DARIEN PUBLIC SCHOOLS

CURRICULUM GUIDE

Principles of Calculus

APPROVED: October 14, 2003

DARIEN PUBLIC SCHOOLS

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SECTION I – COURSE INFORMATION

STATEMENT OF PHILOSOPHY

DARIEN HIGH SCHOOL MATHEMATICS DEPARTMENT PHILOSOPHY

We believe in creating learning environments where students practice and acquire the knowledge of mathematics. We believe that students should be able to proficiently apply a range of numerical, algebraic, geometric and statistical concepts and the skills to formulate, analyze and solve real world problems. The learning environments will facilitate inquiry, use of technology and the exploration of real world phenomena. It will support continuous development of mathematical skills and the appreciation of mathematics as a discipline. Our mathematics program seeks to graduate students who will possess a sense of numbers, data analysis, spatial relationships, symbolic representation and the ability to communicate mathematics with others.

DISTRICT MATHEMATICS PHILOSOPHY

Mathematics is a vigorous and growing discipline – a universal language useful for communication and research in other disciplines. We want our students to reason and communicate mathematically, to be mathematical problem-solvers, to value mathematics and to feel confident in their ability to use mathematics. Creating such a foundation necessitates a well-articulated and developmentally appropriate mathematics program for all, developing the mathematical power of each.

Mathematics is more than a collection of concepts and skills to be mastered. It is the exploration of ideas and concepts, the understanding of relationships, the ability to make predictions, to analyze data, to estimate results, to communicate ideas and to solve problems in this ever-changing world. It is no longer limited to the study of complex calculations and formulas. We are moving from a curriculum often dominated by memorization of isolated facts and procedures to one that emphasizes conceptual understandings, multiple representations, deliberate connections and mathematical problem solving. Rather than being a transmitter of knowledge, the teacher becomes a facilitator of learning, guiding, questioning, listening, clarifying and creating an environment in which the student is an active participant in learning.

The needs of today's society demand that all students become mathematically literate to function effectively. It will be necessary for our students to be able to use mathematics in their personal lives, further studies and future workplaces. As educators, we must recognize that students have differing abilities, performance levels, needs and interests and provide them with the best mathematics education possible so that they may achieve their personal ambitions and career goals.

Too often, students have learned to compute without understanding why the computation procedures make sense or how they apply to their lives. Instruction must focus on the behaviors that contribute to the development of mathematical thinking and number sense – explaining procedures used, justifying reasoning, judging the reasonableness of solutions and reflecting on the application of concepts.

When students gain knowledge from meaningful experiences, they are much more likely to retain and use what they have learned. Sound practice in the teaching of mathematics means that students are guided to use concrete materials and explore ideas with classmates. In this way, knowledge evolves from personal experience.

The fundamental objective of education has always been to prepare students to be contributing members of the society in which they live. The objectives of this mathematics curriculum support and affirm this tradition.

PROGRAM GOALS

- Introduce students to the language of the calculus.
- Have students learn exactly what a derivative and an antiderivative is.
- Enable students to learn to apply derivatives and integrals in real world problems.
- Provide the opportunity for students to develop mathematical and logical reasoning.
- Show how calculus is connected with other disciplines and real world situations.
- Make students aware of the historical development of calculus
- Allow students to utilize the graphing calculator to make and analyze functions.
- Provide opportunity for students to complete and present a complex calculus project.

OVERVIEW

Principles of calculus is a two-semester course. The first semester covers functions and differential calculus. The second semester covers integral calculus and differential equations. During the second semester the students also work on calculus projects and present them to the class. The TI-83 or TI-83 Plus graphing calculator is required and used extensively in the course.

This class is ideal for a college bound student who may be interested in pursuing a degree in engineering, business or mathematics. The material covered will provide the student with a solid foundation in calculus. The math background needed to successfully complete the course is a solid understanding of Geometry, Algebra 2 and pre-calculus. While the class is not an AP class, some students will be able to respond successfully to some of the AP test questions.

ESSENTIAL QUESTIONS

1. How can we better understand the world around us by analyzing and recognizing functions?
2. How can we develop ways to explore and analyze higher-level mathematics in order to assist us in improving our problem solving skills?
3. How can we use mathematical modeling to enable us to more precisely explain, organize and understand the world around us?
4. How can we communicate our mathematical thinking clearly?
5. How can we organize and consolidate our knowledge and sense of numbers and mathematics?
6. What is calculus?

PROCESS SKILLS

- Reading (comprehending)
- Reading (analyzing)
- Reading (appreciating)
- Writing mathematical equations
- Speaking the language of algebra and trigonometry
- Listening
- Viewing
- Studying
- Reasoning and reflecting
- Using learning resources, manipulatives, technology
- Working independently and collaboratively
- Designing
- Creating
- Quantifying
- Understanding mathematical operations
- Computing
- Problem solving
- Graphing
- Using technology
- Applying derivatives
- Applying integration
- Others

STUDENT PERFORMANCE SUMMARY

- Cooperative learning
- Student board demonstration of math skills and problem solving
- Class discussions on selected topics
- Mathematical modeling with written explanation
- Proficiency in using TI-83 calculator to solve problems
- Explaining to other students how to use TI-83 calculator
- Interpreting problems and using TI-83 graphing technology to solve problems.
- Tests and quizzes
- Homework
- Calculus projects and presentations
- Class participation

GRADING GUIDELINES

	Expectations of students	**% of Grade**
Homework	100% of all assignments	10%
Notebook	all notes maintained	
Quizzes	all quizzes taken	35 % (50% in 4th Qtr)
Tests	all tests taken	45 % (none in 4th Qtr)
Mid year exam		20% of 1st semester grade
Projects	High caliber & completed on time	Quiz grade in 3rd Qtr 40% in 4th Qtr
Final exam		20% of 2nd semester grade
Class participation	every day	

SECTION II - UNITS OF STUDY

SUMMARY OF UNITS

Unit Title	Duration (weeks)
ONE: Extensive Precalculus Review: A Library of Functions	**5-6**
TWO: The Derivative	**4-5**
THREE: Derivative Shortcuts	**4-5**
FOUR: Applications of the Derivative	**3-4**
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SIX: Antiderivatives	**2-3**
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TEN: Final Project	**2-3**

UNIT 1 : Extensive Precalculus Review : A Library of Functions

ESSENTIAL QUESTIONS

1. Can the student determine the appropriate function to use to solve a given problem?
2. Can the student demonstrate knowledge of the following types of functions: linear, power, exponential, trigonometric and logarithm?
3. Can the student determine how to represent functions with graphs, tables or formulas?

NCTM STANDARDS

Mathematics as Problem Solving; Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Discrete Mathematics; Conceptual Underpinnings of the Calculus; Mathematical Structure.

CONTENT KNOWLEDGE OBJECTIVES

Content:

1. Linear functions, increasing/decreasing and family of functions.
2. Exponential functions, concavity, growth, decay, doubling time and half life, asymptotes
3. Power functions; compared to exponential and linear functions
4. Inverse functions
5. Logarithms, properties and solving log equations
6. The number e and natural logarithms; continuous growth and decay
7. Composition of functions, even and odd functions
8. Trigonometric functions and their inverses
9. Polynomial and rational functions; end behavior, points of discontinuity and asymptotes
10. Continuous functions

Skills:

1. Identify domain and range of a function, find the roots and draw the graph.
2. Using a table of data representing various functions, determine which set of data can be represented by which type of function; Write the function(s).
3. Given a graph, determine the function and write the equation.
4. Solve simple equations of various types.
5. Read, interpret and solve word problems involving the various types of functions.

VOCABULARY

Function, domain, range, proportional, linear, concave up, concave down, exponential, doubling time, half-life, asymptote, inverse, logarithm, radian, periodic, amplitude, polynomial, rational continuity.

ACTIVITIES

Graphing functions.
Finding zeros.

PERFORMANCE ASSESSMENT

Homework, quizzes, tests, class participation.

CAREER AWARENESS (where appropriate)

Engineering, architecture, teaching, construction, fine arts, athletics, astronomy, business, economics, research, actuarial, marketing

CORE TEXT FOR STUDENTS

Calculus – Single Variable, Second Edition, Hughes-Hallett Gleason, et. al., John Wiley & Sons,

ADDITIONAL TEXTS/RESOURCES FOR USE BY STUDENTS

See Section IV, Learning Resources

MATERIALS AND SUPPLIES

See Section IV, Learning Resources

INTEGRATED TECHNOLOGY

See Section IV, Learning Resources

UNIT 2 : The Derivative

ESSENTIAL QUESTIONS

1. What is the limit of a function?
2. How is the derivative defined and what does this mean geometrically?
3. How is the derivative found using analytic methods?
4. What does the first derivative tell us?
5. What does the second derivative tell us?

NCTM STANDARDS

Mathematics as Problem Solving; Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Discrete Mathematics; Conceptual Underpinnings of the Calculus; Mathematical Structure.

CONTENT KNOWLEDGE OBJECTIVES

Content:

1. Measure speed at a given instant of time
2. Understanding limits and how to find them.
3. Understanding the definition of the derivative.
4. Determining what the derivative tells us.
5. Understanding the second derivative.

Skills:

1. Find limits of functions.
2. Use the definition to find the derivative.
3. Graph the derivative, given a function.
4. Graph the function, given the derivative.
5. Using concavity to understand the function and its derivatives.

VOCABULARY

Speed, velocity, acceleration, instantaneous, limit, derivative, differentiable, concavity.

ACTIVITIES

Graphing functions and their derivatives.

PERFORMANCE ASSESSMENT

Homework, quizzes, tests, class participation.

CAREER AWARENESS (where appropriate)

Engineering, architecture, teaching, construction, fine arts, athletics, astronomy, business, economics, research, actuarial, marketing

CORE TEXT FOR STUDENTS

Calculus – Single Variable, Second Edition, Hughes-Hallett Gleason, et. al., John Wiley & Sons,

ADDITIONAL TEXTS/RESOURCES FOR USE BY STUDENTS

See Section IV, Learning Resources

MATERIALS AND SUPPLIES

See Section IV, Learning Resources

INTEGRATED TECHNOLOGY

See Section IV, Learning Resources

UNIT 3 : Derivative Shortcuts

ESSENTIAL QUESTIONS

1. What are the derivatives rules for functions?
2. How do we find the equation of the tangent line?
3. What is the Chain Rule?

NCTM STANDARDS

Mathematics as Problem Solving; Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Discrete Mathematics; Conceptual Underpinnings of the Calculus; Mathematical Structure.

CONTENT KNOWLEDGE OBJECTIVES

Content:

1. Systematic study of the derivatives of functions.
2. Calculus notation and symbols.

Skills:

1. Define the limit of $f(x)$.
2. Use derivative rules to determine $f'(x)$.
    a. Sum and difference rule
    b. Product and quotient rule.
    c. Power rule
    d. Exponential rules
    e. Trigonometric rules
    f. Log rules
    g. Chain rule
3. Using Implicit Differentiation.
4. Use algebraic techniques (factoring, multiplying by the conjugate of a radical expression) to modify the quotient of two functions so that a limit can be determined.
5. Evaluate a limit or determine that it does not exist.

VOCABULARY

No new vocabulary.

ACTIVITIES

Practice the rules of differential calculus.

PERFORMANCE ASSESSMENT

Homework, quizzes, tests, class participation.

CAREER AWARENESS (where appropriate)

Engineering, architecture, teaching, construction, fine arts, athletics, astronomy, business, economics, research, actuarial, marketing

CORE TEXT FOR STUDENTS

Calculus – Single Variable, Second Edition, Hughes-Hallett Gleason, et. al., John Wiley & Sons,

ADDITIONAL TEXTS/RESOURCES FOR USE BY STUDENTS

See Section IV, Learning Resources

MATERIALS AND SUPPLIES

See Section IV, Learning Resources

INTEGRATED TECHNOLOGY

See Section IV, Learning Resources

UNIT 4 : Applications of the Derivative

ESSENTIAL QUESTIONS

1. How do we use the first and second derivative?
2. What is an optimization problem and how do we solve it?
3. Can we solve real world problems using the calculus?

NCTM STANDARDS

Mathematics as Problem Solving; Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Discrete Mathematics; Conceptual Underpinnings of the Calculus; Mathematical Structure.

CONTENT KNOWLEDGE OBJECTIVES

Content:

1. Understanding critical points.
2. Using the second derivative.
3. Understanding tangent lines.

Skills:

1. Finding local maxima and minima.
2. Finding points of inflection.
3. Finding equation of tangent lines.
4. Using the second derivative test.
5. Finding global maxima and minima.
6. Solving real world optimization problems.

VOCABULARY

Maximum, minimum, point of inflection, tangent line, optimization.

ACTIVITIES

Graphing and analyzing graphs.
Modeling real world problems and solving.

PERFORMANCE ASSESSMENT

Homework, quizzes, tests, class participation.

CAREER AWARENESS (where appropriate)

Engineering, architecture, teaching, construction, fine arts, athletics, astronomy, business, economics, research, actuarial, marketing

CORE TEXT FOR STUDENTS

Calculus – Single Variable, Second Edition, Hughes-Hallett Gleason, et. al., John Wiley & Sons,

ADDITIONAL TEXTS/RESOURCES FOR USE BY STUDENTS

See Section IV, Learning Resources

MATERIALS AND SUPPLIES

See Section IV, Learning Resources

INTEGRATED TECHNOLOGY

See Section IV, Learning Resources

UNIT 5 : The Definite Integral

ESSENTIAL QUESTIONS

1. How do we measure distance traveled?
2. What is a Riemann sum?
3. How do we determine the area under a curve?
4. What is the Fundamental Theorem of Calculus?

NCTM STANDARDS

Mathematics as Problem Solving; Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Discrete Mathematics; Conceptual Underpinnings of the Calculus; Mathematical Structure.

CONTENT KNOWLEDGE OBJECTIVES

Content:

1. Rate of change: velocity and distance
2. Definite integral: cumulative rate of change
3. Riemann sums
4. Area under curve
5. Fundamental Theorem of Calculus

Skills:

1. Graphically calculating distance given velocity.
2. Graphing and computing Riemann sums.
3. Determining accuracy of Riemann sums.
4. Computing the Definite Integral.
5. Finding the area under a curve.
6. Finding the average of a function.
7. Understanding the properties of integration.
8. Using the Fundamental Theorem of Calculus.

VOCABULARY

Velocity, rate of change, increasing/decreasing function, Sigma notation, Riemann sum, definite integral

ACTIVITIES

Graphing functions with and without calculator

Using TI 83 program (AREA) to find definite integral

PERFORMANCE ASSESSMENT

Homework, quizzes, tests, class participation.

CAREER AWARENESS (where appropriate)

Engineering, architecture, teaching, construction, fine arts, athletics, astronomy, business, economics, research, actuarial, marketing

CORE TEXT FOR STUDENTS

Calculus – Single Variable, Second Edition, Hughes-Hallett Gleason, et. al., John Wiley & Sons,

ADDITIONAL TEXTS/RESOURCES FOR USE BY STUDENTS

See Section IV, Learning Resources

MATERIALS AND SUPPLIES

See Section IV, Learning Resources

INTEGRATED TECHNOLOGY

See Section IV, Learning Resources

UNIT 6: Antiderivatives

ESSENTIAL QUESTIONS

1. What does the antiderivative look like graphically?
2. How do we find the antiderivative analytically?
3. The rules of Integration.

NCTM STANDARDS

Mathematics as Problem Solving; Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Discrete Mathematics; Conceptual Underpinnings of the Calculus; Mathematical Structure.

CONTENT KNOWLEDGE OBJECTIVES

Content:

1. Constructing antiderivatives
2. The indefinite integral
3. Introduction to differential equations
4. Second Fundamental Theorem of Calculus

Skills:

1. Know how to use the Fundamental Theorem of Calculus.
2. Constructing f(x) from f'(x).
3. Constructing f'(x) from f(x).
4. Knowing the rules of integration to find the antiderivative.
5. Using the initial condition to determine the exact integral.
6. Construct a student handbook on integration and present to class.

VOCABULARY

Antiderivative, continuous, analytic solution, differential equation

ACTIVITIES

Calculator programming and graphing of equations, derivatives and integrals.

PERFORMANCE ASSESSMENT

Homework, quizzes, tests, class participation and class project presentation.

CAREER AWARENESS (where appropriate)

Engineering, architecture, teaching, construction, fine arts, athletics, astronomy, business, economics, research, actuarial, marketing

CORE TEXT FOR STUDENTS

Calculus – Single Variable, Second Edition, Hughes-Hallett Gleason, et. al., John Wiley & Sons,

ADDITIONAL TEXTS/RESOURCES FOR USE BY STUDENTS

See Section IV, Learning Resources

MATERIALS AND SUPPLIES

See Section IV, Learning Resources

INTEGRATED TECHNOLOGY

See Section IV, Learning Resources

UNIT 7 : Integral Calculus

ESSENTIAL QUESTIONS

1. How do we use integration by substitution?
2. How do we use the table of integrals?
3. Can the student present and teach this material to the class?

NCTM STANDARDS

Mathematics as Problem Solving; Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Discrete Mathematics; Conceptual Underpinnings of the Calculus; Mathematical Structure.

CONTENT KNOWLEDGE OBJECTIVES

Content:

1. Integration by substitution
2. Complex substitution
3. The Table of Integrals

Skills:

1. Knowing how to find the definite or indefinite integral using substitution.
2. Practice using the Table of Integrals.
3. Summarize and present to and teach class integration.

VOCABULARY

Substitution, indefinite integral

ACTIVITIES

Practice integration; preparing and presenting project to class

PERFORMANCE ASSESSMENT

Homework, quizzes, tests, class participation, project presentation.

CAREER AWARENESS (where appropriate)

Engineering, architecture, teaching, construction, fine arts, athletics, astronomy, business, economics, research, actuarial, marketing

CORE TEXT FOR STUDENTS

Calculus – Single Variable, Second Edition, Hughes-Hallett Gleason, et. al., John Wiley & Sons,

ADDITIONAL TEXTS/RESOURCES FOR USE BY STUDENTS

See Section IV, Learning Resources

MATERIALS AND SUPPLIES

See Section IV, Learning Resources

INTEGRATED TECHNOLOGY

See Section IV, Learning Resources

UNIT 8: Applications of the definite integral

ESSENTIAL QUESTIONS

1. What is the definite integral?
2. How do we use the fundamental theorem of calculus?
3. How does integration solve real world problems?

NCTM STANDARDS

Mathematics as Problem Solving; Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Discrete Mathematics; Conceptual Underpinnings of the Calculus; Mathematical Structure.

CONTENT KNOWLEDGE OBJECTIVES

Content:

1. Volumes of Revolution
2. Center of mass
3. Work

Skills:

1. Using integration to find volume of solids generated by revolving curves.
2. Solving other real world problems using integration (work, force, mass, etc.)

VOCABULARY

Volume of solid of revolution, center of mass, work,

ACTIVITIES

Web based instruction
Graphing and solving volumes

PERFORMANCE ASSESSMENT

Homework, quizzes, tests, class participation.

CAREER AWARENESS (where appropriate)

Engineering, architecture, teaching, construction, fine arts, athletics, astronomy, business, economics, research, actuarial, marketing

CORE TEXT FOR STUDENTS

Calculus – Single Variable, Second Edition, Hughes-Hallett Gleason, et. al., John Wiley & Sons,

ADDITIONAL TEXTS/RESOURCES FOR USE BY STUDENTS

See Section IV, Learning Resources

MATERIALS AND SUPPLIES

See Section IV, Learning Resources

INTEGRATED TECHNOLOGY

See Section IV, Learning Resources

UNIT 9: Differential Equations

ESSENTIAL QUESTIONS

1. What is a differential equation?
2. How do we use the separation of variables method?
3. How do we solve real world problems using differential equations?

NCTM STANDARDS

Mathematics as Problem Solving; Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Discrete Mathematics; Conceptual Underpinnings of the Calculus; Mathematical Structure.

CONTENT KNOWLEDGE OBJECTIVES

Content:

1. Differential equations
2. Newton's Law of Cooling and Heating
3. Growth and decay problems
4. Initial conditions

Skills:

1. Use separation of variables method
2. Find exact function using initial conditions.
3. Solve real world problems (murder, cooling, pollution, population, growth, decay).

VOCABULARY

Differential equations, initial condition, Law of Cooling, exponential,

ACTIVITIES

Evaluating real world situations; completing short project and presenting to class

PERFORMANCE ASSESSMENT

Homework, quizzes, tests, class participation, project.

CAREER AWARENESS (where appropriate)

Engineering, architecture, teaching, construction, fine arts, athletics, astronomy, business, economics, research, actuarial, marketing

CORE TEXT FOR STUDENTS

Calculus – Single Variable, Second Edition, Hughes-Hallett Gleason, et. al., John Wiley & Sons,

ADDITIONAL TEXTS/RESOURCES FOR USE BY STUDENTS

See Section IV, Learning Resources

MATERIALS AND SUPPLIES

See Section IV, Learning Resources

INTEGRATED TECHNOLOGY

See Section IV, Learning Resources

UNIT 10 : Final Project

ESSENTIAL QUESTIONS

1. How do we demonstrate proficiency of calculus?
2. How do we evaluate, solve and present a complex real world calculus problem?

NCTM STANDARDS

Mathematics as Problem Solving; Mathematics as Communication; Mathematics as Reasoning; Mathematical Connections; Algebra; Functions; Geometry from a Synthetic Perspective; Geometry from an Algebraic Perspective; Trigonometry; Discrete Mathematics; Conceptual Underpinnings of the Calculus; Mathematical Structure.

CONTENT KNOWLEDGE OBJECTIVES

Content:

1. Final project to meet objective of calculus course.

Skills:

1. Read and understand complex real world project.
2. Work in cooperative teams to complete project.
3. Meet scheduled deadlines.
4. Write and hand in final project.
5. Present project and solution to class.
6. Demonstrate thinking and analytical competency.
7. Peer evaluate other class projects.

VOCABULARY

Dependent on project selected by student.

ACTIVITIES

Reading, writing, thinking, problem solving, preparing and presenting. Using PowerPoint or TI 83 graphing calculator.

PERFORMANCE ASSESSMENT

Project, peer assessment

CAREER AWARENESS (where appropriate)

Engineering, architecture, teaching, construction, fine arts, athletics, astronomy, business, economics, research, actuarial, marketing

CORE TEXT FOR STUDENTS

Calculus – Single Variable, Second Edition, Hughes-Hallett Gleason, et. al., John Wiley & Sons,

ADDITIONAL TEXTS/RESOURCES FOR USE BY STUDENTS

See Section IV, Learning Resources

MATERIALS AND SUPPLIES

See Section IV, Learning Resources

INTEGRATED TECHNOLOGY

See Section IV, Learning Resources

SECTION III - STANDARDS

NCTM STANDARDS

1. Mathematics as Problem Solving

The mathematics curriculum should include the refinement and extension of methods of mathematical problem solving so that students can:

- use, with increasing confidence, problem solving approaches to investigate and understand mathematical content;
- apply integrated mathematical problem solving strategies to solve problems from within and outside mathematics;
- recognize and formulate problems form situations within and outside mathematics;
- apply the process of mathematical modeling to real world situations.

2. Mathematics as Communication

The mathematics curriculum should include the continued development of language and symbolism to communicate mathematical ideas so that students can:

- reflect upon and clarify their thinking about mathematical ideas and relationships;
- formulate mathematical definitions and express generalizations discovered through investigations;
- express mathematical ideas orally and in writing;
- read written presentations of mathematics with understanding;
- ask clarifying and extending questions related to mathematics they have read or heard about;
- appreciate the economy, power and elegance of mathematical notation and its role in the development of mathematical ideas.

3. Mathematics as Reasoning

The mathematics curriculum should include numerous and varied experiences that reinforce and extend logical reasoning skills so that students can:

- make and test conjectures;
- follow logical arguments;
- judge the validity of arguments;
- construct simple valid arguments.

4. Mathematical Connections

The mathematics curriculum should include investigation of the connections and interplay among various mathematical topics and their applications so that students can:

- recognize equivalent representations of the same concept;
- relate procedures in one representation to procedures in an equivalent representation;

- use and value the connections among mathematical topics;
- use and value the connections between mathematics and other disciplines.

5. Algebra

The mathematics curriculum should include the continued study of algebraic concepts and methods so that students can:

- represent situations that involve variable quantities with expressions, equations, inequalities and matrices;
- use tables and graphs as tools to interpret expressions, equations and inequalities;
- operate on expressions and matrices and solve equations and inequalities;
- appreciate the power of mathematical abstraction and symbolism;
- demonstrate technical facility with algebraic transformations, including techniques based on the theory of equations.

6. Functions

The mathematics curriculum should include the continued study of functions so that the student can:

- model real world phenomena with a variety of functions;
- represent and analyze relationships using tables, verbal rules, equations and graphs;
- recognize that a variety of problem situations can be modeled by the same type of function;
- analyze the effects of parameter changes on the graphs of functions;
- understand operations on, and the general properties and behavior of, classes of functions.

7. Geometry from a Synthetic Perspective

The mathematics curriculum should include the continued study of the geometry of two and three dimensions so that students can:

- interpret and draw three dimensional objects;
- represent problem situations with geometric models and apply properties of figures.

8. Geometry from an Algebraic Perspective

The mathematics curriculum should include the study of the geometry of two and three dimensions from an algebraic point of view so that students can:

- translate between synthetic and coordinate representations;
- deduce properties of figures using transformations and using coordinates;
- apply transformations, coordinates and vectors in problem solving.

9. Trigonometry

The mathematics curriculum should include the study of trigonometry so that students can:

- apply trigonometry to problem situations involving triangles;
- explore periodic real world phenomena using the sine and cosine functions;
- understand the connection between trigonometric and circular functions;
- use circular functions to model periodic real world phenomena;
- apply general graphing techniques to trigonometric functions;
- solve trigonometric equations and verify trigonometric identities.

10. Discrete Mathematics
The mathematics curriculum should include topics from discrete mathematics so that students can:

- represent problem situations using discrete structures such as finite graphs, matrices, sequences and recurrence relations.
- develop and analyze algorithms;
- represent and solve problems using linear programming and difference equations.

11. Conceptual Underpinnings of the Calculus
The mathematics curriculum should include the informal exploration of calculus concepts from both a graphical and a numerical perspective so the students can:

- determine maximum and minimum points of a graph and interpret result in problem situations;
- investigate limiting processes;
- understand the conceptual foundations of limit, rate of change and slopes of a tangent line and their applications in other disciplines;
- analyze the graphs of polynomial, rational, radical and transcendental functions.

12. Mathematical Structure
The mathematics curriculum should include the study of mathematical structure so that students can:

- understand the logic of algebraic procedures;
- appreciate that seemingly different mathematical systems may be essentially the same;
- demonstrate an understanding of the nature and purpose of axiomatic systems.

Connecticut Content Standards

1. Number Sense Students will use numbers to count, measure, compare, order, scale, locate and label, and use a variety of numerical representations to present, interpret, communicate and connect various kinds of numerical information.

2. Operations Students will add, subtract, multiply and divide with whole numbers, fractions, decimals and integers, and develop strategies for selecting the appropriate computational and operational methods for solving problems.

3. Estimation and Approximation Students will make estimates and approximations, and judge the reasonableness of results.

4. Ratios, Proportions and Percents Students will use ratios, proportions and percents to represent relationships between quantities and measures and solve problems involving ratios, proportions and percents.

5. Measurement Students will make and use measurements in both customary and metric units to approximate, measure and compute length, area, volume, mass, temperature, angle and time.

6. Spatial Relationships and Geometry Students will analyze and use spatial relationships and basic concepts of geometry to construct, draw, describe and compare geometric models and their transformations, and use geometric relationships and patterns to solve problems.

7. Probability and Statistics Students will use basic concepts of probability and statistics to collect, organize, display and analyze data, simulate events and test hypotheses.

8. Patterns Students will discover, analyze, describe, extend and create patterns, and use patterns to describe mathematical and other real-world phenomena.

9. Algebra and Functions Students will use algebraic skills and concepts, including functions, to describe real-world phenomena symbolically and graphically, and to model quantitative change.

10. Discrete Mathematics Students will use the concepts and processes of discrete mathematics to analyze and model a variety of real-world situations that involve recurring relationships, sequences, networks, combinations and permutations.

SECTION IV -- LEARNING RESOURCES

Text Books (most located in math department)

- *Calculus*, Finney, et. al., Addison-Wesley, 1999
- *Single Variable Calculus*, Stewart, et. al., Thompson Learning Inc., 2003
- *Calculus for the Utterly Confused*, Oman, McGraw-Hill, 1999
- *How to Ace Calculus*, Adams, et. al., W.H.Freeman,& Co., 1998
- *Student Research Projects in Calculus*, MAA, 1998
- *Calculus Mysteries and Thrillers*, MAA, 1997

Integrated Technology and Websites

- TI-83 or TI-83 Plus graphing calculator
- Microsoft PowerPoint
- TTL/C-5 Computer Lab
- Microsoft Excel
- Media center
- Winplot
- LiveMath
- Access
- www.nctm.org
- www.calculus.net
- www.calculus-help.com
- www.learner.org/exhibits/dailymath
- www.math.temple.edu/~paulos
- www.mathforum.org
- www.maa.org
- www.mathematicallycorrect.com
- www.personal.cfw.com/~clayford
- www.math.com
- www.math.uah.edu/psol
- www.nilesonline.com/stats
- www.mathmistakes.com
- www.innumeracy.com
- www.superstringtheory.com

Other

- Numerous Teacher Worksheets
- AP Calculus exams and study guides
- Internet