Math 297
Geometry and Biology
(Section 001)
Fall 2007

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Office Hrs: T Th 12:15-1:30 pm
Course web page: TBA

Class time and location: Tues. and Thurs. 11 - 12:15 in MSB 117

Texts: There are no texts for this course *per se*, but I would like you to have many works at your fingertips, so to speak. These three books are among them:

On Growth and Form (Complete Revised Edition) by D. W. Thompson (Dover, 1992).
In the Beat of a Heart by J. Whitfield (Jos. Henry Press, 2006).
Differential Geometry and Its Applications by J. Oprea (Math. Assoc. of America, 2007).

You will also be required to purchase the Tuesday *New York Times* before the Tuesday class.

Course description: Living things are notoriously complicated, and this presents a dilemma for the biology-minded mathematician, since mathematicians like elegant and straightforward constructs. Most importantly, many phenomena in the biological world depend on *space* -- spatial degrees of freedom -- yet even mathematical biologists often ignore questions of shape and geometry to simplify their models. In this course, we will engage in original research in modeling problems from biology where geometry is crucial to understanding the subject matter. We'll start with problems suggested by recent reports in the popular science literature to hone our skills at formulating

biological questions in terms of mathematical models.

Examples of possible topics to be covered: Introduction to scaling, introduction to differential geometry; elasticity theory and fluid mechanics; geometry and the motion of micro-swimmers; mechanics of 2d membranes; geometrical structures of proteins; and superstructure of DNA, RNA, and knotted macromolecules.

Recommended background: Math 210Q and 211Q, and two semesters of 100-level Physics.

Exams and grading: There are no exams or quizzes. The deliverables in this course consist of Reports (75% of grade) and Presentations (25% of grade) based on the project problems. A realistic goal of the course is to have a draft of one publishable research paper by semester's end.

Project problems: Students will start by working in teams on 2 problems involving the application of mathematics (geometry, in particular) to biology, inspired by recent articles in the Science Times section of the *New York Times* or in *Science News*. The "Science Times" section of the *New York Times* is linked here:

http://www.nytimes.com/pages/science/index.html

and this is the link to the magazine *Science News*:

http://www.sciencenews.org

The process of solving the problems include:

1. Formulation of the problem to be solved.
2. Modeling the problem mathematically.
3. Solve the mathematical formulation.
4. Interpret the results in the original problem context.
5. Write a report - Due one week after the problem has been formulated.

See my guide to report writing for details on the written reports.

Project reports: The four reports are the only deliverables in this class. The period you have to complete each report will be gradually ramped up during the course of the semester. The ramping up will go as follows:

1st report: 1 week
2nd report: 2 weeks
3rd report: 3 weeks
Final report: 6 weeks

The first three reports are team based. The final report will be an individual project. In addition, each student will make a presentation that goes along with their final report.