

BILLINGS PUBLIC SCHOOLS
MATHEMATICS
AP CALCULUS
Learner Objectives

MISSION STATEMENT

In a rapidly changing technological society, mathematics is a tool of great and growing importance. To achieve mathematical power one needs to become a problem solver, to value mathematics, to reason and communicate mathematically, and to be confident in applying mathematics to real world situations. The goal of mathematics education is to develop mathematically literate individuals who understand how mathematics, technology, and society influence one another.

PHILOSOPHY

We believe every student can understand the general nature and uses of mathematics necessary to solve problems, reason inductively and deductively and apply numerical concepts necessary to function in a technological society. We believe instructional strategies must include real world applications and the appropriate use of technology. We believe students must be able to use mathematics as a communications medium.

Therefore, as an educational system we believe we can teach all children and all children can learn. We believe accessing knowledge, reasoning, questioning, and problem solving are the foundations for learning in an ever-changing world. We believe education enables student to recognize and strive for higher standards. Consequently, we will commit our efforts to help students acquire knowledge and attitudes considered valuable in order to develop their potential and/or their career and lifetime aspirations.

LEARNER DOMAINS

- I. The learner will develop an understanding of number sense and mathematical properties.**
- II. The learner will develop an understanding of estimation, computation and mental math.**
- III. The learner will develop an understanding of measurement and geometric concepts.**
- IV. The learner will develop an understanding of patterns, algebraic reasoning and logic.**
- V. The learner will develop an understanding of statistics, probability, and data analysis.**
- VI. The learner will develop an understanding of technological tools.**

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I. The learner will develop an understanding of number sense and mathematical properties.

(I, D, E, A)

1. Apply the laws of exponents to simplify and evaluate expressions. (R)
2. **Recognize the limiting behavior of a basic algebraic expression. (E)**
3. **Use properties of the derivative to facilitate evaluation of derivatives. (E)**
4. **Use properties of the definite integral to facilitate evaluation of definite integrals. (E)**

II. The learner will develop an understanding of estimation, computation and mental math.

(I, D, E, A)

5. Use the properties of radicals to simplify expressions. (R)
6. Apply the laws of exponents to simplify and evaluate expressions and to solve equations. (R)
7. Convert equations between exponential and logarithmic forms. (R)
8. Evaluate common and natural logarithms. (R)
9. Mentally calculate simple logarithmic and exponential expressions without a calculator. (R)
10. Estimate the number of real and complex roots from a graph. (R)
11. **Estimate limits from graphs or tables of data. (E)**
12. **Use a tangent line to a curve at a point to determine a local linear approximation of the functions at that point. (E)**
13. **Recognize instantaneous rate of change as the limit of average rate of change. (E)**
14. **Approximate the rate of change from graphs and tables of values. (E)**
15. **Use Riemann sums and the Trapezoid rule to approximate definite integrals of functions. (E)**

III. The learner will develop an understanding of measurement and geometric concepts.

(I, D, E, A)

16. Convert between degree and radian measure. (R)
17. State the domain, range, and period of trigonometric functions. (R)
18. **Recognize the asymptotic behavior of specific functions. (E)**
19. **Describe asymptotic behavior in terms of limits involving infinity. (E)**
20. **Determine the continuity of a function at a point by examining the limit at that point. (E)**
21. **Demonstrate their understanding of the Intermediate and Extreme Value Theorems as they apply to the graphs of continuous functions. (E)**
22. **Determine whether a function is differentiable and/or continuous at a given point. (E)**

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III. The learner will develop an understanding of measurement and geometric concepts.
(I, D, E, A) (cont.)

23. Recognize the slope of a graph at a point as representing an instantaneous rate of change (derivative) at that point. (E)
24. Sketch a graph of the derivative of a function given the graph of the original function (and vice versa). (E)
25. Recognize the relationship between the increasing and decreasing behavior of a function and the sign of its derivative. (E)
26. Graphically illustrate the mean-value theorem. (E)
27. Recognize the relationship between corresponding characteristics of f , f' , f'' (a function and its first and second derivatives). (E)
28. Recognize the relationship between the concavity of a function and the sign of its second derivative. (E)
29. Recognize inflection points as places where the concavity of the original function changes. (E)
30. Use a Riemann Sums of equal subdivisions to approximate the area under a curve. (E)
31. Use the Fundamental Theorem to represent a particular antiderivative. (E)

IV. The learner will develop an understanding of patterns, algebraic reasoning and logic.
(I, D, E, A)

32. Solve equations involving radicals. (R)
33. Recognize and use the standard forms for the equation of a line. (R)
34. Solve and graph linear and absolute value equations and inequalities. (R)
35. Distinguish between a function and a relation, and apply the vertical line test. (R)
36. Determine the composite of two functions. (R)
37. Determine and graph the inverse of a function. (R)
38. Solve systems of equations and inequalities using a variety of methods. (R)
39. Solve systems of linear equations with three variables. (R)
40. Add, Subtract, multiply and divide polynomials. (R)
41. Factor polynomials including the sum and the difference of two cubes. (R)
42. Factor the sum and the difference of odd-power binomials. (R)
43. Apply the quadratic formula to solve equations. (R)
44. Apply factoring to solving equations and inequalities. (R)
45. Add, subtract, multiply, divide and simplify rational expressions. (R)
46. Apply synthetic substitution/division. (R)
47. Identify and graph parametric situations. (I)
48. Apply the completing the square algorithm. (R)
49. Solve systems of linear-quadratic and quadratic-quadratic relations. (R)
50. Solve and graph exponential and logarithmic functions (R)
51. Apply the laws of logarithms. (R)

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IV. The learner will develop an understanding of patterns, algebraic reasoning and logic. (I, D, E, A) (cont.)

- 52. Solve right triangles using trigonometric relationships. (R)
- 53. Define, graph, and determine values of the circular trigonometric functions. (R)
- 54. Apply the trigonometric identities. (R)
- 55. Identify, write, and graph general variation equations. (R)
- 56. Determine the transformational effects of an equation and its graph from its parent function. (R)
- 57. Analyze classes of functions including linear, quadratic, power, polynomial, absolute value, exponential, logarithmic, trigonometric, polar, piecewise and step functions. (R)
- 58. Analyze function tendencies, including limits, end behavior, and discontinuities. (R)
- 59. Calculate limits using algebra. (E)**
- 60. Compare relative magnitudes of functions and their rates of change. (E)**
- 61. Find the derivative using the formal limit definition of the derivation. (E)**
- 62. Translate a verbal description involving rates into an algebraic equation involving derivatives. (E)**
- 63. Use derivatives to solve problems involving optimization, rates of change, implicit differentiation and curve analysis. (E)**
- 64. Differentiate a function using an appropriate technique including basic differentiation rules (those for sums, products, quotients), chain rule or implicit differentiation. (E)**
- 65. Represent a definite integral as the limit of a Riemann Sum. (E)**
- 66. Use the Fundamental Theorem of Calculus to represent and calculate the change in quantity over a specified interval. (E)**
- 67. Anti-differentiate a function using an appropriate technique including recognition of basic functions, substitution method, integration by parts, and use of a table of integrals. (E)**
- 68. Solve separable differential equations and use them in modeling. (E)**
- 69. Use antiderivatives to solve real-world problems. (E)**

V. The learner will develop an understanding of statistics, probability, and data analysis. (I, D, E, A)

- 70. Identify and fit the proper equation to data (including exponential, log, power and trig). (R)
- 71. Describe and analyze data. (R)
- 72. Collect, organize data and display it graphically. (R)
- 73. Determine the effects of transformations on a set of data. (R)

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VI. The learner will develop an understanding of technological tools. (I, D, E, A)

74. use graphing technology to graph n (th) degree equations. (R)

75. Use graphing technology to solve n (th) degree equations and systems of equations. (R)

76. Enter simple programs into graphing calculators and use them appropriately. (R)

77. Determine the appropriate window on a graphing calculator for a given relations. (R)

78. Use technology to analyze and model data. (R)

79. Use technology to find the limit of derivative at a point, and the value of a definite integral using a variety of methods including programs, built-in functions of the calculator, and symbolic manipulators. (E)