AP Precalculus Syllabus (Math Medic)

Course Overview

AP Precalculus centers on functions modeling dynamic phenomena. This research-based exploration of functions is designed to better prepare students for college-level calculus and provide grounding for other mathematics and science courses. In this course, students study a broad spectrum of function types that are foundational for careers in mathematics, physics, biology, health science, social science, and data science. Furthermore, as AP Precalculus may be the last mathematics course of a student's secondary education, the course is structured to provide a coherent capstone experience and is not exclusively focused on preparation for future courses.

This course will be taught using an Experience First, Formalize Later (EFFL) learning model, where students work collaboratively to think, to discuss, and to construct their own understanding of new content before the teacher helps students to arrive at formal definitions and formulas.

Course Expectations

Students are expected to fully participate in small groups when working through the activity for each new lesson. Each member of the group should contribute to the discussion in the group, as well as to listen to and critique ideas from others.

During the whole-class debrief of the collaborative activity, students will be asked to share ideas generated in their groups. The teacher will guide the discussion towards a more formal understanding of what was learned in the activity. Students will be expected to record any new learning that results from the class discussion.

At the end of each lesson, students work individually or in small groups to complete the Check Your Understanding questions. These formative assessments reinforce the key ideas of the activity and extend students' thinking to other contexts, representations, or applications.

Students are expected to complete all homework problems to the best of their ability. If they need additional support, they can refer to the additional resources listed below.

Additional Resources

The Math Medic Assessment Platform for AP Precalculus provides pre-made homework, quizzes, and tests perfectly aligned to the Math Medic lessons, and covering every topic of the CED (Units 1-3). This resource also allows teachers to edit assessments and build their own assessments from a bank of high-quality questions.

The College Board also provides a plethora of resources to help students learn, practice, and review the content in AP Precalculus.

- AP Daily videos are short 5 – 9-minute videos found in AP Classroom that cover all of the content in the AP Precalculus course. Students can find fill-in-the-blank notes that go with the videos on blog.mathmedic.com.
- Students looking for more practice can request access to additional questions in AP Classroom.

At the end of the year, students will use the Math Medic AP Precalculus Exam Review Course, which includes videos, practice problems, and AP Exam Tips.

Student Practice

The Math Medic Assessment Platform for AP Precalculus provides high-quality homework assignments, quizzes, and tests that can be assigned to students digitally or in print. These questions are perfectly aligned to the Math Medic AP Precalculus lessons and cover every topic in the CED (Units 1-3). The questions vary in difficulty, feature multiple representations, and give students ample opportunities to practice the Mathematical Practices outlined for AP Precalculus.

Throughout each unit, Topic Questions from AP Classroom will also be provided to help students check their understanding. The Topic Questions are especially useful for confirming understanding of difficult or foundational topics before moving on to new content or skills that build upon prior topics. Topic Questions can be assigned before, during, or after a lesson, and as in-class work or homework. Students will get rationales for each Topic Question that will help them understand why an answer is correct or incorrect, and their results will reveal misunderstandings to help them target the content and skills needed for additional practice.

At the end of each unit or at key points within a unit, Personal Progress Checks will be provided in class or as homework assignments in AP Classroom. Students will get a personal report with feedback on every topic, skill, and question that they can

use to chart their progress, and their results will come with rationales that explain every question's answer.

Textbook Requirement CR1

In lieu of a traditional textbook, we will be using the AP Precalculus lessons at portal.mathmedic.com/lesson-plans/course/AP-Precalculus, along with the homework, quizzes, and tests available through the Math Medic Assessment Platform for AP Precalculus. The Math Medic lessons have been vetted by the College Board and meet the Course Audit curricular requirements.

Course Outline and Pacing CR2

- September/October/November – CED Unit 1
- November/December/January – CED Unit 2
- January/February/March – CED Unit 3
- April/May – AP Exam Review

Course Outline and Description CR2

All lessons are from the AP Precalculus curriculum on Math Medic.

Math Medic Unit 1: Exploring Rates of Change

CED Topic 1.1 Change in Tandem (Skill 2.B, 3.A)

- Lesson 1.1: Can We Predict Maximum Heart Rate?
- Lesson 1.2: How Does the Food Industry Set Prices?
- Lesson 1.3: What is the Business Cycle?

CED Topic 1.2 Rates of Change (Skill 2.A, 3.A)

- Lesson 1.4: What is Pamela's Current Speed?

CED Topic 1.3 Rates of Change in Linear and Quadratic Functions (Skill 3.B, 3.C)

- Lesson 1.5: How Much Does it Cost to Rent a U-Haul?
- Lesson 1.6: How Fast Does a Penny Fall from the Empire State Building?

Math Medic Unit 2: Polynomial and Rational Functions

CED Topic 1.4 Polynomial Functions and Rates of Change (Skill 2.A, 3.A)

- Lesson 2.1: Can We Predict Stock Values?

CED Topic 1.5 Polynomial Functions and Complex Zeros (Skill 1.B, 2.B)

- Lesson 2.2: What's Up With the Zeros?
- Lesson 2.3: Who is the Fairest of Them All?

CED Topic 1.6 Polynomial Functions and End Behavior (Skill 3.A)

- Lesson 2.4: The End is in Sight

CED Topic 1.7 Rational Functions and End Behavior (Skill 1.B, 3.A)

- Lesson 2.5: How Much Anesthesia Should the Patient Get?

CED Topic 1.8 Rational Functions and Zeros (Skill 1.A)

- Lesson 2.6: The "Hole" Truth

CED Topic 1.9 Rational Functions and Vertical Asymptotes (Skill 2.A)

- Lesson 2.6: The "Hole" Truth

CED Topic 1.10 Rational Functions and Holes (Skill 3.C)

- Lesson 2.6: The "Hole" Truth

CED Topic 1.11 Equivalent Representations of Polynomial and Rational Expressions (Skill 1.B, 3.B)

- Lesson 2.7: Changing Forms
- Lesson 2.8: Let's Be Rational
- Lesson 2.9: Where Are the Like Terms?

Math Medic Unit 3: Constructing Functions

CED Topic 1.12 Transformations of Functions (Skill 1.C, 3.A)

- Lesson 3.1: Building a Library
- Lesson 3.2: What's My Transformation?

CED Topic 1.13 Function Model Selection and Assumption Articulation (Skill 2.A, 3.C)

- Lesson 3.3: How Much Do I Pay for 4G Data?
- Lesson 3.4: Can You DTR?

CED Topic 1.14 Function Model Construction and Application (Skill 1.C, 3.B)

- Lesson 3.5: Do Females Live Longer Than Males?

Math Medic Unit 4: Exponential Functions

CED Topic 2.1 Change in Arithmetic and Geometric Sequences (Skill 1.B, 3.A)

- Lesson 4.1: #Goals
- Lesson 4.2: Little Red's Crumby Day

CED Topic 2.2 Change in Linear and Exponential Functions (Skill 1.C, 3.B)

- Lesson 4.3: Geri's Greeting Cards

CED Topic 2.3 Exponential Functions (Skill 3.A)

- Lesson 4.4: Game, Set, Flat

CED Topic 2.4 Exponential Function Manipulation (Skill 1.B, 3.A)

- Lesson 4.5: Exponential Match-Up

CED Topic 2.5 Exponential Function Context and Data Modeling (Skill 1.C, 3.B)

- Lesson 4.6: How Do You Grow Your Money?
- Lesson 4.7: How Often Should You Take DayQuil?

CED Topic 2.6 Competing Function Model Validation (Skill 2.A, 3.C)

- Lesson 4.8: Eating Out vs. Eating at Home

Math Medic Unit 5: Logarithmic Functions

CED Topic 2.7 Composition of Functions (Skill 1.C, 2.B)

- Lesson 5.1: How Much Does It Cost to Tile a Pool?

CED Topic 2.8 Inverse Functions (Skill 1.A, 2.B)

- Lesson 5.2: How Much Should You Feed Your Puppy?
- Lesson 5.3: How Long to Reach the Summit?

CED Topic 2.9 Logarithmic Expressions (Skill 1.B)

- Lesson 5.4: The Mystery Function

CED Topic 2.10 Inverses of Exponential Functions (Skill 1.C, 2.B)

- Lesson 5.4: The Mystery Function

CED Topic 2.11 Logarithmic Functions (Skill 3.A)

- Lesson 5.5: Lumberjack Graphs

CED Topic 2.12 Logarithmic Function Manipulation (Skill 1.B, 3.A)

- Lesson 5.6: Puzzling with Properties

CED Topic 2.13 Exponential and Logarithmic Equations and Inequalities (Skill 1.A, 1.B, 1.C)

- Lesson 5.7: Looking for "?"

CED Topic 2.14 Logarithmic Function Context and Data Modeling (Skill 1.C, 3.B)

- Lesson 5.8: What is a 6-Figure Salary?

CED Topic 2.15 Semi-log Plots (Skill 2.B, 3.C)

- Lesson 5.9: How has GDP Per Capita Changed Over Time?

Math Medic Unit 6: Exploring Sine and Cosine Functions

CED Topic 3.1 Periodic Phenomena (Skill 2.B, 3.A)

- Lesson 6.1: How Much Air Is in Your Lungs?

CED Topic 3.2 Sine, Cosine, and Tangent (Skill 2.A, 3.A)

- Lesson 6.2: Can You Measure That in Twizzlers?
- Lesson 6.3: Trig Ratios in the Wild

CED Topic 3.3 Sine and Cosine Function Values (Skill 2.A, 3.B)

- Lesson 6.4: Coming Full Circle

CED Topic 3.4 Sine and Cosine Function Graphs (Skill 2.A, 3.A)

- Lesson 6.5: Spaghetti Waves

CED Topic 3.5 Sinusoidal Functions (Skill 2.A, 3.A)

- Lesson 6.5: Spaghetti Waves

CED Topic 3.6 Sinusoidal Function Transformations (Skill 1.C, 2.B)

- Lesson 6.6: Which One Doesn't Belong?

CED Topic 3.7 Sinusoidal Functions Context and Data Modeling (Skill 1.C, 3.C)

- Lesson 6.7: It's Getting Hot Out Here!

Math Medic Unit 7: Working with Trigonometric Functions

CED Topic 3.8 The Tangent Function (Skill 2.A, 3.A)

- Lesson 7.1: How Are the Slopes Changing?

CED Topic 3.9 Inverse Trigonometric Functions (Skill 1.C, 2.B)

- Lesson 7.2: Caution: Restricted Area

CED Topic 3.10 Trigonometric Equations and Inequalities (Skill 1.A, 2.A, 3.B)

- Lesson 7.3: It's Getting Hot Out Here (Part 2)

CED Topic 3.11 The Secant, Cosecant, and Cotangent Functions (Skill 2.B, 3.A)

- Lesson 7.4: Is There More to Explore?

CED Topic 3.12 Equivalent Representations of Trigonometric Functions (Skill 1.A, 1.B, 3.B)

- Lesson 7.5: Identity Crisis
- Lesson 7.6: Break It Down!

Math Medic Unit 8: Polar Functions

CED Topic 3.13 Trigonometry and Polar Coordinates (Skill 1.B, 2.A)

- Lesson 8.1: Supervising the Sky
- Lesson 8.2: Why so Complex?

CED Topic 3.14 Polar Functions Graphs (Skill 2.B, 3.A)

- Lesson 8.3: A Polar Phenomenon (Part 1)
- Lesson 8.4: A Polar Phenomenon (Part 2)

CED Topic 3.15 Rates of Change in Polar Functions (Skill 3.A, 3.C)

- Lesson 8.5: What's Going On in This Graph?

Developing MP1: Procedural and Symbolic Fluency CR3

In Rational Function Relay, students are given an equation of a rational function and must determine intercepts, vertical asymptotes, and holes without a calculator, by factoring the numerator and denominator expressions and analyzing shared factors.

In Lesson 7.3 ("It's Getting Hot Out Here (Part 2)"), students solve trigonometric equations by hand by applying inverse operations and reasoning using known values on the unit circle. Students must consider the periodicity of the function as well as restrictions in the domain and range of trig functions and their inverses.

Developing MP2: Multiple Representations CR4

In a card sort featuring polynomial, rational, exponential, and logarithmic functions, students connect the graph of a function with its equation, a verbal description of its key characteristics, and limit statements describing the function's end behavior.

In Lesson 8.5 ("What's Going on in this Graph?") students begin with the equation of a polar function and give verbal descriptions of its shape and maximum and minimum values. They then solve for the zeros analytically and use all this information to construct the graph of the function. Finally, students create a tabular representation of the function and use this to analyze the function's behavior on certain intervals of its domain.

Developing MP3: Communication and Reasoning CR5

In FR Quad, students are given the prices of three pizza orders and must justify whether the relationship between two variables (cost and diameter, cost and number of square inches, diameter and number of square inches) is linear, quadratic or neither. Students will **use precise terminology about patterns of covariation** in linear and quadratic functions (constant differences and changes in the average rate of change) to **provide a rationale** for their decision. At the end of the activity, the teacher reviews what counts as sufficient evidence for justifying each function type.

In a speed dating activity, students must describe the features of the function on their card to their partner, **using appropriate mathematical vocabulary** such as intercept, zero, multiplicity, leading coefficient, degree, and end behavior. Partner A may have an equation or a graph, and Partner B must then sketch the graph of the function

described by Partner A, or generate the equation based on the description of the graph. The teacher walks around the room, monitoring pairs, and supporting students in using appropriate mathematical language when describing their function.

Furthermore, each lesson is conducted in the Experience First, Formalize Later model, so students have daily opportunities to reason about and discuss a mathematical task in small groups. Prompts such as "How do you know?" "Give a convincing reason" "Provide a rationale" and "Justify your response" are used in almost every lesson.

Technology Requirement CR6

Each student will purchase or be able to borrow a graphing calculator for individual use. Students will practice solving problems with and without a calculator throughout the year.

In a homework assignment, students use their graphing calculator to determine the relative and absolute extrema of a quartic function.

In Lesson 5.7 ("Solving for ?") students identify numerical solutions to logarithmic equations in one variable using their calculator. They do this by finding the intersections of two graphs, or the intersection between a graph and a horizontal line.

In Lesson 4.8 ("Eating Out vs. Eating at Home") students find regression equations to model real world data about the ratio of restaurant to grocery store retail prices in the years since 1960. They then analyze the residual graphs of each model to determine the best fit.

In Regression Round Table, students use their graphing calculator to generate and analyze regression models for four scenarios.

Solving Real World Problems CR7

In Lesson 3.4 ("Can You DTR?") students are given a variety of scenarios and use **contextual, numerical, and graphical clues to determine which function model would best describe the scenario**. For example, students might note that there is an approximately constant decrease in the number of students not enrolled in primary school in the Middle East between the years 1970 and 2010 based on a graph, and then conclude that a linear function best models this relationship.

In Lesson 3.5 ("Do Females Live Longer than Males?"), students must **identify a quadratic relationship** in a real world data set and then use two alternate methods to **establish the model**. First, students solve for the variables in a system of equations. Then, students identify a "peak" in the data and use this estimate of the maximum to write an equation in vertex form.

In Lesson 4.3 ("Geri's Greeting Cards") students **identify and construct linear and exponential models** for the number of packages stocked during Geri's shift and the number of cards sold over time **based on observations about the covariation of two variables** revealed in a table of data. Students do not use regression in this lesson.

In the "Exploring Data" mini-project students will find or collect their own data and apply modeling techniques to interpret the data. This will give students a chance to practice noticing trends in data, **choosing a regression model** based on those trends, **calculating a regression model** using the capabilities of their graphing calculator, interpreting a residual plot to **assess the suitability of their selection**, and articulating the assumptions and limitations of a particular model.