Transitional Math Syllabus

STEM Pathway

Course Information

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| Course Name | STEM |
| Course Pathway | High School Transitional Math – STEM |
| ISBE SIS Code | 02055A001 |
| Portability Code | TM001 |
| Course Duration | 1 Year |

Contact Information

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| School Name | Hamilton County Senior High |
| Community College Name | Rend Lake College |

Course Description

Math course framework built around essential algebraic competencies designed to prepare students for college and career pathways in areas such as: Science, Technology, Engineering, and Math or STEM which require advanced algebraic skills or calculus. Course design will enable students to transition directly into credit bearing college-level algebra courses. Students will engage in deepening conceptual understanding using algebra and mathematical applications of algebra and functions and how functions naturally arise using authentic modeling situations. The function families (linear, polynomial, rational, radical, and exponential) will be emphasized. Additionally, the course shall emphasize the eight mathematical practices, particularly modeling within the setting of authentic and contextualized applications, and upon completion, the student should be able to: demonstrate and justify both orally and in writing conceptual understanding of functions combined with advanced algebraic knowledge to solve complex, contextualized, multi-step problems in authentic settings.

Evaluation

The grading scale for the course is as follows:

A 90% (or higher)

B 80% (or higher)

C 70% (or higher)

D 60% (not eligible for transferability code for college algebra placement)

F Below 60% (not eligible for transferability code for college algebra placement)

This course is divided across two semesters. The grade at the end of the first semester is a high school grade only. The grade at the end of the second semester is a cumulative total across BOTH semesters; that (cumulative) grade determines whether the student has earned a transferability code allowing automatic placement into college algebra (or any other course which college-algebra readiness implies).

Methods of evaluation will consist of, but are not limited to tests, quizzes, and projects which will follow the guidelines below. A comprehensive final exam at the end of the course will be at least 10% of the course grade. Course grades will be weighted based on the following categories:

* Homework/Quizzes: 15%
* Projects/Portfolio: 25%
* Tests: (at most one retake is allowed AFTER teacher-assigned remediation is completed)

Tests will be taken individually and will be worth 50% of a student’s final course grade.

An individual final exam worth (at least 10%) of the student’s final grade will be taken at the end of the second semester of the course. The content of the exam will be cumulative across BOTH semesters of the course.

**Course Materials (most frequently used)**

**Annenberg Learner**: <https://www.learner.org/subject/mathematics/>

**Betterlessons:** <https://betterlesson.com/browse/common_core_math>

**DESMOS:** <https://teacher.desmos.com/>

**ISU Real Numbers:** <http://www.iltransitionalmath.org/isu-resource-real-numbers-curriculum/>

**Mathalicious:** <https://www.mathalicious.com/>

**STEM Transitions:** <http://www.stemtransitions.org/index.php>

**TI Education:** <https://education.ti.com/en/84activitycentral/us/algebra-ii>

**Course Units of Study**

**Unit 1: Linear Functions**

* Birthday Candles - Students will burn a birthday candle halfway, and collect data regarding time and height, creating a graph; from which they will explore characteristics of a linear function.
  + CA-A1.b (Interpret dependent and independent variables)
  + CA-A1.c (Create/interpret functions in context)
  + CA-A2.a (Modeling linear situations)
  + CA-A2.b (Equations of lines and slope)
  + CA-A2.c (Graph slope-intercept form)
  + CA-A2.d (Find slope-intercept form from graphs and equations)
* Desmos Parallel and Perpendicular Lines - Students will create lines using Desmos to explore the relationship between parallel and perpendicular lines.
  + CA-A2.g (Slopes of parallel and perpendicular lines)
* Hot Dog Sales - Students are introduced to solving equations and inequalities numerically (using a table), graphically and algebraically by determining the profit and cost for hot dog sales.
  + CA-A1.a (Function concept/notation)
  + CA-A1.c (Create/interpret functions in context)
  + CA-A1.d (Function-graph relationship)
  + CA-A1.f (Analyze representations of functions)
  + CA-A2.e (Solving linear equations with graphs)
  + CA-A2.f (Solving linear inequalities)
* Miles of Tiles: The Pool Border Problem (Annenberg) -
  + CA-A1.a (Function concept/notation)
  + CA-A1.c (Create/interpret functions in context)
* Teen Policy Costs - Students will be able to find an equation for their estimated “line of best fit” in slope-intercept form and check to see whether their equation is reasonably accurate for various data points.
  + CA-A2.b (Equations of lines and slope)
  + CA-A2.c (Graph slope-intercept form)
* You’re So Fined (Mathalicious 2018) - Students will complete an activity regarding fines/expenses and discover how much two people with different incomes spend and save per month. At the end of the activity, students will be able to answer the question, “how do municipal fines affect people with different incomes?”
  + CA-A2.b (Equations of lines and slope)
  + CA-A2.c (Graph slope-intercept form)

**Unit 2: Systems of Equations and Inequalities**

* Hassan's Pictures: Linear Programming and Profit Lines (Annenberg Learner) - This lesson helps students learn to find the feasible region in a linear programming problem, to graph a family of profit lines, and to find the optimum point – the point on the feasible region that will produce the greatest profit.
  + CA-A2.b (Equations of lines and slope)
  + CA-A2.f (Solve linear inequalities)
  + CA-A2.g (Slopes of parallel and perpendicular lines)
  + CA-A4.a (Solve linear systems and applications)
  + CA-A4.b (Model linear inequalities and applications)
  + CA-A4.c (Solve linear inequalities by graphing)
* Left Hand, Right Hand - Students compare the speed at which they write with each hand. Students develop a conceptual understanding of the solution types to a system of two equations and two unknowns (one solution, no solution, infinitely many solutions)
  + CA-A4.a (Solve linear systems and applications)
* Romance Cone (Datelines) - Create two linear inequalities to answer the question, “What’s an acceptable dating range?”
  + CA-A2.a (Modeling linear situations)
  + CA-A2.c (Graph slope-intercept form)
  + CA-A2.e (Solve linear equations and applications)
  + CA-A2.f (Graph slope-intercept form)

**Unit 3: Quadratics**

* Be Still My Beating Heart - Students will gather individual data and then work collaboratively to graph and analyze the data using a quadratic model.
  + CA-A2.h (Model and solve polynomials equations)
  + CA-A2.l (Convert between graphs and quadratic equations)
  + CA-A2.n (Solve polynomial equations/inequalities)
* Completing the Square with Algebra Tiles - Students use algebra tiles to see patterns when converting standard form to vertex form when graphing and using algebra tiles. (Teachers who use SmartBoards may wish to use/view the “Factoring Polynomial Activities” task first, also listed under additional skill practice in this Task Template.)
  + CA-A2.k (Solve quadratic equations multiple ways)
  + CA-A2.m (Relationships between zeros and factors of a polynomial)
* Algebra Tiles (CPM) - Students explore the relationship between quadratic expressions and their factors.
  + CA-A2.i (Factoring quadratic equations)
* Fall of Javert: A Lesson by Mathalicious - At the end of the popular musical Les Misérables, Inspector Javert falls from a bridge in the middle of Paris into the river below. As he falls, he sings...and sings...and sings. In this lesson, students use quadratic functions to explore the mathematics of how objects fall. How high was Javert’s bridge, how fast was he traveling when he hit the water, and what’s the maximum height from which someone can safely jump?
  + CA-A2.h (Model and solve polynomial situations)
* Kick the Football (ISU) - Modeling a real-life situation, using student-generated data from another (quadratic) experiment.
  + CA-A2.h (Model and solve polynomial situations)
* Models for Quadratic Inequalities - Graphing and solving quadratic inequalities from word problems
  + CA-A2.n (Solve polynomial equations/inequalities)
* Pulling It Together w/Quadratics - Profits Selling Smart Phones (Better Lessons) - Students integrate concepts learned about quadratic equations and functions to analyze models and make recommendations for maximizing profit on the sale of smart phones.
  + CA-A2.k (Solve quadratic equations multiple ways)
  + CA-A2.m (Relationships between zeros and factors of a polynomial)
* Up, Down, Right, Left (Annenberg Learner) - Students will complete tasks at stations to explore the transformation of quadratic functions by using technology by changing a, h and k in a quadratic function written in the form y = a (x – h)2 + k.
  + CA-A2.l (Convert between graphs and quadratic equations)

**Unit 4: Radicals**

* Investigating a Radical Function - Students will investigate a single radical function; construct its graph; find extraneous solution to a radical equation
  + CA-A2.u (Simplify radicals / rational exponents)
  + CA-A2.s (Model and solve radical equations)
  + CA-A2.v (Solve equations with radicals)
* Radical Ideas - This task provides opportunities for students to become fluent converting between exponential and radical representations of expressions, as well as using the rules of exponents to simplify exponential and radical expressions and to solve equations containing exponents.
  + CA-A2.u (Simplify radicals / rational exponents)
  + CA-A2.t (Convert between radicals and rational exponents)
  + CA-A2.v (Solve equations with radicals)
* Simplifying Radicals - Students will simplify radicals; write in english statements; approximate roots; use prime factorization to simplify radicals (square and cube roots)
  + CA-A2.u (Simplify radicals / rational exponents)
* Skydiving - Students will investigate and learn properties of graphs of radical functions.
  + CA-A1.d (Function-graph relationship)
  + CA-A1.e (Find domain and range)
  + CA-A2.s (Model and solve radical equations)
* Tailgating and solving radical equations - Students will evaluate radical expressions and solve radical equations
  + CA-A2.u (Simplify radicals / rational exponents)
  + CA-A2.s (Model and solve radical equations)
  + CA-A2.v (Solve equations with radicals)
* Modeling the speed of Tsunamis - Students will be able to find the speed of a tsunami given a square root function.
  + CA-A2.u (Simplify radicals / rational exponents)
  + CA-A2.s (Model and solve radical equations)

**Unit 5: Polynomials**

* Desmos Polynomial Zeroe**s -** Working in small groups, students move graphs of polynomials around a coordinate plane to make the zeroes as instructed, and explain their reasoning. They will construct arguments and critique the reasoning of others.
  + CA-A2. (Zeroes and factors of higher order polynomials)
* Polynomial Farm - Students collaborate to add, subtract, multiply, divide, and factor polynomials in real-world context.
  + CA-A2.h (Applications and models with polynomial equations)
  + CA-A2.j (Factoring Polynomials)
* Second Degree (Mathalicious) - In this lesson, students will use polynomial functions to explore the heat index and discuss the life-and-death consequences that cities around the world will face in the coming years. Working in groups or pairs, they will reason abstractly and quantitatively.
  + CA-A2.h (Applications and models with polynomial equations)
* Wonka’s Golden Ticket - Students work in groups and individually on 4 tasks that model packaging candy in a candy factory. Students analyze ideas and patterns to create a model and check their estimate.
  + CA-A2.h (Applications and Models of Polynomials, Volume of cube and estimation)

**Unit 6: Rational Functions**

* Canalysis (Mathalicious) - Students will explore the sizes of soda cans relating to their volume and cost. Students will determine how much money soda companies could save on the cost of cans using rational equations. They will develop the ability to use mathematical skills in diverse scenarios.
  + CA-A2.o (Applications and models)
  + CA-A2.q (Solve rational equations)
* Rational Functions Performance Assessment - Students find the domain and implied domain for a water treatment facility. They solve quadratic inequalities using the graph and table on their calculator, recreate them on their papers, and interpret the results. They then solve the problems algebraically, as well.
  + CA-A2.r (Solve rational inequalities algebraically)
  + CA-A2.o (Applications and models)
  + CA-A1.b (Interpret the dependent and independent variables in context)
  + CA-A1.c (Create and interpret functions; domain)
  + CA-A1.e (Find domain and range)
  + CA-A1.f (Analyze functions using different representations)
* Real-Life Applications of Rational Functions (Betterlessons) - Use the relationship between speed and time to explore rational functions and discover asymptotes in the real world. Students will graph and write rational functions to model real-world situations and describe the behavior of these functions. Students make sense of problems and persevere in solving them in pairs or groups.
  + CA-A2.o (Applications and models)
* Simplifying Rational Expressions and Dividing Polynomials by Factoring Matching Activity - Matching activity for simplifying rational expressions and/or dividing polynomials by factoring. Includes dividing by a greatest common factor, factor by grouping, leading coefficient a = 1 or greater, real world problems involving area and volume - gardening, aerating rectangular landscapes, and optimizing a company's boxes for maximum profits.
  + CA-A2.p (Simplify rational expressions)
* STEMersion Anesthesiologist - Calculating times when sedated patients require more medication by solving rational equations.
  + CA-A2.q (Solve rational equations)
  + CA-A2.o (Applications and models)

**Unit 7: Exponential Functions**

* Create and Interpret Exponential Functions - Students will compare an exponential and linear function. Students will work on applications involving exponential functions and models with mathematics.
  + CA-A3.a (Applications and models)
  + CA-A3.b (Compare exponential growth to linear and polynomial growth)
  + CA-A3.c (Graph exponential functions)
  + CA-A3.e (Solve simple exponential equations algebraically)
* Exponential Functions Project - Students will pick two different cars and compare both the depreciation years after buying, but also explore which is a better purchase based on monthly payments and interest. Students will use technology and compare to algebraically solving.
  + CA-A1.c (Create models)
  + CA-A1.d (Understand graph)
  + CA-A3.a (Applications and Models)
  + CA-A3.d (Solve exponential equations numerically)
* Overrun by Skeeters – This lesson provides students with an introduction to exponential functions. The class first explores the world population since 1650. Students then conduct a simulation in which a population grows at a random yet predictable rate. Both situations are examples of exponential growth. Students use simulations to explore population growth.
  + CA-A3.a (Applications and Models)
  + CA-A3.d (Solve exponential equations numerically)
* Zombie Attack - Students will explore exponential growth (y = ab^x) and what effect changing the a value and b value have on the function. On day two, students will explore exponential decay. Students use different modes of technology and methods of solving (tables, graphs, verbal, algebraic)
  + CA-A1.d (Understand the relationship between a function and its graph)
  + CA-A1.f (Analyze functions using different representations)
  + CA-A3.a (Applications and Models)
  + CA-A3.c (Graph exponential functions)

**Unit 8: Capstone -Portfolio over the year.**

* Create Your Own City Map (end of first semester) - for a new sub-division that is being developed. They are given the project guidelines:
* All streets must be labeled with the name of the road. Buildings and landmarks must be labeled.
* Lines cannot be horizontal or vertical unless otherwise denoted.
* Each of the community requirements must be represented by a different equation.
* For instance, you may not use the same equation to satisfy two different requirements.
* The map should be easy to read and colorful – be creative!
  + CA-A1.a (Function notation)
  + CA-A1.c (Create and interpret functions)
  + CA-A1.d (Relationship between graph and function)
  + CA-A1.e (Find domain and range)
  + CA-A1.f (Analyze functions using different representations)
  + CA-A2.b (Slope)
  + CA-A2.c (Graph a line)
  + CA-A2.e (Use graphs to solve linear equations)
  + CA-A2.f (Solve linear inequalities)
  + CA-A2.g (Parallel and perpendicular lines and slopes)
  + CA-A2.l (Graph quadratic functions)
  + CA-A2.m (Factors and zeros)
  + CA-A2.n (Solve quadratic equations)
* Rational Function Project (middle of second semester) - Your city is planning to try to control pollution that the local utility emits, as part of a “Keep Our City Clean” project. You will analyze a function to see if the city can meet its anti-pollution goals.
  + CA-A1.a (Function notation)
  + CA-A1.b (Independent and dependent variables)
  + CA-A1.d (Relationship between graph and function)
  + CA-A1.e (Domain and range)
  + CA-A1.f (Analyze functions using different representations)
  + CA-A2.q (Solve rational equations)
* Watch out! There is going to be fireworks (middle of second semester) - Students will design a fireworks show for their city. They will model the path of the fireworks in the finale and determine timing and safety by calculating key features of the quadratics.
  + CA-A1.a (Function notation)
  + CA-A1.b (Independent and dependent variables)
  + CA-A1.c (Create models)
  + CA-A1.d (Relationship between graph and function)
  + CA-A1.e (Domain and range)
  + CA-A1.f (Analyze functions using different representations)
* City Population Growth - Students will find and create linear and exponential models for the population of a city of their choosing.
  + CA-A1.c. (Create function models)
  + CA-A1.d. (Relationship between graph and function)
  + CA-A2.a. (Model linear situations)
  + CA-A2.b. (Slope)
  + CA-A2.c. (Graph a line)
  + CA-A3.a. (Create and solve exponential applications)
  + CA-A3.b. (Distinguish exponential from other growth)
  + CA-A3.c. (Graph exponential functions)

Process Competencies

Transitional courses are intended to help students develop conceptual understanding and problem-solving ability as well as college and career readiness. To that end, the courses include process competencies related to mathematical and student success. While these competencies are not assessed directly, they should be a part of instruction and assessed indirectly. See page 6 in the *Competencies and Policies Document* at www.iltransitionalmath.org for more information.

· *In the course, students will be able to demonstrate the Common Core Standards for Mathematical Practice. Through daily collaboration, presentation, and problem-solving tasks, students will be expected to provide evidence of complete understanding of the mathematical topic. In addition to the mathematical skills required to be successful in the course, the students will improve their ability to work with others, through struggle, and engage in appropriate communication with one another.*

· *Students will work collaboratively in groups to conduct investigations that require deeper understanding of concepts presented. They will display this deeper understanding by modeling, computing, and expanding their responses in a prompted format. Students will present their findings within their groups and to the class as a whole. Class discussions will provide feedback and analysis of each groups’ findings. Students will be asked to defend their answers and reason through the appropriateness of their responses.*

Problem/Project-based Learning

Transitional math instruction provides students with the mathematical knowledge and skills to meet their individualized college and career goals and to be successful in college-level math courses, while aligning with the Illinois Learning Standards. These courses work to address the gaps in understanding by working on bigger problems, emphasizing problem-based learning and projects, communication, and integration of concepts, not just skill acquisition. Contexts used should be authentic whenever possible and apply to the student’s college or career path.

• Students can apply, analyze, and evaluate the characteristics of functions in authentic modeling and problem-solving situations.

• Students can perform operations on functions and make use of those operations in authentic modeling and problem-solving situations.

• Students can propose various alternatives, determine reasonableness, and then select optimal estimates to justify solutions.

• Students can demonstrate an understanding of the characteristics of variables and expressions and apply this knowledge in authentic modeling and problem-solving situations.

• Students can perform operations on expressions in authentic modeling and problem-solving situations. Students can create, solve, and reason with Linear, Polynomial, Rational, Radical, and Exponential functions in the context of authentic modeling and problem-solving situations.

• Students can apply, analyze and evaluate the characteristics of functions in authentic modeling and problem-solving situations.

• Students can build and use functions including linear, nonlinear, and exponential models in authentic modeling and problem-solving situations.

• Students can evaluate mathematical models and explain the limitations of those models.

• A minimum of one project will be completed per unit of study. Additionally, authentic problems will be distributed throughout the course.

• An example of a group/pairs project on Linear Functions asks students to burn a birthday candle halfway and to collect data regarding time and height as the candle burns. Students then create a graph of these data points. In pairs or small groups, they continue to explore characteristics of a linear function; students interpret the dependent and independent variables, determine the meaning of the slope and y-intercept, and apply the same process to another (theoretical) candle that is a different height than the original. Finally, students find and explore a published data set (with teacher approval) to analyze in a similar fashion.

• For an example of a problem distributed throughout the course, a portfolio will be created for the Capstone. This consists of 3-4 major projects under “City Maps” where the students will complete projects applied to a city planning including:

**Linear: (Create your own street map)**

Students will:

* Determine the domain and range of linear and quadratic functions.
* Write equations of lines.
* Write linear inequalities in two variables.
* Write systems of two linear equations.
* Graph the solution set of linear inequalities.
* Graph systems of two linear equations.
* Solve systems of two linear equations.
* Write equations of quadratic functions.
* Identify key features of linear and quadratic functions.
* Solve quadratic equations.

**Quadratics: (Watch Out!)**

Students will:

* Design a finale of a fireworks show
* Model the paths of the fireworks and graph them
* Calculate the timing of the finale
* Determine appropriate launch zone and safety audience barricade
* Present, in writing, their unique fireworks proposal

**Rational Functions (Rational Function Capstone)**

Students will:

* Use graphing calculators or graphing app to explore the cost function.
* Determine domain and range.
* Analyze functions verbally, graphically, numerically, and algebraically.
* Model with and solve rational equations.