

**Bicycle chain magic?
Negatively curved vegetables?!
Polydrons!?!**

What on earth is *Geometry and the Imagination* all about?!?!

This is an experimental course in which undergraduates will learn in a real laboratory setting how to explore basic and profound ideas about low-dimensional geometry and topology. It is an updated version of a course we tried here a decade ago, based on similarly-named courses taught at Princeton, Dartmouth, Minnesota and elsewhere. The name borrows – indeed steals! – from the title of a famous book by David Hilbert and Stefan Cohn-Vossen that described the state of modern geometry in the 1930s. In contrast to their wonderfully readable book, however, this course is hands-on (active-learning, discovery-based), so not only will students learn some interesting mathematics, they also can learn about *how* to learn mathematics! There is no textbook – students will write their own....

The instructor is indebted to all those geometers who have preceded him in this effort; Peter Doyle and John Sullivan in particular gave the instructor his first hands-on experience in how this hands-on course might be taught. And since the course is completely hands-on, *CLASS ATTENDANCE* – and full participation – *IS MANDATORY!* To repeat: this is not a course for the absentee student; *YOU* – and your open mind – *NEED TO BE PRESENT* for the course to be successful – for you, and for everyone!!!

Students – and the instructor – will often need to procure the right materials for some of the projects to work. Among the most important things to get (*immediately*, please) are a lab notebook (bound, not looseleaf or spiral) and some colored pens. The details of the notebook are not so important, but it should be big enough for me to read comfortably on a regular basis, perhaps 100 pages (200 sides), and not too big to feel uncomfortable packing around with you everywhere to write ideas down in. (If that's not enough space for the whole semester, get another when it becomes obvious....)

Bring your lab notebook and pens to class all the time. We will work together in various groups, as well as individually, so the notes you take – your rough ideas and false starts, as well as your new (and perhaps great) insights – will form the basis for evaluation. You the student will be expected to reflect, work out, and expand upon the ideas germinated together in class, develop the ideas into coherent, mathematically precise thoughts and

rigorous arguments during the rest of the week, and record it *all* in that very same notebook.

Think of this as a lab course, except it's for a different kind of experimental science – mathematics – where the role of experiment is played by proofs, including the formulation of definitions, lemmas and illustrative examples. Indeed, just as experiment is the ultimate test for reality in other sciences, so mathematical reality is ultimately tested by working out proofs.

We'll do this as rigorously as possible, recognizing that ultimate rigor, in something as rich as mathematics, is itself logically problematic (thanks to Kurt Gödel and his successors). So our emphasis will be to approach rigor “from the top down” (like birds and real mathematicians) rather than “from the bottom up” (like worms and pedagogues).

At this point, you may have reasons to be fainthearted – *don't be!* We'll have fun in this class, and whatever your future plans – doing more math, teaching, doing other sciences or writing or carpentry or whatever – there'll be “relevant” stuff to take away with you. Just be prepared to work hard - and “smart” – to expand your mind....

And as far as evaluation: I already mentioned that I look forward to perusing your notebooks from time to time. But also I think it will be fun and instructive for you all to do a final project for the course that will involve a presentation to the others in the class, as well as something written for me to keep. So as the semester progresses, you might start thinking about a possible topic, and we should certainly settle on one by Spring Break.

Math 462: Geometry and the Imagination
Spring 2009: Mondays & Wednesdays, 1–2:15
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