

Comprehensive Course Syllabus

Course Title

Problem Solving

Course Description:

Problem Solving is a one semester elective course where the emphasis is upon learning a variety of techniques for the solving of problems. The development of these techniques is facilitated through the solving of a variety of problems incorporating a wide range of mathematical ideas.

INSTRUCTOR(S):

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Text(s) / Materials:

No text required. Students will receive a series of teacher generated handouts. Students are expected to maintain a notebook containing class notes, homework assignments, quizzes, and other handouts.

Essential Content:

Mathematics Team Learning Standards targeted (formally assessed) or addressed in this course include:

Standard A – Students studying mathematics at IMSA demonstrate a disposition and propensity to use mathematics, a variety of problem solving strategies, and creative thought to solve problems by:

1. investigating and gaining insight into mathematical concepts by selecting and using a variety of traditional and creative problem solving strategies and methodologies. *Targeted*
3. interpreting, generalizing, and verifying the understanding gained in the problem solving process and extending it to new settings. *Targeted*
4. using a variety of resources and problem solving approaches. *Targeted*
5. demonstrating confidence, persistence, and reflective analysis of the effectiveness of an approach when attempting to solve a problem. *Addressed*

Standard B – reason logically in mathematical situations and understand the nature, role, and necessity of proof and counterexample in mathematical reasoning by:

2. reasoning inductively and deductively. *Targeted*
3. making and testing conjectures, creating proofs, and identifying counterexamples. *Addressed*
4. enhancing inductive and deductive reasoning through the use of intuition, imagination, and other forms of reasoning. *Addressed*
6. understanding the role of logic in the development of mathematics and understanding the necessity of carefully proving assertions. *Addressed*

Standard C – Students studying mathematics at IMSA communicate clearly and accurately about mathematical relationships and results by:

1. understanding mathematical information given in written, oral, symbolic, numeric, or graphic form and interpreting the relationship it represents. *Targeted*
2. accurately recording and effectively communicating using proper notation, vocabulary, and usage in a variety of modalities (written, oral, graphic, algebraic, etc.). *Targeted*

Standard E – Students studying mathematics at IMSA understand and employ the power, economy, clarity, and elegance of mathematical representations by:

1. recognizing that mathematical representations carry specific meanings and using mathematical notation correctly to enhance clarity and avoid ambiguity. *Targeted*
2. applying a variety of techniques to compare and manipulate mathematical representations.. *Targeted*

Standard F – Students studying mathematics at IMSA use and interpret appropriate mathematical models to represent real-world situations by:

1. choosing an appropriate representation or mathematical model for a given situation. *Targeted*
4. interpreting mathematical results in terms of the situation modeled.. *Targeted*

Standard K – Students studying mathematics at IMSA understand and apply discrete mathematical models by:

1. using sequences and their operations to model phenomena. *Targeted*
2. analyzing and interpreting situations using recursive thinking and inductive reasoning.. *Targeted*
4. demonstrating an understanding of basic counting principles and the situations under which they may be applied.. *Targeted*

These standards will be addressed in *Problem Solving* through the study of:

- logic problems and brainteasers
- patterns and pattern recognition

- number theory
- number bases
- sequences
- areas of polygons
- levers and centroids
- existence theorems for triangles

SSLs and Outcomes:

IMSA SSL(s) and outcomes targeted (formally assessed) or addressed in this course include:

SSL I – Developing the Tools of Thought:

- A. Develop automaticity in skills, concepts, and processes that support and enable complex thought. *Targeted*
- B. Construct questions which further understanding, forge connections, and deepen meaning. *Addressed*
- D. Evaluate the soundness and relevance of information and reasoning. *Targeted*

SSL III – Extending and Integrating Thought

- A. Use appropriate technologies as extensions of the mind. *Addressed*
- B. Recognize, pursue, and explain substantive connections within and among areas of knowledge. *Targeted*
- C. Recreate the beautiful conceptions that give coherence to structures of thought. *Addressed*

SSL IV – Expressing and Evaluating Constructs

- A. Construct and support judgments based on evidence. *Targeted*
- B. Write and speak with power, economy, and elegance. *Targeted*

Instructional Design and Approach:

The instructional design of *Problem Solving* provides opportunities for students to work collaboratively on a regular basis both in and out of class. Collaboration encourages oral communication, multiple perspectives in problem solving, and reflection on learning. Throughout the semester there is a focus on the role and usage of patterns, discovery, and connections. Problem solving strategies utilize a constructivist approach to developing a student understanding of a variety of perspectives and for students to be able to extend the forms of problems.

Student Expectations:

All students are expected to:

- be involved in class discussions and explorations, both large and small group.
- maintain a notebook containing class notes, homework assignments, quizzes, and other handouts.
- complete all daily assignments and homework assignments in a timely manner.
- come prepared for each class. (If you come to class unprepared, you not only deprive yourself, but you also deprive the other students at your table, and, in fact, the entire class.)
- take responsibility for learning certain basic skills and relationships.
- take responsibility for seeking additional help as it is needed.
- treat others with respect and politeness, to keep a sense of adventure (and humor), to have patience, and to be willing to try new stuff!

Students are expected to be in class and to participate, contribute and share both in large and small group settings. Students are expected to complete any in-class work or out-of-class assignments prior to coming to the next class.

Assessment Practices, Procedures, and Processes:

Student's grades for the quarter are determined through the assessment of take-home and in-class problem sets, both individual and group work assignments, and quizzes and examinations.

Quarter grades are each worth 40% of the final grade. The final examination is worth 20% of the final grade. Since students are able to use notes, problem sets, and past assessments on the final examination, it is important and imperative that students maintain and keep a comprehensive and detailed notebook of work done throughout the semester.

Sequence of Topics and Activities

- Introduction to problem solving through brainteasers and logic problems.
- Patterns: looking for structure in sequences, games, puzzles and a variety of other mathematical situations.
- Number Theory: a look at factors, number of factors, sums of factors, and some of the big historical results.
- Area of figures in the plane using geometry and trigonometry; connecting many of the mathematical areas students have studied.
- Levers and Centroids: an Archimedean look at the geometry of polygons.
- Existence theorems in geometry: a formal look at the existence of triangles using the triangle inequality, Ceva's theorem, and the logical operators "and" and "or".

- Integers: a look at the mathematical properties of integers.