Unit 04: Rational Functions

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 2**
Length: **2-3 weeks**
Status: **Published**

Brief Summary of Unit

Students will review the four operations with rational functions and utilize asymptotes and charts of values to graph them. Students will also explore techniques to solve rational equations and discuss extraneous solutions.

Revised Date: July 2025

Standards

ELA.L.SS.11–12.1	Demonstrate command of the system and structure of the English language when writing or speaking.
ELA.L.VL.11–12.3	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, including technical meanings, choosing flexibly from a range of strategies.
MATH.9-12.A.APR.D.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.
MATH.9-12.A.APR.D.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.
MATH.9-12.F.IF.B.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.
MATH.9-12.F.IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MATH.9-12.F.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
MATH.9-12.F.IF.C.7.d	Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
MATH.9-12.A.REI.D.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).
MATH.9-12.A.SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
MATH.9-12.A.SSE.A.1.a	Interpret parts of an expression, such as terms, factors, and coefficients.

MATH.9-12.A.SSE.A.1.b	Interpret complicated expressions by viewing one or more of their parts as a single entity.
MATH.9-12.A.SSE.A.2	Use the structure of an expression to identify ways to rewrite it.
SCI.HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
WRK.9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.
WRK.9.2.12.CAP.13	Analyze how the economic, social, and political conditions of a time period can affect the labor market.
TECH.9.4.2.CI.2	Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).
TECH.9.4.2.CT.2	Identify possible approaches and resources to execute a plan (e.g., 1.2.2.CR1b, 8.2.2.ED.3).

Essential Questions

- How are rational expressions simplified?
- How are these simplification techniques applied to solve rational equations and graph rational functions?

Enduring Understandings

- A horizontal asymptote may be crossed by a rational function, but a rational function will never intersect a vertical asymptote.
- Rational equations contain extraneous solution(s) based on the domain of the individual rational functions involved.
- A common denominator is needed whenever two rational functions are added or subtracted.
- Distribution of a negative sign is important when subtracting two rational expressions.
- When dividing by a rational function, one must multiply by its reciprocal.

Students Will Know

- The effect of asymptotes on graphs of rational functions.
- How to find a common denominator and its uses in addition and subtraction of rational expressions.
- The process of dividing and multiplying rational expressions.
- The proper steps that are needed to solve rational equations.

Students Will Be Skilled At

- Applying basic algebraic operations on rational expressions.
- Identifying how asymptotes effect the graph of a rational function.
- Solving rational functions, with one rational on each side or two rationals on one side.

Assessment

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

- Class discussion of daily topic
- Classwork and homework that assess the essential questions
- Provide alternative means of assessments for certain students
- Take tests and quizzes that will assess the essential questions, including pre-assessments.
- Teacher Observation

Learning Plan

The following list is meant to create a day-to-day plan. Teachers are encouraged to slow down or condense days as appropriate to the student population in the class. Assessment(s) should be given when appropriate.

- Introduce multiplying rational expressions, and how to eliminate common factors to simplify the expression. When using factoring, be sure to include various types of factoring methods known to the students.
- Expand these skills to dividing rational expressions. Continue to use various factoring methods. This should also include multiple methods at the same time (for example: both GCF and difference of squares).
- Recall that to add/subtract fractions, a common denominator is required. Expand this into rational expressions. Be careful to distribute the negative sign when subtracting two numerators. Then simplify the rational expression.
- Combine adding/subtracting and dividing skills by simplifying complex fractions.
- Identify how to find a restriction (extraneous solution) of a rational equation, then solve the equation for all valid solutions.
- Identify any holes or asymptotes for a rational function. Explore all cases of horizontal asymptotes. (For advanced students: introduce the topic of slant asymptotes using synthetic division.)
- Plot those attributes on a graph as well as points for the function. Students may recognize some transformation information from Unit 2 on the simpler problems.

Graphing calculators are encouraged to be used as an extension of these topics.

Materials

Core instructional materials: Core Book List including PreCalculus Enhanced with Graphing Utilities, Sullivan, Savvas

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy
- Teacher created activiites
- Teacher created notes
- Whiteboard tables

Integrated Accommodation & Modifications

Possible accommodations/modification for CP PreCalc & Trig