Unit 2 Limits and Continuity

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 1**
Length: **5 weeks**
Status: **Published**

Brief Summary of Unit

Students will study the limits and continuity of a function algebraically and graphically. The limit of a function is the value the function approaches from both the left and right side. If a graph is continuous at a point, then the graph has a limit at the point. Continuity of a function implies there are no breaks in the graph of the function. Students will learn how asymptotes affect the limit of a function.

Revised Date: July 2025

Standards

MATH.K-12.1	Make sense of problems and persevere in solving them
MATH.K-12.2	Reason abstractly and quantitatively
MATH.K-12.3	Construct viable arguments and critique the reasoning of others
MATH.K-12.4	Model with mathematics
MATH.K-12.5	Use appropriate tools strategically
MATH.K-12.6	Attend to precision
MATH.K-12.7	Look for and make use of structure
MATH.K-12.8	Look for and express regularity in repeated reasoning
LA.K-12.NJSLSA.L4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
LA.K-12.NJSLSA.L5	Demonstrate understanding of word relationships and nuances in word meanings.
CS.9-12.8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
CS.K-12.3.a	Identify complex, interdisciplinary, real-world problems that can be solved computationally.
CS.K-12.3.b	Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures.
CS.K-12.3.c	Evaluate whether it is appropriate and feasible to solve a problem computationally.
MA.9-12.I.A	Analysis of graphs
MA.9-12.I.B.1	An intuitive understanding of the limiting process
MA.9-12.I.B.2	Calculating limits using algebra

MA.9-12.I.B.3	Estimating limits from graphs or tables of data
MA.9-12.I.C.1	Understanding asymptotes in terms of graphical behavior
MA.9-12.I.C.2	Describing asymptotic behavior in terms of limits involving infinity
MA.9-12.I.D.1	An intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain.)
MA.9-12.I.D.2	Understanding continuity in terms of limits
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.6	Identify transferable skills in career choices and design alternative career plans based on those skills.

Essential Questions

- How are limits and continuity related to each other?
- How are limits estimated from tables of data?
- How are limits estimated graphically?
- How are limits evaluated algebraically?
- How are limits related to vertical asymptotes and horizontal asymptotes?
- How can the limit of f(x) as x approaches c exist if f(c) is undefined?
- How do asymptotes effect the graphical behavior of a function?
- How does continuity of a function effect data analysis?
- What can be determined if a left sided and right sided limit are the same? What is determined if they are different?
- What does a limit represent? Do limits exist for all functions? Do limits exist at all points of a function?

Enduring Understandings

- A discontinuity of a function may be a removable hole, non-removable jump or a non-removable vertical asymptote.
- A polynomial function is continuous for all real numbers.
- A rational function is continuous for its domain.
- The limit exists for all points of a polynomial function.
- The limit of a function is the value that the graph approaches from both left and right side as x approaches c.

Students Will Know

- The algebraic methods to solve limits including the simplification method (factor/cancel), common denominator, conjugates and table method.
- The connection between continuity and limits of a function.
- The difference between the value of a function at a value and the limit of a function at a value of x.

- The formal definition of a limit.
- The graphical properties of a continuous function.
- The notation for a two sided limit as well as a one sided limit.
- The properties of polynomial and non-polynomial functions.

Students Will Be Skilled At

- Creating graphs of a function given verbal description of the functions limit and continuity.
- Defining continuity in terms of limits.
- Discussing the limit and continuity of a piece wise function.
- Evaluating limits from a table of values.
- Evaluating limits using an algebraic process.
- Evaluating limits using graphical anyalsis.
- Investigating the asymptotic behavior of a function in terms of limits involving infinity.

Assessment

Assessments

- Formative: Daily assessments using examples from class notes, observation of student work on problems in class, student group work
- Summative: Teacher-created assessments
- Alternative Assessments: Differentiated learning tasks in Khan Academy Edia, and/or DeltaMath

- Answer essential questions.
- Class discussion of daily topic.
- Classwork and homework that assess the essential questions.
- Graded Do Now assessments that reflect student understanding of class notes and homework.
- 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

A graphing calculator will be utilized throughout the unit. Students will use the table feature, value feature and zero feature throughout the unit. Students need to be made aware of the limitations of the graphing calculator (the calculator will not show holes visually on the graph, but a blank value will show when using the value feature of the calculator).

5 weeks will be about 20 classes on the rotate drop schedule. Fifteen classes are accounted for below with

some time left for weeks that only have 3 class meetings as well as some extra days for larger assessments.

- Introduction to Limits **(Day 1)**
    - Introduce the concept of a limit in a real-world context.
    - Introduce the formal definition of a limit
    - Introduce the notation for a limit.
- Evaluating Limits **(8 Classes)**
    - Evaluate limits graphically. **(Start on Day 1)**
    - Evaluate limits from a table of values.
    - Evaluate limits algebraically.
        - Factor and cancel
        - Common denominator
        - Using conjugates
    - Incorporate a graphing calculator/Desmos for all methods.
    - Include examples that highlight the difference between evaluating a function for a given value of x verses evaluating a limit as x approaches that values.
        - Holes
        - Asymptotes
    - Include a variety of function types including piece-wise functions.
    - Discuss one-sided limits and proper notation.
- Continuity **(3 Classes)**
    - Define what it means for a function to be continuous in terms of limits.
    - Classify discontinuities as removable or non-removable.
    - Examine a variety of functions including piece-wise functions.
- Discuss how to sketch a function meeting provided criteria. **(3 Classes)**
    - Example: "Sketch a function where the limit exists for all values of x and the function is defined for all values of x with at least one removable discontinuity."

Materials

Core Book List including Calculus Larson 12E

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy
- Teacher created activiites - graphing calculator activites
- Teacher created notes

Integrated Accommodation & Modifications

Possible accommodations/modification for CP Calculus