

Questions to consider: 21st century communication has become more important than the production of material goods; what do students need to know in mathematics to process this non-material world of information? Since computer technology wields an overwhelmingly increasing influence on how mathematics is created and used, what mathematical topics are essential to solve problems using computer methods? What do students need to be informed, insightful critical thinkers and problem solvers? How can students utilize mathematics to challenge, interpret, and apply facts in new and unpredicted ways? How can students handle new facts and make decisions in new situations?

Text: Discrete Mathematics
For All Practical Purposes
Excursions in Modern Mathematics

Overview: The physical world is modeled by continuous mathematics such as Calculus; the processing of information process requires Discrete Mathematics. Discrete Mathematics allows students to explore unique problems that are not directly approachable through writing an equation or applying a formula. Students are often asked to visualize a situation by developing a model or another form of representation. They are asked to analyze specific cases or develop a solution by considering a simpler problem involving fewer cases. In Discrete Mathematics students develop conceptual understanding of the tools and the language of mathematics as well as the ability to reason with them. They learn mathematical ideas that make it possible for business and government to perform their functions better.

Discrete Mathematics uses management science, statistics, social choice, chaos, fractals, dynamic systems, and the mathematics for computer science to prepare students to create potential solutions to new and sometimes unpredictable situations. Discrete Mathematics prepares students to classify problems in three categories: existence problems (deals with whether a given problem has a solution); counting problems (investigates how many solutions may exist for problems with known solutions); and optimization problems (focuses on finding a best solution to a particular problem). Discrete Mathematics creates new approaches to operation research problems.

During the fall term students will learn management science. Students will be given problems to help companies and governments provide services and conduct business as efficiently as possible. They will deal with problems of scheduling and transportation by analyzing problems using networks, critical paths, and linear programming with a variety of intuitive mathematical tools. During this term students will begin to solve problems using social choice. They will examine the fairness of decision making through voting systems. Since there are many situations that need to make choices individually or as a group, students will characterize and compare different voting systems to arrive at responsible conclusions.

During the winter term students will continue social choice problems in ranking priorities in economic and government planning. Students will then study growth and symmetry problems. Students will examine the earth, the moon, and the planets and they will investigate new mathematical ideas to understand the geometry of space and time which forms the basis for some attempted explanations of astrophysical phenomena. Students will look at issues of growth that affect our economy and our environment by investigating possible mathematical solutions to population growth beyond their food supply. They will investigate models of linear and exponential growth to understand and control

epidemics and phenomena. Students will also investigate growth and symmetry using spiral growth, Fibonacci Numbers, growth of populations, symmetry of motion, and symmetry of scale and fractals.

In the spring term the students will study statistics and computer science. The future is filled with uncertainty and a way to reduce the uncertainty is to gather information pertaining to a particular situation and analyze the data. Students will design surveys and experiments which will produce accurate information and the unbiased interpretation of the data. Students will collect data and organize data, and use descriptive statistics, probability and normal distribution. Students will also investigate computer science by developing algorithms and investigate encoding information.

Methods: Through open-ended problems, the students will gather data using real-time download from NASA on space and earth, record and organize this data, explore and discover patterns and conjecture. Students will be encouraged to connect related topics, develop new algorithms and alternate methods of displaying and processing information. For example, students will approach formerly unapproachable problems using dynamical systems. Examples of dynamical systems are the weather, the fluctuation of the stock market average, chemical reactions, and the motion of planets.

In doing so, the students will be learning to:

1. Develop several strategies in solving a problem and identify the optimal solution.
2. Gather data, record data, identify patterns, listen carefully and communicate the processes at arriving at a solution.
3. Recognize situations appropriate for mathematical models and use these models for finding optimal solutions.
4. Identify a variety of settings where Discrete Mathematics problems arise.

Possible Issues:

1. FALL TERM: Management Science
 - a. Network Theory
 - b. Euler and Hamiltonian Circuits
 - c. Spanning and Steiner Trees
 - d. Scheduling Problems
2. WINTER TERM: Social Choice and Growth & Symmetry
 - a. Voting Methods
 - b. Fair Division
 - c. Spiral Growth
 - d. Fibonacci Numbers
 - e. Symmetry of Scale & Fractals
 - f. Chaos
 - g. Dynamic Systems
3. SPRING TERM: Statistics and Computer Science
 - a. Collecting and Organizing Data
 - b. Descriptive Statistics
 - c. Probability
 - d. Algorithms
 - e. Encoding Information

