Course: *Algebra II Functions* **Unit #4:** *Radical Functions*	**Year of Implementation:** 2024-2025

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Stage One - Desired Results

Link(s) to New Jersey Student Learning Standards for this course:
{provide all applicable links to standards here}
https://www.state.nj.us/education/cccs/2020/

- **Unit Standards:** *(keep each of the following headings in place)*

Content Standards

The Real Number System A-RN

A. Extend the properties of exponents to rational exponents.

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.
2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.
3. Simplify radicals, including algebraic radicals

Seeing Structure in Expressions A-SSE

A. 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

Reasoning with Equations and Inequalities A-REI

A. Understand solving equations as a process of reasoning and explain the reasoning

1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

D. Represent and solve equations and inequalities graphically

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

Interpreting Functions F-IF

B. Interpret functions that arise in applications in terms of the context

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship

5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

C. Analyze functions using different representations

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases

b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

21st Century Life & Career Standards

All curriculum writers/revisionists need to include standards that apply to "Career Readiness, Life Literacies, and Key Skills". This should include a brief description of the standard and the standard number. Document only those standards and practices that apply to each unit. Use the following link to assist you [see pages of 31-36; 41-42; 53-56 for specific standard #'s and strands]

https://www.state.nj.us/education/cccs/2020/2020%20NJSLS-CLKS.pdf

- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3)
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)

- 9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).

Interdisciplinary Content Standards

- SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with peers on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- SL.11-12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
- L.11-12.6. Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

NJ Statutes: NJ State law mandates the inclusion of the following topics in lesson design and instruction as aligned to elementary and secondary curriculum.

Amistad Law: N.J.S.A. 18A 52:16A-88 Every board of education shall incorporate the information regarding the contributions of African-Americans to our country in an appropriate place in the curriculum of elementary and secondary school students.

Holocaust Law: N.J.S.A. 18A:35-28 Every board of education shall include instruction on the Holocaust and genocides in an appropriate place in the curriculum of all elementary and secondary school pupils. The instruction shall further emphasize the personal responsibility that each citizen bears to fight racism and hatred whenever and wherever it happens.

LGBT and Disabilities Law: N.J.S.A. 18A:35-4.35 A board of education shall include instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum of middle school and high school students as part of the district's implementation of the New Jersey Student Learning Standards (N.J.S.A.18A:35-4.36) A board of education shall

have policies and procedures in place pertaining to the selection of instructional materials to implement the requirements of N.J.S.A. 18A:35-4.35.

Diversity and Inclusion (N.J.S.A. 18A:35-4.36a) A board of education shall incorporate instruction on diversity and inclusion in an appropriate place in the curriculum of students in grades kindergarten through 12 as part of the district's implementation of the New Jersey Student Learning Standards.

Asian American and Pacific Islanders (AAPI) P.L.2021, c.410 Ensures that the contributions, history, and heritage of Asian Americans and Pacific Islanders (AAPI) are included in the New Jersey Student Learning Standards (NJSLS) for Social Studies in kindergarten through Grade 12 (P.L.2021, c.416)

For additional information, see

NJ Amistad Curriculum: ***https://www.nj.gov/education/amistad/about/***

Diversity and Inclusion: ***https://www.nj.gov/education/standards/dei/index.shtml***

- *(Sample Activities/ Lessons):* ***https://www.nj.gov/education/standards/dei/samples/index.shtml***

Asian American and Pacific Islanders:

- ***Asian American and Pacific Islander Heritage and History in the U.S.***
  A Teacher's Guide from EDSITEment offering a collection of lessons and resources for K-12 social studies, literature and arts classrooms that center around the experiences, achievements and perspectives of Asian Americans and Pacific Islanders across U.S. history.

Transfer Goal: Students will be able to independently use their learning to verify a solution in the context of a given situation.

As aligned with LRHSD Long Term Learning Goal(s):https://www.lrhsd.org/Page/6163

Critical Thinking: construct and effectively communicate valid conclusions and critique the reasoning of others

Precision: determine an answer's appropriateness as a means of determining its validity, while using proper mathematical notation and units

Enduring Understandings	*Essential Questions*

Students will understand that. . . *EU 1* changing the exponent of a function affects its possible solutions.	Why are some solutions restricted in the context of real world phenomena?
<u>Knowledge</u> *Students will know . . .* *EU 1* ● radical expressions can be simplified through addition, subtraction, multiplication and division. (A.RN.A.3) ● radical expressions can be simplified using the properties of exponents (A.RN.A.2) ● increasing the degree of a function will increase the likelihood of extraneous solutions. (A.REI.A.2) ● key features of the graphs of radical functions. (F.IF.C.7.b)	*<u>Skills</u>* *Students will be able to. . .* *EU 1* ● simplify radical expressions through addition, subtraction, multiplication and division. (A.RN.A.3) ● rewrite and simplify expressions involving rational exponents and radicals (A.RN.A.2) ● solve radical equations by raising both sides of the equation to a power. (A.REI. A. 1,2) ● identify solutions and eliminate extraneous solutions to radical equations. (A.REI. A, D) ● graph square root and cube root functions. (F.IF.C.7,9)
Stage Two - Assessment	

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Stage Three - Instruction

Learning Plan: **Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.** *{place A, M and/or T along with the applicable EU number in parentheses after each statement} All knowledge and skills must be addressed in this section with a corresponding lesson/activity which teaches each concept. The following color codes are used to notate activities that correspond with interdisciplinary connections and 21st Century Life & Career Connections (which involves Technology Literacy): Red = Interdisciplinary Connection; Purple = 21st Century Life & Career Connection*

- Activity #1 - Simplifying Higher Degree Roots Battleship (T, EU 1)
  new doc 2023-08-26 11.09.02.pdf

- Activity #2 - Matching Radical Form and Rational Exponential Form Expressions (A, EU 1): Have students get into groups of two. Each group receives 14 total cards. Cards will be in pairs of equivalent radical and exponential forms. All 14 cards are placed face down and students will match radical form with equivalent exponential form

- Activity #3 - Desmos Activity Solving Radical Equations (A, M, EU 1)
  https://teacher.desmos.com/activitybuilder/custom/5f9c4c51e35a712c5726ee37?collections=5f04db439d4c403e8035f933

- Activity #4 - Extraneous Solution Discovery Activity (T, EU 1)
  https://docs.google.com/document/d/1HFRfEk0REJUcaHJ3Ph-YW4KYOqATSG-A/edit?usp=sharing&ouid=116556149573535627307&rtpof=true&sd=true

- Activity #5 - Solving Radical Equations Marathon Activity (M, T, EU 1)
  https://mathleaks.com/study/Slide:A2_U3_C5_Example3

- Activity #6 - Desmos Activity Graphing Square Root and Cube Root Functions (A, M, EU 1)
  https://teacher.desmos.com/activitybuilder/custom/60538dc5a332113aff4a1f76?collections=5cd642c610c1b16bfb7454c9

Suggested Sequence of Learning Activities:
- Simplify Radical Expressions (Square roots and higher degree roots with integers and variables) (A, EU 1)
- Operations with Radical Expressions (add, subtract, multiply, divide) (A, EU 1)

- Activity #1 outlined above: Simplify Higher Degree Roots Battleship Activity (T, EU 1)
- Rewrite Expressions in Radical and Rational Exponential Form (A, EU 1)
- Simplify and Perform Operations with Rational Exponent Expressions (A, EU 1)
- Activity #2 outlined above: Matching Radical Form and Rational Exponential Form Expressions Activity (A, EU 1)
- Activity #3 outlined above: Solving Radical Equations (Radicals on one side of equation) (A, EU1)
- Activity #4 outlined above: Extraneous Solution Discovery Activity (M, T, EU1)
- Solving Radical Equations (Radicals on both sides of equation) (A, M, EU1)
- Activity #5 outlined above: Solving Radical Equations Marathon Activity (M, T, EU1)
- Solving Equations with Rational Exponents (A, EU1)
- Activity #6 outlined above: Desmos Activity Graphing Square Root and Cube Root Functions (A, M, T, EU1)
- Graph Square Root and Cube Root Functions (A, EU1)

Critical Vocabulary:

Index	Extraneous Solution	Nth root
Power	Radical equation	Radical function
Radicand	Rational exponent	Rationalizing the denominator
Root		

Pacing Guide

{This chart will be identical in all of the units for this course.}

Unit #	*Title of Unit*	*Approximate # of teaching days*
1	Unit 1 Quadratic Functions	30
2	Unit 2 Polynomial Functions	18
3	Unit 3 Exponential & Logarithmic Functions	18
4	Unit 4 Radical Functions	18
5	Unit 5 Rational Functions	18
6	Unit 6 Functions	14
7	Unit 7 Statistics & Probability	18

Instructional Materials

TInSpire Calculator
DESMOS online graphing calculator and activities
Khan Academy
Kuta Infinite Software

Accommodations

Special Education: The curriculum will be modified as per the Individualized Education Plan (IEP). Students will be accommodated based on specific accommodations listed in the IEP.
Students with 504 Plans: Students will be accommodated based on specific accommodations listed in the 504 Plan.
English Language Learners: Students will be accommodated based on individual need and in consultation with the ELL teacher.
Students at Risk of School Failure: Students will be accommodated based on individual need and provided various structural supports through their school.
Gifted and Talented Students: Students will be challenged to enhance their knowledge and skills through acceleration and additional independent research on the subject matter.