# AP CALCULUS

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| **Course Name: AP CALCULUS** | |
| **Time Frame: 6 weeks** | |
| **Unit Name** | Unit 1: Local Linearity, Limits, and Continuity |
| **Standards** | Local Linearity<br>• Explore various functions and discover that by zooming in, the function may appear to be a straight line<br>• Find the slope of a line with these two points that are very close together<br>• Students work in pairs to find the slope of the segment connecting the two points<br>    Each pair is responsible for finding the slope at several points on a given function<br>• Explore the various functions as each pair reports on their finding<br>• Refer back to this activity often in our later studies<br>• Use this activity to review concepts needed for calculus<br>• Students use graphing calculators to explore and discover<br>• Emphasize the four capabilities that students are allowed to use on the exam – plot the graph of a function within an arbitrary viewing window, find the zeros of functions, numerically calculate the derivative of a function, and numerically calculate the value of a definite integral<br>• Assessments are given both with and without the graphing calculator<br><br>3. Limits<br>• Intuitive understanding, using algebra<br>• Intuitive understanding estimating limits from graphs and tables of values<br>• Use the graphing calculator to find limits on the graph screen and from the table (TEST 1)<br>4. Continuity<br>• Definition of continuity, one-sided limits, Intermediate Value Theorem |
| **Essential Questions** | What is calculus? Speed? Velocity? Analytically? Graphically?<br>What is IROC? What is AROC?<br>What is tangent? Secant? Derivative?<br>What is the Limit Concept?<br>What are strategies for finding limits?<br>What is continuity? Discontinuity?<br>What are some properties of continuity?<br>What is an asymptote? VA? HA?<br>What is meant by a limit to infinity? Rational, polynomial, exponential, logarithmic?<br>What is BOBO/BETC/BOTU? |
| **Essential Vocabulary** | 1. calculus            9. derivative<br>2. speed             10. limit<br>3. Velocity          11. continuity<br>4. IROC              12. Asymptote/ HA/ VA<br>5. AROC            13. infinity<br>6. slope             14. BOBO/BETC/BOTU<br>7. tangent<br>8. secant |

| Assessments | Formative:<br>Warm-up assesses learning from previous day<br>Questioning and Discussion assess on-going learning throughout class<br>Class examples (individual and cooperative): assesses learning as lesson progresses<br>Homework assesses learning and information retained from class activities<br><br>Summative: AP CALCULUS MOCK EXAM, AP CALCULUS EXAM<br>Quiz<br>Test<br>Unit Test |
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| **Resources & Instructional Activities**<br><br>☒ Blended Instruction<br><br>☒ Literacy<br><br>☒ SCA<br><br>TCA<br>☒ | *Rogawski's Calculus for AP\*, 5 Steps To A 5, Master Math Mentor Software*<br><br>Technology is used daily.<br>_____Smart Board<br>_____ELMO<br>_____ Graphing Calculators<br>_____IPAD<br><br>Literacy: Decoding math problems is used daily.<br><br>SCA: Used daily during cooperative learning – class examples<br><br>TCA: Used daily during lectures, leading class discussions, and presentation of new content. |

| Course Name: AP CALCULUS | |
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| **Time Frame: 6 weeks** | |
| **Unit Name** | UNIT 2: THE DERIVATIVE |
| **Standards** | • Students should understand the meaning of the derivative in terms of a rate of change and local linear approximation, and should be able to use derivatives to solve a variety of problems.<br><br>**A.     Concept of the derivative**<br>1.     Derivative presented graphically, numerically, and analytically<br>2.     Derivative interpreted as an instantaneous rate of change<br>3.     Derivative defined as the limit of the difference quotient<br>4.     Relationship between differentiability and continuity<br><br>**B.     Derivative at a point**<br>1.     Slope of a curve at a point - Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents.<br>2.     Tangent line to a curve at a point and local linear approximation<br>3.     Instantaneous rate of change as a limit of average rate of change<br>4.     Approximate rate of change from graphs and tables of values<br><br>**C.     Derivative as a function**<br>1.     Corresponding characteristics of graphs of  f and f'<br>2.     Relationship between the increasing and decreasing behavior of f and the sign of f'<br>3.     The Mean Value Theorem and its geometric interpretation<br>4.     Equations involving derivatives - Verbal descriptions are translated into equations involving derivative and vice versa.<br><br>**D.     Second derivatives**<br>1.     Corresponding characteristics of the graphs of f, f', and f"<br>2.     Relationship between the concavity of f and the sign of f"<br>3.     Points of inflection as places where concavity changes |
| **Essential Questions** | 1.     What are rules for differentiation?<br>2.     What is The Product Rule, The Quotient Rule, Derivatives of Trig Functions, Higher-Order Derivatives<br>3.     What is the Chain Rule (M&M activity)?<br>4.     What are Derivatives of natural log functions and exponential functions?<br>5.     What is Implicit Differentiation?<br>6.     What are Related Rates?<br>7.     What are Extrema, Relative Extrema, and Critical Numbers?<br>8.     What is Rolle's Theorem and Mean Value Theorem?<br>9.     What is The First Derivative Test and Increasing and Decreasing Functions?<br>10.     How do we apply each of these topics as we use Calculus? |

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| **Essential Vocabulary** | The Constant Rule, The Power Rule, The Constant Multiple Rule, The Sum and Difference Rules, Sine and Cosine, Rates of Change, Derivative, Rules for Differentiation, The Product Rule, The Quotient Rule, Derivatives of Trig Functions, Higher-Order Derivatives, The Chain Rule, Derivatives of natural log functions and exponential functions, Implicit Differentiation, Related Rates, Extrema, Relative Extrema, Critical Numbers, Rolle's Theorem and Mean Value Theorem, The First Derivative Test, Increasing and Decreasing Functions |
| **Assessments** | Formative:<br>Warm-up assesses learning from previous day<br>Questioning and Discussion assess on-going learning throughout class<br>Class examples (individual and cooperative): assesses learning as lesson progresses<br>Homework assesses learning and information retained from class activities<br><br>Summative: AP CALCULUS MOCK EXAM, AP CALCULUS EXAM<br>Quiz<br>Test<br>Unit Test |
| **Resources & Instructional Activities**<br><br>☒ Blended Instruction<br><br>☒ Literacy<br><br>☒ SCA<br><br>TCA<br>☒ | *Rogawski's Calculus for AP\*, 5 Steps To A 5, Master Math Mentor Software*<br><br>Technology is used daily.<br>_____Smart Board<br>_____ELMO<br>_____ Graphing Calculators<br>_____IPAD<br><br>Literacy: Decoding math problems is used daily.<br><br>SCA: Used daily during cooperative learning – class examples<br><br>TCA: Used daily during lectures, leading class discussions, and presentation of new content. |

# AP CALCULUS

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| **Course Name:  AP Calculus** | |

**Time Frame: 9 weeks**

| Unit Name | UNITS  3 - 5: APPLICATIONS OF THE DERIVATIVE |
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| **Standards** | • Students should be able to work with functions represented in a variety of ways: graphical, numerical, analytical, or verbal. They should understand the connection among these representations.<br>• Students should understand the meaning of the derivative in terms of a rate of change and local linear approximation, and should be able to use derivatives to solve a variety of problems. |
| **Essential Questions** | 1 What is the Concept of the derivative?<br>2 How do you represent the derivative presented graphically, numerically, and analytically?<br>3 What is the derivative interpreted as an instantaneous rate of change?<br>4 What is the derivative defined as the limit of the difference quotient?<br>5 Relationship between differentiability and continuity?<br>6 How do you evaluate a derivative at a point?<br>7 How do you find the slope of a curve at a point? What is a vertical tangent and what does it imply?<br>8 How do you find a tangent line to a curve at a point and local linear approximation?<br>9 What is instantaneous rate of change as a limit of average rate of change?<br>10 How do you approximate rate of change from graphs and tables of values?<br>11 How do you use the derivative as a function?<br>12 What are the corresponding characteristics of graphs of f and f'?<br>13 What is the relationship between the increasing and decreasing behavior of f and the sign of f'?<br>14 What is the Mean Value Theorem and its geometric interpretation?<br>15. How do you use equations involving derivatives - Verbal descriptions are translated into equations involving derivative and vice versa?<br>16 What is meant by second derivative?<br>17 What are the corresponding characteristics of the graphs of f, f', and f"?<br>18 What is the relationship between the concavity of f and the sign of f"?<br>19 What are points of inflection as places where concavity changes?<br>20 What are some applications of derivatives?<br>21 What is monotonicity and concavity?<br>22 What is optimization, both absolute (global) and relative (local) extrema?<br>23 How do you interpretation of the derivative as a rate of change in varied applied contexts including velocity, speed, and acceleration?<br>24 What is implicit differentiation?<br>25 What is a related rate? |
| **Essential Vocabulary** | Extrema, Relative Extrema, Critical Numbers, Rolle's Theorem and Mean Value Theorem, The First Derivative Test, Increasing and Decreasing Functions,, Applications of the Derivative, Concavity, Points of Inflection, The Second Derivative Test, Derivative as a rate of change – position, velocity, acceleration, and the question of speed, connecting  in tables and graphs, Curve Sketching without the graphing calculator, Implicit Differentiation, Related Rates |
| **Assessments** | Formative: Warm-up assesses learning from previous day<br>Questioning and Discussion assess on-going learning throughout class<br>Class examples (individual jand cooperative): assesses learning as lesson progresses<br>Homework assesses learning and information retained from class activites<br>Summative: AP CALCULUS MOCK EXAM, AP CALCULUS EXAM |

| | Quiz<br>Test<br>Unit Test |
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| **Resources & Instructional Activities**<br><br>☒ Blended Instruction<br><br>☒ Literacy<br><br>☒ SCA<br><br>  TCA<br>☒ | *Rogawski's Calculus for AP\*, 5 Steps To A 5, Master Math Mentor Software*<br><br>Technology is used daily.<br>_____Smart Board<br>_____ELMO<br>_____ Graphing Calculators<br>_____IPAD<br><br>Literacy: Decoding math problems is used daily.<br><br>SCA: Used daily during cooperative learning – class examples<br><br>TCA: Used daily during lectures, leading class discussions, and presentation of new content. |

| Course Name: AP Calculus | |
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| **Time Frame: 6 weeks** | |
| **Unit Name** | UNIT 6: INTEGRALS |
| **Standards** | Students should understand the meaning of the definite integral both as a limit of Riemann sums and as the net accumulation of change, and should be able to use integrals to solve a variety of problems.<br><br>Students should understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental theorem of Calculus.<br><br>Students should be able to communicate mathematics and explain solutions to problems both verbally and in well-written sentences.<br><br>Students should be able to model a written description of a physical situation with a function, a differential equation, or an integral.<br><br>Students should be able to use technology to solve problems.<br><br>Students should be able to determine the reasonableness of solutions.<br><br>Students should develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment. |
| **Essential Questions** | 1 What is an integral?<br>2 What is a definite/indefinite integral?<br>3 How do you define an integral as a limit of Riemann sums?<br>4 What do you use area and definite integrals? Riemann sum? Left? Right? Midpoint?<br>5 What is the Mean Value Theorem for Integrals and the Average Value of a function?<br>6 What is the Fundamental Theorem of Calculus, I and II<br>7. How do you do integration by substitution? Pattern recognition? Change of variable for definite integrals? Integration of odd and even functions?<br>8 What is the trapezoid approach for finding area?<br>9 What is an inverse function? Derivative of an inverse function?<br>10 How do you integrate natural log and exponential functions? |
| **Essential Vocabulary** | Slope field, differential equation, Area and Definite Integrals, Riemann Sums, left, right, and mid-point The Mean Value Theorem for Integrals and the Average Value of a Function, The Fundamental Theorem of Calculus ( I and II), Integration by Substitution, Pattern Recognition, Change of Variables for Definite Integrals, Integration of Odd and Even Functions, Trapezoid Approach for finding Area, Inverse Functions, Derivative of an Inverse Function, Integration of natural log and exponential functions |

| Resources & Instructional Activities | Rogawski's Calculus for AP*, 5 Steps To A 5, Master Math Mentor Software |
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| ☒ Blended Instruction<br><br>☒ Literacy<br><br>☒ SCA<br><br>TCA<br>☒ | Technology is used daily.<br>_____Smart Board<br>_____ELMO<br>_____ Graphing Calculators<br>_____IPAD<br><br>Literacy: Decoding math problems is used daily.<br><br>SCA: Used daily during cooperative learning – class examples<br><br>TCA: Used daily during lectures, leading class discussions, and presentation of new content. |

**Course Name: AP Calculus**

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| **Time Frame: 5 weeks** | |
| **Unit Name** | UNIT 7: Differential Equations, Mathematical Modeling, Applications of Definite Integrals, and Slope Fields |
| **Standards** | 1. Differential Equations: Students explore Growth and Decay Models<br>2. Students solve Inverse Trig Functions - Derivatives of inverse Trig Functions<br>3. Students will evaluate Integrals Involving Inverse Trig Functions<br>4. Students will find Area between curves<br>5. Students will find Volumes of solids – Disc, Washer, and Known Cross Sections<br>6. Slope fields – students explore several differential equations and draw the slope fields by hand. They learn characteristics of various differential equations. Students identify the slope field by the differential equation that created it and by the function that it could represent. We combine the graphical approach with the algebraic approach, when possible, and compare our results. |
| **Essential Questions** | 1. What is a differential equation? How do you solve a differential equation?<br>2. What is a growth and decay model?<br>3. How do you evaluate derivatives and integrals involving inverse trigonometric functions?<br>4. How do you find area between curves?<br>5. How do you draw a slope field? What is a slope field? |
| **Essential Vocabulary** | Slope field, differential equation, area between curves, inverse trig derivative, inverse trig integral, growth and decay |
| **Assessments** | Formative: Warm-up assesses learning from previous day<br>Questioning and Discussion assess on-going learning throughout class<br>Class examples (individual and cooperative): assesses learning as lesson progresses<br>Homework assesses learning and information retained from class activiites<br>Summative: AP CALCULUS MOCK EXAM, AP CALCULUS EXAM<br>Quiz<br>Test<br>Unit Test |

| Resources & Instructional Activities | *Rogawski's Calculus for AP\*, 5 Steps To A 5, Master Math Mentor Software* |
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| ☒ Blended Instruction<br><br>☒ Literacy<br><br>☒ SCA<br><br>TCA<br>☒ | Technology is used daily.<br>_____Smart Board<br>_____ELMO<br>_____ Graphing Calculators<br>_____IPAD<br><br>Literacy: Decoding math problems is used daily.<br><br>SCA: Used daily during cooperative learning – class examples<br><br>TCA: Used daily during lectures, leading class discussions, and presentation of new content. |

**Course Name: AP Calculus**

**Time Frame: 4 weeks**

| Unit Name | Review: Unit 8: AP Exam Preparation/AP Exam |
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| Standards | All standards previously stated and covered during this course. |
| Essential Questions | All essential questions previously stated and covered during this course. |
| Essential Vocabulary | All essential vocabulary previously stated and covered during this course. |
| Assessments | Formative: Warm-up assesses learning from previous day<br>Questioning and Discussion assess on-going learning throughout class<br>Class examples (individual and cooperative): assesses learning as lesson progresses<br>Homework assesses learning and information retained from class activities<br>Summative: AP CALCULUS MOCK EXAM, AP CALCULUS EXAM<br>Quiz<br>Test<br>Unit Test |
| Instructional Activities<br><br>☒ Blended Instruction<br><br>☒ Literacy<br><br>☒ SCA<br><br>☒ TCA | *Rogawski's Calculus for AP\*, 5 Steps To A 5, Master Math Mentor Software*<br><br>Technology is used daily.<br>_____Smart Board<br>_____ELMO<br>_____ Graphing Calculators<br>_____IPAD<br><br>Literacy: Decoding math problems is used daily.<br><br>SCA: Used daily during cooperative learning – class examples<br><br>TCA: Used daily during lectures, leading class discussions, and presentation of new content. |