Ben- Gurion University of the Negev
Faculty of Health Sciences
Joyce & Irving Goldman Medical School

Name of the module: Biochemistry 1st year Medicine

Number of module: 4718-1004

BGU Credits: 4.5

ECTS credits:

Academic year: 1st year Medicine

Semester: 2nd semester

Hours of instruction: 4 hours per week of frontal presentation along with interactive discussion with the students + 2 laboratory classes, 4 hours each.

Location of instruction: Lectures take place in the Deichmann Building for Health Professions.
Specific classroom numbers are indicated in the schedule.

Language of instruction: Hebrew.

Cycle: B.Med.Sc

Position:.

Field of Education: General and medical biochemistry of human subjects

Responsible Department: Clinical Biochemistry and Pharmacology

General prerequisites: General Chemistry and Organic Chemistry

Grading scale: Successful passing the final exam (a score of $\geq$ 65 of 100) - 90% of the final grade, laboratory grade - 10% of the final grade only for students that passed the final exam

Course Description: The course provides basic knowledge of general and medical biochemistry.

Aims: The goal of this biochemistry course is to provide the tools and the basis for understanding metabolic processes in humans and the basis for the 2nd year biochemistry course. This course also provides knowledge linking structure and function of proteins, enzymes and nucleic acids to human metabolic processes.

Learning outcomes of the module: On successful completion of the course, the student should be able to:

1. Develop basic understanding of metabolic processes in human (glycolysis, gluconeogenesis, Krebs cycle, respiratory burns…)
2. Develop problem-solving and critical-thinking skills
3. Learn to integrate and apply various biochemical concepts to real-life medical and biological problems

Attendance regulation: Attendance is obligatory both to the classes and to the laboratory sessions.

Teaching arrangement and method of instruction:

The course is thought in two parallel groups to enhance interactive discussions with the students and to enable the students asking questions related to the obligatory self reading.

The two laboratory sessions are scheduled so that each lab issue is practiced after the relevant "units" have been concluded.

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Module evaluation: At the end of the semester the students evaluate the module, in order to draw conclusions, and for the university's internal needs.

Confirmation:

Last update: 05/2015

Module Content: It is composed of 11 teaching units, each dealing with a major issue of the course (e.g. amino acids, proteins, the syllabus is attached). Reading before each class is mandatory (mostly' from Principle of Biochemistry' by Lehninger et al, 5th edition). Each unit is built on four hours of teaching (on the average) during which we further discuss the issues read by the students. In the last hour of each unit (usually the 4th) we practice with the students some of the questions in a problem set of the unit which summarizes the topic of the unit. At the end of each unit the students are obliged to submit solutions for all questions included in the problem set. The units, their reading obligations and the problem set are available on the high-learn site as the curse starts.

In Addition, two laboratory classes are part of this biochemistry course. One deals with protein purification techniques and the other - with enzymatic activity as well as basic knowledge on DNA, RNA and protein synthesis.

Assessment:

Students are assessed by passing an exam of both the classes and the lab session with a score of $\geq$ 65.

Work and assignments: Students have to solve and submit the problem set of each "unit" and the lab report.

Time required for individual work: In addition to attending classes and lab sessions the students have to read the relevant textbook chapters, answer the question accompanying each unit and submit lab experiments reports. Roughly 90 minutes per one hour of class meeting and about 2 hrs per each lab session .

Syllabus:

- Introduction to Biochemistry and Metabolism
  Proteins, carbohydrates & lipids, amino acids, essential amino acid, glycerol, fatty acids, vitamins, trace elements, nucleic acids, RNA, DNA physiological caloric value, nitrogen balance, Basal Metabolic Rate (BMR) and BMI.
- Amino Acids
  The 20 amino acids that build proteins, titration curve of organic and amino acids, pI of amino acids, the peptide bond, carboxy terminal, amino terminal, separation among amino acids, ion exchange resin, electrophoresis, isoelectric point.
- Protein Purification
  Gel electrophoresis, chromatography: ion exchange, size exclusion, affinity, HPLC (high pressure/performance liquid chromatography), isoelectric focusing, Mass spectrometry
- Protein Structure
  Primary structure (sequence), secondary structure - 3-dimensional structure (α helix , β pleated sheet, β turns, random coil, the contribution of hydrogen bonds, hydrophobic forces, ionic forces, S-S bonds), denaturation, , quaternary structure (subunits), native structure,tertiary structure (globular and fibrillar) chaperones.
- Enzymes
  Michelis-Menten Kinetics, Michaelis-Menten constant (Km), Maximun Velocity (Vm), Enzyme unit, specific activity, turnover number, coenzyme, cofactor, apoenzyme, specificity.
- Alosteric Enzymes
  Allosteric enzymes, positive/negative modulators, cooperavivity, $K_{0.5}$, regulation, covalent modification, enzyme phosphorylation, zymogen, isoenzymes, isoforms, assembly and disassembly of subunits.
- Introduction to Metabolism
  Metabolism, anabolism, catabolism, intermediates, substrates, identification of the site of a metabolic disorder, cross curve of metabolites, tissue slices, tissue culture, cell free systems, inhibitors, ATP, NADH, NADPH, cell compartments.
- Nucleotides
  Purines, pyrimidines, nucleosides, nucleotides, adenine, guanine, thymine, cytosine, uracil, vitamin B_{12}, antimetabolites: aminopterin, methotrexate, azaserine, sulfanilamide; uric acid, gout, folic acid, dihdrofolate, tetrahydrofolate, Lesch-Nyhan syndrome.
- DNA and RNA Structure
  DNA, RNA, Double helix, complementary base pairs, Chargoff's rules, Watson & Crick model, gene, histone, nucleosome, telomere, DNA melting, DNA hybridization, Epigenetics, messenger, transfer and ribosomal RNA.
- DNA and RNA Synthesis
  Messelson & Stahl, origin of replication, DNA polymerase, template, primer, endonuclease, DNA ligase, base pairing of tautomers, proof reading, leading and lagging strands, topoisomerase, RNA polymerase, transcription, consensus sequences, actinomycin-D, RNA Processing, RNA splicing, intron, exon, cap, poly A, reverse transcriptase, telomerase.
- Protein Synthesis
  The genetic code, codon, anticodon, open reading frame, stop codon, wobble, transfer RNA, ribosomal – RNA, degeneracy of the genetic code, mutation, messenger–RNA, aminoacyl-tRNA, ribosomes, polyribosomes (polysomes), aminoacyl-tRNA synthase, A site, P site, E site, initiation factors, elongation factors, termination, antibiotics.

Required reading: Lehninger et al, Principles of Biochemistry – 5th edition

Additional literature:

*** All units are available for the students on the web ("high-learn").**