

# Syllabus

*Youth Euclid Association*

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## Prelude

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This is everything that's happening before the actual class starts. We will have a public lecture on math pedagogy and philosophy, and we will also be distributing an optional arithmetic handout to establish a base of knowledge students should be coming in with.

## Lesson 0: Pedagogy

These are some meta-comments on how to learn math. We introduce the idea of pedagogy, buckets, and when something “feels” right for a problem. We also teach some lessons and give some warnings that the team wishes we knew back when we started competition math. This will mostly be focused on abstract stuff, but we will strive to make sure that this lesson is meaningful, and we will also be doing math, though at a slower/less strenuous pace than usual.

## § 1 Algebra

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## Lesson 1: Manipulations

We teach students how to manipulate sums, factor expressions, and deal with polynomials. While there are some “pure algebra” questions later in the AMC, this is not our focus - we want students to be able to solve combinatorics, geometry, and number theory questions when there's a little bit of computation involved.

## § 2 Counting

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We introduce the idea of permutations and combinations to students and give some basic counting questions.

## Lesson 2: Basics of Counting

We introduce the idea of permutations and combinations to students and give some basic counting questions. This lesson will be easy for most.

## Lesson 3: Perspectives in Counting

There are lots of counting methods and identities in combinatorics. We delve into why they work, and how to think about them in a succinct fashion. These seemingly unrelated ideas are tied together by one thing - seeing things from a different perspective and state of mind.

Content will include Stars and Bars, and problems solved by very clever bijections.

## § 3 Geometry

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Geometry is the subject that most beginners tend to struggle on, and they tend to struggle hard. We dedicate a lot of time to improve “geometry sense,” and instead of focusing on theorems, we focus on having ‘geometry sense’ and being able to internalize facts, especially angle conditions.

## Lesson 4: Angle Chasing

We present classic angle chasing theorems. We remind students of the parallel lines and collinearity criterion, and we present circle theorems like the Inscribed Angle Theorem and the tangent angle criterion. Supplementary material: Chapter 2 of [Exploring Euclidean Geometry](#).

## Lesson 5: Area Methods

We teach classic methods of finding the area of a triangle such as Heron’s,  $\frac{bh}{2}$ ,  $rs$ ,  $\frac{1}{2}ab \sin C$ , and  $\frac{abc}{4R}$ . Some trigonometry is involved. Required reading: Chapter 4 of [Exploring Euclidean Geometry](#).

♣ **Warning:** This is the hardest lesson. Please make sure to ask teachers or parents for help on this lesson’s problem set and clarifications on the handout or lesson. Read the corresponding chapter thoroughly before class!

## Lesson 6: 3D Geometry

Spatial visualization is very hard, especially without the standard techniques for solving 3D geometry questions. We try to instill a ‘3D sense’ into students to make these questions more approachable.

## § 4 Number Theory

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Number theory is about looking at factorizations and remainders. Being able to look at questions from a higher-level perspective will trivialize many harder problems, and learning number theory well stands to improve scores drastically.

### Lesson 7: GCD/LCM

We formally define divisibility, the greatest common divisor, and the lowest common multiple. We also take a look at some questions pertaining to GCD and LCM. Though lots of problems will come from the latter end of the test, don't be intimidated; many of these problems are secretly trivial.

### Lesson 8: Modular Arithmetic

We introduce the formal concept of a remainder and modular arithmetic. These are generally the “take mod  $n$ ” or “what's the last digit” questions. Though lots of problems will come from the latter end of the test, don't be intimidated; many of these problems are secretly trivial.

## Aftermath

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### Mistakes

We discuss common mistakes, how to mitigate their effects, and give some problems from past contests that are very easy to mess up on.

### AMC 10

As the final exam, we will be giving our own Mock AMC 10.