Introduction to Limits and Derivatives

For Harvard High School Studies Program

Instructor: Esteban Madrigal

[madrigal@college.harvard.edu](mailto:madrigal@college.harvard.edu)

Prerequisites: Algebra II

Recommended: Trigonometry

Overlaps with Calculus

Grades: 9-12

In this course, we will learn about limits and derivatives and their applications. I am willing to slow the pace of the course in order to ensure the mastery of concepts, or speed it up if it’s easy. This course can be taken while taking trigonometry, but will be repetitive if taken with an introductory Calculus Course.

Materials:

I will provide worksheets, but those who want extra practice can use an introductory calculus textbook.

**Part One: Limits**

**Week 1**

An Introduction to Limits

Limits That Fail to Exist

A Formal Definition of a Limit

**Week 2**

Properties of Limits

A Strategy for Finding Limits

Cancellation and Rationalization Techniques

The Squeeze Theorem

**Week 3**

Continuity at a Point and on an Open Interval

One-Sided Limits and Continuity on a Closed Interval

Properties of Continuity

The Intermediate Value Theorem

**Week 4**

Infinite Limits

Vertical Asymptotes

**Part Two: Derivatives**

**Week 5**

The Tangent Line Problem

The Derivative of a Function

Differentiability and Continuity

**Week 6**

The Constant Rule

The Power Rule

The Constant Multiple Rule

The Sum and Difference Rules

Derivatives of Sine and Cosine Functions

Rates of Change

**Week 7**

The Product Rule

The Quotient Rule

Derivatives of Trigonometric Functions

Higher-Order Derivatives