Description: This course covers the principles of protein and nucleic acid structure, stability and dynamics. Topics will include interactions, conformations, forces and thermodynamics that govern 3D structures of biological polymers, and detailed descriptions of their structures. This course will also introduce students to methods used to visualize and analyze large molecules in 3D, and methods used to determine 3D structures.

Place and time: 10:05 am - 10:55 am MWF Molecular Sciences & Engr 1201A.

Office hours: Mon and Fri 11 AM, or by appointment. To make an appointment, please contact my administrator, Sue Winters (sue.winters@chemistry.gatech.edu). It is best to check with her before you plan to visit my office.

Textbooks:
Supplementary: Some material will be presented from:
  R.D. Blake, Informational Biopolymers of Genes and Gene Expression, University Science Books, 2005
These supplementary texts are not required.

Additional Reading/Study Materials:
A number of papers from the primary literature will be posted. Approximately half of these papers will be required reading and the remainder will be optional supplementary reading. Slides will be posted.

Computer Software and Hardware:
You will need access to a computer with an internet connection, and the ability to run certain free software that is downloaded from the internet. We will be using PYMOL in class, so that might be easiest for you to use if you are not already committed to another molecular visualization software package. You will not need a laptop in class!!

Grades: will be based on four exams (60% total), homework assignments and quizzes (25%), and class participation (15%). Exams and quizzes will cover assigned reading and class discussions. Quizzes will be announced at least one class in advance.
Historically, students with class averages of 80-100 received an “A”; those with averages 60-79 received a “B”, those with averages 40-59 received a “C”.

**Exam dates:** September 14, October 12, November 16, and December 16 (11:30 am).
Syllabus

Brief Review of Kinetics, Thermodynamics, Driving Force and Equilibrium
Brief Review of Molecular Structure
The Liquid of Life: Water
Forces that stabilize macromolecular structure
  short range repulsion
  charge-charge
dipole interactions (dipole-charge, dipole-dipole, etc)
  induced dipole
  hydrogen bonds
  screening and dielectric effects
The Covalent Structure of Biopolymers
  Amino Acids
  The Peptide Bond
  Protein Rotamers: Ramachandran plots
  The Nucleic Acid Bases
  The Nucleic Acid Backbone
  Nucleic Acid Rotamers
Introduction to PYMOL: visualization software
Introduction to Databases
  Protein Data Bank
  Sequence Databases, Blast Searches and Alignments
Protein Folding
  The alpha-helix
  The beta-sheet
  Fibrous Proteins
  Turns
  Alpha-Domain Structures
  Alpha/Beta Structures
  Beta Structures
  Protein Folding
Nucleic Acids Structure
  Base pairs and base triples
  Helical Structures: A, B and Z-helices
  Cation Binding
  Triplexes and Quadruplexes
  RNA Structures
  DNA-small molecule interactions
  Supercoiling and Condensation
Protein-Nucleic Acid Interactions and Complexes
  Transcription Factors
  The Nucleosome
  The Ribosome
  Viruses
Introduction to Structure Determination
  X-ray diffraction
NMR spectroscopy
Structure, Prediction and Design
Proteins
RNA