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Mathematical Thinking 2010-11 School Year

Course Description

Students will study four areas of mathematics that are central to many other areas of mathematics. These areas are combinatorics, symbolic logic, sets, and abstract algebra. We shall explore interactions of these areas.

Students will learn combinatorics by working combinatorial problems of increasing difficulty and subtlety. We will consider the idea of probability and apply the combinatorics we learn to computing probabilities of selected events.

Symbolic logic will be students' introduction to an axiomatic system. Students will use the syntax of the system to prove certain formulae of the system. We will consider what counts as proof within the system and what counts as truth and how to determine which formulae are true and which false. We will learn how to write expressions from both mathematics and ordinary language within a logical system and subject them to the same manipulations and semantic scrutiny as other formulae of the system. The idea of mathematical proof will be discussed; the logical structure of arguments in ordinary language will be represented within the logical system and their validity examined.

Students will use Venn diagrams to gain informal insight into the axioms of set theory and to discover set theoretic statements that ought to be true; they will use the algebra of sets to show that what ought to be true is true.

Abstract algebra considers algebra in its most general form. As such, it addresses the very nature of symbolic systems we recognize as algebraic. Students will consider relations, functions, and equivalence classes. Students will work with algebraic structures known as groups focusing on several kinds of groups. While we will not consider in detail algebraic structures beyond that of the group, we will acquire an informal understanding of a field; the real numbers together with certain operations such as addition is the most important example of the algebraic structure called a field.

Core Goals

- Acquire content knowledge and formal skill in the areas we study.
- Develop the qualities of character that are necessary for success in mathematics. These qualities are: curiosity, patience, persistence, tenacity, and resilience to setbacks.
- Understand through personal experience the value and power of creative thinking when it is wed to intellectual discipline and formal skill.
- Learn to reason deductively.
- Acquire the inclination to seek connections between areas of mathematics that might at the outset appear unrelated.

Expectations

In mathematics class, every important point is made *both* audibly in spoken words *and* visually in words, symbols, and drawings that go on the board. When you take notes on a solution, derivation, or proof, you do the mathematics along with your teacher. It is like climbing a mountain step by step with an experienced guide, rather than merely hearing or seeing some directions. Taking notes raises your thinking to a higher level, because you interpret, judge, evaluate, and organize what you are seeing and hearing in class while it is happening.

Mathematics is *not* a grab bag of facts, procedures, techniques, and tricks. Knowing mathematics means using a few basic ideas with skill, insight, and understanding. It means you can often solve a problem seemingly *unlike* any you have already done or seen done. You improve in mathematics through thoughtful and purposeful practice and discussion. Watching someone else do mathematics and feeling like you get it is no guarantee that *you* can do it on your own. Jump in! Question, discuss, argue, and practice!

In mathematics, your learning depends on your thoughtfully preparing assignments in time for the next class, in which we will discuss your comments and answer your questions about the assignment you completed. This is the best way to prepare for exams and to understand new material as it is presented in class. Expect to spend about 2½ hours per week outside of class working on mathematics.

Textbook & Resources

Our printed resources will be photocopied from a variety of books or written by the teacher. Your own notes will be an important element in the written record of the mathematics we investigate and discover.

Web

I will maintain a simple web site at www.math.mnrt.net . I hope that parents and students will make use of this. If you are absent, you can get the day's assignment and any handouts from class at this site. I update the site every weekday almost always by 5:30 PM.

Here you will find:

- the current assignment and all past assignments,
- copies of everything handed out in class including problem sets, and solutions to selected problems, but not including in-class exams and quizzes,
- my notes when the day's topic was especially complex,
- links to sites of mathematical interest.

This is not intended as a substitute for keeping an assignment notebook, which you are required to do. If you are absent from class, check here for the day's assignment and any handouts given during class. Parents will find the definitive answer to the question: "Do you have any mathematics homework?"

Required Materials

A 1½ in. three-ring binder with five divider tabs to be kept at home. A ½ inch three ring binder to be brought to class. Pencils. High quality erasers that do not smudge.

Course Outline

- Combinatorics.
- Symbolic logic.
- Sets.
- Abstract algebra.

Grading & Evaluation

Your trimester mastery grade is determined by full period exams, brief quizzes, and any graded assignments. Your scores on quizzes will make up 20% of your trimester grade. Exams and graded assignments will make up 80%. Exams and quizzes will usually strict time limits, because they seek to assess your level of proficiency with the material that we recently covered. Proficiency often means that you can work a problem in a couple of minutes using the recent material we covered, rather than suffering 15 minutes of furious labor because you were unfamiliar with the recent material we covered.

Homework, although not graded, is the single most important factor in determining your grade on examinations and quizzes, and therefore your trimester grade.

A quiz may be given at any time without prior announcement, although you can expect a short quiz about once per week. Your lowest quiz score will be dropped. Exams will be announced well in advance and will require a full class period to complete.

In sports, music, and theater you play or perform like you practice. Sloppy practice, sloppy performance. Just as you would insist on doing your personal best when practicing a sport at which you desire to excel, so too you should insist on your best when you practice mathematics.

Absence Policy

If you are absent for a quiz or an exam, *you* are expected to arrange to make it up. If you miss a class meeting, do borrow another student's notes to copy. Discussing those notes with the other student will further benefit both you and your kind classmate.

Late Work Policy

Homework is considered practice, so you will not be graded on it. Therefore, no late work policy applies. However, speaking as both a teacher and as a student of mathematics, I assure you that unless you attend to homework when it is assigned, you will not score as high as you might have on exams and quizzes. That is because you will not have learned the material as well as you would have by keeping up with assignments.

Getting Help

Please seek my help outside of class. I teach because I love to do mathematics with you. The student who makes the extra effort to get help when needed makes a very good impression on the teacher. Do not expect the impossible, though. If you have not kept up with assignments, meeting with me for an hour as the exam date approaches is not going to do you much good. If that was all it would take for you to do well, I would not be giving all these assignments in the first place. Remember that asking specific questions rather than saying, "I don't get it" will bring you the most useful help as well as evidence the effort you made in trying to master the material.

Signature

I have read and discussed this syllabus with my child _____
Parent's Signature

I have read and discussed this syllabus with my parent(s) _____
Student's Signature