Syllabus — Scholars Math 11: Calculus

Scholars Math 11 is a full-year Calculus curriculum for highly motivated students willing to face hard problems. This course covers limits, continuity, derivatives and their applications, definite and indefinite integrals, infinite sequences and series, plane curves, polar coordinates, and basic differential equations. At the conclusion of the course, students should have sufficient preparation to take the AP Calculus BC exam; however, AP exam preparation is not the main focus of the course.

In comparison to many high school calculus courses, Scholars Math 11 has two main goals:

- Students will gain a fundamental understanding of single-variable calculus, beyond the level of rote calculation.
- Students will learn how to apply calculus techniques to solve difficult problems.

Textbook(s):

Scholars Math 11 requires *Calculus* by David Patrick.

Sample Problems:

► Let f and g be functions with domain $\mathbb{R}$. Suppose

$$\lim_{x\to a} f(x) = b \text{ and } \lim_{x\to b} g(x) = c.$$

Prove or disprove that we must have $\lim_{x\to a}(g\circ f)(x) = c$.

► Sam wishes to cross a circular lake with diameter 1 km. He can row across the water at a rate of 4 km/hour, or he can walk along the shore (carrying the rowboat) at a rate of 6 km/hour. What is the minimum amount of time necessary to cross the lake?

► A 4-dimensional unit sphere is the set of 4-tuples (w, x, y, z) that satisfy $w^2+x^2+y^2+z^2 = 1$. Compute its volume.

► Suppose a, b, x, y are all positive and $a + b = 1$. Compute $\lim_{t\to 0^+}(ax^t + by^t)^{\frac{1}{t}}$.

Common Core State Standards (High School):

Domain	Subdomain	Standards
Functions	Interpreting Functions	4, 6, 7a
	Trigonometric Functions	5, 6, 8, 9

Time Commitment: 25 lessons, 2 hours in-class + 4–5 hours of homework per lesson.

Content:

Lesson	Scholars Topic
1	Trig Functions, Logarithms, and Exponentials
2	Sets and Functions
3	Limits and Continuity
4	Definition of the Derivative
5	Chain Rule and Implicit Differentiation
6	Interpretation of the Derivative
7	Optimization
8	More Derivative Applications
9	Related Rates
10	The Fundamental Theorem of Calculus
11	Integration I
12	Integration II
13	Integration III
14	Applications of the Integral
15	Infinity
16	Improper Integrals
17	Sequences
18	Taylor Series
19	Parametric Curves
20	Polar Coordinates
21	Extra Problems Day
22	Differential Equations I
23	Differential Equations II
24	Some Harder Problems
25	Course Review