

Syllabus

1. Course Title, style, and credit:

Membrane physiology and structure-function study of ion channels and receptors.

(X) Lecture, () Discussions () Practice]

1 credit

2. Appropriate grade level and Eligible Departments:

(x) 1, (x) 2, (x) 3, (x) 4, (x) 5:

(x) Department of Physiological Science, School of Life Science

3. Lecturer(s):

Yoshihiro Kubo

(ykubo@nips.ac.jp, Tel: 0564-55-7831, Myodaiji Rm 364

4. Time:

(oral) 10:00-12:00 on every Friday from May 12 – June 30, 2017

5. Place:

(oral) Lecture room, 1st Floor, NIPS (Myodaiji Area)

6. Prerequisites and Styles

This course begins with basic introduction of membrane physiology of excitable cells, and there is no lecture course especially requested to have been finished in advance. The entire course will be presented in English.

7. Contents:

Ion channels and receptors are important molecules underlying the excitability of neurons and their communication. In the 1st lecture, we will introduce the fundamental knowledge of general physiology, especially about the mechanisms of the resting potential and the generation of action potential. In the 2nd, we will explain about the molecular diversity and the function mechanisms of ion channels. In the 3rd – 6th lectures, we will introduce some unique and cutting-edge approaches to elucidate the structure-function relationship and the dynamics, including lipid bilayer analysis, molecular dynamics simulation, subunit counting by single molecule imaging, voltage clamp fluorometry and FRET analysis. In the 7th – 8th lecture, we will introduce cutting edge methodology of structure biology, such as high spatial resolution single particle structure analysis by Cryo EM and high time resolution crystal structure analysis by X-ray free electron laser.

8. Course objectives:

- (1) To understand the mechanisms of the resting membrane potential and the generation of action potentials.
- (2) To understand the molecular diversity and the functioning mechanisms of ion channels and receptors.
- (3) To understand the detail and the significance of the various cutting-edge approaches to the dynamic structure-function relationship.
- (4) To understand the detail and the significance of the various cutting-edge approaches in the structure biology field.

9. Schedule:

(1) May 12

Introduction of cell physiology, mechanisms of Membrane potential and generation of action potential

Yoshihiro Kubo (NIPS)

(2) May 19

Molecular diversity and mechanism of function of ion channels and receptors

Yoshihiro Kubo (NIPS)

(3) May 26

Cutting-edge approaches in the research of ion channels and receptors 1

-- Lipid bilayer analysis and molecular dynamics simulation analysis of ion permeation –
Shigetoshi Oiki (Fukui Univ, Med, Molecular Physiology)

(4) June 2

Cutting-edge approaches in the research of ion channels and receptors 2

-- Subunit counting by single molecule live imaging –
Yoshihiro Kubo (NIPS)

(5) June 9

Cutting-edge approaches in the research of ion channels and receptors 3

-- Voltage clamp fluorometry analysis of membrane proteins–
Yasushi Okamura (Osaka Univ, Med, Integrative Physiology)

(6) June 16

Cutting-edge approaches in the research of ion channels and receptors 4

-- FRET analysis of the structural rearrangements of membrane proteins –
Michihiro Tateyama (NIPS)

(7) June 23

Cutting-edge approaches in the research of ion channels and receptors 5

-- High spatial resolution single particle structure analysis by Cryo EM

Kazuyoshi Murata (NIPS)

(8) June 30

Cutting-edge approaches in the research of ion channels and receptors 6

-- Crystal structure analysis – from snapshot to movies --

Takushi Shimomura (NIPS)

10. Lecture materials and readings

(1) Ion channels (by Aidley DJ and Stanfield PR), Cambridge Press, 1996

(2) Ion channels of excitable membranes 3rd Edition (by Hille B), Sinauer, 2001

11. Grades:

A theme based on the four course objectives will be presented by the lecturer at the end of the course. Students are requested to submit an essay report on the theme by the dead line. The grades will be determined by the quality of the report, and will be either “passed” or “failed”.

12. Notes

Nothing particular