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ABSTRACT

This course of study guide is designed to help teachers establish a continuity within the scope and sequence of their elementary school mathematics curriculum and to assist those teachers in formulating some realistic goals for themselves and their students. Part I contains an introduction and statement of philosophy. Part II contains course descriptions for General Mathematics, Applied Mathematics, Pre-Algebra, Algebra I, Geometry, Algebra II, and Advanced Mathematics (Pre-Calculus). A position statement for secondary mathematics, discussion on computers and calculators, an agenda for action recommendations for school mathematics of the 1990's, and the ten basic skill areas from the National Council of Supervisors of Mathematics (NCSM) are also included. (JRH)

IDAHO SECONDARY MATHEMATICS

COURSE OF STUDY GUIDE

A Guide for Excellence in Mathematics Education

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TABLE OF CONTENTS

STATE OF IDAHO

DEPARTMENT OF EDUCATION

IDAHO SECONDARY MATHEMATICS COURSE OF STUDY GUIDE

Written June 1987
Updated April 1990
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FOREWORD

A 12-member curriculum committee was assembled to review and revise Idaho's Secondary Mathematics Course of Study Guide. The committee was composed of educators involved in classroom teaching from the kindergarten through 12th grade level. Administrators and college level personnel, under the guidance of the State Department of Education, worked together with the classroom teachers to revise and rewrite the secondary guide. Resources from various progressive states, as well as input from our local school districts, were used in writing Idaho's guide.

This Course of Study Guide has been designed to help teachers establish a continuity with the scope and sequence of their elementary school mathematics curriculum and to assist in formulating some realistic goals for themselves and their students. It is not our purpose to outline methods and procedures nor to recommend activities, projects, units, or plans for students and teachers to do. These are adequately treated in the teachers' manuals of the State adopted textbooks and by local district-developed curriculum guides.

It is recommended that all Idaho public school districts utilize the State Secondary Mathematics Course of Study Guide as a basic resource. It is the responsibility of the local boards, parents, administrators, and building supervisors to ensure that their program of instruction follows, at the minimum, the State guide.

I commend each person who participated in the writing of this guide. If used as a basic resource for the development of local guides, it should serve the public schools well and ensure quality instruction for Idaho students.

State Superintendent of Public Instruction

SECONDARY MATHEMATICS

Position Statement

Secondary mathematics textbooks have been carefully reviewed by the State Textbook and Improvement of Instruction Committee and adopted by the State Board of Education. The trends in mathematics education were reviewed, major factors were discussed, and are listed on page three as the "Ten Basic Skill Areas." A district selecting new mathematics books should consider these in selecting textbooks.

COMPUTERS AND CALCULATORS

Both the NCSM and the NCTM have goals for both computer literacy and calculator/computer use for all students. Both the computer and the calculator should be available, if at all possible, and allowed for use in the secondary mathematics classes.

Problem Solving

Two national groups, the National Council of Teachers of Mathematics (NCTM) and the National Council of Supervisors of Mathematics (NCSM) have both listed Problem Solving as the first and primary goal for the mathematics programs in the decade ahead. (See lists of recommendations below:)

AN AGENDA FOR ACTION
RECOMMENDATIONS FOR
SCHOOL MATHEMATICS OF THE 1990'S

The National Council of Teachers of Mathematics recommends that --

- Problem solving continue to be a focus of school mathematics in the 1990's.
- Basic skills in mathematics be defined to encompass more than computational facility.
- Mathematics programs take full advantage of the power of calculators and computers at all grade levels.
- Stringent standards of both effectiveness and efficiency be applied to the teaching of mathematics.
- The success of mathematics programs and student learning be evaluated by a wider range of measures than conventional testing.
- More mathematics study be required for all students and flexible curriculum with a greater range of options be designed to accommodate the diverse needs of the students population.
- Mathematics teachers demand of themselves and their colleagues a high level of professionalism.
- Public support for mathematics instruction be raised to a level commensurate with the importance of mathematical understanding to individuals and society.

NATIONAL COUNCIL OF SUPERVISORS OF MATHEMATICS
Ten Basic Skill Areas

PROBLEM SOLVING
Students should learn specific strategies for problem solving since learning to solve problems is the principal reason for studying mathematics.

APPLYING MATHEMATICS TO EVERYDAY SITUATIONS
Students would learn to inspect all results and to check for reasonableness in terms of the original problem.

ALERTNESS TO THE REASONABLENESS OF RESULTS
Students should learn to inspect all results and to check for reasonableness in terms of the original problem.

ESTIMATION AND APPROXIMATION
Students should be able to carry out rapid approximate calculations by first rounding off numbers and having some sense of what the result should be.

APPROPRIATE COMPUTATIONAL SKILLS
Students should gain computational facility with addition, subtraction, multiplication, and division with whole numbers, fractions, decimals, and percentages.

GEOMETRY
Students should have knowledge of concepts such as point, line, plane, parallel, perpendicular, simple geometric figures, both plane and solid, and measurement and problem solving skills.

MEASUREMENT
Students should be able to measure distance, weight, time, capacity, temperature, both in the metric and customary systems.

READING, INTERPRETING, AND CONSTRUCTING TABLES
Students should know how to read and draw conclusions from simple tables, maps, charts, and graphs and also make charts, maps, tables and graphs from data.

USING MATHEMATICS TO PREDICT
Students should learn how elementary notions of probability are used to determine the likelihood of future events.

COMPUTER LITERACY
Students should be aware of the many uses of computers in society, such as their use in teaching/learning, financial transactions and information storage and retrieval.

MATHEMATICS

Philosophy

Mathematics is the language of the scientific, business, and commercial worlds. It is reflected in most other facets of our lives to some degree. There are two major aspects of mathematics, (1) use and/or application and (2) beauty, symmetry and appreciation. In the area of application, mathematics is used to count, model or predict. In the area of appreciation are recurring patterns, symmetry, predictability and the excitement of discovery that is inherent in the study of mathematics itself.

Learning to solve problems is the principal reason for studying mathematics. In general, two main efforts must be made in order to accomplish this:

1. Good computational skills must be taught and maintained in addition, subtraction, multiplication and division using whole numbers, decimals and fractions.

2. Problem solving skills and strategies must be taught and reinforced by using meaningful problems.

Most textbooks provide for computational skill teaching but supplementary material is generally needed for the teaching of problem solving.

> "A problem is a situation either quantitative or verbal that requires a solution for which the individual sees no apparent or obvious means or path to obtain the solution."

Obviously, thinking skills and understanding must be employed and will be enhanced by purposeful use of problems keyed to the basic concepts to be taught.

Other key elements in the philosophical framework for the mathematics curriculum must include the goal of mathematical literacy for all students. Literacy implies that the individual can apply mathematical knowledge and skills to satisfy common, personal, vocational and citizenship needs. Applying mathematics must not be left to artificial or trivial situations, but must be meaningful and motivating. Mathematics must also be taught as a way of thinking.

The use of technology must be incorporated where appropriate. Computer and calculator applications to mathematics, logic, statistics, graphing, probability and consumer mathematics must be made. It must be clear that pencil and paper computation is not prerequisite to the mathematics that adults do by estimation or approximation and use of calculators or computers. Adults do a great deal of the mathematics applied to the working world using technology and test the reasonableness of the results using that same technology.

There are major goals and critical components that must be present to have a useful and meaningful mathematics curriculum at all levels. The critical components of any curriculum or program are those basic elements that lie within the content of that curriculum. In general, the critical components of mathematics are number and operations, sets, functions, relations, systems and statistics, graphing and problem solving strategies. The critical components should not be confused with the important outcomes of mathematics. These are:

- Problem solving skills
- Estimation skills
- Computation skills
- Reasoning and thinking skills
- Application skills

For all mathematics curriculum some or most of the above critical components must be a part of the course and all of the listed outcomes should be the goal for the course.

This course of study covers the following topics:

- General Mathematics
- Applied Mathematics
- Pre Algebra
- Algebra I
- Geometry
- Algebra II
- Advanced Mathematics (Pre-Calculus)

Two years of mathematics are required for graduation. A student can satisfy the requirement with any combination of two of the above listed courses.

GENERAL MATHEMATICS

Course Description

General Mathematics is a course for students not planning to complete a college preparatory program in mathematics. General mathematics emphasizes considerable development of computational skill and, in addition, General Mathematics contains some of the "discrete" mathematics necessary for a person with limited technical training to function in a technological society.

The concepts and content in General Mathematics are predicated upon the need for students to become capable in problem solving, computation, mathematics applications, and nontechnical "discrete" mathematics. Alternately named courses such as Career Mathematics, Personal Mathematics, Proficiency Mathematics, or Occupational Mathematics, etc. may serve as the vehicle for accomplishing proficiency in these concepts provided such courses cover the critical components, goals and objectives.

General Mathematics may satisfy two of the four credits required for graduation.

Critical Components

In order to satisfy the state graduation requirement, General Mathematics must deal significantly with:

- Problem Solving
- Numbers and Operations
- Measurement
- Geometry
- Rates, Ratios, Proportions, and Relations
- Graphs
- Probability and Statistics
- "Discrete" Mathematics

I. PROBLEM SOLVING

A. GOAL:

Students will improve proficiency in applying a variety of problem solving strategies to typical real life problems.

OBJECTIVES: Students will

1. Use a calculator to solve problems involving long or tedious computations.

2. Use estimation procedures to determine the "reasonableness" of calculator results.

3. Use appropriate software for computer solutions to problems.

II. NUMBERS AND OPERATIONS

A. GOAL:

Students will be able to select and apply appropriate computational skills to solve problems.

OBJECTIVES: Students will

1. Select and use appropriate computational skills in solving a variety of occupational and personal real life problems.

2. Use estimation procedures to determine the "reasonableness" of the results of their computations.

III. MEASUREMENT

A. GOAL:

Students will demonstrate proficiency in the use of customary and metric measures.

OBJECTIVES: Students will

1. Select and use appropriate customary and metric measures for common occupational and personal needs.

2. determine approximate equivalent customary and metric measures in "common" use.

IV. GEOMETRY

A. GOAL:

Students will select and use the common geometric concepts in solving appropriate problems.

OBJECTIVES: Students will

1. Determine perimeters, areas, and volumes of common geometric shapes and solids.

2. Apply common formulas to calculate desired measurements.

3. Calculate desired measurements of non-common shapes by breaking the shape into combinations of common shapes.

4. Apply the Pythagorean Principle to appropriate occupational and personal problems.

B. **GOAL:**

Students will demonstrate proficiency in the use of the coordinate system.

OBJECTIVES: Students will

1. Use a coordinate system to interpret appropriate problems.

2. Graph common mathematical relationships using a coordinate system.

V. RATES, RATIOS, PROPORTIONS, AND RELATIONS

A. **GOAL:**

Students will be able to determine and use ratios, and proportions in solving common problems.

OBJECTIVE: Students will

1. Apply ratio and proportion concepts and skills to a variety of occupational and personal problems.

B. **GOAL:**

Students will interpret fractions and decimals as ratios and work with percents.

OBJECTIVES: Students will

1. Express fractions and decimals as ratios.

2. Express ratios as fractions and decimals.

3. Apply appropriate ratios to solving problems with fraction or decimal data.

4. Show proficiency in working with percentages and their applications.

C. **GOAL:**

Students will recognize and use relationships that exist in sequential processes.

OBJECTIVES: Students will

1. Construct and use flow charts or sequenced directions to describe problem solving plans.

2. Complete forms requiring sequenced operations.

IV. GRAPHS

A. **GOAL:**

Students will prepare and interpret graphs, charts, and tables.

OBJECTIVES: Students will

1. Use charts and graphs to predict or explain.

2. Interpret data from a chart or graph.

3. Organize raw data in percent form.

4. Determine mean, median, and mode of data in roster, graph, or chart form.

VII. PROBABILITY AND STATISTICS

A. **GOAL:**

Students will use "simple" statistics and probability procedures to interpret data.

OBJECTIVES: Students will

1. Collect data.

2. Determine the range, mean, median, an mode of data.,

3. Make reasonable predictions from data.

4. Determine the "chance" of an event happening.

VIII. "DISCRETE" MATHEMATICS

A. GOAL:

Students will become familiar, at a non-technical or non-rigorous level, with the mathematics of computers and technology.

OBJECTIVES: Students will

1. Use common algorithms to solve problems.
2. Recognize a matrix as a rectangular array.
3. Use matrices to organize data.
4. Determine "reasonableness" of computer results.
5. Identify what computers can and cannot do.
6. Recognize and construct simple sequences.
7. Identify simple counting procedures (e.g., tree diagrams, and multiplication principles).

APPLIED MATHEMATICS

Course Description

Applied mathematics is a course designed around a laboratory work place approach to teaching mathematics. It provides for a hands-on, applicable, useful, and experiential way of learning and using mathematics. The course should be offered to those students who require a more concrete, rather than abstract, approach to learning mathematics.

The overall course shall include material that focuses on arithmetic operations, problem solving, estimation, measurement, geometry, probability and statistics, algebraic principles, and the applications of mathematics. This is a course that must take advantage of the use of technology and in general will have content consistent with courses traditionally taught in arithmetic, algebra, and geometry at the high school level. But, the emphasis should remain on the ability to understand and apply functional mathematics to solve problems in the world of work.

The course does not necessarily offer the content in the same way that is in traditional college preparatory mathematics courses, but Applied Mathematics should enhance the opportunity for students to bridge the gap between their not taking algebra I and taking algebra I. The course should provide a background in mathematics conducive to success at the college level.

Critical Components:

In order to satisfy the state graduation requirement, the content of Applied Mathematics must significantly include:

1. Problem solving techniques
2. Measuring; estimating; precision, accuracy and tolerance
3. Dealing with data; graphing data; using graphs, charts and tables
4. Shapes in two dimensions; working with lines and angles; shapes in three dimensions; scale drawings
5. Ratios and proportions
6. Signed numbers, vectors; solving with formulas
7. Scientific notation; powers and roots
8. Linear equations; nonlinear equations
9. Probability and statistics
10. Right-triangle relations; trigonometric functions

The critical components should be addressed through instruction in:

- Problem Solving
- Number systems and operations
- Measurement and estimation
- Geometry and trigonometry
- Rates, ratios, proportions, and functions relations
- Graphing and equations
- Probability and statistics
- Using technology to solve problems wherever appropriate

I. PROBLEM SOLVING

A. GOAL:

Students will be made aware of problem solving strategies and be able to apply such strategies to problems.

OBJECTIVE: Students will

1. Use problem solving strategies to include guess and check, look for a pattern, make a chart or drawing, work backwards, analyze information, and make a plan for solving problems.

B. GOAL:

Students will demonstrate proficiency in problem solving with the calculator and computer wherever appropriate.

OBJECTIVES: Students will

1. Use the calculator to solve problems involving long or tedious computations.

2. Use a calculator or a computer as a tool in applying mathematical knowledge.

C. GOAL:

Students will learn and apply the relationships that exist in sequential processes.

OBJECTIVE: Students will

1. Apply skills to step-by-step processes in

   a. Using a flow chart or sequence of directions

b. Completing forms such as applications, order forms, etc.
c. Completing forms using tables.

II. NUMBERS AND OPERATIONS

A. GOAL:

Students will be able to apply appropriate computational skills to specific applications.

OBJECTIVES: Students will

1. Know and use computational skills of addition, subtraction, multiplication and division of whole numbers, decimals, percents, and fractions, and know when to use each in a problem setting.

2. Estimate solutions to calculations and determine the reasonableness of the results by computation.

B. GOAL:

Students will learn appropriate computational skills.

OBJECTIVES: Students will

1. Demonstrate proficiency in computations of addition, subtraction, multiplication and division with integers, fractions and decimals.

2. Demonstrate proficiency in computations with percent, ratios, and proportions, and their applications.

3. Apply appropriate computational skills to specific applications.

C. GOAL:

Students will be aware of the uses of technology in the application of the fundamental operations.

OBJECTIVES: Students will

1. Use a calculator as a tool in applying mathematical knowledge.

2. Use computational skills involving whole numbers and decimals through personal accounting, budgeting and check balancing.

3. Use computers as problem solving tools when appropriate and available.

III. MEASUREMENT AND ESTIMATION

A. GOAL:

Students will become familiar with both customary and metric systems and the seven different kinds of measurement.

OBJECTIVES: Students will

1. Independently perform and interpret standard measurements in both metric and customary systems, and make approximate comparison between metric and customary measures.

2. List the seven kinds of measurement (time, angles, length, area, volume, weight, and temperature) and compare the different ways to measure and apply the problems involving:

   a. Time and temperature measurement.
   b. Application of perimeter, area, volume, and surface area calculations such as buying fencing, carpeting or painting a house.
   c. Metric units and conversion between metric units.
   d. Approximation of metric units to customary units for comparison.

3. Develop estimation skills and reasonableness of answers.

IV. GEOMETRY AND TRIGONOMETRY

A. GOAL:

Students will identify and use common geometric ideas such as lengths, area, volume, and the Pythagorean and the trigonometric relationships.

OBJECTIVES: Students will

1. Identify and define common geometric shapes.

2. Distinguish between area, perimeter, volume and apply the formulas to find these measures for common geometric shapes.

3. Describe the use of geometric shapes in building designs and structures.

4. Apply the Pythagorean theorem to appropriate problems.

B. **GOAL:**

Students will identify and use the number system with geometric applications.

OBJECTIVES: Students will

1. Use number line models and form a coordinate system.

2. Read and apply coordinate systems to problem solving.

3. Learn and use the three basic trigonometric ratios in solving problems.

V. RATES, RATIOS, PROPORTIONS, FUNCTIONS, AND RELATIONS

A. **GOAL:**

Students will understand the use of rates, ratios and proportions for applications.

OBJECTIVE: Students will

1. Apply ratio concepts and skills to:

   a. Scale drawing and maps.
   b. Comparison buying through unit pricing.
   c. Distance and time relationships.
   d. Cost ratios.

B. **GOAL:**

Students will understand that terminating decimals and percents can be expressed as ratios and will be able to apply them in problem solving.

OBJECTIVES: Students will

1. Convert ratios and fractions into decimals and vice versa.

2. Apply decimals and percents to problems in taxes, interest, and real life situations.

C. **GOAL:**

Students will identify functions and relations.

OBJECTIVES: Students will

1. Graph relations in the coordinate plane.

2. Express a relation or function as a line and determine the relation or function given a line.

3. Use direct and inverse variation.

VI. GRAPHING AND EQUATIONS

A. GOAL:

Students will use information from line, bar and circle graphs, charts and tables.

OBJECTIVE: Students will

1. Apply the following methods of data analysis and prediction:

   a. Use information from charts and graphs, to predict or explain.
   b. Organize data into charts and graphs.
   c. Analyze raw data into percentages.
   d. Determine mean, median, and mode from a set of data, graph, or chart.
   e. Graph equations.

VII. PROBABILITY AND STATISTICS

A. GOAL:

Students will understand, collect and organize data for analysis.

OBJECTIVES: Students will

1. Collect data from projects.

   a. To find range, mean, mode and median.
   b. To develop tables, charts, graphs, and histograms.

2. Use fractions or decimals to express probabilities.

3. Read and interpret probabilities as chance.

4. Calculate probabilities of simple experiments, spinners, dice, etc.

5. Examine the use of probabilities in making predictions.

6. Use statistical data to make predictions.

VIII. TECHNOLOGY

A. GOAL:

Students will use computers, hand-held calculators and other appropriate tools to solve problems and investigate mathematical concepts.

OBJECTIVES: Students will

1. Use technology tools to enhance problem solving and relieve them of unnecessary computation.

2. Know when the use of technology is appropriate.

PRE-ALGEBRA

Course Description

Pre-Algebra is one of three courses for students not ready for the college preparatory course of Algebra I. Applied Mathematics and General Mathematics are also designed for students not yet ready for Algebra I. Each course can satisfy one of the two units in mathematics required for graduation. A student could take two of these three courses and fulfill the graduation requirement in mathematics. Pre-algebra differs from Applied Mathematics and General Mathematics mainly in the matter of emphasis. Pre-algebra, as its name implies, is a math course emphasizing the basic core goals of General Mathematics but with an emphasis on skills leading to preparation for Algebra I.

In this course problem solving, computation and mathematical applications should be emphasized.

Critical Components

In order to satisfy the state graduation requirement, Pre-algebra must deal significantly with:

- Problem Solving, Logic, Estimation
- Number Systems and Operations in Those Number Systems
- Variables, Functions and Relations
- Graphs
- Probability and Statistics
- Geometry, Measurement

I. PROBLEM SOLVING, LOGIC, AND ESTIMATION

A. GOAL:

Students will be aware of problem solving strategies and be able to apply such strategies to problems.

OBJECTIVES: Students will

1. Clarify the problem by asking questions.
2. Make and use a drawing or a model.
3. Make a systematic list or table.
4. Break a problem into manageable parts.

5. Look for patterns.

6. Guess and check.

7. Work backwards.

8. Eliminate possibilities.

B. **GOAL:**

Students will demonstrate proficiency in problem solving with the calculator and computer with appropriate answer estimation.

OBJECTIVES: Students will

1. Use the calculator in solving tedious and difficult problems.

2. Use the computer to extend the curriculum to some more realistic and meaningful problems.

3. Estimate and check answers.

C. **GOAL:**

Students will demonstrate their understanding of logic.

OBJECTIVES: Students will

1. Use flow charting and sequential step listing for planning and problem solving.

2. Prove or "show" simple conclusions with deductive reasoning.

II. NUMBER SYSTEM AND OPERATIONS

A. **GOAL:**

Students will work with whole numbers, integers, rational and irrational numbers.

OBJECTIVES: Students will

1. Determine sum, difference, product and quotient, of whole numbers, fractions and decimal fractions.

2. Compute with percent, ratios and proportions, and their applications.

3. Graph rational numbers, and integers using the number line and other modeling instruments.

4. Define and identify irrational numbers.

5. Compute with irrational numbers.

B. GOAL:

Students will be aware of use technology where appropriate in computations with integers and rational numbers.

OBJECTIVE: Students will

1. Use a calculator and computer where applicable as a tool to compute with rational numbers and integers.

III. VARIABLES, FUNCTIONS, AND RELATIONS

A. GOAL:

Students will use the model of sets to interpret functions.

OBJECTIVES: Students will

1. Define a set and express a set in roster, rule and graph form.

2. Identify a subsets of a set.

3. Determine the union and intersection of two sets.

4. Graph a set of ordered pairs in a plane.

5. Determine the function rule for a set of ordered pairs that represent a function.

6. Substitute values for the variable in first and second degree functions and determine the truth set.

B. GOAL:

Students will solve equations.

OBJECTIVES: Students will

1. Translate between grammatical and mathematical phrases and sentences.

2. Determine the solution to equations involving addition and/or subtraction of polynomials.

3. Determine the solution to linear equations involving multiplication of a polynomial.

4. Evaluate an open expression given replacement values.

B. GOAL:

Students will manipulate the necessary algebraic symbols to solve problems.

OBJECTIVES: Students will

1. Combine similar algebraic terms.

2. Determine the sum and difference of two polynomials.

3. Determine the product and quotient of two polynomials, a monomial and a binomial, and two binomials.

4. Simplify an expression containing at least three grouping symbols.

5. Apply these algebraic concepts to realistic and specific problems.

IV. GRAPHS

A. GOAL:

Students will use information from graphs, charts, tables and circle graphs.

OBJECTIVES: Students will

1. Read, interpret and draw conclusions from information in table and graph form.

2. Develop a hypothesis, collect appropriate new data, and construct a graph to display the data.

B. **GOAL:**

Students will relate number systems to graphs.

OBJECTIVES: Students will

1. Graph rational numbers on a number line.
2. Graph sets of ordered number pairs in a plane.
3. Graph simple relations and functions.

V. PROBABILITY AND STATISTICS

A. **GOAL:**

Students will understand, collect and organize data for predicting.

OBJECTIVES: Students will

1. Collect data and find range, mean, mode and median.
2. collect data and develop tables, charts, graphs and histograms.
3. Use the calculator or computer as a tool in analyzing data.

VI. GEOMETRY AND MEASUREMENT

A. **GOAL:**

Students will apply measurement to common geometric objects.

OBJECTIVES: Students will

1. Determine the area of common geometric shapes and objects.
2. Determine the perimeter of common geometric shapes.
3. Determine the volume of common geometric solids.
4. Know and use the Pythagorean relationship.

ALGEBRA I

Course Description

This is generally the first course in the college preparatory mathematics program. Algebra is more than generalized arithmetic. The concepts and content of Algebra I include the use of variables representing known or unknown quantities. These variables are then used in equations and inequalities to solve particular problems that would be more difficult without their use. In addition, it is important for the student to acquire some proficiency in the inductive process in problem solving and the use of the computer or hand held calculator as a tool in problem solving.

Critical Components

In order to satisfy the state graduation requirement, Algebra I must deal significantly with:

- Problem Solving and Mathematics Reasoning
- Properties of Number Systems
- Solving Equations
- Solving Inequalities
- Polynomials and Factoring
- Functions, Relations, Variables
- Graphs
- Systems of Equations
- Radicals and Exponents, Irrational Numbers
- Quadratic Equations

I. PROBLEM SOLVING AND MATHEMATICAL REASONING

A. GOAL:

Students will understand and show proficiency in problem solving.

OBJECTIVES: Students will

1. Read and properly interpret problem statements.
2. Select appropriate problem solving strategies.
3. Apply strategies to solve "real world" problems.
4. Use calculators and/or computers as problem solving tools.
5. Use estimation skills to check reasonableness of solutions.

B. **GOAL:**

Students will understand inductive and deductive reasoning.

OBJECTIVE: Students will

1. Use

   a. Inductive and deductive reasoning to justify simple results.
   b. Valid argument forms, including direct and indirect reasoning.
   c. Deduction to derive proofs of theorems from axioms or previously proven theorems.

II. PROPERTIES OF REAL NUMBER SYSTEMS

A. **GOAL:**

Students will understand the structure and properties of the real number system.

OBJECTIVES: Students will

1. Use symbols of groupings, variables, exponents.

2. List and define the properties of the number system (i.e., commutative, associative, distributive, etc.)

3. Use the four operations in relation to the real number system.

4. Recognize and use basic theorems based on the properties of the real number system.

III. SOLVING EQUATIONS

A. **GOAL:**

Students will understand the use of variables, equations and the solution strategies for equations.

OBJECTIVES: Students will

1. Use the addition and subtraction principles in solving equations.

2. Use the multiplication and division principles in solving equations.

3. Transform word problems to equations, solve and check the solutions.

IV. SOLVING INEQUALITIES

A. GOAL:

Students will learn the skills necessary for solving inequalities.

OBJECTIVES: Students will

1. Define monomial, binomial, and polynomial.
2. Combine and simplify polynomial expression.
3. Factor monomials, binomials and polynomials.
4. Solve problems and equations involving polynomials.

V. FUNCTIONS, RELATIONS, AND VARIATIONS

A. GOAL:

Students will understand relationships between systems and variables and how these relations may be expressed.

OBJECTIVES: Students will

1. Graph relations in the coordinate plane.
2. Express a relation or function as a line and determine the relation or function given a line.
3. Use direct and inverse variation.

VI. GRAPHS

A. GOAL:

Students will understand and interpret graphs.

OBJECTIVES: Students will

1. Graph linear equations in the coordinate plane.
2. Determine the slope of lines.
3. Develop equations of lines given the graph of lines.

VII. SYSTEMS OF EQUATIONS

A. **GOAL:**

Students will understand systems of equations.

OBJECTIVES: Students will

1. Solve systems of linear equations using substitution, and addition methods for solution.

2. Make application of systems of equations to meaningful problems.

VIII. RADICALS, EXPONENTS, AND IRRATIONAL NUMBERS

A. **GOAL:**

Students will understand radicals, exponents and irrational numbers and their operations.

OBJECTIVES: Students will

1. Be able to define irrational numbers.

2. Do operations with radicals and exponents.

3. Use radicals with the Pythagorean property.

IX. QUADRATIC EQUATIONS

A. **GOAL:**

Students will understand some applications and derivations of quadratic equations and solve them.

OBJECTIVES: Students will

1. Solve quadratic equations by simple factoring and completing the square.

2. Solve quadratic equations using the quadratic formula.

GEOMETRY

Course Description

Geometry was derived from real world measurements of lines, planes and solids. These developed into concepts that were idealized and defined. A systematic logical approach was then made with the relations these idealized figures have with themselves. Therefore, it is always useful to start with tangible figures and intuitively develop definitions and agreed upon propositions as a basis for study in geometry.

1. Along with numbers, geometry uniquely connects mathematics with the physical world.

2. Geometry uniquely enables ideas from other areas of mathematics to be pictured.

3. Geometry non-uniquely provides an example of a mathematical system.

The direct connection that geometry makes with the physical world takes the form of shapes for buildings, city layouts, and construction of many types. It answers questions like, "How far?", "How big?" or "How long?". Areas, perimeters, volumes and the Pythagorean relations are examples of the usefulness of geometry. Also analysis and classifications of shapes and relationships between figures using congruence or similarity are useful ideas explored in geometry. Geometry also can be used to picture algebraic ideas. Using coordinate geometry, graphs of lines and curves can be generated. Sine, cosine and tangent curves can be pictured. The derivative of a function as a tangent to a curve at a point on that curve, and statistics using bar and circle graphs and curve fitting are uses of geometry. Despite these unique and direct aspects for studying geometry, the non-unique aspect of geometry as a mathematical system, historically has been the most influential focus contained in the content of the geometry course. The emphasis on proofs must be there but not to the exclusion of the other aspects of geometry. In order to do that:

1. Treat obvious statements informally and not as rigorous proofs.

2. Shorten the prolonged periods for proofs using the same two column format.

3. Include topics from coordinate geometry, and transformational geometry and simple uses of statistics.

Geometry has traditionally been taught between Algebra I and Algebra II. Flexibility should be kept so that geometry could be taught after Algebra II.

Critical Components

In order to satisfy the graduation requirement, geometry must deal significantly with:

- Geometry as a Logical System
- Problem Solving
- Lines and Angles
- Triangles
- Geometric Constructions
- Polygons
- Circles, Arcs
- Coordinate Geometry
- Transformations
- Solid Figures

I. GEOMETRY AS A LOGICAL SYSTEM

A. GOAL:

Students will understand and approach geometric problems using measurement.

OBJECTIVES: Students will

1. Use measurement to derive definitions and assumptions.

2. Use the deductive system to prove basic (important) theorems.

3. Use other than formal methods of demonstration for non-essential problems and theorems.

II. PROBLEM SOLVING

A. GOAL:

Students will understand problem solving and select strategies generally used in geometry.

OBJECTIVES: Students will

1. Learn and apply the four step problem solving procedure of

   a. Identifying and analyzing the problem.
   b. Formulating a plan to solve the problem.
   c. Solving the problem.
   d. Looking for patterns that are useful for solving other problems.

2. Learn and use the following problem solving strategies

   a. Drawing a picture or diagram.
   b. Solving part of the problem.
   c. Looking for a pattern.
   d. Work backwards from conclusion to condition.

III. LINES AND ANGLES

A. GOAL:

Students will understand and demonstrate proficiency in the geometry of lines.

OBJECTIVE: Students will

1. Define and use

   a. Parallel and perpendicular lines, transversals and skewlines.
   b. Parts of lines (points, segments, rays).
   c. Angles, angle measurement and classification of angles.

IV. TRIANGLES

A. GOAL:

Students will understand triangles and some of their applications.

OBJECTIVE: Students will

1. Define and use

   a. Congruence of triangles.
   b. Calculation and application of area of triangles.
   c. Similarity and proportionality of triangles.
   d. The Pythagorean theorem and apply this principle to meaningful problems.
   e. Elementary right triangle trigonometry functions (sine, cosine, tangent) and apply to meaningful problems.

V. GEOMETRIC CONSTRUCTIONS

A. GOAL:

Students will understand how to construct certain geometric figures.

OBJECTIVES: Students will

1. Explain methods and construct
   a. Line segments, angles, triangles
   b. The bisection of segments and angles, subdivision of a line into "N" equal segments.
   c. Perpendiculars, parallels and simple polygons.
2. Use the concept of locus of points to define a curve.

VI. POLYGONS

A. GOAL:

Students will understand parts and uses of polygons.

OBJECTIVES: Students will

1. Name the components of polygons and their properties.
2. Compute areas of polygons.
3. Measure interior and exterior angles of polygons.

VII. CIRCLES, ARCS

A. GOAL:

Students will understand the properties of the circle and arc of a circle.

OBJECTIVES: Students will

1. Define properties and relationships involving circles and arcs or circles and interior angles.
2. Calculate and use areas of circles.
3. Develop equations of circles.

VIII. COORDINATE GEOMETRY

A. GOAL:

Students will understand the use of geometry to picture functions.

OBJECTIVES: Students will

1. Use the coordinate system to define graph functions.
2. Define slope of the line, parallel and perpendicular lines.
3. Relate linear equations to specific lines and vice versa.

IX. TRANSFORMATIONS

A. GOAL:

Students will understand the unifying nature of transformations concerning congruence, symmetry and similarity in conclusions and deductions about geometry.

OBJECTIVE: Students will

1. Define and demonstrate reflection, rotation, translation and dilation as moves in showing congruence and similarity of geometric figures.

X. SOLID GEOMETRY

A. GOAL:

Students will understand introductory ideas of three-dimensional geometry.

OBJECTIVE: Students will

1. Study and use ideas from
   a. Families of polyhedra: Prisms, pyramids, and regular polyhedra.
   b. Cones and cylinders.
   c. Geometry of spheres: Areas of great circles, volume of spheres.
   d. Perspectives and cross sections.
   e. Drawing three-dimensional shapes.
   f. Surface areas and volumes of solids.
   g. The proportionality of lengths, areas, and volumes.

ALGEBRA II

Course Description

Algebra II has historically been the third course in the college preparatory mathematics program. However, some schools allow many of their students to either take both Algebra II and geometry the same year or take Algebra II before they take geometry. Algebra II is an extension of Algebra I. Topics are added in the area of functions that expand the algebras to include conic sections and trigonometry, thus relating algebra to geometric concepts. Algebra II is generally preliminary to a course in analysis, analytical geometry and ideas of limits and the calculus. This course also ties together many of the ideas from arithmetic and geometry.

Critical Components

In order to satisfy the state graduation requirement, Algebra II must deal significantly with:

- Problem Solving and Mathematical Reasoning
- Real Numbers and Properties
- Equations and Inequalities
- Functions
- Polynomials and Factoring
- Powers, Roots and Complex Numbers
- Quadratic Equations and Functions
- Sequences, Series
- Probability and Statistics
- Trigonometric Functions
- Matrices and Determinants

I. PROBLEM SOLVING AND MATHEMATICAL REASONING

A. GOAL:

Students will understand and show proficiency in problem solving.

OBJECTIVES: Students will

1. Read and properly interpret problem statements.
2. Select appropriate problem solving strategies.
3. Apply strategies to solve "real world" problems.
4. Use calculators and/or computers as problem solving tools.

5. Use estimation skills to check reasonableness of solutions.

B. **GOAL:**

Students will apply an organized problem solving procedure.

OBJECTIVES: Students will

1. Identify and analyze the problem.
2. Formulate a plan to solve the problem.
3. Solve the problem.
4. Look back for patterns that can be useful for solving other problems.

II. REAL NUMBERS AND PROPERTIES

A. **GOAL:**

Students will understand real numbers as a mathematical system.

OBJECTIVE: Students will

1. Review basic computational operations in the real number system and solve problems in this system.

III. EQUATIONS AND INEQUALITIES

A. **GOAL:**

Students will understand the use of equations and inequalities.

OBJECTIVES: Students will

1. Solve and graph equations and inequalities with applications.
2. Use absolute value functions.

IV. FUNCTIONS

A. **GOAL:**

Students will understand polynomial use and factoring.

OBJECTIVES: Students will

1. Factor a monomial, binomial, polynomial, quadratic polynomial.

2. Solve polynomial equations by factoring.

3. Use synthetic division and binomial expansion.

V. POWERS, ROOTS, AND COMPLEX NUMBERS

A. GOAL:

Students will understand the use of powers and roots and their relationship.

OBJECTIVES: Students will

1. Multiply, divide and simplify radical expressions.

2. Operate with powers and exponents.

B. GOAL:

Students will use and understand complex numbers.

OBJECTIVE: Students will

1. Solve equations and simplify expressions involving imaginary and complex numbers.

VI. QUADRATIC EQUATIONS, GRAPHS, AND FUNCTIONS

A. GOAL:

Students will understand the application of quadratic functions and equations.

OBJECTIVES: Students will

1. Graph quadratic functions and relate them to the conic sections (ellipses, hyperboles, parabolas).

2. Solve systems of equations both linear and quadratic.

3. Derive the quadratic formula.

VII. EXPONENTS AND LOGARITHMIC FUNCTIONS

A. **GOAL:**

Students will understand the relationship between logarithmic and exponential functions.

OBJECTIVES: Students will

1. Define and use logarithms and exponents as a inverse relation.

2. Solve exponential and logarithmic equations.

VIII. SEQUENCES AND SERIES

A. **GOAL:**

Students will understand and use series and sequences.

OBJECTIVES: Students will

1. Define sequences and series.

2. Distinguish between arithmetic, geometric and other sequences and series.

3. Use the binomial theorem.

IX. PROBABILITY AND STATISTICS

A. **GOAL:**

Students will understand the basic principles of probability and statistics.

OBJECTIVES: Students will

1. Define and use permutations and combinations.

2. Apply the binomial theorem to probability.

3. Solve for median, mode, mean, and range.

4. use frequency distributions and histograms.

X. TRIGONOMETRIC FUNCTIONS

A. GOAL:

Students will understand trigonometric functions and identities.

OBJECTIVES: Students will

1. Define and use trigonometric functions as circular functions as well as triangular functions.
2. Graph trigonometry functions.
3. Solve simple identities.

XI. MATRICES

A. GOAL:

Students will understand the use of matrices.

OBJECTIVES: Students will

1. Add, subtract and multiply matrices.
2. Solve systems of linear equations by the use of matrix methods.

ADVANCED MATHEMATICS (PRE-CALCULUS)

Course Description

This course is an extension of Algebra II with the emphasis in Trigonometry, Limits, and introductory calculus topics. All major areas covered in Algebra II are reinforced at a greater depth with additional applications aided by the use of calculators and computers. The course is designed to encompass all those topics necessary to be successful in a college calculus course.

Critical Components

In order to satisfy the state graduation requirements, Advanced Mathematics (Pre-calculus) must deal significantly with:

- Problem Solving
- The Complex Number System
- Equations and Inequalities
- Functions
- Sequences and Series
- Probability and Statistics
- Matrices, Determinants and Vectors
- Introductory Calculus
- Polar and Parametric Functions

I. PROBLEM SOLVING

A. GOAL:

Students will understand and show proficiency in problem solving.

OBJECTIVES: Students will

1. Read and properly interpret problem statements.
2. Select appropriate problem solving strategies.
3. Apply strategies to solve "Real World" problems.
4. Use calculators and/or computers as problem solving tools.
5. Use estimation skills to check reasonableness of solutions.

B. **GOAL:**

Students will apply an organized problem solving procedure.

OBJECTIVES: Students will

1. Identify and analyze the problem.
2. Formulate a plan to solve the problem.
3. Solve the problem.
4. Check solution for accuracy.
5. Look back for patterns that can be useful in solving other problems.

II. THE COMPLEX NUMBER SYSTEM

A. **GOAL:**

The students will understand complex numbers as a mathematical system.

OBJECTIVE: Students will

1. Review and extend basic computational operations from the real to the complex number system and solve related problems.

III. EQUATIONS AND INEQUALITIES

A. **GOAL:**

The students will understand the use of equations and inequalities.

OBJECTIVES: Students will

1. Expand skills in solving and graphing equations and inequalities with applications.
2. Extend the use of absolute value functions.
3. Learn greatest integer function $f(x) = [x]$.

IV. FUNCTIONS

A. GOAL:

Students will understand polynomial, trigonometric, exponential, and logarithmic functions.

OBJECTIVES: Students will

1. Extend the use and methods involved in factoring, including synthetic division.
2. Expand binomials using the binomial theorem.
3. Solve exponential and logarithmic equations.
4. Solve trigonometric equations.
5. Define and use inverses as they relate to exponential, logarithmic, and trigonometric functions.
6. Solve triangles using trigonometric relationships, the law of sines, and the law of cosines.
7. Graph exponential, logarithmic, and trigonometric functions using translations and symmetry.
8. Prove trigonometric identities.
9. Graph conic sections.
10. Find equations of conic sections given pertinent data.

V. SEQUENCES AND SERIES

A. GOAL:

Students will understand and use sequences and series.

OBJECTIVES: Students will

1. Distinguish between arithmetic, geometric and other sequences and series.
2. Calculate various terms of all types of sequences.

3. Compute the sum of finite series.

4. Compute the n(th) partial sum of a given infinite series and use limits to find the sum.

5. Use mathematical induction for appropriate proofs.

VI. PROBABILITY AND STATISTICS

A. GOAL:

Students will understand the basic principles of probability and statistics.

OBJECTIVES: Students will

1. Define and use permutations and combinations.

2. Apply the binomial theorem to probability.

3. Calculate the probability of an event.

4. Apply the binomial theorem to probability.

5. Solve for mean, median and mode.

6. Use frequency distributions and histograms.

VII. MATRICES AND DETERMINANTS

A. GOAL:

Students will understand the use of matrices and determinants.

OBJECTIVES: Students will

1. Evaluate determinants using minors.

2. Solve systems of equations using Cramer's Rule.

3. Perform arithmetic operations with matrices.

4. Use calculators when appropriate to solve matrices.

5. Solve systems of equations using augmented matrices.

VIII. INTRODUCTORY CALCULUS

A. GOAL:

Students will understand the concept of limit, derivative, and integral and their applications.

OBJECTIVES: Students will

1. Define limits at positive and negative infinity, and a point (in terms of epsilons and deltas).
2. Calculate limits of functions.
3. Define continuity.
4. Define and compute derivatives.
5. Find equations of tangent lines to curves.
6. Solve maximum-minimum problems.
7. Approximate a definite integral by computing and summing areas of rectangles.
8. Compute basic antiderivatives.

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