FREEHOLD REGIONAL HIGH SCHOOL DISTRICT

OFFICE OF CURRICULUM AND INSTRUCTION

MATHEMATICS DEPARTMENT

DISCRETE MATH

Grade Level: 11-12

Credits: 5

BOARD OF EDUCATION ADOPTION DATE:

AUGUST 30, 2010

SUPPORTING RESOURCES AVAILABLE IN DISTRICT RESOURCE SHARING
APPENDIX A: ACCOMMODATIONS AND MODIFICATIONS
APPENDIX B: ASSESSMENT EVIDENCE
APPENDIX C: INTERDISCIPLINARY CONNECTIONS

Course Philosophy

This curriculum is based on the belief that mastery in learning takes place over an extended period of time. Students will learn to value mathematics; recognize recurring themes across mathematical domains; strengthen mathematical proficiency through problem solving, inquiry, and discover; learn to communicate and reason mathematically; and create mathematical representations through the use of technology. Mathematically talented students are offered the appropriate balance of analytical techniques and technological instruction, in Discrete Mathematics, as a basis for development and use of mathematical models to reflect real life applications and to foster a life-long learning and appreciation for mathematics.

Course Description

This college preparatory mathematics course includes units on mathematics of social choice, management science, growth and symmetry, and the development and use of mathematical models to reflect real-life applications.

Freehold Regional High School District
Curriculum Map
Discrete Math

Relevant Standards[1]	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
4.1A Number sense is an intuitive feel for numbers and a common sense approach to using them. It involves an understanding of how different types of numbers are related to each other and how each can best be used to describe a particular situation.	A quantity can be represented numerically in various ways. Problem solving depends upon choosing wise ways.	How do mathematical ideas interconnect and build on one another to produce a coherent whole?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects
4.1B Numerical operations are an essential part of the mathematics curriculum. Students must be able to select and apply various computational methods, including mental math, pencil and paper techniques and use of calculators.	There are multiple algorithms for finding a solution. Computational fluency includes understanding the meaning and appropriate use of numerical operations. The magnitude of numbers affects the outcome of the operations on them.	What makes a computational strategy both effective and efficient? How do mathematical representations reflect the needs of society? How do operations affect numbers?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects
4.2B Reflections, rotations, translation and dilations are important to natural phenomena. Patterns of transformations are relevant to determining the graphs of points, lines, and functions.	Shape and area can be conserved during mathematical transformation.	What situations can be analyzed using mathematical transformations and symmetries?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects
4.2D Real world phenomena come with units of measure. Recognizing the appropriate units and various representations of measure will help problem solving strategies.	Everyday objects have a variety of attributes, each of which can be measured in various ways. Measurements can be used to describe, compare and make sense of phenomena.	How can measurements be used to solve problems?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects

Relevant Standards[1]	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
4.3A Algebra provides the language through which we communicate the patterns in mathematics. Students should have the opportunities to analyze, extend and create a variety of patterns and to use pattern-based thinking.	The symbolic language of algebra and generalization of patterns in mathematics are used to communicate and understand mathematics. Algebraic representation can be used to generalize patterns and relationships.	How can patterns, relations, and functions be used as tools to best describe and represent change?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects
4.4A In today's information-based world, students need to be able to read, understand and interpret data in order to make informed decisions. Students should increasingly be expected to analyze and make inferences from data as well as to analyze data and inferences made by others.	The message conveyed by the data depends on how the data is collected, represented, and summarized. The result of a statistical investigation can be used to support or refute an argument.	How can the collection, organization, interpretation, and display of data be used to answer questions and be used to predict future events?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects
4.4C Development of strategies for organizing, representing and interpreting non-consistent data solve real world problems.	Grouping by attributes (classifications) can be used to answer mathematical questions. Algorithms can effectively and efficiently be used to quantify and interpret discrete information.	How can attributes be use to classify data/objects? What is the best way to solve this?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects
4.4D Students should represent data and solve problems from real-world contexts and use algebraic representations to find optimal solutions to given problems.	Optimization is finding the best solution within given constraints. Algorithms can effectively and efficiently be used to quantify and interpret discrete information.	How can visual tools such as networks (vertex-edge graphs) be used to answer questions? How can algorithmic thinking be used to solve problems?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects

Relevant Standards[1]	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
4.5A Problem posing and problem solving involves examining situations that arise in mathematics, other disciplines and in common experiences.	Mathematics can be learned through problem solving, inquiry, and discovery.	How can clear and concise organization and higher-level thinking enhance the mathematics student?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects
4.5B Communication of mathematical ideas involves students' sharing their mathematical understandings in oral and written form with their classmates, teachers, and parents.	Use communication to organize and clarify mathematical thinking.	How can connections in mathematics be helpful in the sciences, social sciences, and the arts; and to the everyday world?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects
4.5C Making connections involve seeing relationships between different topics and drawing on those relationships in future study.	Students can translate readily between algebra, geometry and/or calculus.	How can students use prior knowledge and skills to reason and conquer a wide array of conceptual mathematical problems?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects
4.5D Mathematical reasoning is the critical skill that enables a student to make use of all other mathematical skills.	With the development of mathematical reasoning, students recognize that mathematics makes sense and can be understood.	What type of alternate perspectives can be used to tackle the solution to a problem?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects

Relevant Standards[1]	Enduring Understandings	Essential Questions	Assessments		
			Diagnostic (before)	Formative (during)	Summative (after)
4.5E Representations refer to the use of physical objects, drawings, charts, graphs, and symbols to represent mathematical concepts and problem situations.	By using various representations students will be better able to communicate their thinking and solve problems.	How are charts, diagrams and/or graphs used to enhance conceptual learning and problem solving?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects
4.5F Calculators and computers need to be used along with other mathematical tools by students in both instructional and assessment activities.	Tools should be used not to replace mental math and paper and pencil computation, but to enhance understanding of mathematics and the power to use mathematics.	How can the use of technology enhance the learning environment?	Anticipatory Set	Guided/Independent/ Partner/Group Practice Remote Responders Quizzes Games/Activities	Unit Test with multiple choice and open-ended Projects

Note: All students will use mathematical process of problem solving, communication, connections, reasoning, representations, and technology to solve problems and communicate mathematical ideas, as indicated in Standards 4.5 A-F, throughout each unit.

Freehold Regional High School District
Course Proficiencies and Pacing
Discrete Math

Unit Title	Unit Understandings and Goals	Recommended Duration
Unit #1: Management Science	Optimization is finding the best solution within given constraints. Algorithms can effectively and efficiently be used to quantify and interpret discrete information. 1. Students will understand how individuals can improve efficiency through planning and scheduling techniques.	10 weeks
Unit #2: The Mathematics of Social Choices	The message conveyed by the data depends on how the data is collected, represented, and summarized. The result of a statistical investigation can be used to support or refute an argument. 1. Students will understand how a group of individuals, with their own set of values; can select one outcome from a list of possibilities.	8 weeks
Unit #3: Growth and Symmetry	Shape and area can be conserved during mathematical transformation. Everyday objects have a variety of attributes, each of which can be measured in various ways. Measurements can be used to describe, compare and make sense of phenomena. The symbolic language of algebra and generalization of patterns in mathematics are used to communicate and understand mathematics. Algebraic representation can be used to generalize patterns and relationships. Grouping by attributes (classifications) can be used to answer mathematical questions. 1. Students will understand the similarities and differences in figures using motion and stabilization.	8 weeks
Unit #4: Mathematical Models	A quantity can be represented numerically in various ways. Problem solving depends upon choosing wise ways. There are multiple algorithms for finding a solution. Computational fluency includes understanding the meaning and appropriate use of numerical operations. The magnitude of numbers affects the outcome of the operations on them. The symbolic language of algebra and generalization of patterns in mathematics are used to communicate and understand mathematics. The message conveyed by the data depends on how the data is collected, represented, and summarized. The result of a statistical investigation can be used to support or refute an argument. Algorithms can effectively and efficiently be used to quantify and interpret discrete information. 1. Students will understand how mathematical models can be used to analyze real world problems.	8 weeks

Freehold Regional High School District
Discrete Math

Unit #1: Management Science

Enduring Understandings: Optimization is finding the best solution within given constraints.
Algorithms can effectively and efficiently be used to quantify and interpret discrete information.

Essential Questions: How can visual tools such as networks (vertex-edge graphs) be used to answer questions?
How can algorithmic thinking be used to solve problems?
How are charts, diagrams and/or graphs used to enhance conceptual learning and problem solving?

Unit Goal: Students will understand how individuals can improve efficiency through planning and scheduling techniques.

Duration of Unit: 10 weeks

NJCCCS: 4.4 D and 4.5A-F

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
• Why are graphs used to represent real world situations? • How can you determine whether a path, circuit, or neither exists in graphs? • How do you recognize complete graphs and determine the number of Hamilton circuits? • How can you connect cities or lay cable lines using the least amount of material? • How can you solve problems such as providing services efficiently and on time? • How can you use coloring methods to solve problems in the real world?	• Convert a real world situation into a graph. • Identify paths and circuits within the graph using Euler's Theorems, Eulerizing when necessary. • Find Hamilton paths and circuits and use a variety of methods to find an optimal solution to a Traveling Salesman Problem. • Identify, find, and utilize minimum spanning trees. • Use digraphs to represent real world applications including scheduling. • Use the Four Color Theorem and vertex coloring to solve real world application problems.	• Worksheets and samples problems to analyze step-by-step solutions of the problems • Textbook ancillaries • Teacher driven worksheets • Overheads • PowerPoints • Technology	• Anticipatory sets to review basic skills • Use guided and independent practice • Use the board, overhead, PowerPoint, SmartBoard and worksheets to reinforce the concepts • Use technology driven activities (when applicable) • Use cooperative learning activities • Use white boards to show immediate feedback (when applicable)	• Anticipatory set to reinforce previous lessons • Closure questions • Quizzes • Tests • Classwork • Homework • Projects
Suggestions on how to differentiate in this unit: Use of graphing calculators, white boards, cooperative learning activities, and alternate assessments to meet the needs of all learners. Students with individual learning styles can be assisted through adjustments in assessment standards, one-to-one teacher support, additional testing time, and use of technological, visual and auditory teaching methods. A wide variety of assessments and strategies complement the individual learning experience.				

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Unit #2: Mathematics of Social Choices

Enduring Understandings: The message conveyed by the data depends on how the data is collected, represented, and summarized.
The result of a statistical investigation can be used to support or refute an argument.
Essential Question: How can the collection, organization, interpretation, and display of data be used to answer questions and be used to predict future events?
Unit Goal: Students will understand how a group of individuals, with their own set of values; can select one outcome from a list of possibilities.
Duration of Unit: 8 weeks
NJCCCS: 4.4 A and 4.5 A-F

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
• How can you determine a winner using a variety of methods? • How do you determine if a voting method is fair? • How do you measure a voter's power? • How do you fairly divide a set of objects among a specified number of players?	• Determine a winner of an election under a variety of methods. • Determine if the election was fair. • Determine the power of each voter using The Banzhaf Power Index and The Shapley-Shubik Power Index Methods for weighted voting systems. • Determine which fair division procedure is best in a given situation.	• Worksheets and samples problems to analyze step-by-step solutions of the problems • Textbook ancillaries • Teacher driven worksheets • Overheads • PowerPoints • Technology	• Anticipatory sets to review basic skills • Use guided and independent practice • Use the board, overhead, PowerPoint, SmartBoard and worksheets to reinforce the concepts • Use technology driven activities (when applicable) • Use cooperative learning activities • Use white boards to show immediate feedback (when applicable)	• Anticipatory set to reinforce previous lessons • Closure questions • Quizzes • Tests • Classwork • Homework • Projects

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Unit #3: Growth and Symmetry

Enduring Understandings: Shape and area can be conserved during mathematical transformation.
Everyday objects have a variety of attributes, each of which can be measured in various ways. Measurements can be used to describe, compare and make sense of phenomena.
The symbolic language of algebra and generalization of patterns in mathematics are used to communicate and understand mathematics. Algebraic representation can be used to generalize patterns and relationships.
Grouping by attributes (classifications) can be used to answer mathematical questions.

Essential Questions: What situations can be analyzed using mathematical transformations and symmetries?
How can measurements be used to solve problems?
How can patterns, relations, and functions be used as tools to best describe and represent change?
How can attributes be use to classify data/objects?

Unit Goal: Students will understand the similarities and differences in figures using motion and stabilization.
Duration of Unit: 8 weeks
NJCCCS: 4.2B, 4.2D, 4.3A, 4.4C and 4.5A-F

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
• Where can you locate a Fibonacci sequence in nature? • How has the golden ratio and the golden rectangle been used in society? • How are transformations formed? • How do you use an iterative process to create a fractal like structure? • How can you create a regular and semi-regular tiling?	• Recognize the Fibonacci sequence as a recursive rule. • Recognize and use the golden ratio. • Recognize, describe, and create transformations. • Understand iterative and recursive processes including Koch Snowflake and Sierpinski Gasket. • Create and identify regular and semi-regular tilings.	• Worksheets and samples problems to analyze step-by-step solutions of the problems • Textbook ancillaries • Teacher driven worksheets • Overheads • PowerPoints • Technology	• Anticipatory sets to review basic skills • Use guided and independent practice • Use the board, overhead, PowerPoint, SmartBoard and worksheets to reinforce the concepts • Use technology driven activities (when applicable) • Use cooperative learning activities • Use white boards to show immediate feedback (when applicable)	• Anticipatory set to reinforce previous lessons • Closure questions • Quizzes • Tests • Classwork • Homework • Projects

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Unit #4: Mathematical Models

Enduring Understandings: A quantity can be represented numerically in various ways. Problem solving depends upon choosing wise ways.
There are multiple algorithms for finding a solution. Computational fluency includes understanding the meaning and appropriate use of numerical operations. The magnitude of numbers affects the outcome of the operations on them.
The symbolic language of algebra and generalization of patterns in mathematics are used to communicate and understand mathematics.
The message conveyed by the data depends on how the data is collected, represented, and summarized. The result of a statistical investigation can be used to support or refute an argument.
Algorithms can effectively and efficiently be used to quantify and interpret discrete information.

Essential Questions: How do mathematical ideas interconnect and build on one another to produce a coherent whole?
What makes a computational strategy both effective and efficient?
How do mathematical representations reflect the needs of society?
How do operations affect numbers?
How can patterns, relations, and functions be used as tools to best describe and represent change?
How can the collection, organization, interpretation, and display of data be used to answer questions and be used to predict future events?
What is the best way to solve this?

Unit Goal: Students will understand how mathematical models can be used to analyze real world problems.

Duration of Unit: 8 weeks

NJCCCS: 4.1A, 4.1B, 4.3A, 4.4A, 4.4C, and 4.5A-F

Guiding / Topical Questions	Content, Themes, Concepts, and Skills	Instructional Resources and Materials	Teaching Strategies	Assessment Strategies
• Why are codes important in our society? • How is logic used in everyday life? • How can game theory be applied in practical situations in other disciplines? • What is the difference between a randomized comparative experiment and a double-blind study? • How can you use algorithms to solve real world problems?	• Detect, break, and find check digits for multiple forms of codes. • Solve basic logic problems. (optional) • Use various strategies of game theory. (optional) • Use various sampling techniques for statistical analysis. (optional) • Apply algorithmic thinking to real world applications. (optional)	• Worksheets and sample problems to analyze step-by-step solutions of the problems • Textbook ancillaries • Teacher driven worksheets • Overheads • PowerPoints • Technology	• Anticipatory sets to review basic skills • Use guided and independent practice • Use the board, overhead, PowerPoint, SmartBoard and worksheets to reinforce the concepts • Use technology driven activities (when applicable) • Use cooperative learning activities	• Anticipatory set to reinforce previous lessons • Closure questions • Quizzes/Tests • Classwork • Homework • Projects

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