Intro to Calculus - Unit A - Rebuilding the Prerequisite Skills for Calculus

Unit Focus

This course is not meant to take the place of AB Calculus or Calculus I but meant to be an introduction to the basic conceptual foundations of differentiation and integration and the algebraic applications used in formulaic differentiation and integration. Major concepts taught are differentiation (Chain rule and implicit application, curve sketching and related rates) and integration (substitution, application, simple initial value problems).

Even though this is an introductory course, students will be required to use specific, correct notation in all written work. Limit notation, parentheses, etc, if left out, completely change the meaning of the written expression.

The initial unit serves as a summarized review of the concepts taught in PreCalculus which are a prerequisite to the study of differentiation and integration in calculus. Students may spend up to 25% of the course time in this unit. Students are encouraged to work in groups to help each other as needed to strengthen skills and understanding.

Stage 1: Desired Results - Key Understandings

Standard(s)

Common Core
Mathematics: 9-12

- Define appropriate quantities for the purpose of descriptive modeling. (CCSS.MATH.CONTENT.HSN.Q.A.2)
- Interpret expressions that represent a quantity in terms of its context. (CCSS.MATH.CONTENT.HSA.SSE.A.1)
- Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$. (CCSS.MATH.CONTENT.HSA.SSE.A.2)
- Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial. (CCSS.MATH.CONTENT.HSA.APR.B.3)
- 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). (CCSS.MATH.CONTENT.HSA.REI.D.10)
- Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.* (CCSS.MATH.CONTENT.HSA.REI.D.11)
- Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. (CCSS.MATH.CONTENT.HSF.IF.A.2)

Transfer

Students will be able to independently use their learning to...
T1 manipulate equations/expressions or objects to create order and establish relationships.
T2 draw conclusions about graphs, shapes, equations, or objects.

Meaning

Understanding(s)	Essential Question(s)
Students will understand that... **U1** Mathematicians flexibly use different tools, strategies, and operations to build conceptual knowledge or solve problems. **U2** Mathematicians identify relevant tools, strategies, relationships, and/or information in order to draw conclusions. **U3** Mathematicians use models to represent and make meaning of quantitative relationships.	*Students will keep considering...* **Q1** What does the solution tell me? **Q2** What math tools/models/ strategies can I use to solve the problem?

Acquisition of Knowledge and Skill

Knowledge	Skill(s)
Students will know... **K1** the distance formula and its geometric application	*Students will be skilled at...* **S1** solving linear, absolute value and rational equations

Stage 1: Desired Results - Key Understandings

- 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. (CCSS.MATH.CONTENT.HSF.IF.B.4)
- Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. (CCSS.MATH.CONTENT.HSF.IF.B.6)
- Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. (CCSS.MATH.CONTENT.HSF.IF.C.7.C)
- Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. (CCSS.MATH.CONTENT.HSF.IF.C.7.D)
- Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. (CCSS.MATH.CONTENT.HSF.IF.C.7.E)
- Compose functions. (CCSS.MATH.CONTENT.HSF.BF.A.1.C)
- 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. (CCSS.MATH.CONTENT.HSF.BF.B.3)
- Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. (CCSS.MATH.CONTENT.HSF.BF.B.5)

- Reason abstractly and quantitatively. (CCSS.MATH.MP.2)
- Construct viable arguments and critique the reasoning of others. (CCSS.MATH.MP.3)
- Model with mathematics. (CCSS.MATH.MP.4)
- Attend to precision. (CCSS.MATH.MP.6)
- Look for and make use of structure. (CCSS.MATH.MP.7)

Madison Public Schools Profile of a Graduate

- Analyzing: Examining information/data/ evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)
- Collective Intelligence: Working respectfully and responsibly with others, exchanging and evaluating ideas to achieve a common objective. (POG.3.1)

K2 the slope formula geometric application
K3 three forms of a linear equation
K4 the relationship between roots and x intercepts of an equation
K5 what constitutes a 'complete' graph sketch (relative max, min, asymptotes, intercepts)
K6 the relationship between the six trigonometric functions
K7 amplitude and period
K8 pythagorean double angle identities
K9 sum and difference identities
K10 rules of exponents and logs
K11 how to convert between exponential and log expressions
K12 Vocabulary: parallel, perpendicular, composite functions, length of a curve, limit of a sequence

S2 solving linear, absolute value and rational inequalities and express their solutions both algebraically and graphically
S3 graphing a line in any form on a coordinate plane
S4 finding the equation of any line given specific information about the line
S5 finding the domain of any polynomial, rational or radical equation
S6 finding a reasonable window for and sketch any polynomial or rational function
S7 determining intercepts or local local extrema of the graph
S8 solving equations on the calculator
S9 solving a polynomial equations by factoring
S10 sketching the graph of any of the six basic trig functions
S11 sketching sine and cosine graphs using transformations
S12 solving trig equations using identities
S13 simplifying exponential and logarithmic expressions
S14 solving exponential and logarithmic equations
S15 determining and simplifying the composition of 2 functions and the resulting domain.
S16 applying transformations to a given parent function
S17 estimating the length of a curve using increasing numbers of line segments
S18 determining the limit of a sequence