

# Calculus Math Curriculum



## Egg Harbor Township School District

State Board Adoption Date of Standards: 5/2016

## Unit Overview (Standards Coverage)

Unit	Standards	Unit Focus	Standards for Mathematical Practice	Open Educational Resources
<b>Unit 1</b> <i>Limits and Continuity</i> 20 Days	<b>Limits</b> <b>Continuity</b>	<b>How does knowing the value of a limit, or that a limit does not exist, help you to make sense of interesting features of functions and their graphs?</b>	MP.1 Determine expressions and values using mathematical procedures and rules.	<b>AP Central</b> <b>Khan Academy</b> <b>Wolfram Mathworld</b> <b>Delta Math</b>
<b>Unit 2</b> <i>Differentiation</i> 50 Days	<b>Differentiation</b> <b>Continuity and Differentiability</b> <b>Rules of Differentiation</b> <b>Applications of Derivatives</b>	<b>What is meant by an instantaneous rate of change? How do mathematical properties and rules for simplifying and evaluating limits apply to differentiation?</b>	MP.2 Translate mathematical information from a single representation or across multiple representations.	<b>AP Central</b> <b>Khan Academy</b> <b>Wolfram Mathworld</b> <b>Delta Math</b>
<b>Unit 3</b> <i>Integration</i> 50 Days	<b>Area</b> <b>Integration</b> <b>Differential Equations</b> <b>Applications of Integration</b>	<b>How is integrating to find areas related to differentiating to find slopes?</b>	MP.3 Justify reasoning and solutions.  MP.4 Use correct notation, language, and mathematical conventions to communicate results or solutions.	<b>AP Central</b> <b>Khan Academy</b> <b>Wolfram Mathworld</b> <b>Delta Math</b>

**This document outlines in detail the answers to following four questions:**

1. What do we want our students to know?
2. How do we know if they learned it?
3. What do we do if they did not learn it?
4. What do we do when they did learn it?

**Curricular Framework MATH-Calculus**

Unit 1 CALCULUS: Limits and Continuity		
Content & Practice Standards	Interdisciplinary Standards	Critical Knowledge & Skills
<ul style="list-style-type: none"> <li>● Limits</li> <li>● Continuity</li> <li>● Asymptotes</li> </ul>	<ul style="list-style-type: none"> <li>● <b>Reading:</b> Infused within the unit are connections to the NJSLs for Mathematics, Language Arts Literacy WHST.11-12.10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</li> <li>● <b>Educational Technology:</b> All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.</li> </ul>	Students will solve for Limits, Continuity and Asymptotes.
Unit 1 CALCULUS: Limits and Continuity		
Stage 1 – Desired Results		
UNIT SUMMARY	CORE AND SUPPLEMENTAL MATERIALS/RESOURCES	
Students must understand the concept of limits before proceeding on to differentiation. We learn to interpret functions graphically, numerically, analytically, and verbally.	<ul style="list-style-type: none"> <li>● Textbook</li> <li>● TI-89 Graphing Calculator</li> </ul>	
UNDERSTANDINGS		
Students will understand there may be a difference between the value of a function at a given point and the limit of that function as $x$ approaches the given point. Students will understand that mathematical information can be presented graphically, numerically, analytically, and/or verbally.		
Students will know...	Students will be able to...	
What is meant by the concepts of limits and continuity. How to evaluate/estimate limits graphically, numerically, and analytically.	Evaluate/estimate limits graphically, numerically, and analytically. Use appropriate notation for limits.	
Stage 2 – Assessment Evidence		
Performance Tasks: <i>What projects, hands-on lessons, use of manipulatives, active participation in new situations, etc. will reveal evidence of meaning-making and transfer (true understanding)?</i> <u>Performance Tasks/Use of Technology</u> <ul style="list-style-type: none"> <li>● Khan Academy</li> <li>● Delta Math</li> <li>● College Board</li> </ul>	Other Evidence: <i>What other means of assessment will be used throughout this unit?</i> <u>Formative</u> <ul style="list-style-type: none"> <li>● Observation</li> <li>● Homework</li> <li>● Class Participation</li> <li>● Notebook Checks</li> <li>● Self-assessment</li> </ul>	

	<p><b>Summative</b></p> <ul style="list-style-type: none"> <li>● Chapter/Unit Test</li> <li>● Quizzes</li> <li>● Presentations</li> <li>● Unit Projects</li> </ul>
<b>Stage 3 – Learning Plan</b>	
<p>Introducing Calculus: Can Change Occur at an Instant?          Defining Limits and Using Limit Notation          Estimating Limit Values from Graphs and Tables          Determining Limits Algebraically          Selecting Procedures for Determining Limits          Determining Limits Using the Squeeze Theorem          Connecting Multiple Representations of Limits          Defining Continuity at a Point and Over an Interval          Connecting Limits and Asymptotes</p>	
<b>Planned Differentiation &amp; Interventions for Tiers I, II, III, ELL, SPED, and Gift &amp; Talented Students</b>	
<ul style="list-style-type: none"> <li>• <i>Rethink and revise. Dig deeper into ideas at issue (through the faces of understanding). Revise, rehearse, and refine, as needed. Guide students in self-assessment and self-adjustment, based on feedback from inquiry, results, and discussion.</i></li> <li>• <i>Evaluate understandings. Reveal what has been understood through final performances and products. Involve students in a final self-assessment to identify remaining questions, set future goals, and point toward new units and lessons.</i></li> <li>• <i>Tailor (personalize) the work to ensure maximum interest and achievement. Differentiate the approaches used and provide sufficient options and variety (without compromising goals) to make it most likely that all students will be engaged and effective.</i></li> </ul>	
<p><b>Gifted &amp; Talented:</b></p> <ul style="list-style-type: none"> <li>● “Differentiating the Lesson” in Big Ideas online resources for all sections</li> <li>● “Additional Topics” in Big Ideas online resources to extend and enhance instruction</li> <li>● Big Ideas Game Closet</li> <li>● Big Ideas Differentiated Instruction options</li> <li>● Big Ideas Mini-Assessments</li> <li>● Design Challenges</li> </ul>	

- Student Choice/Driven Activities
- Group Projects
- MobyMax
- LinkIt!
- Rocket Math
- [Intervention Central](#)
- [Do to Learn](#)
- [Differentiation Strategies for Math](#)
- [Discovery Education Math](#)
- [Everyday Mathematics](#)
- [Homework Spot](#)
- [Math Fact Fluency](#)

**Tier I:**

- “Differentiating the Lesson” in Big Ideas online resources for all sections
- Big Ideas MATH Pyramid of Tiered Interventions for additional resources
- Record and Practice Journal
- Differentiated Instruction options
- Fair Game Review
- Vocabulary Support Glossary resources
- Mini-Assessments
- Game Closet
- Lesson Tutorials
- Flash Cards
- Extended Time
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Math Tutoring Center (HS only)
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**Tier II:**

- Lesson Tutorials
- Basic Skills Handbook
- Skills Review Handbook
- Differentiated Instruction Big Ideas resources
- Game Closet
- Centers/Small Group Instruction
- Math Tutoring Center (HS only)
- Math Lab/Tutorial
- MobyMax
- LinkIt!
- Math Fact Fluency/Rocket Math

**Tier III:**

- Customized Learning Intervention Activities resources
- Intensive Intervention resource
- Systematic Assessments to focus on specific deficits

**ELL:**

- Big Ideas Math Student Editions are available online in Spanish
- Letters to Parents are available in the Resources by Chapter book to assist in guiding parents through each chapter and offer helpful suggestions they can use to demonstrate mathematical concepts for their child in daily activities. These letters are editable so teachers can customize them.
- Student Dynamic eBook Audio has the option to be read in English or Spanish
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- ELL Notes included in Teacher Edition to help teachers overcome obstacles.
- Record & Practice Journal available in Spanish.
- Student Journal available in Spanish.
- Chapter Reviews available in English and Spanish.
- Vocabulary Flash Cards
- Chunking Information

- Math Word Wall/Word Bank
- Multi-Sensory Instruction
- Use of Translation software
- Gradual Release Model
- [TODOS: Mathematics for ALL](#) - Excellence and Equity in Mathematics
- [FABRIC - A Learning Paradigm for ELLs](#) (NJDOE resource)

**SPED:**

- Menu Math (mostly for very low functioning students)
- Math Labs/Tutorial
- MobyMax
- LinkIt!
- IXL
- Learning Ally (audio version for textbooks and other published materials) – Also available for 504 students
- Apex Online Learning – Bridge students only
- Use of specialized equipment such as beeping balls, text to speech and speech to text software, special seats or desks
- Use of hands-on materials for problem solving
- Visual supports and Use of Manipulatives
- Extended time to complete tests and assignments
- Graphic Organizers/Study Guides
- Mnemonic tricks to improve memory
- Reducing workload
- Centers/Small Group Instruction
- Adjusting accountability for standards by focusing only on essential standards
- Use of iPads or laptops for students with motor issues that make writing difficult
- Use of tangible rewards (certificates, small toys, etc. per behavior plan)
- Use prompts and model directions
- Use task analysis to break down activities and lessons into each individual step needed to complete the task
- Use concrete examples to teach concepts
- Have student repeat/rephrase written directions
- Provide multi-sensory, hands-on materials for instruction
- Chunking Information
- Modify all fine motor tasks for example: (fat crayons, pencil grip, adaptive scissors)
- Functional or practical emphasis

**504:**

- Learning Ally (audio version for textbooks and other published materials)
- Extra help opportunities

- Reduce workload
- Partial credit
- Allow use of calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed ( use interactive notebook)
- Preferential Seating
- Extra Practice
- Directions repeated, clarified and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives

**Curricular Framework MATH-Calculus**

<b>Unit 2 CALCULUS: Differentiation</b>		
<b>Content &amp; Practice Standards</b>	<b>Interdisciplinary Standards</b>	<b>Critical Knowledge &amp; Skills</b>
<ul style="list-style-type: none"> <li>● <b>Differentiation</b></li> <li>● <b>Continuity and Differentiability</b></li> <li>● <b>Rules of Differentiation</b></li> <li>● <b>Applications of Derivatives</b></li> </ul>	<ul style="list-style-type: none"> <li>● <b>Reading:</b> Infused within the unit are connections to the NJSLs for Mathematics, Language Arts Literacy WHST.11-12.10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</li> <li>● <b>Educational Technology:</b> All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.</li> </ul>	<p>Students must understand and apply differentiation, continuity, differentiability, rules of differentiation and application of derivatives.</p>
<b>Unit 2 CALCULUS: Differentiation</b>		
<b>Stage 1 – Desired Results</b>		
<b>UNIT SUMMARY</b>	<b>CORE AND SUPPLEMENTAL MATERIALS/RESOURCES</b>	
<p>We solve the tangent line problem and learn that the instantaneous rate of change is equivalent to the slope of the tangent line. We learn that the slope of the tangent line is dependent on the <math>x</math>-value, and is therefore a function. We proceed to learn algebraic methods of finding derivatives, and explore their applications beyond the slope.</p>	<ul style="list-style-type: none"> <li>● Textbook</li> <li>● TI-89 Graphing Calculator</li> </ul>	
<b>UNDERSTANDINGS</b>		
<p>Students will understand that the slope of the tangent line is equivalent to the instantaneous rate of change.            Students will understand that the slope of a curve at a point is a function of the <math>x</math>-value at that point.            Students will understand that the derivative can be used to gain additional information about the behavior of the function.</p>		
<b>Students will know...</b>	<b>Students will be able to...</b>	
<p>Limit Definition of Derivative            Power Rule; Product Rule; Quotient Rule; Chain Rule            Derivatives of Trig functions and Exponential Functions            Higher-Order Derivatives</p>	<p>Evaluate Derivatives            Evaluate Derivatives of functions defined implicitly            Solve related rates problems</p>	
<b>Stage 2 – Assessment Evidence</b>		
<b>Performance Tasks/Use of Technology</b>	<b>Other Evidence:</b>	
<ul style="list-style-type: none"> <li>● Khan Academy</li> <li>● Delta Math</li> <li>● College Board</li> </ul>	<p><b>Formative</b></p> <ul style="list-style-type: none"> <li>● Observation</li> <li>● Homework</li> <li>● Class Participation</li> <li>● Notebook Checks</li> </ul>	

## Curricular Framework MATH-Calculus

- Self-assessment

### Summative

- Chapter/Unit Test
- Quizzes
- Presentations
- Unit Projects

### Stage 3 – Learning Plan

Define Average and Instantaneous Rate of Change  
Define Derivative and Derivative Notation  
Derivatives of Polynomial; Trigonometric; Exponential Functions  
Power Rule; Product Rule; Quotient Rule; Chain Rule  
Higher-Order Derivatives  
Using Derivatives to solve problems: Related Rates  
Using Derivatives to sketch curves

### Planned Differentiation & Interventions for Tiers I, II, III, ELL, SPED, and Gift & Talented Students

- *Rethink and revise. Dig deeper into ideas at issue (through the faces of understanding). Revise, rehearse, and refine, as needed. Guide students in self-assessment and self-adjustment, based on feedback from inquiry, results, and discussion.*
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**Tier II:**

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**Tier III:**

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- Use of tangible rewards (certificates, small toys, etc. per behavior plan)
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- Functional or practical emphasis

**504:**

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- Extra help opportunities
- Reduce workload
- Partial credit
- Allow use of calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed ( use interactive notebook)
- Preferential Seating
- Extra Practice
- Directions repeated, clarified and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives

**Curricular Framework MATH-Calculus**

<b>Unit 3 CALCULUS: Integration</b>		
<b>Content &amp; Practice Standards</b>	<b>Interdisciplinary Standards</b>	<b>Critical Knowledge &amp; Skills</b>
<ul style="list-style-type: none"> <li>● <b>Accumulation of Change</b></li> <li>● <b>Anti-differentiation</b></li> <li>● <b>Fundamental Theorem of Calculus</b></li> <li>● <b>Techniques of Integration</b></li> <li>● <b>Applications of Integration</b></li> <li>● <b>Differential Equations</b></li> </ul>	<ul style="list-style-type: none"> <li>● <b>Reading:</b> Infused within the unit are connections to the NJSLs for Mathematics, Language Arts Literacy WHST.11-12.10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</li> <li>● <b>Educational Technology:</b> All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.</li> </ul>	<p>Students will utilize and apply Accumulation of Change, anti-differentiation, Fundamental Theorem of Calculus, Techniques of Integration, Applications of Integration and Differential Equations.</p>
<b>Unit 3 CALCULUS</b>		
<b>Stage 1 – Desired Results</b>		
<b>UNIT SUMMARY</b>	<b>CORE AND SUPPLEMENTAL MATERIALS/RESOURCES</b>	
<p>We approximate accumulated change with Riemann sums, and apply the limit process to calculate actual change. We learn the relationship between accumulated change and the anti-derivative, and the Fundamental Theorem of Calculus. We then explore different techniques of integration and applications of integration. We use integration to solve differential equations, to find areas of unusual regions, and to find volumes of solids.</p>	<ul style="list-style-type: none"> <li>● Textbook</li> <li>● TI-89 Graphing Calculator</li> </ul>	
<b>UNDERSTANDINGS</b>		
<p>Students will understand that the anti-derivative is not a function of <math>x</math>, but rather a family of functions of <math>x</math>.</p> <p>Students will understand that accumulation of change is related to the area under the curve.</p> <p>Students will understand that a differential equation relates a function of an independent variable to its derivatives.</p>		
<b>Students will know...</b>	<b>Students will be able to...</b>	
<p>Approximating area using Riemann sums.                      Integration of polynomial, trigonometric, exponential and logarithmic functions.                      Integration by substitution.                      The Fundamental Theorem of Calculus.                      Solving Differential Equations.                      Volumes of solids of rotation.</p>	<p>Find the area under a curve.                      Find definite and indefinite integrals.                      Solve Differential Equations.                      Find Volumes of solids of rotation.</p>	
<b>Stage 2 – Assessment Evidence</b>		
<p>Performance Tasks:</p>	<p>Other Evidence:  <i>What other means of assessment will be used throughout this unit?</i></p>	

## Curricular Framework MATH-Calculus

*What projects, hands-on lessons, use of manipulatives, active participation in new situations, etc. will reveal evidence of meaning-making and transfer (true understanding)?*

**Performance Tasks/Use of Technology**

- Khan Academy
- Delta Math
- College Board

**Formative**

- Observation
- Homework
- Class Participation
- Notebook Checks
- Self-assessment

**Summative**

- Chapter/Unit Test
- Quizzes
- Presentations
- Unit Projects

### Stage 3 – Learning Plan

Introduce accumulation of change and area under a curve  
 Apply the limit process to Riemann Sum approximation to find exact areas  
 The Fundamental Theorem of Calculus  
 The substitution technique for integration  
 Rules of Integration: polynomial; trigonometric; exponential; logarithmic  
 Differential Equations  
 Volumes of solids of rotation

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