

MATHEMATICS APPLICATIONS AND PROBLEM SOLVING 2007

COURSE DESCRIPTION:

The objective of this one semester course is to develop students' problem-solving skills through the application of core mathematical concepts to actual problems drawn from the disciplines of mathematics, business, and the physical and social sciences. Accordingly, content is aligned with the first four content clusters of the NJCCS with the primary instructional strategy driven by the fifth standard, **Standard 4.5 (Mathematical Processes)**.

The principle criteria for the selection of content for inclusion in this course are broad applicability to problems in business and the sciences, and the junior level HSPA. While the primary focus of the course is problem solving, to ensure an appropriate level of competency in each content area and to establish the relevancy of mathematical concepts to applications, students are provided with instruction on concepts prior to attempting open-ended problems. Open-ended problems are approached employing a disciplined procedure with results evaluating according to an objective rubric.

Prerequisites: Successful completion of courses in Algebra 1 and Geometry, or the equivalent.

CORE CURRICULUM CONTENT STANDARDS:

4.1 (Number and Numerical Operations) All students will develop number sense and will perform standard numerical operations and estimations on all types of numbers in a variety of ways.

4.2 (Geometry and Measurement) All students will develop spatial sense and the ability to use geometric properties, relationships and measurement to model, describe and analyze phenomena.

4.3 (Patterns and Algebra) All students will represent and analyze relationships among variable quantities and solve problems involving patterns, functions, and algebraic concepts and processes.

4.4 (Data Analysis, Probability, and Discrete Mathematics) All students will develop an understanding of the concepts and techniques of data analysis, probability, and discrete mathematics, and will use them to model situations, solve problems, and analyze and draw appropriate inferences from data.

4.5 (Mathematical Processes) All students will use mathematical processes of problem solving, communication, connections, reasoning, representations, and technology to solve problems and communicate mathematical ideas.

CUMULATIVE PROGRESS INDICATORS (CPIs):

CPIs are drawn respectively from Grades 8 and 12 as indicated.

4.1.A. Number Sense

4.1.A.3 Understand and use ratios, proportions, and percents (Grade 8).

4.1.B. Numerical Operations

4.1.B.1 Extend understanding and use of operations to real numbers and algebraic procedures (Grade 12).

4.2.A. Geometric Properties

4.2.A.2 Understand and apply the Pythagorean theorem (Grade 8).

4.2.A.4 Understand and apply the concept of similarity (Grade 8).

4.2.A.1 Use geometric models to represent real-world situations and objects and to solve problems using those models (Grade 12).

4.2.C. Coordinate Geometry

4.2.C.1 Use coordinate geometry to represent and verify properties of lines (Grade 12).

4.2.C.2 Show position and represent motion in the coordinate plane using vectors (Grade 12).

4.2.D. Units of Measure

4.2.D.1 Solve problems requiring calculations that involve different units of measurement within a measurement system (Grade 8).

4.2.D.6 Solve problems that involve compound measurement units, such as speed, air pressure, and population density (Grade 8).

4.2.E. Measuring Geometric Objects

4.2.E.1 Use techniques of indirect measurement to represent and solve problems. (Grade 12).

4.2.E.2 Use a variety of strategies to determine perimeter and area, and surface area and volume (Grade 12).

4.3.B. Functions and Relationships

4.3.B.1 Understand relations and functions.(Grade 12).

4.3.C. Modeling

4.3.B.1 Use functions to model real-world phenomena and solve problems that involve varying quantities (Grade 12).

4.3.D. Procedures

4.3.B.1 Evaluate and simplify expressions (Grade 12).

4.3.B.2 Select and use appropriate methods to solve equations and inequalities (Grade 12)

4.4.A. Data Analysis

4.4.A.1 Select and use appropriate representations for sets of data, and measures of central tendency (mean, median, and mode). (Grade 8).

4.4.A.2 Make inferences (Grade 8).

4.4.A.3 Estimate lines of best fit and use them to interpolate (Grade 8).

4.4.A.5 Analyze data using technology, and use statistical terminology to describe conclusions (Grade 12).

4.4.B. Probability

4.4.B.1 Interpret probabilities as ratios, percents, and decimals. (Grade 8).

4.4.B.2 Determine probabilities of compound events. (Grade 8).

4.4.B.1 Calculate the expected value of a probability-based game and determine whether the game is fair (Grade 12).

4.4.B.2 Use concepts and formulas of area to calculate geometric probabilities (Grade 12).

4.4.B.3 Model situations involving probability with simulations (Grade 12).

4.4.B.4 Determine probabilities in complex situations (Grade 12).

4.4.B.5 Estimate probabilities and make predictions based on experimental and theoretical probabilities (Grade 12).

4.4.B.6 Understand the Law of Large Numbers (Grade 12).

4.5.A. Problem Solving

4.5.A.1 Learn mathematics through problem solving, inquiry, and discovery.

4.5.A.2 Solve problems that arise in mathematics and in other contexts.

4.5.A.3 Select and apply problem-solving strategies.

4.5.B. Communications

4.5.B.2 Communicate their mathematical thinking coherently and clearly in writing.

4.5.C. Connections

4.5.C.1 Recognize recurring themes across mathematical domains.

4.5.C.4 Apply mathematics in practical situations and in other disciplines.

4.5.D. Reasoning

4.5.D.4 Rely on reasoning to check the correctness of their problem solving,

4.5.E. Representations

4.5.E.3 Use representations to model and interpret physical, social and mathematical phenomena.

4.5.F. Technology

4.5.F.2. Use computer spreadsheets, software, and graphing utilities to organize and display quantitative information.

SUGGESTED ACTIVITIES THAT ADDRESS THESE STANDARDS MAY INCLUDE BUT ARE NOT LIMITED TO:

4.1 (Number and Numerical Operations)

A comprehensive review of mathematical concepts and procedures is provided in each of the content areas.

4.2 (Geometry and Measurement)

Open-ended problems involving direction, distance and magnitude, scale models and measurement are presented. Problems are drawn predominately from applications involving measurement in the physical sciences.

4.3 (Patterns and Algebra)

Open-ended problems exploring functional relationships in one and two variable systems are presented. Problems from the physical sciences and finance involving rates are emphasized (speed, fuel consumption, interest, etc.)

Students complete a computer-based Discounted Cash Flow Analysis.

4.4 (Data Analysis, Probability, and Discrete Mathematics)

Open-ended problems investigating theoretical and experimental probabilities are presented, as well as problems focusing on the analysis of data distributions; measures of central tendency and variability in sample data to make inferences and generate forecasts of the underlying population. Applications in biology and the social sciences are presented.

4.5 (Mathematical Processes)

Instruction on a general problem-solving procedure as applied to open-ended problems in mathematics, business, and the physical and the social sciences is provided.

Students use Microsoft Excel as their primary modeling tool. Students will complete a computer-based tutorial on the basics of Excel.

INSTRUCTIONAL STRATEGIES:

Students are provided instruction on mathematical concepts in each of the content areas prior to the attempting open-ended problems.

Students strengthen their problem-solving abilities by applying mathematical content knowledge to problems in mathematics, business, and the physical and social sciences. Problems are modeled upon HSPA and SRA open-ended problems.

To gain facility in the use of the computer to model applications, students complete computer-based lessons in Excel and Discounted Cash Flow Analysis

EVALUATION/ASSESSMENT OF STUDENTS:

Competencies with mathematical concepts are assessed using written examinations, homework and class participation.

Competencies with applications are evaluated using an open-ended problem rubric.

Computer-based instruction is assessed based upon performance on directed exercises contained in the instruction modules.

EVALUATION/ASSESSMENT OF CURRICULUM:

This course of study will be evaluated/assessed by instructional staff during the first year of implementation for the purpose of necessary revision at the end of the first year. In addition, this course of study will be reviewed according to the Five-Year Curriculum Review schedule (see attached).

RESOURCES/BIBLIOGRAPHY:

REA HSPA Mathematics Textbook.

Instructor's HSPA and SRA Instructional Material.

Mathematics, Business, Physical and Social Sciences Textbooks.