



## Learning Power Course: AP® Calculus AB 2009-2010

Sections: Online AP® Calculus AB: Students view class segments as streamed digital video via a direct link to the NSU server

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Office Hours: Students are encouraged to call or email any time; I will respond as quickly as possible. I also take questions in the evenings and on weekends. Individual students can schedule study time with me. To call, please use the toll free Help Desk number (1-866-693-0163) and ask for me.

### There are two (2) required textbooks:

1. The required textbook can be purchased at this website:

[http://www.mcdougallittell.com/store/ProductCatalogController?cmd=Browse&subcmd=LoadDetail&ID=1007500000073093&imprint=hm&frontOrBack=F&division=M01&sortProductsBy=SEQ\\_TITLE&sortEntriesBy=SEQ\\_NAME#order](http://www.mcdougallittell.com/store/ProductCatalogController?cmd=Browse&subcmd=LoadDetail&ID=1007500000073093&imprint=hm&frontOrBack=F&division=M01&sortProductsBy=SEQ_TITLE&sortEntriesBy=SEQ_NAME#order)

The printable order form is linked on the left side of the page.

**The required textbook: Calculus of a Single Variable, 9<sup>th</sup> Ed. (High School AP Version)**

Calculus of a Single Variable, 9th Ed. (High School AP\* version)

ISBN/ISBN10

978-0-547-21290-6  
0-547-21290-9

<b>Order#</b>	1406255
<b>Price</b>	\$116.21

### Electronic Version of the Required Text

eBook CD-ROM	
<b>ISBN/ISBN10</b>	978-0-547-21306-4 0-547-21306-9
<b>Order#</b>	1406276
<b>Price</b>	\$79.75

### 2. The required supplement to the textbook can be purchased at this website:

[http://www.mcdougallittell.com/store/ProductCatalogController?cmd=Browse&subcmd=LoadDetail&ID=1007500000073111&imprint=hm&frontOrBack=F&division=M01&sortProductsBy=SEQ\\_TITLE&sortEntriesBy=SEQ\\_NAME#order](http://www.mcdougallittell.com/store/ProductCatalogController?cmd=Browse&subcmd=LoadDetail&ID=1007500000073111&imprint=hm&frontOrBack=F&division=M01&sortProductsBy=SEQ_TITLE&sortEntriesBy=SEQ_NAME#order)

The printable order form is linked on the left side of this page.

### The required supplement: **Fast Track to a 5: Preparing for the AP Exam**

Complete Catalog Listing				
Product	Order #	ISBN/ISBN10	Price	Quantity
<a href="#">Fast Track to a 5: Preparing for the AP* Exam</a>	1406150	978-0-547-21307-1 0-547-21307-7	\$30.25	

Required Calculator: TI89

Course Prerequisites: Algebra I and II, Geometry, Trigonometry

Course Description: The course is designed to build a strong foundation in the basics of calculus: differentiation and integration. Students are introduced to new ways of thinking about math, including graphical, numerical, and analytical approaches; modeling; problem solving; and analysis emphasizing real-life data.

**Student Expectations:** Students are expected to have a strong commitment to learning evidenced through spirited explorations and narratives, online discussions and attention to homework. Homework is a basic component of the class. Students may submit homework electronically, by fax, and by mail.

**Course Support:** Academic assistance is available via a toll free help line, also via the Internet with Desire2Learn resources including access to course materials, discussion boards, email, and homework “chat” opportunities. Live, synchronous net meeting studying is also available.

**Course Policies:** All homework and projects must be submitted in a timely manner. Late papers will result in a reduced grade. Make-up work should be addressed immediately with arrangements being made with the instructor.

**Academic Honesty:** All students are expected to conduct themselves in a manner consistent with academic pursuits. Cheating will not be tolerated. Specifically, students may not use or give unauthorized assistance during quizzes or tests; students may not use the work of others or claim it as their own.

**Course Goals (as stated in the College Board Course Description):**

1. Students should be able to work with functions represented in a variety of ways: graphical, numerical, analytical, or verbal. They should understand the connections among these representations.
2. 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.
3. 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.
4. Students should understand the relationship between the derivative and the indefinite integral as expressed in both parts of the Fundamental Theorem of Calculus.
5. Students should be able to communicate mathematics both orally and in well-written sentences and should be able to explain solutions to problems.
6. Students should be able to model a written description of a physical situation with a function, a differential equation, or an integral.
7. Students should be able to use technology to help solve problems, experiment, interpret results, and verify conclusions.
8. Students should be able to determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
9. Students should develop an understanding of calculus as a coherent body of knowledge and as a human accomplishment.

**Technology:** I have a Desire2Learn course site for managing course materials. On that site, the discussion board provides a forum for posting problems as well as discussing concepts and issues (a part of most assignments). I use animations whenever possible to assist students in understanding topics and concepts. I use a tablet pc for lesson design, to enhance power point presentations and animations, and to post problems for discussion or assistance. Students share access to these technologies.

**Assessment:** I use online homework quizzes as content embedded assessment for learning. The immediacy of the format gives me formative information during the course of chapters. I use performance assessment to culminate the studies of each unit. I use format assessment in the form of chapter tests that mimic the AP exam. Other assessments involve homework assignments as well as class explorations and activities.

**Course Grading Scale:**

90%-100% A

80%-89% B

70%-79% C

60%-69% D

0%-50% F

**A note about transcendental functions:** Historically, my students have struggled with transcendental functions. To overcome this deficiency, I have integrated transcendental function problems into every assignment from the beginning of the school year. Thus, there is no separate section for transcendental function problems in the Topic Outlines because they are included in every section.

**A note about calculator skills:** All students have Ti89 calculators used in conjunction with class work. The students graph functions (in appropriate windows for optimal viewing), find zeros and the intersection points of graphs, find numerical values for derivatives and definite integrals, and use the symbolic capabilities for practice with equivalent forms of answers. The calculator is the student's tool for solving problems, experimenting, interpreting results, and verifying conclusions.

**The Course**

**Review of Functions and Their Graphs (about 1 week): Goal 1**

**The students should be able to**

Demonstrate a knowledge of and proficiency with all functions, graphs, models, and rates of change with particular emphasis on transcendental functions.

**Limits and Their Properties (about 4 weeks)**

Topic Outline:

**The students should be able to**

- I. A Preview of Calculus (**Goal 9**)
  - A. Compare calculus and pre-calculus
  - B. Understand the tangent line problem is basic to calculus
  - C. Understand the area problem is basic to calculus
- II. Finding the Limit Graphically and Numerically (**Goals 1, 5, 7**)
  - A. Estimate the limit from a graph or a table
  - B. Understand the role of domain in vertical asymptotes of a graph (an intuitive understanding of continuity)
  - C. Understand the role of domain in creating holes in graphs (an intuitive understanding of continuity)
  - D. Examine and understand the behavior of piecewise-defined functions (with and without gaps) and step functions
  - E. Recognize ways that a limit fails to exist
  - F. Use the formal definition of a limit
- III. Evaluating Limits Analytically (**Goals 1, 5, 7**)
  - A. Use limit properties to evaluate a limit
  - B. Develop and use different strategies for finding limits
  - C. Use dividing out and rationalizing techniques to find a limit
  - D. Find the limit of a composite function
  - E. Use the Squeeze Theorem to find a limit
- IV. Continuity and One-sided Limits (**Goals 1, 5, 7**)
  - A. Determine continuity at a point and on an open interval
  - B. Classify discontinuities as removable and nonremovable
  - C. Understand continuity in respect to limits and vice versa
  - D. Use the definition of continuity
  - E. Find one-sided limits
  - F. Determine continuity on a closed interval
  - G. Use the properties of continuity
  - H. Understand and use the Intermediate Value Theorem
- V. Infinite Limits (**Goals 1, 5, 7**)
  - A. Find infinite limits from the left and the right
  - B. Examine the domain of functions for vertical asymptotes
  - C. Understand the role of domain and vertical asymptotes in unbounded behavior
  - D. Sketch graphs with vertical asymptotes and using the sketch to examine infinite limits
  - E. Understand and use the properties of infinite limits
- VI. Limits at Infinity (**Goals 1, 5, 7**)
  - A. Find limits at infinity
  - B. Find the horizontal asymptotes of a graph numerically, graphically and analytically
  - C. Associate limits at infinity with horizontal asymptotes
  - D. Use the definition of infinite limits at infinity

**Differentiation (about 8 weeks)**

Topic Outline:

**The students should be able to**

- I. The Derivative and the Tangent Line Problem (**Goals 1, 2, 5, 9**)
  - A. Find the slope of the tangent line to a curve at a point
  - B. Use the limit definition of the derivative
  - C. Understand the conditions where derivatives fail to exist
  - D. Examine continuity with the graphs of functions and discussing the intuitive definition of continuity
  - E. Examine the relationship between differentiability and continuity
- II. Basic Differentiation Rules and Rates of Change (**Goals 1, 2, 5, 6, 7**)
  - A. Find the derivative using the Constant Rule
  - B. Find the derivative using the Power Rule
  - C. Find the derivative using the Constant Multiple Rule
  - D. Find the derivative using Sum and Difference Rules
  - E. Find the derivative of sine and cosine
  - F. Understand the derivative as a rate of change and using the derivative to find rates of change
  - G. Compare average rate of change and instantaneous rate of change and understanding the relationship
  - H. Compare the magnitude of a function with its rate of change
  - I. Understand and work with vertical motion problems as an application of derivatives
  - J. Recognize  $f$  and  $f'$  when given only the graph.
- III. The Product and Quotient Rules and Higher-Order Derivatives (**Goals 1, 2, 5, 6, 7**)
  - A. Find the derivative using the Product Rule
  - B. Find the derivative using the Quotient Rule
  - C. Find the derivative of trigonometric functions
  - D. Find higher-order derivatives of functions
  - E. Use derivative rules in abstract formats
  - F. Use position, velocity and acceleration as applications of derivatives
  - G. Recognize  $f$ ,  $f'$ , and  $f''$  when given only the graph
- IV. The Chain Rule (**Goals 1, 2, 5, 7**)
  - A. Find the derivative of a composite function using the Chain Rule
  - B. Find the derivative of a function using the General Power Rule
  - C. Simplify derivatives of functions using algebraic techniques
  - D. Find the derivative of trigonometric functions using the Chain Rule
  - E. Recognize  $f$ ,  $f'$ , and  $f''$  when given only the graph
  - F. Use derivative rules in abstract formats
- V. Implicit Differentiation (**Goals 1, 2, 5**)
  - A. Distinguish between functions in explicit and implicit form
  - B. Find the derivative using implicit differentiation
  - C. Find second derivatives in terms of  $x$  and  $y$
- VI. Related Rates (**Goals 1, 2, 5, 6, 8**)

- A. Find a related rate using implicit differentiation with respect to time
- B. Develop and understand guidelines for related-rate problems
- C. Use related rates to solve real-life problems
- D. Determine the reasonableness of solutions including sign, size, relative accuracy, and units of measurement.

### **Applications of Differentiation (about 8 weeks)**

Topic Outline:

**The students should be able to**

- I. Extrema on an Interval (**Goals 1, 5, 7**)
  - A. Use the definition of extrema on an interval for various functions
  - B. Understand the implications of the Extreme Value Theorem
  - C. Understand and use the definition of relative extrema of a function on an open interval
  - D. Understand and use the definition of a critical number
  - E. Demonstrate the relationship between critical numbers and relative extrema
  - F. Find extrema on closed intervals
  - G. Develop and use guidelines for finding extrema on a closed interval
  - H. Compare relative and absolute extrema
- II. Rolle's Theorem and the Mean Value Theorem (**Goals 1, 5, 7, 9**)
  - A. Use Rolle's Theorem to justify the existence of an extreme value (and critical number) on a closed interval
  - B. Understand and use the Mean Value Theorem (in the context of tangent lines with the same slope as secant lines)
- III. Increasing and Decreasing Functions and Tests for Relative Extrema (**Goals 1, 7**)
  - A. Determine intervals where functions are increasing or decreasing
  - B. Understand and recognize the implications of strictly monotonic functions
  - C. Apply the First Derivative Test to find relative extrema analytically
  - D. Apply the Second Derivative Test to find relative extrema analytically
  - E. Apply the concept of increasing/decreasing to functions given in abstract formats
  - F. Use graphing and numerical comparisons of function behaviors in conjunction with an analytic approach
  - G. Sketch  $f'$  given the graph of  $f$
- IV. Concavity (**Goals 1, 5, 7**)
  - A. Determine intervals on which a function is concave up and concave down
  - B. Develop a working definition of what concave up and concave down mean when examining a graph
  - C. Find points of inflection
  - D. Test for concavity analytically
  - E. Sketch graphs of functions based on verbal descriptions
  - F. Sketch  $f'$  and  $f''$  given the graph of  $f$

- V. Optimization Problems (**Goals 1, 2, 5, 6, 7, 8**)
  - A. Solve applied maximum and minimum problems
  - B. Develop guidelines for solving applied maximum and minimum problems (including recognizing the primary and secondary equations)
  - C. Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement
- VI. Differentials (**Goals 1, 5, 6, 7**)
  - A. Demonstrate an understanding the concept of the tangent line approximation
  - B. Compare the differential with actual change
  - C. Estimate propagated error
  - D. Find the differential of a function

### **Integration (about 6 weeks)**

Topic Outline:

**The students should be able to**

- I. Antiderivatives and the Indefinite Integral (**Goals 1, 3, 4, 5, 6, 7, 8, 9**)
  - A. Find general solutions for a differential equation
  - B. Use indefinite integral notation
  - C. Use basic integration rules
  - D. Understand the graphical significance of the constant of integration
  - E. Find (and draw) solutions (general and specific) to a differential equation (slope fields)
  - F. Solve vertical motion problems
  - G. Solve rectilinear motion problems
  - H. Use the graph of  $f'$  to answer questions about  $f$  and  $f''$ .
  - I. Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement
- II. Area (**Goals 1, 3, 4, 5, 6, 7, 8**)
  - A. Use sigma notation to write and evaluate a sum
  - B. Understand the concept of area
  - C. Approximate the area of a region numerically (from a graph on a grid as well as from inscribed and circumscribed rectangles)
  - D. Find the area of a region using limits (upper sums/lower sums)
  - E. Find the area of regions bounded by the y-axis
- III. Riemann Sums and Definite Integrals (**Goals 1, 3, 4, 5, 6, 7, 8**)
  - A. Understand the definition of a Riemann sum (left, right and midpoint)
  - B. Evaluate a definite integral using limits
  - C. Evaluate a definite integral using the properties of definite integrals
  - D. Find definite integrals using the areas of common geometric figures and properties of integrals
  - E. Approximate definite integrals using graphs on a grid with shaded area
  - F. Determine the reasonableness of solutions, including sign and size
- IV. The Fundamental Theorem of Calculus (**Goals 3, 4, 5, 6, 7, 8, 9**)

- A. Evaluate the definite integral using the Fundamental Theorem of Calculus
- B. Understand and use the Mean Value Theorem for Integrals
- C. Find the average value of a function over a closed interval
- D. Understand and use the Second Fundamental Theorem of Calculus
- E. Evaluate a definite integral using a function graph and properties of definite integrals
- F. Interpret the definite integral as an accumulation function
- G. Use the Fundamental Theorem of Calculus in rectilinear motion problems
- H. Determine the reasonableness of solutions, including sign and size
- V. Integration by Substitution (**Goals 3, 4, 5, 6, 7, 8**)
  - A. Use pattern recognition to evaluate an indefinite integral
  - B. Find the antiderivative of a composite function
  - C. Use a change of variables to evaluate the definite integral
  - D. Develop guidelines for the change of variables technique
  - E. Use the General Power Rule for Integration to evaluate an indefinite integral
  - F. Evaluate a definite integral using even or odd functions
  - G. Use a slope field to graphically model the general and particular solution to a differential equation
  - H. Use a graphing utility to find the area of a region
  - I. Determine the reasonableness of solutions, including sign and size
- VI. Numerical Integration (**Goals 1, 3, 4, 5, 6, 7, 8**)
  - A. Approximate a definite integral using the Trapezoidal Rule
  - B. Compare the Midpoint Rule and the Trapezoidal Rule
  - C. Compare the results of the left end point rule, the mid point rule, the right end point rule and the trapezoidal rule for accuracy and agreement
  - D. Use tabular data or a graph to find area using the Trapezoidal Rule
  - E. Determine the reasonableness of solutions, including sign and size

## **Inverse Functions and Differential Equations (about 2 weeks)**

Topic Outline:

**The students should be able to**

- I. Inverse Functions (**Goals 1, 2**)
  - A. Verify that one function is the inverse of another function (graphically, numerically and analytically)
  - B. Determine whether functions have an inverse
  - C. Understand the characteristics of functions and inverses
  - D. Understand continuity and differentiability as applied to inverse functions
  - E. Find the derivative of inverse functions (implicit differentiation)
- II. Differential Equations (**Goals 1, 3, 4, 6, 7, 8**)

- A. Use separation of variables to solve a simple differential equation
  - B. Use exponential functions to model growth and decay
  - C. Use slope fields to visually provide solutions to differential equations
  - D. Use initial conditions to find particular solutions to differential equations
  - E. Recognize and solve differential equations that can be solved by separation of variables
  - F. Use differential equations to model and solve applied problems
  - G. Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement
- III. Inverse Trigonometric Functions (**Goals 1, 2, 3, 4**)
- A. Develop properties of the six inverse trigonometric functions
  - B. Differentiate inverse trigonometric functions
  - C. Remember and demonstrate the basic differentiation formulas for elementary functions
  - D. Integrate inverse trigonometric functions
  - E. Remember and demonstrate basic integration formulas for elementary functions

### **Applications of Integration (about 2 weeks)**

Topic Outline:

**The students should be able to**

- I. Area of a Region Between Two Curves (**Goals 1, 3, 4, 5, 6, 7, 8, 9**)
  - A. Find the area of a region between two curves using integration
  - B. Find the area of a region between intersecting curves using integration (vertical representative rectangles)
  - C. Use horizontal representative rectangles to find the area of a region between two curves
  - D. Describe integration as an accumulating process in real-life applications
  - E. Determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement
- II. Volume: The Disk Method (**Goals 1, 3, 4, 5, 6, 7, 8, 9**)
  - A. Find the volume of a solid region of revolution using the disk method
  - B. Find the volume of a solid of revolution using the washer method
  - C. Approximate the volume of a solid of revolution from the sketch of a graph on a grid
  - D. Find the volume of a solid with known cross sections
- III. Volume: The Shell Method (**Goals 1, 3, 4, 5, 6, 7, 8**)
  - A. Find the volume of a solid of revolution using the shell method
  - B. Compare the uses of the disk method and the shell method

### **Review for AP Calculus AB Exam (about 4 weeks) (Goal 9)**

**South Dakota Mathematics Content Standards Alignment**  
**Grades 9-12**  
**Course: AP Calculus AB**

Since “Advanced standards are intended to apply to students having achieved the core mathematics standards and are more advanced than first-year algebra and basic geometry” only the advanced standards apply for this course. Also, since AP Calculus AB is a college level course, much of the work only loosely aligns with high school standards. For the most part, the skills are embedded in the analytical processes of calculus itself.

**Advanced High School Algebra Grade Standards**

**Indicator 1: Use procedures to transform algebraic expressions.**

Standard	Supporting Skill: Textbook Section
<b>9-12.A.1.1A. Students are able to write equivalent forms of rational algebraic expressions using properties of real numbers. (Application)</b>	<b>continually practicing this skill</b>
<b>9-12.A.1.2A. Students are able to extend the use of real number properties to expressions involving complex numbers. (Application)</b>	<b>continually practicing this skill</b>

**Indicator 2: Use a variety of algebraic concepts and methods to solve equations and inequalities.**

<b>9-12.A.2.1A. Students are able to determine solutions of quadratic equations. (Analysis)</b>	<ul style="list-style-type: none"> <li>• Use the quadratic formula: <b>occasional practice</b></li> <li>• Use the discriminant to describe the nature of the roots: <b>occasional practice</b></li> </ul>
<b>9-12.A.2.2A. Students are able to determine the solution of systems of equations and systems of inequalities. (Application)</b>	<b>limited practice</b>
<b>9-12.A.2.3A. Students are able to determine solutions to absolute value statements. (Application)</b>	<b>limited practice</b>

**Indicator 3: Interpret and develop mathematical models.**

<b>9-12.A.3.1A. Students are able to distinguish between linear, quadratic, inverse variation, and exponential models. (Analysis)</b>	<b>continually practicing this skill</b>
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9-12.A.3.2A. Students are able to create formulas to model relationships that are algebraic, geometric, trigonometric, and exponential. (Synthesis)	continually practicing this skill
9-12.A.3.3A. Students are able to use sequences and series to model relationships. (Analysis)	used in the context of approximating areas

**Indicator 4: Describe and use properties and behaviors of relations, functions, and inverses.**

9-12.A.4.1A. Students are able to determine the domain, range, and intercepts of a function. (Analysis)	continually practicing this skill
9-12.A.4.2A. Students are able to describe the behavior of a polynomial, given the leading coefficient, roots, and degree. (Analysis)	continually practicing this skill
9-12.A.4.3A. Students are able to apply transformations to graphs and describe the results. (Analysis)	<ul style="list-style-type: none"> <li>• Change coefficients or constants: <b>limited practice</b></li> <li>• Graph the inverse of a function: <b>limited practice</b></li> </ul>
9-12.A.4.4A. Students are able to apply properties and definitions of trigonometric, exponential, and logarithmic expressions. (Application)	continually practicing this skill
9-12.A.4.5A. Students are able to describe characteristics of nonlinear functions and relations. (Analysis)	<ul style="list-style-type: none"> <li>• Conic sections:</li> <li>• Trigonometric Functions: <b>continually practicing this skill</b></li> <li>• Exponential and logarithmic functions: <b>continually practicing this skill</b></li> </ul>

### Advanced High School Geometry Grade Standards

**Indicator 1: Use deductive and inductive reasoning to recognize and apply properties of geometric figures.**

9-12.G.1.2A. Students are able to determine the values of the sine, cosine, and tangent ratios of right triangles. (Evaluation)	<ul style="list-style-type: none"> <li>• Write a direct proof:</li> <li>• Make conjectures: <b>limited practice in this context</b></li> </ul>
9-12.G.1.2A. Students are able to determine the values of the sine, cosine,	continually practicing this skill

<b>and tangent ratios of right triangles. (Application)</b>	
<b>9-12.G.1.3A. Students are able to apply properties associated with circles. (Application)</b>	<b>limited practice in the context of problems</b>
<b>9-12.G.1.4A. Students are able to use formulas for surface area and volume to solve problems involving three-dimensional figures. (Analysis)</b>	<b>Related Rates Problems, Optimization Problems, Various Area Problems</b>

**Indicator 2: Use properties of geometric figures to solve problems from a variety of perspectives.**

<b>9-12.G.2.1A. Students are able to use Cartesian coordinates to verify geometric properties. (Synthesis)</b>	<b>using graphical representations to approximate functions and areas</b>
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### **Advanced High School Measurement Grade Standards**

**Indicator 1: Apply measurement concepts in practical applications.**

<b>9-12.M.1.1A. Students are able to use dimensional analysis to check answers and determine units of a problem solution. (Application)</b>	<b>continually practicing this skill</b>
<b>9-12.M.1.2A. Students are able to use indirect measurement in problem situations that defy direct measurement. (Analysis)</b>	<b>continually practicing this skill</b>

### **Advanced High School Number Sense Grade Standards**

**Indicator 1: Analyze the structural characteristics of the real number system and its various subsystems. Analyze the concept of value, magnitude, and relative magnitude of real numbers.**

<b>9-12.N.1.1A. Students are able to describe the relationship of the real number system to the complex number system. (Comprehension)</b>	<b>limited practice</b>
<b>9-12.N.1.2A. Students are able to apply properties and axioms of the real number system to various subsets, e.g., axioms of order, closure. (Application)</b>	<b>limited practice</b>

**Indicator 2: Apply number operations with real numbers and other number systems.**

<b>9-12.N.2.1A. Students are able to add, subtract, multiply, and divide real numbers including rational exponents. (Application)</b>	<b>continually practicing this skill</b>
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**Advanced High School Statistics & Probability Grade Standards**

**Indicator 1: Use statistical models to gather, analyze, and display data to draw conclusions.**

<b>9-12.S.1.2A. Students are able to analyze and evaluate graphical displays of data. (Evaluation)</b>	<b>limited practice</b>
<b>9-12.S.1.5A. Students are able to use scatterplots, best-fit lines, and correlation coefficients to model data and support conclusions. (Application)</b>	<b>limited practice</b>

**NCTM Principles and Standards for School Mathematics (2000)  
Grades 9-12**

**Number and Operations**

Instructional programs from pre-kindergarten through grade 12 should enable all students to –	<ul style="list-style-type: none"> <li>• Indicator: Textbook Sections</li> </ul>
Understand numbers, ways of representing numbers, relationships among numbers, and number systems.	<ul style="list-style-type: none"> <li>• Develop a deeper understanding of very large and very small numbers and of various representations of them: 1.2, 1.3, 1.4, 1.5, 3.5</li> <li>• Compare and contrast the properties of numbers and number systems, including the rational and real numbers, and understand complex numbers as solutions to quadratic equations that do not have real solutions:</li> <li>• Understand vectors and matrices as systems that have some of the properties of the real-number system:</li> <li>• Use number-theory arguments to justify relationships involving</li> </ul>

	whole numbers:
Understand meanings of operations and how they relate to one another.	<ul style="list-style-type: none"><li>• Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitude of quantities:</li><li>• Develop an understanding of properties of and representations for, the addition and multiplication of vectors and matrices:</li><li>• Develop an understanding of permutations and combinations as counting techniques:</li></ul>

<p>Compute fluently and make reasonable estimates.</p>	<ul style="list-style-type: none"> <li>• Develop fluency in operations with real numbers, vectors, and matrices, using mental computations or paper-and-pencil calculations for simple cases and technology for more-complicated cases: continually practicing this skill</li> <li>• Judge the reasonableness of numerical computations and their results: continually practicing this skill</li> </ul>
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## Algebra

<p>Understand patterns, relations, and functions.</p>	<ul style="list-style-type: none"> <li>• Generalize patterns using explicitly defined and recursively defined functions:</li> <li>• Understand relations and functions and select, convert flexibly among, and use various representations for them: continually practicing this skill</li> <li>• Analyze functions of one variable by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior: continually practicing this skill</li> <li>• Understand and perform transformations such as arithmetically combining, composing, and inverting commonly used functions, using technology to perform such operations on more-complicated symbolic expressions: continually practicing this skill</li> <li>• Understand and compare the properties of classes of functions, including exponential, polynomial, rational, logarithmic, and periodic functions: continually practicing this skill</li> <li>• Interpret representations of functions of two variables: continually practicing this skill</li> </ul>
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<p>Represent and analyze mathematical situations and structures using algebraic symbols.</p>	<ul style="list-style-type: none"> <li>• Understand the meaning of equivalent forms of expressions, equations, inequalities, and relations: continually practicing this skill</li> <li>• Write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency – mentally or with paper and pencil in simple cases and using technology in all cases: continually practicing this skill</li> <li>• Use symbolic algebra to represent and explain mathematical relationships: continually practicing this skill</li> <li>• Use a variety of symbolic representation, including recursive and parametric equations, for functions and relations:</li> <li>• Judge the meaning, utility, and reasonableness of the results of symbolic manipulations, including those carried out by technology: continually practicing this skill</li> </ul>
<p>Use mathematical models to represent and understand quantitative relationships.</p>	<ul style="list-style-type: none"> <li>• Identify essential quantitative relationships in a situation and determine the class or classes of functions that might model the relationship:</li> <li>• Use symbolic expressions, including iterative and recursive forms, to represent relationships arising from various contexts: continually practicing this skill</li> <li>• Draw reasonable conclusions about a situation being modeled: continually practicing this skill</li> </ul>

Analyze change in various contexts.	<ul style="list-style-type: none"> <li>Approximate and interpret rates of change from graphical and numerical data: continually practicing this skill</li> </ul>
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## Geometry

Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships.	<ul style="list-style-type: none"> <li>Analyze properties and determine attributes of two- and three-dimensional objects:</li> <li>Explore relationships (including congruence and similarity) among classes of two- and three-dimensional geometric objects, make and test conjectures about them, and solve problems involving them:</li> <li>Establish the validity of geometric conjectures using deduction, prove theorems, and critique arguments made by others:</li> <li>Use trigonometric relationships to determine lengths and angle measure:</li> </ul>
Specify locations and describe spatial relationships using coordinate systems.	<ul style="list-style-type: none"> <li>Use Cartesian coordinates and other coordinate systems, such as navigational, polar, or spherical systems, to analyze geometric situations:</li> <li>Investigate conjectures and solve problems involving two- and three-dimensional objects represented with Cartesian coordinates:</li> </ul>
Apply transformations and use symmetry to analyze mathematical situations.	<ul style="list-style-type: none"> <li>Understand and represent translations, reflections, rotations, and dilations of objects in the plane by using sketches, coordinates, vectors, function notation, and matrices:</li> <li>Use various representations to help understand the effects of simple transformations and their compositions:</li> </ul>

<p>Use visualizations, spatial reasoning, and geometric modeling to solve problems.</p>	<ul style="list-style-type: none"> <li>• Draw and construct representations of two-and three-dimensional geometric objects using a variety of tools:</li> <li>• Visualize three-dimensional objects from different perspectives and analyze their cross sections: 6.2</li> <li>• Use vertex-edge graphs to model and solve problems:</li> <li>• Use geometric models to gain insight into, and answer questions in, other areas of mathematics: continually practicing this skill</li> <li>• Use geometric ideas to solve problems in, and gain insight into, other disciplines and other areas of interest such as art and architecture:</li> </ul>
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### Measurement

<p>Understand measurable attributes of objects and the units, systems, and processes of measurement.</p>	<ul style="list-style-type: none"> <li>• Makes decisions about units and scales that are appropriate for problems involving measurement: continually practicing this skill</li> </ul>
<p>Apply appropriate techniques, tools, and formulas to determine measurement.</p>	<ul style="list-style-type: none"> <li>• Analyze precision, accuracy, and approximate error in measurement situations:</li> <li>• Understand and use formulas for the area, surface area, and volume of geometric figures, including cones, spheres, and cylinders: 6.2</li> <li>• Apply informal concepts of successive approximation, upper and lower bounds, and limit in measurement situations: 3.2, 3.8</li> <li>• Use unit analysis to check measurement computations: continually practicing this skill</li> </ul>

## Data Analysis and Probability

<p>Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.</p>	<ul style="list-style-type: none"><li>• Understands the difference among various kinds of studies and which types of inferences can legitimately be drawn from each:</li><li>• know the characteristics of well-designed studies, including role of randomization in surveys and experiments:</li><li>• understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable:</li><li>• understand histograms, parallel box plots, and scatterplots and use them to display data:</li><li>• compute basic statistics and understand the distinction between statistic and parameter:</li></ul>
<p>Select and use appropriate statistical methods to analyze data.</p>	<ul style="list-style-type: none"><li>• For univariate measurement of data, be able to display the distribution, describe its shape, and select and calculate summary statistics:</li><li>• For bivariate measurement data, be able to display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools:</li><li>• Display and discuss bivariate data where at least one variable is categorical:</li><li>• Recognize how linear transformations of univariate data affect shape, center and spread:</li><li>• Identify trends in bivariate data and find functions that model the data or transform the data so that they can be modeled: occasional practice of this skill</li></ul>

<p>Develop and evaluate inferences and predictions that are based on data.</p>	<ul style="list-style-type: none"> <li>• Use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions:</li> <li>• Understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference:</li> <li>• Evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions:</li> <li>• Understand how basic statistical techniques are used to monitor process characteristics in the workplace:</li> </ul>
<p>Understand and apply basic concepts of probability.</p>	<ul style="list-style-type: none"> <li>• Understand the concepts of sample space and probability distribution and construct sample spaces and distributions in simple cases:</li> <li>• Use simulations to construct empirical probability distributions:</li> <li>• Compute and interpret the expected value of random variables in simple cases:</li> <li>• Understand the concepts of conditional probability and independent events:</li> <li>• Understand how to compute the probability of a compound event:</li> </ul>