338001 - Control of Cellular Bioenergetics

Winter 2020-2021

Credit: 2.5

Pre courses 044130, 336537

Which questions will we discuss in this course?

How is energy generated in the body? How is energy quantified? What are the control mechanisms that match between ATP supply to demand? How does energy production adapt with cardiac disease? How does failure to produce energy affect electrical and mechanical mechanisms in the cell?

What will the student know at the end of the semester?

The control energy mechanisms: how to quantify mathematically and how to use experimental tools to measure energetic, to build computational and numerical model of energetic, literature survey to find parameters for the model, criticize published works related to the course area.

Course structure

During the semester there will be 8 lectures and 3 tutorials. All lectures will be recorded in advance and uploaded to the course website at least one week before the lecture time. During the official hours of the lecture there will be Q&A and discussion on the weekly article. The tutorials will be given online (ZOOM) in specific dates that will be published in advance. Computer with MATLAB program is mandatory!

Grading

Quiz (10% mandatory)

The students are expected to watch each lecture before the official hours of the course. At the first 10 minutes of the lecture, a quiz will be open in the course site. The password for the quiz will be given during the lecture. The grades of best 5 out of 8 quizzes will be taken into account. Personal reasons or sickness for lass then two weeks are not a justifying reasons for absence. Military service or child birth are justified.

Homework (20% mandatory)

One week before each lecture an article that will be discussed in class will be given. At the end of the lecture, a homework assignment regarding the article will be opened in the course site for 1 week. The grades of best 5 out of 8 assignments will be taken into account.

Personal reasons or sickness for lass then two weeks is not a justify reasons for non-submission. Military service or child birth are justified.

Project (60%)

The final project will include a summary of an article including simulations. Each student should prepare a 20-minutes presentation, and upload a recorded version to the course site (additional explanation will be provided in the lectures). The project should be submitted until 26.1.21. No delay in project presentation.

Review (10%)

Each student will be required to review 2 projects of his/her colleagues, the review should include short summary of 3 positive statements and 3 recommended revisions. Each review should be one page only.

Office hours

Yael Yaniv	Silver Building 321	04-8294124	yaely@bm.technion.ac.il
Limor Arbel Ganon	Silver Building 322	04-8294121	slimli@campus.technion.ac.il
Savyon Mazgaoker	Silver Building 322	04-8294121	mazsavyon@campus.techion.ac.il

Please request meeting at least 24 hours in advance.

Course Website

https://moodle.technion.ac.il/course/view.php?id=4826

Electronic email is the official way to receive information.

Textbook

1. Nicholls and Ferguson , Bioenergetics 3

Most of the lectures are outside the textbook and related to recent literature.

Course topics

Topic 1: Introduction: mitochondrial function and structure (Chapters **8** and **10** in the book)

Topic 2: Respiration and oxidative phosphorylation: Krebs cycle, Electron transport chain and proton pumps (Chapter **5** in the book).

Topic 3: Complex V: Structure of F_1-ATPase and F_0 complexes, hydrolysis and synthase by complex V, the role of IF_1, mechanics method and application, elastic energy storage in proton translocation (Chapter **7** in the book).

Topic 4: Electrochemistry: Mitochondrial membrane potential: measurement methods, importance during ischemia (Chapter **4** in the book).

Topic 5: Biomedical tools to measure bioenergetics: Oxygen consumption, Redox state, NADH, FADH (Chapter **4** in the book).

Topic 6: Swelling, cardiac protection and the mitochondrial permeability transition pore (Chapter **9** in the book).

Topic 7: Control mechanisms of respirations (ATP and Pi model).

Topic 8: Control mechanisms of respirations (Calcium model, Phosphorylation model)