Unit 06 (Chpt 5) Rational Exponents and Radical Functions

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 3**
Length: **3-4 weeks**
Status: **Published**

Brief Summary of Unit

Students will work with the family of rational exponent and radical functions. The unit will explore the relationship between rational exponents and radicals, then we will use function operations and composition to create new functions. Students will graph cube root and square root functions using previous translation method knowledge learned in the quadratic functions unit. The concept of extraneous solutions will be covered when rational exponent and radical equations are solved.

Revised Date: June 2024

Standards

ELA.K-12.1	Developing Responsibility for Learning: Cultivating independence, self-reflection, and responsibility for one's own learning.
MATH.9-12.N.RN.A.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.
ELA.K-12.3	Valuing Evidence in Argumentation: Constructing viable claims and evaluating, defending, challenging, and qualifying the arguments of others.
ELA.K-12.4	Building Knowledge: Building strong content knowledge and connecting ideas across disciplines using a variety of text resources and media.
	For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.
MATH.9-12.F.BF.A.1.b	Combine standard function types using arithmetic operations.
MATH.9-12.N.RN.A.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
ELA.K-12.5	Leveraging Technology: Employing technology and digital media thoughtfully, strategically and capably to enhance reading, writing, speaking, listening, and language use.
MATH.9-12.N.RN.A.3	Simplify radicals, including algebraic radicals (e.g., $\sqrt[3]{54} = 3\sqrt[3]{2}$, simplify $\sqrt{32x^2}$).
MATH.9-12.F.BF.A.1.c	Compose functions.
MATH.9-12.F.BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\ f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k(both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.
MATH.9-12.F.BF.B.4	Find inverse functions.

MATH.9-12.F.BF.B.4.a	Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse.
MATH.9-12.F.BF.B.4.b	Verify by composition that one function is the inverse of another.
MATH.9-12.F.BF.B.4.c	Read values of an inverse function from a graph or a table, given that the function has an inverse.
MATH.9-12.F.BF.B.4.d	Produce an invertible function from a non-invertible function by restricting the domain.
MATH.9-12.A.REI.A.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
MATH.9-12.F.IF.C.7.b	Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
TEC.K-12.8.1	All students will use computer applications to gather and organize information and to solve problems.
TEC.K-12.8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world as they relate to the individual society, and the environment.
WORK.K-12.9.1	All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace.
WORK.K-12.9.2	All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace.

Essential Questions

- How can we find the inverse of radical functions?
- How are square root and cube root functions and their graphs similar to linear functions, quadratic functions, and polynomial functions? How are they different?
- How can we solve radical equations?
- How can we use rational exponents to represent a power involving a radical?
- How can we use the properties of exponents to simplify products and quotients of radicals?

Essential Understandings

- Students will understand how inverse functions relate to their parent functions.
- Students will understand the relationship between rational exponents and radicals functions.

Students Will Know

- Students will know how to describe the properties of rational exponents and radicals.
- Students will know how to find compositions and inverses of functions.
- Students will know how to represent roots using rational exponents.
- Students will know how to solve radical equations.

Students Will Be Skilled At

- Students will be skilled at describing transformations of radical functions.
- Students will be skilled at determining whether a pair of functions are inverses.
- Students will be skilled at evaluating a composition of functions.
- Students will be skilled at evaluating an arithmetic combinations of two functions for a given input.
- Students will be skilled at evaluating expressions with rational exponents.
- Students will be skilled at explaining the meaning of a rational exponent.
- Students will be skilled at explaining what inverse functions are.
- Students will be skilled at explaining what it means to perform an arithmetic operation on two functions.
- Students will be skilled at explaining when radical expressions are in simplest form.
- Students will be skilled at finding a composition of functions.
- Students will be skilled at finding inverses of linear and nonlinear functions.
- Students will be skilled at finding the arithmetic combinations of two functions.
- Students will be skilled at graphing radical functions.
- Students will be skilled at identifying extraneous solutions of radical equations.
- Students will be skilled at identifying radical equations.
- Students will be skilled at simplifying radical Expressions with rational exponents.
- Students will be skilled at simplifying variable expressions containing rational exponents and radicals.
- Students will be skilled at solving equations using nth roots.
- Students will be skilled at solving radical equations.
- Students will be skilled at solving real life problems involving radical equations.
- Students will be skilled at stating the domain of an arithmetic combinations of two functions.
- Students will be skilled at writing functions that represent transformations of radical functions.

Evidence/Performance Tasks

Assessments

- Formative: Daily assessments using examples from class notes, NJSLA test bank problems, and/or Albert/AP Classroom assessments
- Summative: Teacher-created assessments, NJSLA test bank problems, Big Ideas Math online platform problems, Albert/AP Classroom and/or Big Ideas Math unit assessments
- Benchmark: IXL or teacher created diagnostic assessments in addition to unit assessments from Big Ideas Math
- Alternative Assessments: Student-centered activities such as scavenger hunts, various projects involving real world applications, and differentiated learning tasks in Khan Academy, DeltaMath, and IXL

- Answer essential questions
- Class discussion of daily topic
- Classwork and homework that assess the essential questions
- Provide alternative means of assessments for certain students
- Teacher Observation
- Tests and quizzes that assess the essential questions
- Written assignments that assess the essential questions that involves providing explanations

Learning Plan

Unit 6 Rational Exponents and Radical Functions (Chapter 5) (3 weeks)

This unit can be split into three mini units, with 3 assessments and a possible comprehensive unit assessment if time allows.

Prior to the start of the unit, rules for exponents should be reviewed. These are standards that are included in Algebra 1 and were included with the summer review. It would be most beneficial if rules of exponents were worked in throughout the year during spiral type review.

5.1: nth roots and Rational Exponents (1 day)

- Discuss nth roots and how many solutions are found when n is even or n is odd.
- Introduce Rational Exponents. Spend time with examples and have students write the same expression in exponential form and radical form. Also stress that in radical form it doesn't matter which is evaluated first, the root or the exponent. Students may be given a list of perfect squares, cubes, fourths and a few fifths to use as a reference during this unit.
- Solve equations by taking the nth root. Remember when n is even, there could be two or zero solutions, but when n is odd, there is only one solution.

5.2: Properties of Rational Exponents and Radicals (3 days instruction, 1 additional day practice)

- Day 1–Properties of Rational Exponents
    - Review properties of exponents using rational exponents. Students should have ample time to practice in class. Give students the list of the properties of exponents and have them refer to it to decide which to use for the given problem.
- Day 2–Simplifying Radical Expressions
    - Product and Quotient Properties

- Discuss when a radical expression is fully simplified.
- Rationalize a denominator when the root is something other than 2.
- Use conjugates to rationalize when a binomial is in the denominator.
- Adding and Subtracting "like" Radicals

- Day 3–Simplifying Variable Expressions
  - Apply previous properties and skills when variables are involved.
  - Students will simplify radicals with variables when the variable has an exponent that is higher than the root.
  - If the root is even, remember to use absolute value (from 5.1) when needed.

Homework should be assigned each day. It is important that students check their homework; find their mistakes. Answers should be supplied. Only trouble HW problems should be reviewed as the class time will be needed for new material and practice.

Review day, then assessment on 5.1 and 5.2

5.3: Graphing Radical Functions (2 days)

- Graphing square and cube roots. Define parent function and its characteristics. Use xy-table to find parent functions. Discuss restrictions on domain.
- Graph transformations of radical functions. Students should remember rules of transformations.
- Reflection over y-axis for cube root is the same as reflection over x-axis. Reflection over y-axis is different than the reflection over the x-axis for square root. Using technology and tables (Desmos) can be efficient with this topic.

5.4: Solving Radical Equations. (2 days)

- Solving radical equations. Solve algebraically and graphically. Using the graphing method can help reinforce why extraneous solutions exist.
- Review factoring, squaring a binomial requires FOIL.
- Check for extraneous solutions.
- Show examples where squaring both sides is required twice.
- Solve equations with Rational Exponents using reciprocals. When the denominator is even, an even

root will be taken. This will result in two solutions.

Assessment on 5.3 and 5.4

5.5 Function Operations (1 day)

- Review definition of a function. Discuss what is and is not a function (this will be useful when learning about inverses).
- Review Adding, Subtracting, Multiplying and Dividing Functions.
- Find the domain of resulting function.
- Evaluate the resulting function.
- Function operations on graphs of f(x) and g(x). Students should see that an equation is not always needed to complete function operations.

5.6: Composition of Functions (1 day)

- Define the new operation, composition.
- Perform composition examples, including "both directions" and composition onto itself–f(f(x)).
- Evaluate composed functions.
- Use graphs of f(x) and g(x) to find compositions.

5.7 Inverse Functions (2 days)

- Discuss definition of inverse functions. Use algebra and graphs to illustrate inverse functions.
- Discuss restricting domain of f(x) so that its inverse will be a function. Introduce the Horizontal Line Test.
- Find inverse of linear, quadratic, cubic and radical functions algebraically.
- Find inverse of given points in a table.
- Find inverse of a given graph by simply reversing x and y and sketching new points.
- Use composition to determine if two functions are inverses of each other.

Function assessment from 5.5, 5.6 and 5.7

If time allows, large assessment on entire unit.

Materials

Core instructional materials:Core Book List including Big Ideas Math Algebra 2 2022

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook and ancillary materials.
- Online programs: Khan Academy, Desmos, Edia, Ed Puzzle, Delta Math
- Teacher created activiites
- Teacher created notes

Suggested Strategies for Modifications

QSAC Accomodations for Algebra 2/Intro to Trig CP