Syllabus Development Guide: AP Calculus AB

<u>To the AP teacher</u>: Please take full advantage of this guide. It is designed to support you as you develop your syllabus for the AP Course Audit. The guide contains the following sections and information:

Curricular Requirements The curricular requirements are the core elements of the course. Your syllabus must provide clear evidence that each requirement is fully addressed in your course.

Scoring Components Some curricular requirements consist of complex, multi-part statements. These particular requirements are broken down into their component parts and restated as "scoring components". Reviewers will look for evidence that each scoring component is included in your course.

Key Terms To ensure the clarity of certain terms or expressions that may have multiple meanings, each of these terms is clearly defined.

Evaluation Guidelines These are the exact guidelines used by reviewers as they evaluate the evidence in your syllabus. Use these to interpret any requirement you may find ambiguous.

Important Considerations Aligned with the Evaluation Guidelines, these statements provide advice on the type of evidence your syllabus should include.

Reference As appropriate, references to specific sections of the official AP Course Description or other pertinent publications are included here.

Samples of Evidence For each scoring component, three separate samples of evidence are provided. These statements provide either verbatim samples from actual authorized syllabi or clear descriptions of what acceptable evidence should look like.

<table>
<tr><th>Curricular Requirements</th><th colspan="4">Scoring Components, Key Terms, Evaluation Guidelines, Important Considerations, References and Samples of Evidence</th></tr>
<tr><td rowspan="6">Curricular Requirement 1: The course teaches all topics associated with Functions, Graphs, and Limits; Derivatives; and Integrals as delineated in the Calculus AB Topic Outline in the AP Calculus Course Description.</td><td colspan="4">Scoring Component 1*: The course teaches all topics associated with Functions, Graphs, and Limits as delineated in the Calculus AB Topic Outline in the AP Calculus course description.</td></tr>
<tr><td colspan="4">*Note Each Curricular Requirement may be subdivided into two or more distinct Scoring Components.</td></tr>
<tr><td>Key Term(s)</td><td>Evaluation Guideline(s)</td><td>Important Consideration(s)</td><td>Reference</td></tr>
<tr><td>All terminology in the Scoring Component is clear. No clarification is needed.</td><td>When the sub-topics outlined in the AP Course Description are not identified within the scoring component, they are not considered requisite. Syllabi do not need incontrovertible proof of every portion of a topic as listed in the AP Course Description.

If a reasonable inference based on available evidence in the syllabus can be made about the presence of a practice or topic delineated in a scoring component, then the scoring component is satisfied.

If there are absolutely no materials listed (textbooks or otherwise), then the scoring component is not met.</td><td>The syllabus should include a list of topics associated with Functions, Graphs, and Limits that is as complete as possible.</td><td>For more information see pages 5-8 of the AP Calculus Course Description.</td></tr>
<tr><td colspan="4">Samples of Evidence</td></tr>
<tr><td>Sample 1</td><td>Sample 2</td><td colspan="2">Sample 3</td></tr>
<tr><td>In the course overview, the syllabus lists all topics and sub-topics associated with Functions, Graphs and Limits as delineated in the course description.</td><td>In the course overview, the syllabus lists all topics and sub-topics associated with Functions, Graphs and Limits as in the course description in the order the instructor presents them in class.</td><td colspan="2">In the course overview, the syllabus lists all topics and sub-topics associated with Functions, Graphs and Limits as in the course description together with additional related topics.</td></tr>
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Curricular Requirement 1 (continued): The course teaches all topics associated with Functions, Graphs, and Limits; Derivatives; and Integrals as delineated in the Calculus AB Topic Outline in the AP Calculus Course Description.	**Scoring Component 2: The course teaches all topics associated with Derivatives as delineated in the Calculus AB Topic Outline in the AP Calculus course description.**			
	Key Term(s)	Evaluation Guideline(s)	Important Consideration(s)	Reference
	All terminology in the Scoring Component is clear. No clarification is needed.	When the sub-topics outlined in the AP Course Description are not identified within the scoring component, they are not considered requisite. Syllabi do not need incontrovertible proof of every portion of a topic as listed in the AP Course Description. If a reasonable inference based on available evidence in the syllabus can be made about the presence of a practice or topic delineated in a scoring component, then the scoring component is satisfied. If there are absolutely no materials listed (textbooks or otherwise), then the scoring component is not met.	The syllabus should include a list of topics associated with Derivatives that is as complete as possible.	For more information see pages 6-7 of the AP Calculus Course Description.
	Samples of Evidence			
	Sample 1	Sample 2	Sample 3	
	In the course overview, the syllabus lists all topics and sub-topics associated with Derivatives as delineated in the course description.	In the course overview, the syllabus lists all topics and sub-topics associated with Derivatives as in the course description in the order the instructor presents them in class.	In the course overview, the syllabus lists all topics and sub-topics associated with Derivatives as in the course description together with additional related topics.	

Curricular Requirement 1 (continued): The course teaches all topics associated with Functions, Graphs, and Limits; Derivatives; and Integrals as delineated in the Calculus AB Topic Outline in the AP Calculus Course Description.	**Scoring Component 3: The course teaches all topics associated with Integrals as delineated in the Calculus AB Topic Outline in the AP Calculus course description.**			
	Key Term(s)	Evaluation Guideline(s)	Important Consideration(s)	Reference
	All terminology in the Scoring Component is clear. No clarification is needed.	When the sub-topics outlined in the AP Course Description are not identified within the scoring component, they are not considered requisite. Syllabi do not need incontrovertible proof of every portion of a topic as listed in the AP Course Description. If a reasonable inference based on available evidence in the syllabus can be made about the presence of a practice or topic delineated in a scoring component, then the scoring component is satisfied. If there are absolutely no materials listed (textbooks or otherwise), then the scoring component is not met.	The syllabus should include a list of topics associated with Integrals that is as complete as possible.	For more information see pages 7 – 8 of the AP Calculus Course Description.
	Samples of Evidence			
	Sample 1	Sample 2	Sample 3	
	In the course overview, the syllabus lists all topics and sub-topics associated with Integrals as delineated in the course description.	In the course overview, the syllabus lists all topics and sub-topics associated with Integrals as in the course description in the order the instructor presents them in class.	In the course overview, the syllabus lists all topics and sub-topics associated with Integrals as in the course description together with additional related topics.	

Curricular Requirement 2: The course provides students with the opportunity to work with functions represented in a variety of ways -- graphically, numerically, analytically, and verbally - and emphasizes the connections among these representations.	**Scoring Component 4: The course provides students the opportunity to work with functions represented graphically.**			
	Key Term(s)	Evaluation Guideline(s)	Important Consideration(s)	Reference
	Function represented graphically: one that is drawn as a set of points on a pair of coordinate axes. Limits, derivatives, and integrals could be represented in graphical form.	The syllabus must show explicit evidence that students have the opportunity to work with functions represented graphically.	Scoring Component is clear and explicit. No Important Considerations are needed.	No references to external documents are needed for this Scoring Component.
	Samples of Evidence			
	Sample 1	Sample 2	Sample 3	
	The syllabus includes a variety of activities to represent a function graphically, including curve sketching to determine relative and absolute extrema, sketching slope fields and relating the graph of f to the graphs of its first and second derivatives.	The syllabus includes a variety of activities to represent a function graphically, including estimating the value of a limit from a graph, estimating the value of a derivative at a point from a graph, and estimating the value of a definite integral from a graph.	The syllabus includes a variety of activities to represent a function graphically including the geometric interpretation of limits, derivatives, mean value theorem definite integrals and slope fields.	

<table>
<tr><td rowspan="6">Curricular Requirement 2 (continued): The course provides students with the opportunity to work with functions represented in a variety of ways -- graphically, numerically, analytically, and verbally -- and emphasizes the connections among these representations.</td><td colspan="4">Scoring Component 5: The course provides students with the opportunity to work with functions represented numerically.</td></tr>
<tr><td>Key Term(s)</td><td>Evaluation Guideline(s)</td><td>Important Consideration(s)</td><td>Reference</td></tr>
<tr><td>Function represented numerically: one whose values are given as discrete data, for example as numbers in a table, as coordinates of points (e.g. (2,3) or f(2)=3), or in some similar fashion.</td><td>The syllabus must show explicit evidence that students have the opportunity to work with functions represented numerically.</td><td>Scoring Component is clear and explicit. No Important Considerations are needed.</td><td>No references to external documents are needed for this Scoring Component.</td></tr>
<tr><td colspan="4">Samples of Evidence</td></tr>
<tr><td>Sample 1</td><td>Sample 2</td><td colspan="2">Sample 3</td></tr>
<tr><td>The syllabus includes a variety of ways to work with a function represented numerically such as estimating the value of a limit, rate of change and the value of a definite integral from a table of values of a function.</td><td>The syllabus includes a variety of ways to work with a function represented numerically such as using a table of values to reach conclusions using the Intermediate Value Theorem, Mean Value Theorem and properties of inverse functions. [See for instance FR #3 on 2007 AB exam]</td><td colspan="2">The syllabus includes a variety of ways to work with a function represented numerically. For instance, starting with a table of values for a function and its first and second derivatives and deriving conclusions about the relative extrema of the function. Also, starting with a table of values for two functions and their derivatives, be able to compute the value of the derivative of the product, quotient or composition of the two functions.</td></tr>
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<tr><td rowspan="4">Curricular Requirement 2 (continued): The course provides students with the opportunity to work with functions represented in a variety of ways -- graphically, numerically, analytically, and verbally -- and emphasizes the connections among these representations.</td><td colspan="4">Scoring Component 6: The course provides students with the opportunity to work with functions represented analytically.</td></tr>
<tr><td>Key Term(s)</td><td>Evaluation Guideline(s)</td><td>Important Consideration(s)</td><td>Reference</td></tr>
<tr><td>Function represented analytically: one that is given as what typically is considered a formula such as f(x)=sin(3x).</td><td>The syllabus must show explicit evidence that students have the opportunity to work with functions represented analytically.</td><td>Scoring Component is clear and explicit. No Important Considerations are needed.</td><td>No references to external documents are needed for this Scoring Component.</td></tr>
<tr><td colspan="4">Samples of Evidence</td></tr>
<tr><td></td><td>Sample 1</td><td>Sample 2</td><td colspan="2">Sample 3</td></tr>
<tr><td></td><td>The syllabus includes a variety of ways to represent a function analytically, such as the use of (1) the product rule on functions given as formulae, (2) the chain rule on functions given as formulae, and (3) the Fundamental Theorem of Calculus on functions given as formulae.</td><td>The syllabus includes a variety of ways to represent a function analytically, such as the use of functions given as formulae of (1) algebra to compute limits, (2) the limit definition to compute derivatives, and (3) the limit definition to compute definite integrals.</td><td colspan="2">The syllabus includes a variety of ways to represent a function analytically, such as (1) the use of implicit differentiation, (2) the solving of separable differential equations, and (3) the finding of specific anti-derivatives using initial conditions.</td></tr>
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<tr><td rowspan="6">Curricular Requirement 2 (continued): The course provides students with the opportunity to work with functions represented in a variety of ways -- graphically, numerically, analytically, and verbally -- and emphasizes the connections among these representations.</td><td colspan="4">Scoring Component 7: The course provides students with the opportunity to work with functions represented verbally.</td></tr>
<tr><td>Key Term(s)</td><td>Evaluation Guideline(s)</td><td>Important Consideration(s)</td><td>Reference</td></tr>
<tr><td>Function represented verbally: one that is described in words. Some examples are applications or problems that are written in complete, well-written sentences.</td><td>The syllabus must show explicit evidence that students have the opportunity to work with functions represented verbally.</td><td>Scoring Component is clear and explicit. No Important Considerations are needed.</td><td>No references to external documents are needed for this Scoring Component.</td></tr>
<tr><td colspan="4">Samples of Evidence</td></tr>
<tr><td>Sample 1</td><td>Sample 2</td><td colspan="2">Sample 3</td></tr>
<tr><td>The syllabus includes a variety of ways to represent a function verbally, including the use of differentiation to solve related rates, optimization, velocity, acceleration, and free fall application problems.</td><td>The syllabus includes a variety of ways to represent a function verbally, including the use of various integration techniques to solve work, force and fluid pressure application problems.</td><td colspan="2">The syllabus includes a variety of ways to represent a function verbally, including the use of various techniques to solve growth and decay application problems.</td></tr>
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Curricular Requirement 3: The course teaches students how to communicate mathematics and explain solutions to problems both verbally and in written sentences.	**Scoring Component 8: The course teaches students how to explain solutions to problems orally.**			
	Key Term(s)	Evaluation Guideline(s)	Important Consideration(s)	Reference
	Oral communication: communication of mathematical ideas by word of mouth or verbally.	To meet the scoring component, the syllabus must explicitly reference types of instruction, exercises, and/or assignments that include communicating mathematical ideas orally. Explicit evidence of students working collaboratively in groups is sufficient.	Scoring Component is clear and explicit. No Important Considerations are needed.	No references to external documents are needed for this Scoring Component.
	Samples of Evidence			
	Sample 1	Sample 2	Sample 3	
	The syllabus states that students work in groups or give group presentations.	The syllabus includes presentations where students solve problems on the board.	The syllabus states that students use cooperative learning techniques to learn calculus.	

Curricular Requirement 3 (continued): The course teaches students how to communicate mathematics and explain solutions to problems both verbally and in written sentences.	**Scoring Component 9: The course teaches students how to explain solutions to problems in written sentences.**			
	Key Term(s)	Evaluation Guideline(s)	Important Consideration(s)	Reference
	Written communication: communication of mathematics in complete and well-written sentences.	The syllabus must explicitly reference types of instruction, exercises, and/or assignments that include communicating mathematical ideas in written sentences. Evidence of working with sample free response questions alone is not sufficient.	Scoring Component is clear and explicit. No Important Considerations are needed.	For more information see pages 5 and 13 of the AP Calculus Course Description.
	Samples of Evidence			
	Sample 1	Sample 2	Sample 3	
	Graded tests and homework assignments include components (such as sample free-response questions from past AP exams accompanied by text assignments and instructor generated assignments) where students are required to explain and/or justify their solutions to problems in well-written sentences.	Students will work on projects, which include the expectation of explaining the procedures used and the mathematical outcomes obtained in well-written sentences.	Students will be assigned the task of doing research into a mathematical topic and then writing a report on their findings. The expectations of the report will include that the mathematics described is accurate and that the writing style used in the report is of high quality.	

Curricular Requirement 4: The course teaches students how to use graphing calculators to help solve problems, experiment, interpret results, and support conclusions.	**Scoring Component 10: The course teaches students how to use graphing calculators to help solve problems.**			
	Key Term(s)	Evaluation Guideline(s)	Important Consideration(s)	Reference
	Solve problems: the use of a graphing calculator to solve various types of problems.	Stating that a calculator is required for the course is not sufficient.	Scoring Component is clear and explicit. No Important Considerations are needed.	For more information see page 12 of the AP Calculus Course Description.
	Samples of Evidence			
	Sample 1	Sample 2	Sample 3	
	The syllabus includes a variety of ways in which graphing calculators are used to solve problems, such as (1) estimating limits with a graphing calculator, (2) estimating the root of a function with a graphing calculator, and (3) estimating the coordinates of the point of intersection of two functions with a graphing calculator.	The syllabus includes a variety of ways in which graphing calculators are used to solve problems, such as (1) performing numerical differentiation with a graphing calculator and (2) performing numerical integration with a graphing calculator.	The syllabus includes a variety of ways in which graphing calculators are used to solve problems, such as (1) determining the asymptotic behavior of a function with a graphing calculator and (2) comparing the relative magnitudes of two functions with a graphing calculator.	

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<tr><td rowspan="6">Curricular Requirement 4 (continued): The course teaches students how to use graphing calculators to help solve problems, experiment, interpret results, and support conclusions.</td><td colspan="4">Scoring Component 11: The course teaches students how to use graphing calculators to experiment.</td></tr>
<tr><td>Key Term(s)</td><td>Evaluation Guideline(s)</td><td>Important Consideration(s)</td><td>Reference</td></tr>
<tr><td>Experiment: the use of a graphing calculator to explore mathematical ideas.</td><td>Stating that a calculator is required for the course is not sufficient.</td><td>Scoring Component is clear and explicit. No Important Considerations are needed.</td><td>For more information see page 13 of the AP Calculus Course Description.</td></tr>
<tr><td colspan="4">Samples of Evidence</td></tr>
<tr><td>Sample 1</td><td>Sample 2</td><td colspan="2">Sample 3</td></tr>
<tr><td>The syllabus explicitly states that students use a graphing calculator to investigate a numerical approach to evaluate the limit of a function, to determine the asymptotic behavior of a function, and to explore the continuity of a function.</td><td>The syllabus explicitly states that students use the zooming feature of a graphing calculator to predict and find the linearization of a function, and to predict solutions to problems using slope fields.</td><td colspan="2">The syllabus explicitly states that students use a graphing calculator to investigate a population growth model, and to investigate the slope of the line tangent to a function at a point.</td></tr>
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<tr><td rowspan="5">Curricular Requirement 4 (continued): The course teaches students how to use graphing calculators to help solve problems, experiment, interpret results, and support conclusions.</td><td colspan="4">Scoring Component 12: The course teaches students how to use graphing calculators to interpret results and support conclusions.</td></tr>
<tr><td>Key Term(s)</td><td>Evaluation Guideline(s)</td><td>Important Consideration(s)</td><td>Reference</td></tr>
<tr><td>Interpret results: the calculator is used to obtain graphs/data that confirms results found by analytical means and refers to the use of the calculator to clarify or explain a non-calculator result.

Support conclusions: the use of a graphing calculator to justify mathematical calculations, work, or conclusions.</td><td>Stating that a calculator is required for the course is not sufficient.</td><td>Scoring Component is clear and explicit. No Important Considerations are needed.</td><td>No references to external documents are needed for this Scoring Component.</td></tr>
<tr><td colspan="4">Samples of Evidence</td></tr>
<tr><td>Sample 1</td><td>Sample 2</td><td colspan="2">Sample 3</td></tr>
<tr><td>The syllabus explicitly states that students use a graphing calculator to analyze mathematical ideas, such as interpreting the effect of varying a parameter on a family of curves.</td><td>The syllabus states that students use a calculator to approximate the value of an answer found analytically in order to verify whether it seems reasonable.</td><td colspan="2">The syllabus states that students use a calculator to view the graph of a function proposed as the answer to the problem; and again to check whether the answer has the desired traits.</td></tr>
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