Biochemistry I - KB4002 (7,5 hp)

Course Coordinator: Rob Daniels
Room:TBA

Aim

This Biochemistry I course is designed for molecular biology and life science majors that want to establish a strong foundation in the basic biochemistry that contributes to prokaryotic and eukaryotic cell homeostasis. It can also be taken as a free-standing course for students with a general interest in biochemistry. The topics will include: nucleotides, amino acids, lipids, pH, transcription, translation, protein folding, enzyme kinetics, metabolism, signal transduction and gene regulation. The course is organized over six weeks with lectures run in parallel to lab practicals where the classroom knowledge is applied to address a scientific question. Students will be expected to discuss basic biochemical principles, perform lab experiments, and critically evaluate their findings in regards to relevant literature. The main aim of this course is to strengthen the biochemical foundation of each student and to provide exposure to practical applications of biochemistry.

Upon completion of the course you should be able to:

- Define the basic chemical properties of nucleotides, amino acids and lipids
- Explain how genetic information is translated into functional protein structures
- Describe the function of an enzyme, enzyme kinetics, reaction mechanisms and regulation
- Explain the metabolic processes and regulation mechanisms used by cells to generate energy
- Describe how cells respond to chemical signals by signal transduction and gene regulation
- Design experiments to express/isolate proteins and analyze enzyme-substrate interactions
- Discuss and critically evaluate literature relevant to the course and lab

You will be expected to:

- Attend the lectures and read the assigned literature
- Actively participate in the lab and discussions with other students and faculty
- Complete the laboratory exercises on time and present the results in a scientific manner
- Take a final exam consisting of short answer questions at the end of the course

Assessment

1. Laboratory – Written lab reports, active participation in the discussions and lab.
   *Attendance at all labs is a requirement to pass the course and the reports must be completed within two weeks of the final exam date to receive a grade.
2. Theory - Final exam consisting of short answer questions – Exam questions are written to assess the knowledge level regarding the key concepts outlined in the course and lecture intended learning outcomes (ILOs).

Instructors

Dr. Rob Daniels, office: A423, e-mail: robert.daniels@dbb.su.se
Dr. Agneta Noren, e-mail: agneta.noren@dbb.su.se

Required Course Literature

Cox, Michael M., and David L. Nelson. (2013). *Lehninger – Principles of Biochemistry.* (6th Ed.). New York, NY: W. H. Freeman. (Cost ~800 SEK text + 80 SEK for eBook)

Recommended Complimentary Literature

Lodish, Harvey, et al. (2013). *Molecular Cell Biology.* (7th Ed.). New York, NY: W. H. Freeman.

COURSE SCHEDULE

Date	Time	Room	Activity	Teacher	Reading Lehninger
21/3 Tues	9-12:00	TBA	Course Introduction Lecture 1: Cell building blocks, bonds&buffers	RD	Ch.1 (p. 1-31) Ch.2 (p47-69)
***22/3 Wed**	9-12:00 13-16:00	TBA Lab	Lab Introduction	RD	
***23/3 Thur**	9-12:00 13-14:00	TBA Lab	Lecture 2: DNA replication, transcription and translation – How it differs between prokaryotes and eukaryotes	RD	Ch.8 (p. 281-99) Ch.25(1009-25) Ch.26(1057-81) Ch.27(1103-15)
***24/3 Fri**	9-10:00 10-15:00	TBA Lab	Prelab	RD	
27/3 Mon	9-12:00	TBA	Lecture 3: Amino acids, protein structure & folding	RD	Ch. 3 (75-88) Ch. 4 (115-151) Ch.27(1115-39)
***28/3 Tues**	9-10:00 10-17:00	TBA Lab	Prelab	RD	
***29/3 Wed**	9-12:00 13-14:00	TBA Lab	Lecture 4: Protein targeting, trafficking, membranes & lipid biosynthesis	RD	Ch.10,11,21
30/3 Thur	9-12:00	TBA	Lecture 5: Protein function - ligand binding & enzyme catalysis	RD	Ch. 5, 6
***31/3 Fri**	9-10:00 10-16:00	TBA Lab	Prelab	RD	
3/4 Mon	9-12:00	TBA	Lecture 6: Prokaryotic & eukaryotic gene regulation	RD	Ch. 24(977-1001) Ch. 28(1155-84)
4/4 Tues	9-12:00	TBA	Lecture 7: Signal transduction – How Signals are transduced across membranes	RD	Ch. 12(433-480)
5/4 Wed	9-12:00	TBA	Lecture 8: Regulation of carbohydrate metabolism	AN	
6/4 Thur	9-12:00	TBA	Lecture 9: Regulation of carbohydrate and lipi metabolism, and the role of TCA and respiration in regulation	AN	
***7/4 Fri**	9-10:00 10-17:00	TBA Lab	Prelab	RD	
***10/4 Mon**	9-10:00 10-16:00	TBA Lab	Prelab	RD	
***11/4 Tues**	9-10:00 10-16:00	TBA Lab	Prelab	RD	
***12/4 Wed**	9-10:00 10-16:00	TBA Lab	Prelab	RD	
***13/4 Thur**	9-10:00 10-16:00	TBA Lab	Prelab	RD	
14/4 Fri			Good Friday		
17/4 Mon			Easter Holiday Annandag påsk		
18/4 Tues	9-12:00	TBA	Lecture 10: Integration of metabolism	AN	
***19/4 Wed**	9-10:00 10-16:00	TBA Lab	Lab help session sequence results, calculations Extra lab time if necessary	RD	
***20/4 Thur**	9-16:00	Lab	Lab if necessary otherwise prepare lab reports	RD	
***21/4 Fri**			Prepare lab reports	RD	
24/4 Mon	9-12:00	TBA	Pre-exam help session	RD,AN	
24-27/4			Study		
28/4 Fri			Final Exam**		

Prelabs will occur in the classroom prior to lab

*-Lab component scheduled for this day (see lab schedule for details)

**-Re-exam date is scheduled for Friday 2017-06-09

Biochemistry I – Laboratory

Instructor: Rob Daniels
Rooms: TBA

Aim

The lab module of this Biochemistry I course is designed to provide students with the opportunity to apply the class concepts in an investigative research project for one month that can potentially result in publishable biochemical data. The project will utilize several molecular biology and biochemical techniques in a supervised setting to reconstitute an enzymatic pathway. Each group will collect data on the enzymatic properties of their proteins; compare their values with other groups and with respect to literature to decide on the suitability of the data for publication. The isolated enzymes will then be combined in an attempt to reconstitute a catabolic process in vitro. The overarching goal of this lab is to strengthen the practical skills in biochemistry and expose each student to the scientific process.

Upon completion of the lab portion of the course you should be able to:

- Define the goal of an experiment
- Describe the biochemical principles utilized in each experimental method (see list below)
- Explain the experimental results in a scientific manner
- Compare and contrast the results obtained by other groups
- Discuss and critically evaluate your work in reference to relevant literature
- Interpret your results to develop a hypothesis

You will be expected to:

- Attend and actively participate in the lab with other students and teachers
- Explain the scientific basis behind the techniques used in the labs
- Complete the laboratory exercises on time and present the results from each part in a report

Report 1: Protein expression and purification
Report 2: Gene isolation and subcloning into an expression vector
Report 3: Enzyme property analysis

Methods covered:

- Plasmid and primer design, transformation and selection.
- Polymerase chain reaction (PCR), cloning, agarose gel electrophoresis, and sequencing
- Inducible expression in *E. coli*, protein purification (affinity tag), dialysis, SDS-PAGE
- Protein quantification
- Determine enzymatic properties, pH optimum, thermostability, K_m, V_{max} and k_{cat}
- Analyze enzyme inhibition

Laboratory Assistants

Henrik Östbye henrik.ostbye@dbb.su.se
Rageia Elfageih rageia.elfageih@dbb.su.se
Ivan Hernandez Neuta ivan.hernandez@dbb.su.se
Iven Winkelmann iven.winkelmann@dbb.su.se

Lab schedule

Date	Time	Room	Lab	Activity	TA
***22/3 Wed**	9-12:00	TBA		Lab introduction – Background& papers How to write a lab report, primer design	RD, HÖ, RE, IW
	13-16:00	Lab		Pipetting, transformation, and design primers	
23/3 Thur	13-14:00	Lab	#1- Protein expression, purification and quantification	Set-up starter culture, prepare for large culture	HÖ, RE, IW
***24/3 Fri**	10-15:00	Lab		Start large culture, induce expression, harvest the pellet & store	HÖ, RE, IW
***28/3 Tues**	10-17:00	Lab		Protein purification and SDS-PAGE	HÖ, RE, IW
29/3 Wed	13-14:00	Lab		Analyze SDS-PAGE and dialysis	HÖ, RE, IW
***31/3 Fri**	10-16:00	Lab		Protein quantification and storage (Lab Report 1)	HÖ, RE, IW
***7/4 Fri**	10-17:00	Lab	#2 - Gene amplification & subcloning	Gene isolation by PCR & transformation	HÖ, RE, IW
***10/4 Mon**	10-16:00	Lab		Clone identification	HÖ, RE, IW
***11/4 Tues**	9-12:00	Lab		DNA isolation and preparation for sequencing	HÖ, RE, IW
***12/4 Wed**	10-16:00	Lab	#3 – Enzymatic analysis properties & inhibition	Enzyme analysis 1: enzyme titration &pH optimum	HÖ, RE, IW
***13/4 Thur**	10-17:00	Lab		Enzyme analysis 2: Thermostability, K_m & V_{max} determination 2)	HÖ, RE, IW
***19/4 Wed**	9-16:00	Lab		Help session with sequencing results (Lab Report2) & enzyme calculations (Lab Report 3), extra time	HÖ, RE, IW
20/4 Thur	9-16:00	Lab		Lab if necessary otherwise prepare lab reports	
21/4 Fri				Prepare lab reports	

*Prelab before beginning at 9:00 in classroom TBA

There are large time windows during incubations, use this to talk to your TAs and prepare your lab reports