SECTION FIVE: Draft High School Functions

5A: Core Function Focus

The standards listed in this table name the priority instructional content for high school functions (HSF). The right-hand column contains draft focus content that would be core content for all students in a student's first two credits after K-8 mathematics. Specific modeling standards are indicated by a star symbol (★).

HSF.IF – Interpreting Functions

Standard	Standard Statements (Jan 2021 Draft)
HSF.IF.A.1	Understand a function as a rule that assigns a unique output for every input and that functions model situations where one quantity determines another. Integrated with Standard(s): HSF.IF.A.2
HSF.IF.A.2	Use function notation and interpret statements that use function notation in terms of the context and the relationship it describes. Integrated with Standard(s): HSF.IF.A.1
HSF.IF.B.4	Interpret key features of functions, from multiple representations, and conversely predict features of functions from knowledge of context. (★) Integrated with Standard(s): HSF.IF.A.1, HSF.IF.A.2
HSF.IF.B.5	Relate the domain of a function to its graph and to its context. (★)
HSF.IF.B.6	Calculate and interpret the average rate of change of a function over a specified interval. (★)
HSF.IF.C.7	Graph functions to show key features. (★)
HSF.IF.C.9	Compare properties of two functions using multiple representations. (★)

HSF.BF – Building Functions

Standard	Standard Statements (Jan 2021 Draft)
HSF.BF.A.2	Model situations involving arithmetic and geometric sequences. Use a variety of representations including an explicit formula for the sequence, and translate between the forms. (★)
HSF.BF.B.3	Identify and interpret the effect on the graph of a function when the equation has been transformed.

HSF.LE – Linear, Quadratic, & Exponential Models

Standard	Standard Statements (Jan 2021 Draft)
HSF.LE.A.1	Explain why a situation can be modeled with a linear function, an exponential function, or neither. (★) Explanations should connect to the reasoning required in HSF.LE.A.1a

5B: Remaining Function Considerations

The concepts listed in this table represent remaining content that is often taught in high school but should only be attended to if students demonstrate proficiency in priority content. The right-hand column contains considerations where this content could be included, integrated, or excluded as well as reference standards for the identified remaining concepts.

Concept	Core Alignment Consideration (January 2021 Draft)
Quadratic Functions	**Combine** lessons on quadratic functions with the study of expressions, equations, and functions in support of math modeling applications. **Eliminate** use of paper and pencil methods (e.g. quadratic formula, factoring trinomials, completing the square) in the first two credit courses, and possible **reduced** use in third credit courses as applicable for an advanced algebra course. Reference Standard(s): HSA.REI.B.4
Inverse Functions	**Eliminate** lessons on inverse functions in the first three credit courses with possible inclusion in fourth credit courses such as pre-calculus. Reference Standard(s): HSF.BF.B.4
Interpret expressions for functions	**Integrate** lessons on interpreting the parameters for functions in context of modeling applications only. Reference Standard(s): HSF.LE.B.5
Trigonometric Functions	**Limit** lessons to applications using right triangle trigonometry using appropriate technology in first two credits. Possible reduced emphasis of additional trigonometric applications in third and fourth credit courses as applicable for advanced algebra options. Reference Standard(s): HSF.TF
Unit Circle, Periodic Functions	**Eliminate** lessons in the first two credit courses. **Limit** emphasis of periodic behavior within third or fourth credit courses as applicable for advanced algebra options. Reference Standard(s): HSF.TF.B.5, HSF.TF.A.1, HSF.TF.A.2
Trigonometric Identities	**Eliminate** lessons in the first two credits and **limited** emphasis in a third or fourth credit option. Reference Standard(s): HSF.TF.C.8

5C: High School Functions Crosswalk with Clarifying Guidance

CLUSTER: HSF.IF – Interpreting Functions

STANDARD: HSF.IF.A.1

DRAFT Standards Statement (JAN 2021):

Understand a function as a rule that assigns a unique output for every input and that functions model situations where one quantity determines another.

DRAFT Clarifying Guidance (JAN 2021):

Functions are often represented by tables, expressions or graphs. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range.

Modeling examples should include both contexts where only one quantity can be considered the independent variable as well as contexts where both quantities could.

MP

MP4: Mathematical Modeling

Original CCSS Text (2010):

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

STANDARD: HSF.IF.A.2

Original CCSS Text (2010):

Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

DRAFT Standards Statement (JAN 2021):

Use function notation and interpret statements that use function notation in terms of the context and the relationship it describes.

DRAFT Clarifying Guidance (JAN 2021):

MP

MP4: mathematical modeling

STANDARD: HSF.IF.B.4

DRAFT Standards Statement (JAN 2021):

Interpret key features of functions, from multiple representations, and conversely predict features of functions from knowledge of context. (★)

DRAFT Clarifying Guidance (JAN 2021):

Key features include: domain, range, discrete, continuous, intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums. Representations include: graphs, tables, spreadsheet representations, as well as symbolic.

MP

MP4: mathematical modeling

MP7: using structure

Original CCSS Text (2010):

*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.**

STANDARD: HSF.IF.B.5

DRAFT Standards Statement (JAN 2021):

Relate the domain of a function to its graph and to its context.

DRAFT Clarifying Guidance (JAN 2021):

Contexts can demand discrete vs. continuous and domain restrictions.

MP

MP4: mathematical model

MP6: precision

Original CCSS Text (2010):

*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.**

STANDARD: HSF.IF.B.6

DRAFT Standards Statement (JAN 2021):

Calculate and interpret the average rate of change of a function over a specified interval.

DRAFT Clarifying Guidance (JAN 2021):

Work with functions presented as graphs, tables or symbolically.

Students should choose intervals for analysis of functions with substantially varying rates of change.

MP

MP6: precision

MP7: structural thinking

Original CCSS Text (2010):

*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.**

STANDARD: HSF.IF.C.7

DRAFT Standards Statement (JAN 2021):

Graph functions to show key features.

DRAFT Clarifying Guidance (JAN 2021):

Use technology to graph functions expressed symbolically or in tables, with intentional choices of window and scale. Graph functions by hand in simple cases or for approximations.

Key features include: specific values when context demands; domain and range; discrete or continuous; intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maxima and minima.

MP

MP4: mathematical modeling

MP5: using graphing technology

Original CCSS Text (2010):

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

HSF.IF.C.7.A	*Graph linear and quadratic functions and show intercepts, maxima, and minima.*
HSF.IF.C.7.B	*Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.*
HSF.IF.C.7.C	*Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.*
HSF.IF.C.7.D	*(+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.*
HSF.IF.C.7.E	*Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.*

STANDARD: HSF.IF.C.9

DRAFT Standards Statement (JAN 2021):

Compare properties of two functions using multiple representations.

DRAFT Clarifying Guidance (JAN 2021):

Functions can be represented algebraically, graphically, numerically in tables, or by verbal descriptions.

Original CCSS Text (2010):

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

CLUSTER: HSF.BF – Building Functions

STANDARD: HSF.BF.A.2

DRAFT Standards Statement (JAN 2021):

Model situations involving arithmetic and geometric sequences. Use a variety of representations including an explicit formula for the sequence, and translate between the forms.*

DRAFT Clarifying Guidance (JAN 2021):

MP

MP2: quantitative and abstract reasoning

MP4: mathematical modeling

Original CCSS Text (2010):

*Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.**

STANDARD: HSF.BF.B.3

DRAFT Standards Statement (JAN 2021):

Identify and interpret the effect on the graph of a function when the equation has been transformed.

DRAFT Clarifying Guidance (JAN 2021):

Transformations include translations (f(x)+k, and f(x-h)), reflections (e.g. -f(x) and f(-x), and dilations (e.g. a*f(x)). Interpretations include accounting for different choices of variables, such as initial values or units.

Full proficiency with linear functions and developing proficiency with exponential functions is expected. Technology provides opportunities for exploration with other functions.

MP4: mathematical modeling

MP5: using graphing technology

Original CCSS Text (2010):

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.

CLUSTER: HSF.LE – Linear, Quadratic, & Exponential Models

STANDARD: HSF.LE.A.1

DRAFT Standards Statement (JAN 2021):

Explain why a situation can be modeled with a linear function, an exponential function, or neither.

DRAFT Clarifying Guidance (JAN 2021):

MP

MP4: Mathematical Modeling

Original CCSS Text (2010):

Distinguish between situations that can be modeled with linear functions and with exponential functions.

HSF.LE.A.1.A *Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.*

HSF.LE.A.1.B *Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.*

HSF.LE.A.1.C *Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.*