DESCRIPTION OF TRAINING PROGRAMME

FOT THE DOCTORAL SCHOOL AT THE KAZIMIERZ WIELKI UNIVERSITY

INFORMATION ON COURSE	
Course	**Monographic lecture/ Title: Mechanisms of contraction and cell motility**
Type of classes	specialist classes
Academic year	**2021/2022**
Field of science	natural sciences
Discipline of science	**biological sciences**
Class instructor	**prof. dr hab. Joanna Moraczewska**
Number of hours	**30**
Forme of classes	**lecture**
Pass rules	**credit**
Language of lecture	**English**
Framework learning outcomes (8 PRK)	• knows and understands to such an extent that is possible to revise existing paradigms – world heritage, including theoretical foundations, general issues and selected specific issues – specific to a scientific or artistic discipline • knows and understands the main trends in the development of the scientific or artistic disciplines covered in the curricula • is able to communicate on specialist topics to the extent that they enable an active participation in the international scientific community • is able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment

DETAILED DESCRIPTION OF CLASSES	
Particular learning outcomes	**Methods of verifications of learning outcomes**
• knows and understands to such an extent that is possible to revise existing paradigms in the field of structure and function of contractile proteins and mechanisms of cell motility • knows and understands the main trends in the development of cell biology with the focus on actin cytoskeleton and microtubules • is able to communicate on specialist topics within the field of molecular and cell biology to the extent that they enable an active participation in the international scientific community • is able to speak English at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment.	• discussion of the lecture topics • discussion of the specific scientific problems that still need to be solved • solving quizzes by the student after completing thematic blocks

PROGRAM CONTENT IMPLEMENTED DURNING CLASSES

- Structure of contractile proteins – actin and myosin
- Muscle cell specialization for contraction - structure of contractile units in skeletal, heart and smooth muscle
- Mechanisms of contraction regulation in striated, cardiac and smooth muscle
- Non-muscle actin filaments
- Structural and functional diversity of actin-binding proteins
- Myosins in non-muscle cells
- Mechanisms of actin- and myosin-dependent cell motility
- Signaling pathways controlling cell motility
- Microtubules – structure and dynamics
- Kinesin and dynein – microtubule-associated molecular motors
- Mechanisms of microtubules-dependent cell motility
- Cellular functions depending on actin- and microtubule motility – cytokinesis, karyokinesis, mesenchymal and ameboidal cell movement, endocytosis, intracellular transport.

Didactic methods and educational techniques	Lecture with discussion, PowerPoint presentations
Evaluation criteria	credit
The form and conditions of passing (the form of verification of learning outcomes)	The presence and active participation in 80% of lectures.
Literature	Basic literature: 1. Lodish H, Berk A, Zipursky SL, et al. Molecular Cell Biology. 4th edition. New York: W. H. Freeman; 2000. https://www.ncbi.nlm.nih.gov/books/NBK21493/ 2. Alberts B, Johnson A, Lewis J, et al. Molecular Biology of the Cell. 4th edition. New York: Garland Science; 2002. https://www.ncbi.nlm.nih.gov/books/NBK26809/ 3. Berg JM, Tymoczko JL, Stryer L. Biochemistry. 5th edition. New York: W H Freeman; 2002. https://www.ncbi.nlm.nih.gov/books/NBK21154/ Supplementary literature: 1. Svitkina, T. The Actin Cytoskeleton and Actin-Based Motility. *Cold Spring Harb Perspect Biol* **2018**, *10*, doi:10.1101/cshperspect.a018267. 2. Svitkina, T.M. Ultrastructure of the actin cytoskeleton. *Curr Opin Cell Biol* **2018**, *54*, 1-8, doi:10.1016/j.ceb.2018.02.007. 3. Efimova, N.; Svitkina, T.M. Branched actin networks push against each other at adherens junctions to maintain cell-cell adhesion. *J Cell Biol* **2018**, *217*, 1827-1845, doi:10.1083/jcb.201708103. 4. Zhang, R.; Lee, D.M.; Jimah, J.R.; Gerassimov, N.; Yang, C.; Kim, S.; Luvsanjav, D.; Winkelman, J.; Mettlen, M.; Abrams, M.E., et al. Dynamin regulates the dynamics and mechanical strength of the actin cytoskeleton as a multifilament actin-bundling protein. *Nature cell biology* **2020**, *22*, 674-688, doi:10.1038/s41556-020-0519-7. 5. Svitkina, T.M. Actin Cell Cortex: Structure and Molecular Organization. *Trends Cell Biol* **2020**, *30*, 556-565, doi:10.1016/j.tcb.2020.03.005. 6. Alexandrova, A.Y.; Chikina, A.S.; Svitkina, T.M. Actin cytoskeleton in mesenchymal-to-amoeboid transition of cancer cells. *Int Rev Cell Mol Biol* **2020**, *356*, 197-256, doi:10.1016/bs.ircmb.2020.06.002. 7. Pollard, T.D.; Cooper, J.A. Actin, a central player in cell shape and movement. *Science* **2009**, *326*, 1208-1212, doi:10.1126/science.1175862. 8. Pollard, T.D.; Blanchoin, L.; Mullins, R.D. Actin dynamics. *J Cell Sci* **2001**, *114*, 3-4.

9. Pollard, T.D.; Borisy, G.G. Cellular motility driven by assembly and disassembly of actin filaments. *Cell* **2003**, *112*, 453-465.
10. Sweeney, H.L.; Hammers, D.W. Muscle Contraction. *Cold Spring Harb Perspect Biol* **2018**, *10*, doi:10.1101/cshperspect.a023200.
11. Shima, A.; Morimoto, Y.; Sweeney, H.L.; Takeuchi, S. Three-dimensional contractile muscle tissue consisting of human skeletal myocyte cell line. *Exp Cell Res* **2018**, *370*, 168-173, doi:10.1016/j.yexcr.2018.06.015.
12. Hill, C.; Brunello, E.; Fusi, L.; Ovejero, J.G.; Irving, M. Myosin-based regulation of twitch and tetanic contractions in mammalian skeletal muscle. *Elife* **2021**, *10*, doi:10.7554/eLife.68211.
13. Gordon, A.M.; Homsher, E.; Regnier, M. Regulation of contraction in striated muscle. *Physiol. Rev.* **2000**, *80*, 853-924.
14. Gunning, P.W.; Hardeman, E.C.; Lappalainen, P.; Mulvihill, D.P. Tropomyosin - master regulator of actin filament function in the cytoskeleton. *J. Cell. Sci.* **2015**, *128*, 2965-2974, doi:10.1242/jcs.172502.
15. Dominguez, R.; Holmes, K.C. Actin structure and function. *Annu Rev Biophys* **2011**, *40*, 169-186, doi:10.1146/annurev-biophys-042910-155359.
16. Fili, N.; Toseland, C.P. Unconventional Myosins: How Regulation Meets Function. *Int J Mol Sci* **2019**, *21*, doi:10.3390/ijms21010067.
17. Andrianantoandro, E.; Pollard, T.D. Mechanism of actin filament turnover by severing and nucleation at different concentrations of ADF/cofilin. *Mol. Cell* **2006**, *24*, 13-23, doi:10.1016/j.molcel.2006.08.006.
18. Ali, I.; Yang, W.C. The functions of kinesin and kinesin-related proteins in eukaryotes. *Cell Adh Migr* **2020**, *14*, 139-152, doi:10.1080/19336918.2020.1810939.
19. Canty, J.T.; Tan, R.; Kusakci, E.; Fernandes, J.; Yildiz, A. Structure and Mechanics of Dynein Motors. *Annu Rev Biophys* **2021**, *50*, 549-574, doi:10.1146/annurev-biophys-111020-101511.
20. Xiang, X.; Qiu, R. Cargo-Mediated Activation of Cytoplasmic Dynein in vivo. *Front Cell Dev Biol* **2020**, *8*, 598952, doi:10.3389/fcell.2020.598952.

*niepotrzebne skreślić