Course Overview
In **DISCOVERY PRE-CALCULUS – A CREATIVE AND CONNECTED APPROACH**, students will deepen and extend their knowledge of functions, graphs, and equations from their high school algebra and geometry courses so that they can successfully work with the concepts in a rigorous university level Calculus course. This course is designed to push students well beyond drill and kill type exercises, with an emphasis on unpacking mathematical definitions and making logical arguments to their peers.

Content
The course is organized around the following **Big Ideas**:

- **Functions, Rates, & Patterns**: Functions model processes and relationships.
- **Algebra & Geometry**: Algebra is an abstraction of geometry.
- **Exponential & Logarithmic Functions**: Exponential functions model growth and decay in the world.
- **Trigonometry**: Trigonometry functions model cycle processes and relate geometry to algebra. Thinking about the mathematics of the circle helps us capture and describe cyclical phenomena.
- **Limits & Rate of Change Functions**: Change and motion lie at the core of our sense of how our dynamic world works. Limits are one strategy of reanalyzing the way functions change.
- **Exploring other Coordinating Systems**: Coordinate systems are set up to precisely identify locations, to accommodate extra parameters, or to represent some situation in simpler ways than other systems.
- **Sequencing & Series**: Sequences are lists of numbers, and appear frequently when we consider measure data that change over time.
**College Credit**

**DISCOVERY PRE-CALCULUS** is a *dual enrollment* course, so in addition to high school credit, students will have the opportunity to receive college credit through The University of Texas at Austin for *M 305G: Preparation for Calculus*. This course counts as a core requirement (*Mathematics, Texas core code 021*) for all undergraduates at Texas public institutions.

**Blended Learning and UT Support**

This course is taught in a *blended learning* environment, meaning that a substantial portion of the course is completed in an *online environment* and the rest of the course is taught *locally* by a high school teacher with digital resources and substantial support from the University of Texas. In particular, UT provides curricular material, professional development, on-demand support, and college readiness assessments.

**Inquiry-Based Learning**

This course uses Inquiry-Based Learning (IBL), a pedagogy designed to engage students in the educational process. IBL frames learning in the context of real-world exploration, and allows students to *struggle* to solve the problem with minimal guidance from the teacher. IBL comes from a constructivist view of how people learn, and has the primary focus of developing students critical thinking skills while deepening their conceptual understanding of content.

**Online Learning Environment**

UT provides an online learning environment—based on the Canvas learning management software—that delivers content, enables online discussion, provides ongoing assessment, and supports essential course administration and clerical tasks. These materials are supplemented with various outside sources, including the course textbook (*available to students and teachers in CANVAS*):

> Discovery Pre-Calculus: a Creative and Connected Approach by Daniels et al.
Grading
High school grades are wholly determined by high school teachers and may leverage the wealth of resources available to students through the provided curriculum (e.g. explorations, online quizzes). However, the UT course grade is based only on students’ performance on 7 exams. At the end of seven units covered during the semester, students will take an exam. The first three questions from these exams will be used for the purposes of computing a grade for this college course. Each question will be scored on a scale from 0 to 4; there are 84 points possible in the course.

Exams (7 total) 100%
Students who qualify for dual enrollment may elect to take it as Credit/No-Credit or for a course grade, using the following grade scale:

<table>
<thead>
<tr>
<th>Points</th>
<th>Grade</th>
</tr>
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<tbody>
<tr>
<td>74-84</td>
<td>A</td>
</tr>
<tr>
<td>53-73</td>
<td>B</td>
</tr>
<tr>
<td>Below 53</td>
<td>No Credit</td>
</tr>
</tbody>
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Drop Policy
In order to facilitate student achievement while avoiding negative impact on future college enrollments, students who score less than a B or receive No-Credit for the course will have their grades expunged. Effectively, these scores will not appear on official UT transcripts. Student can request that no letter grade be entered for them. The last day to make this request is May 2.

Calculator Policy
Calculators may only be used on exams given for the purposes of college credit when permission to do so is given in the written instructions for the exam.

Academic Integrity
Academic integrity is highly valued and seriously regarded at the University of Texas at Austin. Infractions will be investigated and administered by UT personnel as warranted by UT’s academic integrity policy. Be safe; ask questions first!
Course Sequence and Learning Outcomes

UNIT 0: Core Competencies
0.1 Explain, in their own words, the logical basis for each algebraic manipulation they perform.
0.2 Give graphical or written proofs of basic geometric formulae or statements.
0.3 Develop strategies for approaching non-routine problems, and persevere in solving such problems.

UNIT 1: Functions, Rates, and Patterns
1.1 Apply functions and composite/multistep functions to a constant or an algebraic expression and use function notation properly.
1.2 Predict when a function will have an inverse and explain how the inverse function is related to the original.
1.3 Explain what it means for a function to have certain properties and why these properties would be useful.
1.4 Produce examples of functions or function graphs with given properties, and identify properties held by given graphs or formulas.
1.5 Given a real-world data set, find function representations that model the relationship between variables and make predictions.
1.6 Given one representation for a function, create other types of representations for the same function.

UNIT 2: Algebra and Geometry
2.1 Give a sequence of steps (in the correct order) to transform from a standard graph to a given one.
2.2 Connect properties of geometric objects to the related algebraic representations.
2.3 Apply linear regression and residual plots to data sets and interpret the results.

UNIT 3: Exponential and Logarithmic Functions
3.1 Compute or approximate exponents and logarithms of some constant values mentally or without a calculator.
3.2 Identify situations in which a quantity is growing or decaying exponentially.
3.3 Create models for exponential growth or decay, and make predictions about the long-term behavior of a variable.
3.4 Use the inverse relationship of logarithmic and exponential functions to deduce the graph and other properties of a log function, and to solve exponential and logarithmic equations.

UNIT 4: Trigonometric Functions
4.1 Explain how radians are born and describe how to convert between degree measurements and radian measurements.
4.2 Explain how sine, cosine, and tangent are born, why the unit circle definition and the triangle definition are equivalent, and the connection between the unit circle definition of a trigonometric function and its graph.
4.3 Evaluate any of the six trigonometric functions at inputs measured in either degrees or radians, including negative and large inputs.
4.4 Model appropriate real-world situations using (possibly inverse) trigonometric equations and explain why the equations model the situations.
4.5 Differentiate between equations that are always true, sometimes true, and never true, and apply common trigonometric identities to simplify algebraic expressions.
4.6 Analyze a trigonometric equation, describe a series of steps necessary for solving this equation, and perform those steps accurately, making use of trigonometric identities or inverse trigonometric functions when appropriate.

UNIT 5: Rates of Change of Functions and Limits
5.1 Recognize real-life problems involving rates of change.
5.2 Relate rate of change to the slope of a secant line.
5.3 Compute or estimate average rate of change using function formulas and graphs, and describe situations in which the average rate of change would be useful or not useful.
5.4 Estimate instantaneous rates of change using graphs, and develop methods of estimating these instantaneous rates of change using function formulas and secant lines.
5.5 Find limits of functions at particular points by looking at the graph of the function or by using the algebraic formula for the function and properties of limits.
5.6 Draw graphs of functions with particular limiting behavior.

UNIT 6: Coordinates Systems
6.1 Translate between graphing a point on the plane, its Cartesian coordinates, and its polar coordinates.
6.2 Decide whether a situation that requires graphing would be best served with Cartesian or polar coordinates.
6.3 Connect parametric equations to their graphs.
6.4 Connect parametric situations to the concept of vectors in the plane.

UNIT 7: Sequences and Series
7.1 Translate between a formula, a list of terms, a recursive definition, and a verbal description of a sequence.
7.2 Identify arithmetic and geometric sequences; given one representation for such a sequence, find others; find partial sums of these sequences.
7.3 Explain what each piece of summation notation means, and translate between this notation and writing out a sum.
7.4 Explain the relationship between the concepts of sequences, series, and partial sums.
7.5 Explain what it means, conceptually, for a sequence or series to converge. Further, determine the limit of a convergent geometric series.
7.6 Apply the Binomial Theorem appropriately.

NOTE: These are estimates based on the 2013–2014 school year. Scope and sequence may change in future offerings.