exponents. Equation solution methods will extend to exponential equations.

Focus of this Unit:

Students will extend the laws of exponents to rational exponents. The relationship of rational and irrational numbers will be explored by looking at their decimal representations. Students will solve problems with exponential equations.

Connections to Subsequent Learning:

Students will use these skills as they expand the types of functions used in modeling problems.

Desired Outcomes

Standard(s):

Extend the properties of exponents to rational exponents.

- N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, *we define* $(5^{1/3})^3$ *must equal 5 because we want* $(5^{1/3})^3=5^{(1/3)3}$ *to hold, so* $(5^{1/3})^3$ *must equal 5.*
- N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Use properties of rational and irrational numbers.

- N.RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Create equations that describe numbers or relationships.

- A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions~~, and simple rational~~ and exponential functions.* *

*Elements of this standard that are crossed out are not addressed in this unit and will be addressed at a different time.

Transfer:

Students will apply concepts and procedures involving rational exponents and use exponential equations to solve real-world problems in future units.

Ex. Suppose a television costs $450 now. How much would the price increase in eight months with an annual inflation rate of 4.5%?

Ex. A women's regulation-sized basketball is slightly smaller than a men's basketball. Using the volume formula for a sphere, find the radius of a men's and women's basketball given that their volumes are 455 in^3 and 413 in^3 respectfully.

Understandings: *Students will understand …*

- Radical expressions can be written equivalently using rational exponents.
- Properties of integer exponents may be applied to expressions with rational exponents.
- Adding and multiplying two rational numbers results in a rational number.
- The result of adding a rational number and an irrational number is an irrational number.
- The result of multiplying a non-zero rational number to an irrational number is an irrational number.

Essential Questions:

- How can radical expressions and expressions with rational exponents be written in equivalent forms?
- Do the properties of integer exponents apply to rational exponents?
- What type of number results when adding or multiplying two rational numbers?
- What type of number results when adding a rational number to an irrational number?
- What type of number results when multiplying a non-zero rational number to an irrational number?

Mathematical Practices: (Practices to be explicitly emphasized are indicated with an *.)

1. **Make sense of problems and persevere in solving them.**

*2. **Reason abstractly and quantitatively.** Students will use concrete examples of numerical manipulation to examine closure of rational and irrational numbers. For example, students will use numeric examples of sums and products of rational numbers to generalize the closure of rational numbers under addition and multiplication.

3. **Construct viable arguments and critique the reasoning of others.**

*4. **Model with mathematics.** Students will create equations using rational or radical expressions to represent mathematical models of real-world situations like interest rates or depreciation.

5. **Use appropriate tools strategically.**
6. **Attend to precision.**

*7. **Look for and make use of structure.** Students will see the relationship between radical and exponential notation.

*8. **Look for and express regularity in repeated reasoning.** Students will see that they are using the same processes for rational exponents as they used previously with integer exponents.

Prerequisite Skills/Concepts:
Students should already be able to:

- Apply the properties of integer exponents.
- Recognize radical notation.
- Recognize an irrational number.
- Write rational numbers as terminating or repeating decimals.
- Write irrational numbers as non-terminating, non-repeating decimals.
- Solve linear equations.

Advanced Skills/Concepts:
Some students may be ready to:

- Solve equations with radical expressions on both sides, attending to extraneous solutions.
- Explain why the solution to a radical equation may be extraneous.
- Graph functions involving rational exponents, such as $f(x) = x^{\frac{2}{3}}$.
- Use a computer algebra system to investigate patterns with radicals and rational exponents.
- Explore irrational exponents.

Knowledge: *Students will know…*

All standards in this unit go beyond the knowledge level.

Skills: *Students will be able to …*

- Apply the properties of exponents to algebraic expressions with integer exponents.
- Apply the properties of exponents to algebraic expressions with rational exponents.
- Write radical expressions as expressions with rational exponents.
- Write expressions with rational exponents as radical expressions.
- Write an exponential equation or inequality that models a given context.
- Solve an exponential equation or inequality.
- Interpret the solution of an equation or inequality in the context of the problem.

WIDA Standard: (English Language Learners)

English language learners communicate information, ideas and concepts necessary for academic success in the content area of Mathematics.
English language learners benefit from:

- explicit vocabulary instruction with regard to rational and irrational numbers, and their components.
- guided discussion regarding the connections between graphic, tabular, algebraic and language representations of equations and inequalities.

Academic Vocabulary:

Critical Terms:	Supplemental Terms:
Exponent Linear Quadratic Rational Exponential Radical	Real number Rational number Irrational number Integer Sum Product Expression

Assessment

Pre-Assessments	Formative Assessments	Summative Assessments	Self-Assessments
Properties of Exponents Pre-assessment	Check Their Work Rational Expressions (T/F) Operations on Rational and Irrational Jimmy and Joanie Argument		Exit Slip

Sample Lesson Sequence

1. **N-RN.1 & N-RN.2 - Making connections between properties of integer exponents and rational exponents. Rewriting expressions with rational exponents as radical expressions and vice versa. (Model Lesson)**
2. N-RN.3 – Compare and contrast operations involving irrational and rational numbers.
3. A-CED.1 – Applying N-RN.1, 2 and 3 to solving equations involving rational exponents and radical expressions.