

## BIOL 4520/6520: Molecular Biophysics

**Course description:** Introduction to thermodynamics, kinetics and their applications to biological systems. 3 Hours. Additional description for BIOL 6520: Students are expected to enhance their understanding of current biological literature that contains biophysical concepts covered in this course.

**Prerequisite:** For BIOL 4520: MATH 2261, BIOL 1107, 1107L, BIOL 1108, 1108L, BIOL 3200, BIOL 3250, CHEM 1211, CHEM 1211L, CHEM 1212, CHEM 1212L, and either PHYS 1111K or PHYS 2211K or consent of the instructor. For BIOL 6520: Admission into the graduate program or permission of the instructor.

**Instructor:** Dr. Jonghoon Kang (Office 2217; Phone 2293337140; E-mail [jkang@valdosta.edu](mailto:jkang@valdosta.edu))

**Class time and place:** 5:00 PM – 6:15 PM, Mon and Wed, Bailey Science Center Room 2202

**Required materials:** Biophysical Chemistry from CRC (ISBN 9781482252231)

**Office hours:** 3:30 PM – 4:30 PM, Mon and Wed

**Communication:** You may see me during my office hours or send me emails from your Valdosta email account. We may discuss course-related issues and you may ask questions on course material during my office hours. So take advantage of my office hours.

**Course objectives:** We will learn how biological phenomena can be understood, interpreted, and analyzed using mathematics, physics, and chemistry. The knowledge and techniques that students learn from this course will prepare them in their advanced research in biomedical science or related fields. This course should be *directly* useful for students who will take standard tests such as MCAT and DAT, as the topics of this course are the major components in those tests. (You can check the validity of this statement by going to their homepage and verifying their exam contents.) You don't remember the url of their homepage? Not a problem. Just Google it and you will see it. By the way, check this out if you have time ([https://aamc-orange.global.ssl.fastly.net/production/media/filer\\_public/d4/39/d4391571-1a80-4fd8-aafa-e8e53fb94ecf/periodictable.pdf](https://aamc-orange.global.ssl.fastly.net/production/media/filer_public/d4/39/d4391571-1a80-4fd8-aafa-e8e53fb94ecf/periodictable.pdf)) Often time I see students worry about their math skills for those tests. Math skills that you learn from this course should resolve your concerns if you enjoy the course and work hard.

**Course assignments:** There will be three in-class exams and three quizzes and one final exam. Student are expected to read the textbook and attend all class. Occasionally I will upload additional reading materials on Blazeview that students need to read. I will assign a problem set time to time and students are expected to work on those problems. Graduate students are required to turn in a term paper based on the topics assigned by the instructor. Graduate students are required to have a very short (about 15 min) weekly meeting with me to check the progress in their term paper.

**Course policies:** If you miss any assignment due to medical or family-related emergency you can have make-up assignments as long as you prove the valid reason of your absence (doctor's notes). Otherwise no make-up tests! And you will get a zero point for the missing part.

**Accommodations Statement:** Students with documented disabilities who are experiencing barriers in this course may contact the Access Office for assistance in determining and implementing reasonable accommodations. The access Office is located in Farbar Hall. The phone numbers are 229-245-2498 (V), 229-375-5871. For more information, please visit VSU's Access Office or email: [access@valdosta.edu](mailto:access@valdosta.edu).

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University's Title IX Coordinator: the Director of the Office of Social Equity, titleix@valdosta.edu, 1208 N. Patterson St., Valdosta State University, Valdosta, Georgia 31698, 229-333-5463.

**Grading criteria**

BIOL 4520 grade = Three in-class exams (100 pts each) + One Final (200 pts) = 500

BIOL 6520 grade = BIOL 4520 grade + Term paper (200 pts) = 700

Your score  $\geq 90$ ,  $\geq 80$ ,  $\geq 70$ ,  $\geq 60$ ,  $< 60\%$  are A, B, C, D, and F, respectively.

**Tentative schedule**

<b>Week</b>	<b>Topics to discuss and pages in the textbook</b>
Aug 19	Why biophysics? Syllabus; Periodic table; Molecular weights (Do we need the periodic table? Why or why not?) Concentrations Thermodynamics basics: 1 – 4 Equilibrium constants: 68, 71 Free energy change and equilibrium constant: 67 – 69 Delta: this is about before and after or past and future: 5 – 7 Ideal gas constant, Avogadro's number, and Boltzmann constant. How come they are related to each other? 36 Standard states: 43
Aug 26	Chemical potential: 46 – 63 (an <i>extremely</i> serious concept)
Sept 2	Labor Day (September 2); Free energy is made of enthalpy and entropy! What?! 69 – 82
Sept 9	Enthalpy in detail and heat capacity: 26 – 29 Entropy, one of the most fundamental concepts in science: 29 – 37
Sept 16	Review; <b>EXAM I (Sept 18)</b>
Sept 23	Back to the free energy: 37 – 45; Diffusion: 85 – 90
Sept 30	Chemiosmosis, Membrane transport, Brownian ratchet: 90 – 98 Electrochemistry, Nernst equation, Redox reactions in biology, Membrane potentials, Electrophysiology: 101 – 116
Oct 7	Fall Break (October 7-8) Electrochemistry, Nernst equation, Redox reactions in biology, Membrane potentials, Electrophysiology: 101 – 116
Oct 14	Review; <b>EXAM II (Oct 16)</b> Withdrawal Deadline for full-term VSU courses (October 17)
Oct 21	Reaction velocities: 119 – 123 Integrated rate laws: 125 – 135
Oct 28	Integrated rate laws: 125 – 135 Reaction types: 137 – 146
Nov 4	Rate-limiting steps: 147 – 151 Binding reactions: 153 – 159
Nov 11	Enzyme kinetics: 161 – 189
Nov 18	Enzyme kinetics: 161 – 189 Temperature dependence of rate constants: 203 – 208
Nov 25	<b>EXAM III (Nov 25)</b> Thanksgiving Holidays (November 27-29)
Dec 2	Principles of catalysis: 209 – 217; Molecular structure and interactions: 221 – 238
Dec 9	Proteins: 239 – 302 <b>Open-notebook Final Exam (5 – 7 PM) Dec 11</b>