Course: *Algebra II Functions* **Unit #5:** *Rational 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***

Arithmetic with Polynomial and Rational Expressions A-APR

D. 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.

Reasoning with Equations and Inequalities A-REI

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

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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.

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.

d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

Building Functions F-BF

B. Build new functions from existing functions

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. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

- ***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 analyze, model, and show relationships between two variables in the real world.

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

Modeling: demonstrate mastery of concepts by evaluating models that others have constructed or by creating appropriate models of their own

Enduring Understandings Students will understand that. . . EU1 ● the characteristics and solutions of rational functions are essential when interpreting real world problems.	*Essential Questions* Why are domain restrictions and the simplification of mathematical expressions necessary for rational functions?
Knowledge *Students will know . . .* *EU 1* ● basic operations with fractions can be applied to algebraic rational expressions. (A-APR D) ● the properties of solving polynomial functions can be extended to include rational functions. (A-REI A2) ● restrictions on a rational function coincide with the extraneous solutions. (A-REI A2, F-IF B) ● key characteristics of rational graphs (Asymptotes, Discontinuities, x and y intercepts). (F-IF B&C, F-BF B)	*Skills* *Students will be able to. . .* *EU 1* ● add, subtract, multiply and divide rational expressions, both simple and complex. (A-APR D) ● state restrictions on the variable in a rational expression. (F-IF B) ● solve rational equations and identify any extraneous solutions. (A-REI A,D) ● recognize solutions that are extraneous. (A-REI A,D) ● sketch rational graphs using graphing technology. (F-IF B&C, F-BF B)
Stage Two - Assessment	
●	
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 - Rational Expressions Stack Activity (simplifying and operations). Working in groups, students have 10 cards. The front has answers and the back has questions. Students flip the first card over, simplify or perform the indicated operation, and find the answer on another card. They then flip that card over and start the same process. All 10 cards will be flipped over by the end of the activity. (A, EU1)

- Activity #2 - Applications of Rational Functions (YouTube video and class discussion) (M, T, EU 1)
  https://youtu.be/gAwydISd4Vo?si=0wu4QyraggminRQv

- Activity #3 - Desmos (Rational Functions - Asymptotes & Holes) (A, M, EU 1)
  https://teacher.desmos.com/activitybuilder/custom/621b967b94c9bd34fdef3d6a

- Activity #4 - Desmos Marbleslide Activity (M, T EU1)
  https://teacher.desmos.com/activitybuilder/custom/566b31794e38e1e21a10aae8?collections=featured-collections%2C5e73b3a1bb8b0c7628d2809c

- Activity #5 - Write a rational function with given restrictions (M, T EU 1)
  https://mathequalslove.net/end-behavior-of-rational-functions-stations-activity/

- Activity #6 - Calc-Medic Anesthesia Activity (M, T, EU1)
  https://www.calc-medic.com/precalc-unit-2-day-11

Suggested Sequence of Learning Activities:

- Simplify Rational Expressions (A, EU 1)
- Perform Operations with Rational Expressions (Add, Subtract, Multiply, and Divide) (A, EU1)
- Activity #1 outlined above: Rational Expressions Card Stack Activity (A, EU1)
- Simplify Complex Fractions (A, EU1)
- Solve Rational Equations (Include Extraneous Solutions) (A, EU1)
- Activity #2 outlined above: Applications of Rational Functions (M, T, EU 1)

- Graph Rational Functions and Identify Key Components (Vertical Asymptote, Horizontal Asymptote, Slant Asymptote, Holes, X-intercepts, and Y-intercepts) (A, EU1)
- Activity #3 outlined above: Desmos (Rational Functions - Asymptotes & Holes) (A, M, EU 1)
- Activity #4 outlined above: Desmos Marbleslide Activity (M, T EU1)
- Activity #5 outlined above: Write a rational function with given restrictions (M, T EU 1)
- Activity #6 outlined above: Calc-Medic Anesthesia Activity (M, T, EU1)

Critical Vocabulary:

Asymptote	Complex Fractions	Denominator
Extraneous Solutions	Factor	Least Common Denominator
Numerator	Polynomial	Proportion
Rational Expression	Rational Equation	Reciprocal

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.