



DISCRETE MATH A

Approved by KSD Board of Education: February 23, 2026

Course Description:

Students enrolled in this course will use rigorous thought and reasoning skills to explore areas of mathematics not traditionally covered in the algebra-precalculus-calculus sequence. Topics include secret codes and encryption, infinity and different levels of infinity, different geometries, topology, chaos and fractals and probability. Discrete mathematics lends itself to a wide variety of real-world applications. Problems discussed will range from determining if there are two people on earth with the exact same number of hairs on their bodies to devising secret codes to examining the probability of winning the lottery.

Discrete Mathematics A is only offered during the first semester. Students do *not* have to take Discrete Mathematics A before taking Discrete Mathematics B.

Grade Level: 11th-12th Grade

Unit Scope and Sequence

- Unit 1:** Problem Solving
- Unit 2:** Number Theory
- Unit 3:** Mods and Codes
- Unit 4:** Fractals

Course Enduring Understandings:

- Mathematical information can be translated from a single representation or across multiple representations in order to develop processes to problem solve.
- Mathematical reasoning requires justification of both process and solution.

Course Essential Questions:

- How can mathematical reasoning be applied to understand and solve problems in non-traditional areas of mathematics?
- In what ways can mathematical concepts enhance our problem-solving skills and critical thinking in everyday life?
- How can we evaluate the effectiveness of different problem-solving strategies in various contexts?

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Unit 1: Problem Solving

In this unit, students will engage with a variety of puzzles designed to enhance their critical thinking and reasoning skills. The focus will be on both inductive and deductive reasoning as essential tools for problem-solving.

Unit 1 Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
• Problem-solving requires both inductive and deductive reasoning, and understanding when to apply each method enhances analytical skills. • The skills gained through solving puzzles are applicable to real-world scenarios, enhancing critical thinking in everyday decision-making and complex problem-solving situations.	• How do inductive and deductive reasoning differ, and how can each be applied effectively in problem-solving? • How can we evaluate the effectiveness of different problem-solving strategies in various contexts?
<i>Students must know:</i>	<i>Students must be able to:</i>
• Inductive Reasoning • Deductive Reasoning	• differentiate between inductive and deductive reasoning and select the appropriate method for a given problem. • analyze puzzles to identify underlying patterns and use those patterns to make logical inferences. • construct valid logical arguments using premises and conclusions, demonstrating sound deductive reasoning. • evaluate the effectiveness of various problem-solving strategies and justify their choices based on context.

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Unit 1: Problem Solving

Missouri Learning Standards

Standards for Mathematical Practice

- HS.MP.1 Make sense of problems and persevere in solving them.
- HS.MP.2 Reason abstractly and quantitatively.
- HS.MP.3 Construct viable arguments and critique the reasoning of others.
- HS.MP.4 Model with mathematics.
- HS.MP.5 Use appropriate tools strategically.
- HS.MP.6 Attend to precision.
- HS.MP.7 Look for and make use of structure.
- HS.MP.8 Look for and express regularity in repeated reasoning.

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Unit 2: Number Theory

In this unit, students will explore the realm of number theory, focusing on key concepts that reveal the underlying structures and relationships within mathematics. Through hands-on activities and real-world applications, students will deepen their understanding of various number properties and their implications.

Unit 2 Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
• Number theory reveals intricate patterns and relationships among numbers, helping us understand the structure of mathematics. • Engaging with number theory encourages curiosity and exploration, fostering a deeper appreciation for the beauty and complexity of mathematics.	• What are the practical applications of number theory concepts? • What role do patterns play in understanding and predicting numerical relationships?
<i>Students must know:</i>	<i>Students must be able to:</i>
• Pigeonhole Principle • Properties of Prime Numbers • Fibonacci Sequence • Properties of Rational Numbers • Relationships between rational numbers, integers, and fractions	• apply the pigeonhole principle to solve problems related to grouping and distribution in various contexts. • identify prime numbers and demonstrate their properties, including divisibility and prime factorization. • generate the Fibonacci sequence and recognize its patterns and applications in nature and mathematics. • perform operations with rational numbers, including addition, subtraction, multiplication, and division, and convert between different forms (fractions, decimals). • use mathematical reasoning to draw conclusions based on properties of numbers and sequences.

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Unit 2: Number Theory

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Unit 3: Mods and Codes

In this unit, students will explore modular arithmetic and its applications in coding and cryptography. Through hands-on activities and problem-solving exercises, students will learn to manipulate numbers within a modular system, unlocking the secrets of remainder calculations and code deciphering.

Unit 3 Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
- Modular arithmetic provides a unique framework for understanding numbers and operations through the concept of remainders, which is essential for various mathematical applications. - The rules of modular arithmetic differ from traditional arithmetic, allowing for a deeper understanding of number behavior and the properties of operations within a finite set. - Engaging with modular arithmetic enhances critical thinking and logical reasoning skills, as students learn to analyze and solve complex problems systematically.	- What is the significance of remainders in modular arithmetic, and how do they influence mathematical operations? - How do the rules of modular arithmetic differ from those of traditional arithmetic, and what implications do these differences have for problem-solving? - In what ways can modular arithmetic be seen as a bridge between different areas of mathematics and their practical applications?
<i>Students must know:</i>	<i>Students must be able to:</i>
- Modular Arithmetic - Modulus (n) - Remainder - Congruence - Linear Congruence - Deciphering - Cipher - Encryption - Decryption - Finite Set - Residue Class - Exponentiation (mod n)	- accurately calculate remainders in modular arithmetic for any given integer and modulus n. - perform addition, subtraction, and multiplication within a modular system, applying the appropriate rules of modular arithmetic. - solve equations involving modular arithmetic, demonstrating an understanding of congruences and their applications. - apply knowledge of modular arithmetic to decipher coded messages. - articulate differences between modular arithmetic and traditional arithmetic, explaining how these differences influence problem-solving approaches. - identify the significance of modular arithmetic in practical applications such as coding, cryptography, and computer science.

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Unit 3: Mods and Codes

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Unit 4: Fractals

In this unit, students will study fractals by exploring their mathematical properties and real-life applications. Students will learn how to model complex natural phenomena using fractal geometry, discovering how intricate patterns can emerge from simple algorithms.

Unit 4 Essential Learning Targets

<i>Enduring Understandings</i>	<i>Essential Questions</i>
• Fractals are complex patterns that are self-similar across different scales, illustrating how simple mathematical rules can lead to intricate structures found in nature. • Fractals provide powerful tools for modeling real-world phenomena, enabling students to understand and predict behaviors in various fields such as biology, geography, and computer science. • The study of fractals demonstrates the connections between algebra and geometry, showing how these mathematical disciplines can work together to solve problems and create visual representations.	• In what ways can fractals be used to model real-world phenomena, and what are some specific examples of their applications in various fields? • How do algebraic and geometric concepts interrelate in the study of fractals, and how can they be used together to generate and analyze fractal patterns? • What problem-solving strategies can be employed when working with fractals, and how do these strategies promote critical thinking and analytical skills?
<i>Students must know:</i>	<i>Students must be able to:</i>
• Fractal • Self-similarity • Recursive • Iteration • Dimension • Algorithm • Chaos Theory • Geometric Transformation • Scale • Complex Numbers	• model real-world situations using fractals, demonstrating their understanding of self-similarity and recursion. • create fractals using iterative processes and algorithms, applying mathematical principles to produce complex patterns. • use algebraic expressions and functions to analyze and manipulate fractals, understanding the relationships between variables and patterns. • apply geometric transformations to fractals, exploring how changes in shape and size affect their structure. • describe and calculate the dimensions of various fractals, including understanding the concept of fractional dimensions. • identify and explain practical applications of fractals in fields such as nature, art, and technology.

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Unit 4: Fractals

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