

**Discrete Mathematics**DEPARTMENT: MathematicsCOURSE: Discrete Mathematics

Week	Marking Period 1	Week	Marking Period 3
1	Election Theory	19	Binary Numbers and Operations
2	Election Theory	20	Arithmetic Sequences and Series
3	Election Theory	21	Geometric Sequences and Series
4	Election Theory	22	More Graphs, Subgraphs, & Trees
5	Fair Division	23	More Graphs, Subgraphs, & Trees
6	Fair Division	24	More Graphs, Subgraphs, & Trees
7	Fair Division	25	More Graphs, Subgraphs, & Trees
8	Fair Division	26	More Graphs, Subgraphs, & Trees
9	Matrix Operations and Applications	27	Counting & Probability
Week	Marking Period 2	Week	Marking Period 4
10	Matrix Operations and Applications	28	Counting & Probability
11	Matrix Operations and Applications	29	Counting & Probability
12	Matrix Operations and Applications	30	Counting & Probability
13	Matrix Operations and Applications	31	Matrices Revisited
14	Graphs & Their Applications	32	Matrices Revisited
15	Graphs & Their Applications	33	Matrices Revisited
16	Graphs & Their Applications	34	Recursion
17	Graphs & Their Applications	35	Recursion
18	Graphs & Their Applications	36	Recursion

## Discrete Mathematics

Time Frame	Standard- 20 days	Block- 10 days			
<b>Topic</b>					
Election Theory					
<b>Essential Questions</b>					
How are the wishes of many individuals combined to yield a single result?					
Do the methods for doing so always treat each choice fairly?					
If not, is it possible to improve on these methods?					
<b>Enduring Understandings</b>					
Election Activity					
Group-Ranking Methods and Algorithms					
More Group-Ranking Methods and Paradoxes					
Arrow's Conditions and Approval Voting					
Weighted Voting and Voting Power					
Proportional Representation					
<b>Alignment to New Jersey Student Learning Standards</b>					
N-RN.3. , N-Q.1. , N-Q.2. , S-IC.3.					
<b>Key Concepts and Skills</b>					
<ul style="list-style-type: none"> <li>• Rank items, collect votes, and combine rankings</li> <li>• Explore plurality and majority winners</li> <li>• Describe runoff methods</li> <li>• Examine data for a Condorcet winner and paradox</li> <li>• Determine arrow's conditions</li> <li>• Explore approval voting</li> <li>• Determine weighted voting &amp; voting power</li> <li>• Investigate proportional voting</li> </ul>					
<b>Learning Activities</b>					
<ul style="list-style-type: none"> <li>• Soft Drink Voting Activity</li> <li>• Run Off Elections Exploration</li> <li>• Google Page Discussion</li> </ul>					
<b>Assessments</b>					
Voting activities					
Completing exercise questions					
Quiz on Group-Ranking Method					
Election Theory Test					
<b>21<sup>st</sup> Century Skills</b>					
x	Creativity	x	Critical Thinking	Communication	Collaboration
x	Life & Career Skills		Information Literacy	Media Literacy	
<b>Interdisciplinary Connections</b>					
Social Studies and History of Elections					
<b>Technology Integration</b>					
8.1 Educational Technology- All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.					
LCD Projector					
Document Camera					
Laptop Computer					
Internet Websites Such as Google					

## Discrete Mathematics

Time Frame	Standard-20 days	Block- 10 days				
<b>Topic</b>						
Fair Division						
<b>Essential Questions</b>						
<p>How can a portion of food be divided fairly among two or more children?            Is the meaning of fairness when food is divided among children differently from the meaning of fairness when an estate is divided among heirs or when seats in Congress are divided among states? Are the methods that are commonly used to divide food, estates, and legislatures necessarily the fairest methods?</p>						
<b>Enduring Understandings</b>						
A Fair Division Activity Estate Division Apportionment Algorithms More Apportionment Algorithms and Paradoxes Fair Division Algorithms: The Continuous Case Mathematical Induction Envy-Free Division						
<b>Alignment to New Jersey Student Learning Standards</b>						
N-RN.3, N-Q.2, S-IC.1.						
<b>Key Concepts and Skills</b>						
<ul style="list-style-type: none"> <li>• Explore divisions of food and property</li> <li>• Apply knowledge of weighting to determine fairness of situations</li> <li>• Determine averages</li> <li>• Understand and utilize properties of algorithms</li> </ul>						
<b>Learning Activities</b>						
<ul style="list-style-type: none"> <li>• Estate division project</li> <li>• Evaluation of Census</li> </ul>						
<b>Assessments</b>						
Completing exercise questions Estate division project Quiz on algorithms Census activity Fair Division Test						
<b>21<sup>st</sup> Century Skills</b>						
Creativity	x	Critical Thinking	x	Communication	x	Collaboration
Life & Career Skills		Information Literacy		Media Literacy		
<b>Interdisciplinary Connections</b>						
<b>Technology Integration</b>						
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## Discrete Mathematics

Time Frame	Standard- 25 days	Block- 12 days					
<b>Topic</b>							
Matrix Operations and Applications							
<b>Essential Questions</b>							
How can large collections of data be organized and managed in an efficient way?							
What calculations provide meaningful information to people who use the data?							
How can computers and calculators assist them?							
<b>Enduring Understandings</b>							
Addition and Subtraction of Matrices							
Multiplication of Matrices							
Population Growth: Leslie Model							
Keyword Matrices							
<b>Alignment to New Jersey Student Learning Standards</b>							
N-VM.5. , N-VM.6. , N-VM.7. , N-VM.8. , N-VM.9.							
<b>Key Concepts and Skills</b>							
<ul style="list-style-type: none"> <li>• Utilize properties of matrices-addition, subtraction &amp; multiplication</li> <li>• Understand Population Growth</li> <li>• Utilize the Leslie Model</li> </ul>							
<b>Learning Activities</b>							
<ul style="list-style-type: none"> <li>• Patterns for Profit Project</li> <li>• Population Growth Project</li> <li>• Coding &amp; Decoding messages</li> </ul>							
<b>Assessments</b>							
Completing exercise questions							
Quiz on basic operations with Matrices							
Projects – Population Growth & Patterns for Profit							
Matrices Operations & Application test							
<b>21st Century Skills</b>							
x	Creativity	x	Critical Thinking	x	Communication	x	Collaboration
x	Life & Career Skills	x	Information Literacy	x	Media Literacy		
<b>Interdisciplinary Connections</b>							
Social Population Growth							
<b>Technology Integration</b>							
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LCD Projector							
Document Camera							
Laptop Computer							
Graphing Calculators							
Internet Websites							

## Discrete Mathematics

Time Frame	Standard- 25 days	Block- 14 days					
<b>Topic</b>							
Graphs and Their Applications							
<b>Essential Questions</b>							
What is the minimum number of colors needed to color any map? Optimally, how do you color a map? What do coloring maps and scheduling meetings times for your school organizations have in common?							
<b>Enduring Understandings</b>							
Modeling Projects Critical Paths The Vocabulary and Representations of Graphs Euler Circuits and Paths Hamiltonian Circuits and Paths Graph Coloring Eulerizing Graphs							
<b>Alignment to New Jersey Student Learning Standards</b>							
N-Q.1., N-Q.2., N-Q.3.							
<b>Key Concepts and Skills</b>							
<ul style="list-style-type: none"> <li>• Explore modeling projects with graphical representation</li> <li>• Evaluate the most efficient critical path</li> <li>• Understand vocabulary &amp; representation of graphs</li> <li>• Explore Matrix representation of graphs</li> <li>• Investigate the Euler &amp; Hamiltonian circuits &amp; paths</li> </ul>							
<b>Learning Activities</b>							
<ul style="list-style-type: none"> <li>• Map design project</li> <li>• Mail carrier packet</li> <li>• Eulerizing Graph Exploration</li> </ul>							
<b>Assessments</b>							
Completing exercise questions Quiz on vocabulary of graphs Euler & Hamiltonian circuits Circuits Quiz Graphs and Their Applications Test							
<b>21<sup>st</sup> Century Skills</b>							
x	Creativity	x	Critical Thinking	x	Communication	x	Collaboration
x	Life & Career Skills	x	Information Literacy	x	Media Literacy		
<b>Interdisciplinary Connections</b>							
History of the Rival Between Hamilton and Jefferson							
<b>Technology Integration</b>							
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## Discrete Mathematics

Time Frame	Standard- 22 days	Block- 11 days				
<b>Topic</b>						
More Graphs, Subgraphs and Trees						
<b>Essential Questions</b>						
How communication networks that link several locations together are constructed at the least possible cost? How is the most efficient route between two locations in a network found? Can the methods used to find the best route between points in a communication network also be used to plan the best route for an automobile or plane trip?						
<b>Enduring Understandings</b>						
Planarity and Coloring The Traveling Salesperson Problem Finding the Shortest Route Trees and Their Properties Minimum Spanning Trees Binary Trees, Expression Trees and Traversals Steiner Trees						
<b>Alignment to New Jersey Student Learning Standards</b>						
N-Q.1., N-Q.2., N-Q.3.						
<b>Key Concepts and Skills</b>						
<ul style="list-style-type: none"> <li>• Explore Planarity and Coloring</li> <li>• Describe Bipartite graphs</li> <li>• Understand Algorithms</li> <li>• Determine the shortest route</li> <li>• Exploration of Tree &amp; Properties</li> </ul>						
<b>Learning Activities</b>						
<ul style="list-style-type: none"> <li>• Planarity &amp; Coloring</li> <li>• Finding the shortest route</li> <li>• Finding spanning trees</li> </ul>						
<b>Assessments</b>						
Completing exercise questions Quiz on algorithms Quiz on shortest route Project on Trees Graphs, Subgraphs and Trees Test						
<b>21<sup>st</sup> Century Skills</b>						
X	Creativity	X	Critical Thinking	Communication	X	Collaboration
X	Life & Career Skills		Information Literacy	Media Literacy		
<b>Interdisciplinary Connections</b>						
Social Studies & History						
<b>Technology Integration</b>						
8.1 Educational Technology- All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.						
LCD Projector			Laptop Computer			
Document Camera			Internet Websites			
Graphing Calculators						

## Discrete Mathematics

<b>Time Frame</b>	<b>Standard- 20 days</b>	<b>Block- 12 days</b>					
<b>Topic</b>							
Counting and Probability							
<b>Essential Questions</b>							
In how many ways can a lottery participant choose several numbers from those on a lottery ticket?							
What is the probability of winning a lottery jackpot?							
What is the probability that a medial test's results are correct?							
How has an understanding of probability helped improve reliability of U.S. space shuttle launches?							
<b>Enduring Understandings</b>							
A Counting Activity							
Counting Techniques							
Probability							
Monte Carlo Methods							
<b>Alignment to New Jersey Student Learning Standards</b>							
S-CP.2., S-CP.3., S-CP.7.							
<b>Key Concepts and Skills</b>							
<ul style="list-style-type: none"> <li>• Define &amp; Explore Counting Techniques (mutually exclusive &amp; disjoint)</li> <li>• Understand Probability, Permutation &amp; Factorials</li> <li>• Work with combinations of Probability, Permutation &amp; Factorials</li> <li>• Understand Binomial Probability Distribution</li> </ul>							
<b>Learning Activities</b>							
<ul style="list-style-type: none"> <li>• Lottery Activity</li> <li>• Probability Activity (Die, cards, &amp; Chips)</li> <li>• Combining probability with permutation &amp; probability with combinations</li> </ul>							
<b>Assessments</b>							
Completing exercise questions							
Quiz on Multiplication & Addition Principles							
Probability Activity							
Factorial Exploration							
Counting & Probability Test							
<b>21<sup>st</sup> Century Skills</b>							
x	Creativity	x	Critical Thinking	x	Communication	x	Collaboration
x	Life & Career Skills		Information Literacy		Media Literacy		
<b>Interdisciplinary Connections</b>							
<b>Technology Integration</b>							
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LCD Projector Document Camera							
Laptop Computer							
SmartBoard							

## Discrete Mathematics

<b>Time Frame</b>	<b>Standard- 20 days</b>	<b>Block- 10 days</b>					
<b>Topic</b>							
Matrices Revisited							
<b>Essential Questions</b>							
<p>How can a company that provides batteries for another company's compact disc players be sure that it will have enough batteries on hand to fill orders?</p> <p>How does a fast-food chain determine prices that will allow it to do as well as possible against a competitor?</p> <p>How can a meteorologist use data about recent weather activity to predict the weather for tomorrow or a week from now?</p> <p>How can a park service use birth rates and survival rates of deer in managing herd populations?</p>							
<b>Enduring Understandings</b>							
<p>The Leontief Input-Output Model</p> <p>Markov Chains</p> <p>Game Theory</p> <p>A Look at a Dominance Matrix</p>							
<b>Alignment to New Jersey Student Learning Standards</b>							
N-VM.6., N-VM.7., N-VM.8., N-VM.9.							
<b>Key Concepts and Skills</b>							
<ul style="list-style-type: none"> <li>• Investigation of Leontief Input-Output Model</li> <li>• Solve systems of equations with Matrices</li> <li>• Explore Markov Chains</li> <li>• Understand the Game Theory</li> </ul>							
<b>Learning Activities</b>							
<ul style="list-style-type: none"> <li>• Exploration of Supply &amp; Demand (Input-Output Model)</li> <li>• Game Theory Activity</li> <li>• Historical Mathematician Project</li> </ul>							
<b>Assessments</b>							
<p>Completing exercise questions</p> <p>Battery &amp; Motor Division Problem</p> <p>Quiz on solving systems of equations</p> <p>Heads/Tails Activity</p> <p>Matrices Revisited Test</p>							
<b>21<sup>st</sup> Century Skills</b>							
X	Creativity	X	Critical Thinking	X	Communication	X	Collaboration
X	Life & Career Skills		Information Literacy		Media Literacy		
<b>Interdisciplinary Connections</b>							
History							
<b>Technology Integration</b>							
<p>8.1 Educational Technology- All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.</p> <p>LCD</p> <p>Projector</p> <p>Document Camera</p> <p>Laptop Computer Graphing Calculators</p> <p>Internet Websites</p>							



## Discrete Mathematics

Time Frame	Standard- 20 days	Block- 10 days	
<b>Topic</b>			
Recursion			
<b>Essential Questions</b>			
How can recursion be used to create appealing images?			
How can recursion help people plan their financial futures?			
How can slight changes in recursive process change behavior from predictable to chaotic?			
<b>Enduring Understandings</b>			
Introduction to Recursive Thinking			
Finite Differences			
Arithmetic and Geometric Recursion			
Mixed Recursion			
Cobweb Diagrams			
Fractal Dimension			
<b>Alignment to New Jersey Student Learning Standards</b>			
N-Q.1., F-BF.1., F-BF.2.			
<b>Key Concepts and Skills</b>			
<ul style="list-style-type: none"> <li>• Discussion on recursive thinking</li> <li>• Explore finite differences</li> <li>• Explore Arithmetic &amp; Geometric Recursion</li> <li>• Investigate mixed recursion (annuities)</li> <li>• Discuss Cobweb Diagrams</li> </ul>			
<b>Learning Activities</b>			
<ul style="list-style-type: none"> <li>• Handshake Activity</li> <li>• Computer Project on Excel</li> <li>• Calculator Activity on Sums of Arithmetic &amp; Geometric Series</li> <li>• College cost Project</li> <li>• Annuity Exploration</li> <li>• Sample Market investments</li> <li>• Graphing Calculator Cobweb diagram exploration</li> </ul>			
<b>Assessments</b>			
Completing exercise questions			
Quiz on recursion			
Computer exploration on recursion			
Quiz on finite differences			
Application problems on arithmetic & geometric information Recursion Test			
<b>21<sup>st</sup> Century Skills</b>			
	Creativity	Critical Thinking	Communication
	Life & Career Skills	Information Literacy	Media Literacy
<b>Interdisciplinary Connections</b>			
<b>Technology Integration</b>			
8.1 Educational Technology- All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaboratively and to create and communicate knowledge.			
LCD Projector	Document Camera	Laptop Computer	
Excel Program			