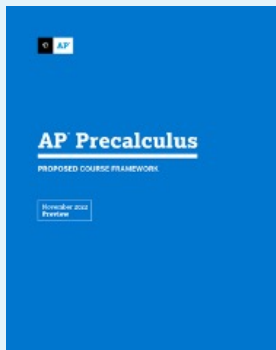**AP**

Introducing
AP Precalculus

Launch Year: **2023-24**
First Exam: May 2024

UPDATED NOV 17

AP Precalculus

Created to prepare a wide range of students to succeed in math they'll encounter in college.

AP Precalculus
PROPOSED COURSE FRAMEWORK
November 2022 Preview

Spring 2022

Download the AP Course Framework

AP Course and Exam Description

Spring 2023

Download the AP Course and Exam Description

Spring 2023

AP Course Audit opens for teachers to begin submitting their syllabus.

Summer 2023

AP Summer Institutes offer AP Precalculus.

Fall 2023

School can offer AP Precalculus in the 2023-24 academic year.

May 2024

First AP Precalculus Exam given.

Introducing AP Precalculus

01 **Why offer AP Precalculus?**

Inadequate Preparation for College Math, Benefits of AP Precalculus

02 **Who should take AP Precalculus?**

Algebra 1 in Grade 9, Algebra 1 in Grade 8, Majors/Careers Not Requiring Calculus

03 **What's in AP Precalculus?**

Student Experience, Unit Outline, Course at a Glance, Mathematical Practices

04 **Bring AP Precalculus to your school.**

Textbooks, Calculators, Teacher Supports, Student Readiness

1

Why offer AP Precalculus?

College math represents a frustrating barrier to success.

Every year, thousands of new college students must take remedial math.

40%

Students who enter college as STEM majors, but switch to a non-STEM major or fall short of a degree after failing common gateway courses, particularly calculus.[2]

The Mathematical Association of America has described Americans' struggle with math as **"the most significant barrier"** to completing both STEM and non-STEM degrees.[1]

"The evidence is clear that **calculus functions as a critical gatekeeper for U.S. students seeking to enter STEM majors and careers**," according to researchers from Just Equations, a California-based public policy institute. "Calculus' reputation as a weed-out course is well deserved."[3]

Looking across all majors, **40% of college students lack sufficient math in high school to enroll in college-level math courses**, so must spend time and money on remedial math courses that do not count toward their degrees. Nearly half of these students fail to fulfill the math requirement.[4]

[1] "A Common Vision" Mathematical Association of America (MAA) https://www.maa.org/sites/default/files/pdf/CommonVisionFinal.pdf

[2] https://www.nytimes.com/2011/11/06/education/edlife/why-science-majors-change-their-mind-its-just-so-darn-hard.html?pagewanted=all

[3] https://justequations.org/wp-content/uploads/Learning-Lab-Calculus-Report-Layout-ADA.pdf

[4] Chen, X. (2016). Remedial Coursetaking at U.S. Public 2- and 4-Year Institutions: Scope, Experiences, and Outcomes (NCES 2016-405). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved May 2022 from http://nces.ed.gov/pubsearch.

How will AP Precalculus make a difference?

1 **More time.**

AP Precalculus provides students with 140 hours of contact time with their instructor; in comparison, students who wait and take precalculus in college will typically receive 48 hours of contact.

2 **Familiar space, more practice.**

AP Precalculus meets students where they are in the familiar environment of a high school classroom and provides free online practice and videos that can be tailored to individual students' needs for additional help.

3 **Motivation.**

Many students are galvanized by the opportunity to earn college credit, devoting more time and effort to the sort of practice and focus that math proficiency demands.

4 **Trusted standard.**

The AP Precalculus exam is developed and scored by college professors, rather than by a student's own teacher, setting an unimpeachable standard across a wide range of classrooms.

5 **Teacher as coach, ally.**

AP students tend to see their teachers as their coaches and allies, dedicated to helping them learn what is necessary for college credit.

2

Who should take AP Precalculus?

Who should take AP Precalculus?

1 **Algebra 1 in Grade 9**

AP Precalculus will prepare students who start Algebra 1 in 9th grade for a successful transition into a STEM major in college.

2 **Algebra 1 in Grade 8**

AP Precalculus will help students who take Algebra 1 before 9th grade be more prepared for success in AP Calculus.

3 **Majors/Careers Not Requiring Calculus**

AP Precalculus will help students fulfill their college math requirement when their majors and careers do not require calculus.

The culminating math experience

1

Algebra 1 in Grade 9

AP Precalculus will prepare students who start Algebra 1 in 9th grade for a successful transition into a STEM major in college.

- Half of American students don't begin Algebra 1 until 9th grade.

- Accordingly, most of these students interested in STEM majors and careers will first encounter calculus in college. If they're not ready for calculus, they will need to take precalculus in college first.

- These students deserve solid preparation for STEM majors and careers. Providing them with an AP credit opportunity for precalculus will motivate many students to persist in four years of high school math and will significantly boost student readiness for the subsequent math classes they will need to major in STEM.

Prep for AP Calculus

2

Algebra 1 in Grade 8

AP Precalculus will help students who take Algebra 1 before 9th grade be more prepared for success in AP Calculus.

- Half of American students take Algebra 1 prior to 9th grade.

- While many of these students aspire to take calculus in high school, many are not ready.

- Students who take AP Precalculus before their senior year will be much better prepared for success in AP Calculus, and for any subsequent math they may need in college.

For no-calculus majors/careers

3

Majors/Careers Not Requiring Calculus

AP Precalculus will help students fulfill their college math requirement when their majors and careers do not require calculus.

- Students interested in non-STEM majors will often be able to use a qualifying AP Precalculus Exam score to fulfill a college math requirement.

- These students can then focus their valuable time and college budget on the courses most necessary for their majors and careers, avoiding the need to repeat content already mastered in AP Precalculus.

- Offering a college-level precalculus course in high school will afford a wide range of high school students a new and valuable way to improve math readiness and on-time college graduation.

Math Pathways

The math pathways available to students starting with Algebra 1.

Year 1	Year 2	Year 3	Year 4	Year 5+
Algebra 1	Geometry	Algebra 2	**AP Precalculus***	AP Calculus AB* AP Calculus BC*^ AP Statistics*
			AP Statistics	AP Calculus AB AP Calculus BC **AP Precalculus**
			AP Calculus AB	AP Calculus BC AP Statistics
	Algebra 2	Geometry	**AP Precalculus*** AP Calculus AB AP Statistics	AP Calculus AB* AP Calculus BC*^ AP Statistics*
	Geometry and Algebra 2	**AP Precalculus*** AP Statistics AP Calculus AB	AP Calculus AB* AP Calculus BC*^ AP Statistics	AP Calculus AB AP Calculus BC AP Statistics*

* Represents an anticipated sequence for most students on this pathway.
^ It is anticipated that a higher percentage of students may pursue AP Calculus BC having had AP Precalculus due to topic coverage not found in some precalculus courses.
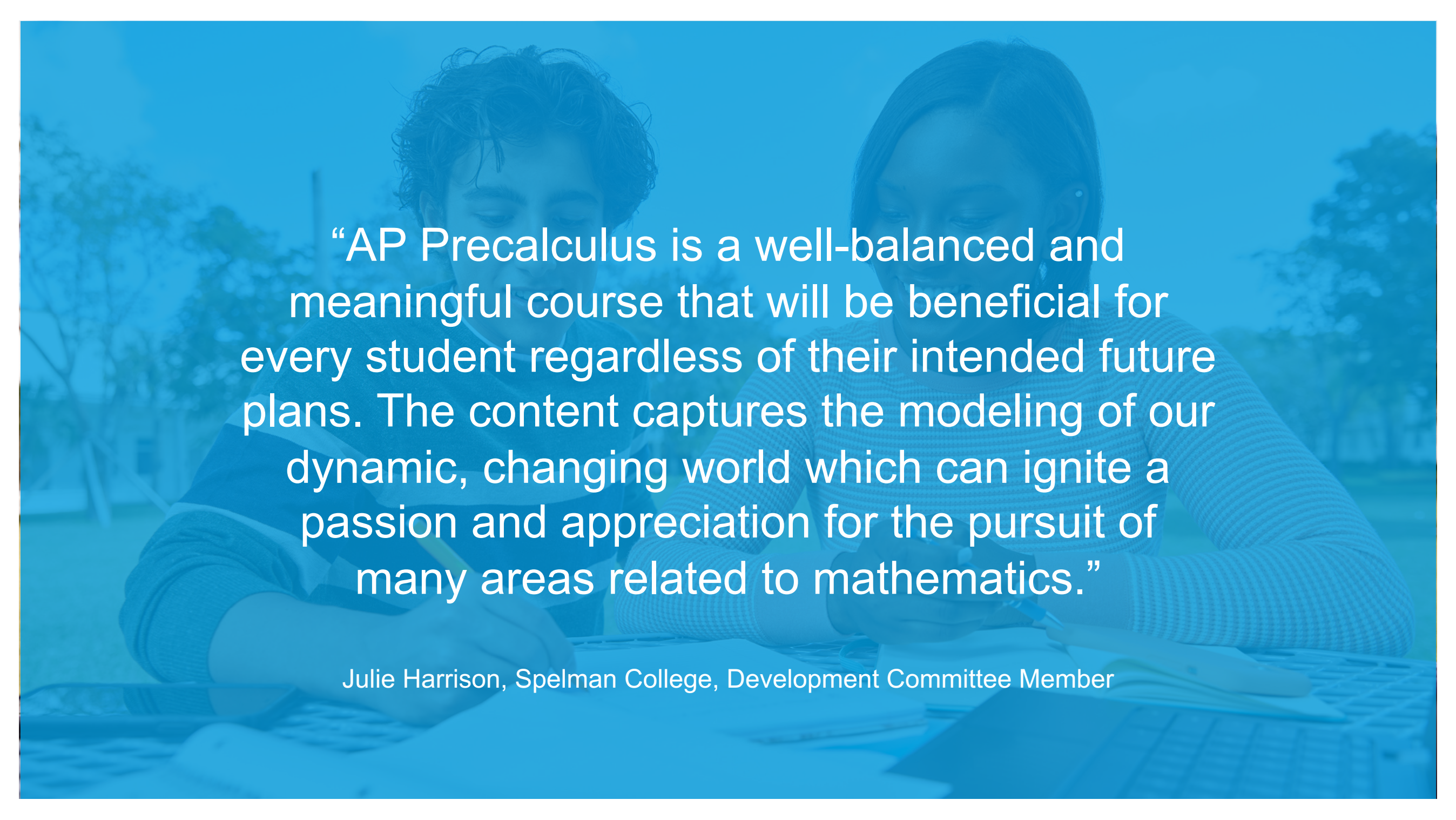
Note: The **Pre-AP** course sequence is Pre-AP Algebra 1, Pre-AP Geometry with Statistics, Pre-AP Algebra 2.

Credit and Placement

AP Precalculus

- Precalculus fulfills a math requirement at a diverse range of colleges and universities, including the majority of public institutions.

- However, most highly selective colleges do not treat precalculus as a college-level course, and thus college credit for AP Precalculus will not be available at such institutions; instead, AP Precalculus will provide students attending such colleges with superb preparation for AP Calculus in high school or college calculus when they matriculate.

- AP Precalculus exam scores can also be used by college for math and science course placement among newly enrolling students.

"AP Precalculus is a well-balanced and meaningful course that will be beneficial for every student regardless of their intended future plans. The content captures the modeling of our dynamic, changing world which can ignite a passion and appreciation for the pursuit of many areas related to mathematics."

Julie Harrison, Spelman College, Development Committee Member

3

What's in AP Precalculus?

About the Course

AP Precalculus

The AP Program convened college faculty to build a precalculus course that invites a diverse group of students to prepare for college mathematics, encourages more students to complete four years of mathematics in high school, and improves student readiness to succeed in STEM courses and majors in college.

- In AP Precalculus, **students explore everyday situations** and phenomena using mathematical tools and lenses.

- Through regular practice, students build deep mastery of modeling and functions, and they examine scenarios through multiple representations. **They will learn how to observe, explore, and build mathematical meaning** from dynamic systems, an important practice for thriving in an ever-changing world.

AP Precalculus prepares students for other college-level mathematics and science courses.

What will students experience in AP Precalculus?

- **Modeling Real-World Data**: Students will apply the mathematical tools they acquire in real-world modeling situations. By examining scenarios, conditions, and data sets and determining and validating an appropriate function model, students gain a deeper understanding of the nature and behavior of each function type.

- **Exploring Multiple Representations**: Students will examine functions through multiple representations. Students will gain a deeper understanding of functions by examining them graphically, numerically, verbally, and analytically.

What will students experience in AP Precalculus? *(continued)*

- **Mastering Symbolic Manipulation**: Students will develop rigorous symbolic manipulation skills needed for future mathematics courses. Students learn that a single mathematical object can have different analytical representations depending on the function type or coordinate system, and that the different analytical representations reveal different attributes of the mathematical object.

- **Harnessing a Dynamic World**: Students will engage in function building that reflects not a static view of things but embodies how things change. Every function representation characterizes the way in which values of one variable simultaneously change as the values in another variable change. This understanding of functions and their graphs as embodying dynamic covariation of quantities prepares students to tame an ever-changing world.

Unit Outline

Course Content

The course content is organized into units of study that provide a suggested sequence for the course. These units comprise the content and conceptual understandings that colleges and universities typically expect students to master to qualify for college credit and/or placement.

UNIT 1 — **Polynomial and Rational Functions**

UNIT 2 — **Exponential and Logarithmic Functions**

UNIT 3 — **Trigonometric and Polar Functions**

UNIT 4 — **Functions Involving Parameters, Vectors, and Matrices**
Additional Topics Available to Schools
(not included on AP Precalculus Exam)

Course at a Glance

AP Precalculus

Unit 1	Polynomial and Rational Functions
1.1	Change in Tandem
1.2	Rates of Change
1.3	Rates of Change in Linear and Quadratic Functions
1.4	Polynomial Functions and Rates of Change
1.5	Polynomial Functions and Complex Zeros
1.6	Polynomial Functions and End Behavior
1.7	Rational Functions and End Behavior
1.8	Rational Functions and Zeros
1.9	Rational Functions and Vertical Asymptotes
1.10	Rational Functions and Holes
1.11	Equivalent Representations of Polynomial and Rational Expressions
1.12	Transformations of Functions
1.13	Function Model Selection and Assumption Articulation
1.14	Function Model Construction and Application

Unit 2	Exponential and Logarithmic Functions
2.1	Change in Arithmetic and Geometric Sequences
2.2	Change in Linear and Exponential Functions
2.3	Exponential Functions
2.4	Exponential Function Manipulation
2.5	Exponential Function Context and Data Modeling
2.6	Competing Function Model Validation
2.7	Composition of Functions
2.8	Inverse Functions
2.9	Logarithmic Expressions
2.10	Inverses of Exponential Functions
2.11	Logarithmic Functions
2.12	Logarithmic Function Manipulation
2.13	Exponential and Logarithmic Equations and Inequalities
2.14	Logarithmic Function Context and Data Modeling
2.15	Semi-log Plots

Unit 3	Trigonometric and Polar Functions
3.1	Periodic Phenomena
3.2	Sine, Cosine, and Tangent
3.3	Sine and Cosine Function Values
3.4	Sine and Cosine Function Graphs
3.5	Sinusoidal Functions
3.6	Sinusoidal Function Transformations
3.7	Sinusoidal Function Context and Data Modeling
3.8	The Tangent Function
3.9	Inverse Trigonometric Functions
3.10	Trigonometric Equations and Inequalities
3.11	The Secant, Cosecant, and Cotangent Functions
3.12	Equivalent Representations of Trigonometric Functions
3.13	Trigonometry and Polar Coordinates
3.14	Polar Function Graphs
3.15	Rates of Change in Polar Functions

☑ **Units 1-3** will be tested on the AP Precalculus Exam. These units are required by colleges for credit and placement into Calculus 1.

Local discretion.

Unit 4	Functions Involving Parameters, Vectors, and Matrices
4.1	Parametric Functions
4.2	Parametric Functions Modeling Planar Motion
4.3	Parametric Functions and Rates of Change
4.4	Parametrically Defined Circles and Lines
4.5	Implicitly Defined Functions
4.6	Conic Sections
4.7	Parametrization of Implicitly Defined Functions
4.8	Vectors
4.9	Vector-Valued Functions
4.10	Matrices
4.11	The Inverse and Determinant of a Matrix
4.12	Linear Transformations and Matrices
4.13	Matrices as Functions
4.14	Matrices Modeling Contexts

⊘ **Unit 4** will <u>not</u> be tested on the AP Precalculus Exam.

Mathematical Practices

AP Precalculus

The eight distinct skills are associated with three mathematical practices.

- Students should build and master these skills throughout the course.

- While many different skills can be applied to any one content topic, the framework supplies skill focus recommendations for each topic to help assure skill distribution throughout the course.

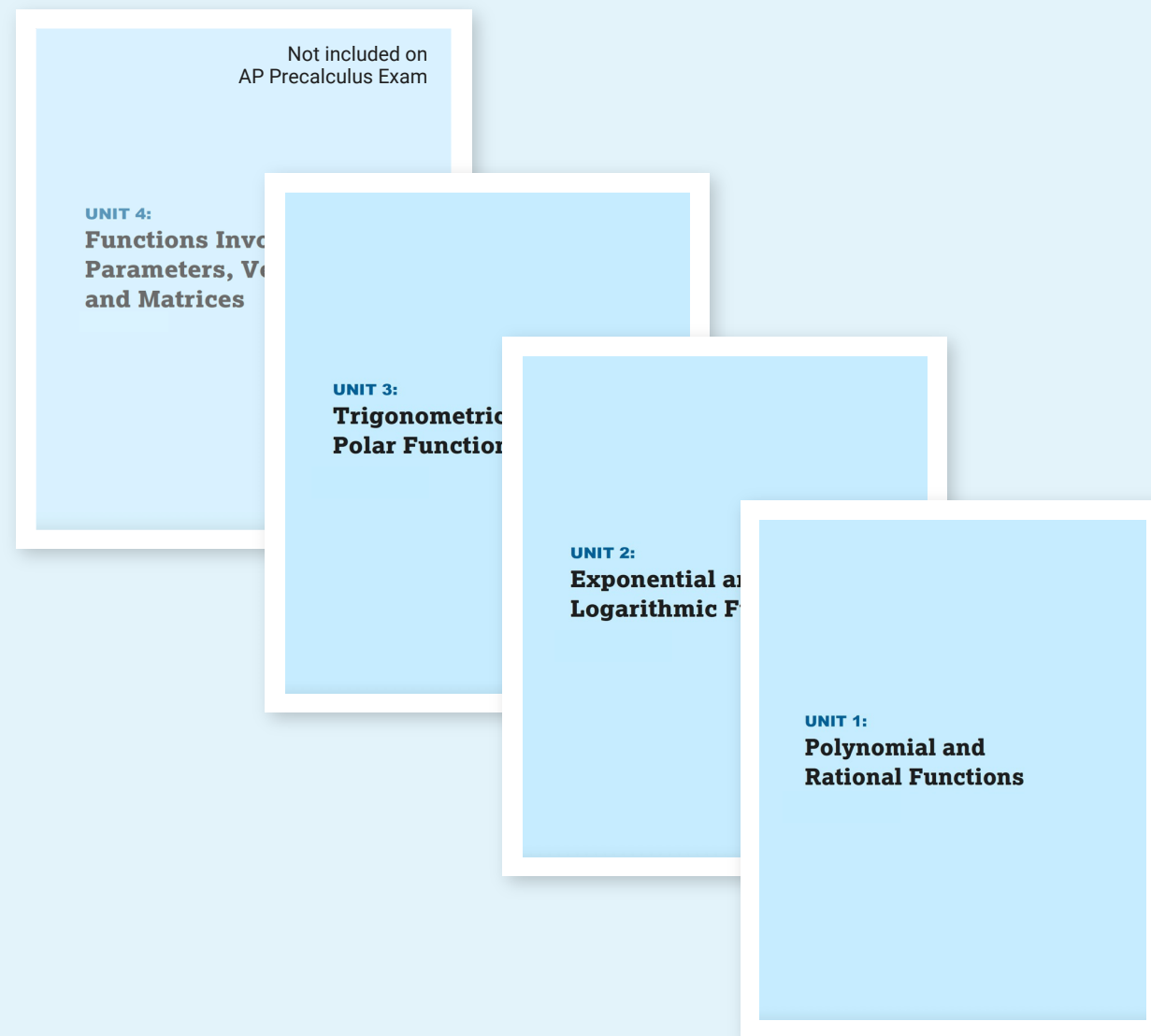| Practice 1	Practice 2	Practice 3
Procedural and Symbolic Fluency Algebraically manipulate functions, equations, and expressions.	**Multiple Representations** Translate mathematical information between representations.	**Communication and Reasoning** Communicate with precise language, and provide rationales for conclusions.
Skill 1.A: Solve equations and inequalities represented analytically, with and without technology. **Skill 1.B: Express** functions, equations, or expressions in analytically **equivalent forms** that are useful in a given mathematical or applied context. **Skill 1.C: Construct new functions**, using transformations, compositions, inverses, or regressions, that may be useful in modeling contexts, criteria, or data, with and without technology.	**Skill 2.A: Identify information from** graphical, numerical, analytical, and verbal **representations** to answer a question or construct a model, with and without technology. **Skill 2.B: Construct equivalent** graphical, numerical, analytical, and verbal **representations** of functions that are useful in a given mathematical or applied context, with and without technology.	**Skill 3.A: Describe** the **characteristics** of a function with varying levels of precision, depending on the function representation and available mathematical tools. **Skill 3.B: Apply** numerical **results** in a given mathematical or applied context. **Skill 3.C: Support conclusions** or choices with a logical rationale or appropriate data.

Unit Guides

AP Precalculus

Each unit includes these features:

- Exploration, analysis, and application of **new function types**.

- Deep development of a **key function concept** applicable across function types such as transformations, compositions, and inverses.

- Examination of **how variables change relative to each other** for each of the function types.

- Use of each function type to **model contexts and data sets**.

- Rigorous application of the **algebraic skills** needed to engage with each function type.

Not included on
AP Precalculus Exam

UNIT 4:
**Functions Invo...
Parameters, V...
and Matrices**

UNIT 3:
**Trigonometric...
Polar Function...**

UNIT 2:
**Exponential a...
Logarithmic F...**

UNIT 1:
**Polynomial and
Rational Functions**

Technology Notes

Technology should be used throughout the course as a tool to explore concepts.

Students should specifically practice using technology to do the following:

- Perform calculations (e.g., exponents, roots, trigonometric values, logarithms)

- Graph functions and analyze graphs

- Generate a table of values for a function

- Find real zeros of functions

- Find points of intersection of graphs of functions

- Find minima/maxima of functions

- Find numerical solutions to equations in one variable

- Find regressions equations to model data

- Perform matrix operations (e.g., multiplication, finding inverses)

Important: Technology should not replace the development of symbolic manipulation skills.

- When algebraic expressions and equations are accessible with precalculus-level algebraic manipulation, students are expected to find zeros, solve equations, and calculate values without the help of technology.

- Most of the AP Exam will need to be completed without the use of technology. However, selected questions will require students to use a graphing calculator to complete the tasks delineated above.

About the Exam

AP Precalculus

- The AP Precalculus Exam assesses student understanding of the mathematical practices and learning objectives outlined in **Units 1-3** in the course framework.

- **The exam is 3 hours long and includes 40 multiple-choice questions and four 6-point free-response questions.**

- The details of the exam, including exam weighting, timing, and calculator requirements, can be found to the right.

Section	Question Type	Number of Questions	Exam Weighting	Timing
I	**MULTIPLE-CHOICE QUESTIONS**			
	Part A: Graphing calculator not permitted	28	43.75%	80 minutes
	Part B: Graphing calculator required	12	18.75%	40 minutes
II	**FREE-RESPONSE QUESTIONS**			
	Part A: Graphing calculator required	2	18.75%	30 minutes
	Part B: Graphing calculator not permitted	2	18.75%	30 minutes

Reminder: **Unit 4** is <u>not</u> assessed on the AP Precalculus Exam.

4 Bring AP Precalculus to Your School

No Need to Switch: Use Your Existing Textbook

Precalculus is precalculus

Continue to use your existing precalculus textbook

- Teachers will find that the AP Precalculus course covers much of the same content as their existing precalculus course.

- They can continue to use their existing precalculus textbook, which is already college level, and follow along with the course and exam description.

- Free additional resources will be available in AP Classroom, including AP Daily videos and Personal Progress Checks.

Be Ready with Approved Calculators

What's Permitted on Exam Day

Course	Type of calculator allowed	Section I Multiple Choice	Section II Free Response
AP Precalculus	Graphing calculator	Required for Part B	Required for Part A
AP Calculus AB	Graphing calculator	Required for Part B	Required for Part A
AP Calculus BC	Graphing calculator	Required for Part B	Required for Part A

SUMMER 2022

The list of approved graphing calculators for AP Exams will be updated to indicate which approved calculators have the built-in capabilities needed for AP Precalculus.

Reminders about exam day rules:

- Students can't share calculators with other exam takers.

- If a student doesn't want to use a calculator, they may take an exam without one. However, if a student choose to take an exam without a calculator, they must hand copy, date, and sign a Calculator Release Statement on exam day, which will be provided by the AP coordinator or proctor.

Support Teachers

Professional Learning Opportunities

- Teachers can enroll in an AP Summer Institute (APSI) for Precalculus, a four-day professional learning experience that equips teachers with a deep understanding of the course framework, exam, and instructional supports. APSI scholarships will be available to teachers who qualify.

- Additional one-day professional learning workshops will also be available.

- AP students and teachers receive access to AP Classroom, free, digital instructional resources and through-course supports that include instructional videos, formative assessments, and personalized feedback reports.

Ensure Students are Ready

For Success in AP Precalculus

Expected Prior Knowledge and Skills	Algebra 1	Geometry	Algebra 2
Proficiency with linear functions	✔	✔	✔
Proficiency in polynomial addition and multiplication	✔		✔
Proficiency in factoring quadratic trinomials	✔		✔
Proficiency in using the quadratic formula	✔		✔
Proficiency in solving right triangle problems involving trigonometry		✔	✔
Proficiency in solving linear and quadratic equations and inequalities	✔		✔
Proficiency in algebraic manipulation of linear equations and expressions	✔	✔	
Proficiency in solving systems of equations in two and three variables	✔		✔
Familiarity with piecewise-defined functions	✔		✔
Familiarity with exponential functions and rules for exponents	✔		✔
Familiarity with radicals (e.g., square roots, cube roots)	✔	✔	
Familiarity with complex numbers			✔

About AP Precalculus

AP Central
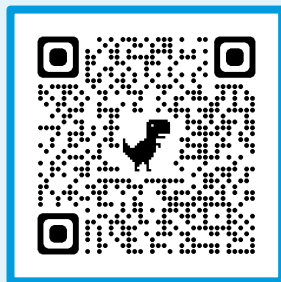
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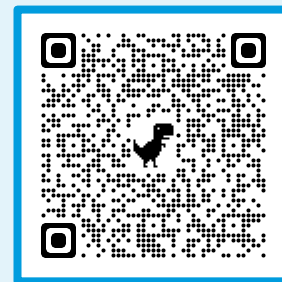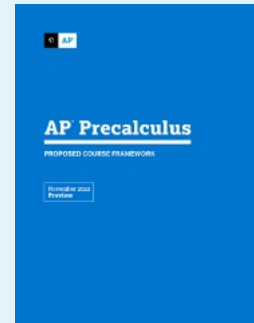
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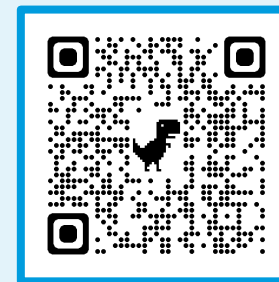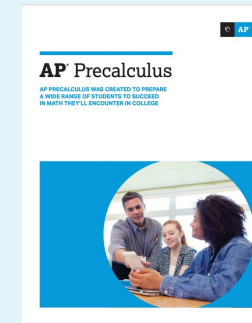
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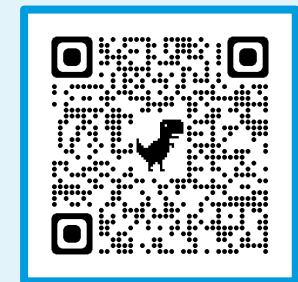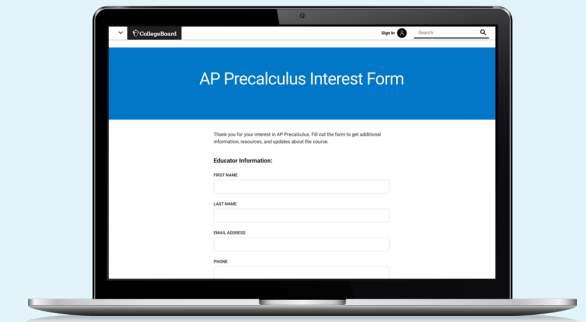
Download the **Offer AP Precalculus** Presentation

Presentation

Offer **AP Precalculus** at Your School
2023-24 School Year
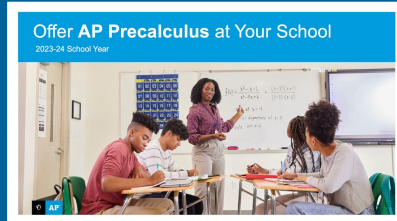
Here's what's inside:

01	Students
02	Content
03	Resources
04	Why
05	Learn More

Thank you.