**Course Overview**

This course will cover four major topics in the study of calculus: limits, derivatives, indefinite integrals, and definite integrals plus numerical approximations to definite integrals. These topics will be based on a sound and thorough understanding and familiarity with functions and graphs. For the necessary depth of understanding, the “why” that underlies the theories and concepts studied will be emphasized. Students will use discovery and inquiry learning techniques, graphing calculator technology, and lecture, skill and drill, and memorization to develop the skills and knowledge necessary to be successful in the class as well as on the AP exam. Each student will have their own graphing calculator, with the Casio fx-9860G being the choice of our district. Calculators will be used daily to explore concepts discussed in class, and to promote student’s ability to delve deeper into each topic and to develop the skill of asking questions that evidence higher depth of knowledge. This course will teach students how to use the graphing calculators to ***interpret results*** and ***support conclusions*.** The Visual Calculus website at the University of Tennessee – Knoxville will be used extensively in class on a SmartBoard, as well as independently by the students to develop a visual approach to the concept of limit, derivative, and integral.

**Primary Textbook**

Ron Larson and Bruce Edwards, *Calculus of a Single Variable - AP Edition, 10E*. Brooks/Cole, 2014.

The chapter numbers follow the textbook.

**Chapter P:** Functions and Models (1 – 2 weeks)

* Linear Models and Rates of Change
* Functions and their graphs
* Getting familiar with the graphing calculator

**Chapter 1:** Limits and Derivatives (4 – 5 weeks)

* Limits: finding limits graphically and numerically
* Evaluating Limits Analytically
* Continuity and One-Sided Limits
* Limits at Infinity; Horizontal Asymptotes
* Tangents, Velocities, and Other Rates of Change
* Derivatives

**Chapter 2:** Differentiation Rules (5 weeks)

* The Derivative and the Tangent Line Problem
* Basic Differentiation Rules and Rates of Change
* The Product and Quotient Rules and Higher Order Derivatives
* The Chain Rule
* Implicit Differentiation
* Derivatives of Logarithmic Functions
* Related Rates
* Linear Approximation and Differentials

**Chapter 3:** Applications of Differentitation (4 – 5 weeks)

* Maximum and Minimum Values
* The Mean Value Theorem
* How Derivatives Affect the Shape of a Graph
* Indeterminate Forms and L’Hospital’s Rule
* Summary of Curve Sketching
* Graphing with Calculus and Calculators
* Optimization Problems

**Chapter 4:** Integration (5 weeks)

* Areas and Distances
* The Definite Integral
* The Fundamental Theorem of Calculus
* Indefinite Integrals and the Net Change Theorem
* The Substitution Rule
* The Logarithm Defined as an Integral

**Chapter 7:** Applications of Integration (5 weeks)

* Area of a Region Between Two Curves
* Volume
  + The Disk Method
  + The Shell Method
* Arc Length and Surfaces of Revolution
* Work
* Moments, Centers of Mass and Centroids
* Fluid Pressure and Fluid Force

**Chapter 8:** Inegration Techniques, L’Hopital’s Rule, and Improper Integrals (2 – 3 weeks)

* Basic Integration Rules
* Integration by Parts
* Trigonometric Integrals
* Trigonometric Substitution
* Partial Fractions
* Integration by Table and Other Integration Techniques
* Indeterminate Forms and L’Hopital’s Rule
* Improper Integrals

**Chapter 6:** Differential Equations (1-2 weeks)

* Modeling with Differential Equations
* Direction Fields and Euler’s Method
* Separable Equations
* Exponential Growth and Decay
* The Logistic Equations
* Linear Equations
* Slope Fields

**Chapter 10:** Conics, Parametric Equations, and Polar Coordinates (2 – 3 weeks)

* Conics and Calculus
* Plane Curves and Parametric Equations
* Parametric Equations and Calculus
* Polar Coordinates and Polar Graphs
* Area and Arc Length in Polar Coordinates
* Polar Equations of Conics and Kepler’s Laws

This schedule leaves room for flexibility so that the needs of the students may be addressed in an effective manner. For many of our students this will be their first experience in an AP class, and while they are aware that the expectations are higher than they may be accustomed to, there will be a period of adjustment as the students acclimatize to these expectations.

**Student Activities**

The format for activities in each unit will alternate between two formats. First, students will work in teams or groups to complete all assignments, projects, and activities. Each team member will receive the same grade and be responsible for the material submitted by the group. This strategy is designed to develop team skills, cooperation, collaboration, and mentoring, thereby encouraging the ability to communicate mathematically and clearly with one another.

On alternating units each student will be responsible for their own work and collaboration is not permitted. All assignments, projects, and activities will be the responsibility of each student.

Students will also be assessed on a regular basis using quizzes and unit tests to determine mastery of stated goals and objectives from each unit.

*Limit Activity:*

The notion of limit is the basis of all of calculus. A limit can be thought of as a means of describing a function’s behavior at a point where the function cannot be evaluated. Let’s consider the function f(x) =  which is undefined at x = 0, but defined at all other x. The question arises, what do the values of the function do as x approaches 0? Using graphing calculators students will use a table of values and a plot of the graph to examine the behavior of the function near x = 0. By setting the delta y values to .01 it will be determined that the function approaches 1 as x values approach 0, which would be expressed mathematically by writing the limit as x approaches 0 of  = 1.

*Derivative Activity:*

The purpose of this activity is to reinforce the geometric interpretations of the derivative of a function f in terms of the graph of f. Students will graph the function f(x) = x4 – 6x3 + 8x2 in a [-2,5] by [-15,20] window. They will then find approximations for the endpoints, and state the intervals on which:

a) f(x) is positive b) f(x) is negative

c) f(x) is increasing d) f(x) is decreasing

e) the graph is concave up f) the graph is concave down

Add the graph of the derivative f ‘ (x) = 4x3 – 18x2 + 16 x, and using the same endpoints, state the intervals on which

a) f ‘ (x) is positive b) f ‘ (x) is negative

c) f ‘ (x) is increasing d) f ‘ (x) is decreasing

Students will finish the activity by writing a short paper explaining any patterns they have discerned and relationships between the graph of f(x) and its derivative.

*Antidifferentiation and rectilinear motion activity:*

A small rocket has a mass of 100 kg, including 30 kg of fuel. Its engine burns fuel at a constant rate of 1 kg/sec and produces a constant thrust of 980 Newtons until the fuel is exhausted. The engine is ignited at time t = 0, propelling the rocket upward on a vertical path.

1. Express the mass m of the rocket, including fuel as a function of t, for t 0. after how many seconds does the rocket run out of fuel?

2. Let y(t) denote the height in meters of the rocket at time t seconds. If we ignore air resistance, Newton’s second law gives the equation

(m(t)) = -9.8m(t) +m980,

up until the instant when the rocket runs out of fuel. Find the height function y(t) that is in effect up until the instant when the rocket runs out of fuel. What are the velocity and the height of the rocket at the instant when the rocket runs out of fuel?

3. After the rocket runs out of fuel, the problem becomes a simple one concerning the height of a projectile for which the only acceleration comes from gravity, and the initial height and velocity are known. Extend the height function y(t) from #2 so that it is valid from time t = 0 until the rocket falls to the ground

4. Find the maximum height attained by the rocket.

***Modes of Assessment:***

**Written Tests:**

Written tests will be administered periodically in order to assess the students’ knowledge of topics within Calculus.

**Homework Assignments:**

***The importance of homework is to be emphasized in this course.*** Homework is given on a regular basis and students are to complete the assignments in a thorough manner. Homework is given to develop skills taught in class and benefits the student, and is therefore not optional.

**Projects:**

In order to fully implement the concept of Calculus, application is essential. Therefore, students will be expected to perform in-depth research and create projects on topics assigned. This component of the course will be conducted on an individual or group basis.

**Class Work/Activities:**

Students are expected to actively and respectfully participate in all activities and assignments. ***Courtesy, consistency and work ethic are major factors in grading*** these activities.

**Oral Presentations:**

Students will be expected to present topics that will adequately demonstrate their understanding of Calculus concepts.

***Grading Scale:***

A = 90 to 100%

B = 80 to 89%

C = 70 to 79%

D = 60 to 69%

F = 0 to 59%

***Course Evaluations:***

Averages for each quarter shall be determined as follows:

**Class work – 40%**

* Labs, Projects, Independent Work, Research Assignments, Presentations

**Assessments – 35%**

* Quizzes, Tests, Final Exams, Benchmarks, EOC exams, AP exams

**Participation – 15%**

* Do Now, Journals, Discussion Posts, Exit Slips, Leadership Roles

**Homework – 10%**

***Main Textbook:***

**Calculus of a Single Variable 10e: by Ron Larson and Bruce Edwards**

*(Last two sheets, below attached, are contractual printout for parental and student signatures)*

**Classroom Rules:**

* **WE WILL RESPECT ONE ANOTHER**
  + Coarse language is unacceptable
  + Inappropriate physical contact is unacceptable
* **WE WILL BE PUNCTUAL**
  + Be in room and on task on time everyday
* **WE WILL BE PREPARED**
  + Bring textbook, calculator, paper, pencil and eraser everyday
* **WE WILL BE PROFESSIONAL**
  + Stay seated and working
  + Respectfully raise hands for help
  + Maintain reasonably quiet room for everyone’s benefit
  + Dress according to school codes
  + Damage or destroy nothing
  + Do not leave seats or room until officially dismissed

**Consequences:**

* VERBAL WARNING
* LOSS OF BONUS POINTS
* REFERRAL AND PARENTAL NOTIFICATION
* PRINCIPAL DISCIPLINARY ACTION(S)
* *Consequences may not always occur in this order. Disturbances will result in appropriate consequences*.

**Micro Economy Bonus and Demerit Designations:**

**Daily Participation: 10 points** *(Must be present to gain these points)*

**Bonus: Fines:**

Exceptionality +2 Insubordination -2 per occurrence

Work Ethic +2 Tardiness -2 per occurrence

Group Value +2 Wardrobe Violation -1 per occurrence

**Note to Parent and Student:**

**Attendance, punctuality, and engagement are critical factors to success** and can have adverse effects upon grade if they are not appropriately managed. Please be sure to attend, be on time, and prepared physically and mentally to engage in the learning process to ensure your best possible experience in this class.

**Parents:**

If you have any questions or concerns about your student’s achievement, or if there is anything that I should know that might help me to teach your student, please feel free to contact me [gregory.taylor@slps.org](mailto:gregory.taylor@slps.org) throughout the school year. Electronic copy of the syllabus is available at: <http://math-science.weebly.com/calculus-syllabus.html>

I am here to prepare your child for college and/or the adult working environment. Good citizenship is highly emphasizes and factored in the grades using cooperative activities, bonus awards, along with peer and self assessments. Whether this is a freshman, or up to a senior level course, citizenship and work ethic shall be emphasized and expected. Any help you might offer will be greatly appreciated and utilized. Thank you.

Finally there is an expectation that you will assume the responsibility of maintaining a current phone number with me, or the main office, to ensure my ability to contact you with issues of concern, or excellence, as necessary throughout the year.

I have read and understand the rules and regulations for Dr. Taylor’s class:

***Parent phone for immediate discretionary contact: ( ) -***

Parent Signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Student Signature\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Print Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_\_\_\_\_\_\_\_

By signing above ALL parties agree to abide by the technology acceptable usage criteria for both the SLPS district and Carnahan HSOF. Any infraction can result in the above student losing ALL technology privileges for the remainder of the school year.

Returning this portion of the syllabus document completed and signed in a prompt manner is the ***first assignment*** of the year and ***does carry point value*** for your student grade. Failure to complete this will result in a PAN *(parental appearance notification).*

I also acknowledge that failing to take the AP Central final examination will result in a failing grade for the class. It is imperative that ALL students take the AP exam on the official school wide date which shall be announced during the term of this class. There are NO exceptions to this policy.

Thank you for all of your support.

Gregory L. Taylor, Ed.D.