**Syllabuses of obligatory courses 2021/2022 (ECTS 6)**

**1.**

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| Course: **Animal Physiology** | |
| Course Instructor: Sebastian Maciak, PhD,  Email: maciaks@uwb.edu.pl | |
| Language: English | |
| Semester: **winter/summer** | Number of hours (total): **30**  \*Lecture: **15**  \*Laboratory: **15** |
| ECTS: **6** |
| Substantive content:  Basal Metabolic Rate as a fundamental trait of all living organisms. Metabolic rate measurements. Closed respirometry;  Experiments with artificial selection as a model systems;  The structure and function of different types of cells. The basis for animal’s histology. Histological slides preparation;  Animal cell growth and cell division rate;  DNA content and cell size variation. The impact of cell size and cell division rate on physiological properties of an organism and variation in the metabolic rates;  The basic microscopy techniques. Cell size measurements;  The main genes involved in regulation of cellular metabolism. Metabolic signaling pathways;  Cellular aerobic pathways and formation of reactive oxygen species (ROS);  Oxidative stress and examples for dietary interventions;  Evolution of the cell size as a key factor to develop nowadays maladies as metabolic syndrome, diabetes, or cancer;  Peto’s paradox and general methods of cancer prevention;  Evolutionary context of carcinogenesis and its possible contribution to understanding of mechanisms of cancer initation;  The use of animal models in cancer and diabetes research;  The clinical aspect of the physiological studies and trends in the individualization of metabolic disease therapies; | |
| Literature:  Schmidt-Nielsen K. 1997. Animal Physiology. Adaptation and environment. 5th eds.  Cambridge University Press  Moyes Ch.D., Schulte P.M. 2016. Principles of Animal Physiology 3rd eds. Pearson Education. | |
| Forms and conditions of credit:  - attendance on the lecture  - final report from the laboratory | |

**2.**

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| Course: **Biochemistry** | |
| Course Instructor: prof. Andrzej Bajguz, Alicja Piotrowska-Niczyporuk, PhD  Email: abajguz@uwb.edu.pl, alicjap@uwb.edu.pl | |
| Language: English | |
| Semester: **winter/summer** | Number of hours (total): **30**  \*Lecture: **15**  \*Laboratory: **15** |
| ECTS: **6** |
| Substantive content:  Biological oxygenation, types, energetics and meaning: oxidative and non-oxidative decarboxylation of pyruvate, tricarboxylic acids cycle and respiratory chain  Biosynthesis ATP – photosynthetic, oxidative and substrate phosphorylation  Basic mechanisms regulation of metabolism  Nucleic acids – their structure, types and function  Amino acids, peptides, proteins – their structure, types and functions  Catabolism of proteins, amino acids and nucleotides: deamination, urea cycle, degradation of purines and pyrimidines  Enzymes, coenzymes, vitamins – their structure, types, biological and metabolic functions  Replication and transcription. Translation and modification of proteins  Saccharides and lipids – their structure, types and function  Carbohydrate metabolism: glycolysis, gluconeogenesis and pentose phosphate pathway  Lipids metabolism: biosynthesis and oxidation of fatty acids  Porphyrins – their structure, types and functions | |
| Literature:  Tymoczko J.L., Berg J.M., Gatto Jr. G.J., Stryer L., Biochemistry. 8th Edition. W. H. Freeman and Company, 2015.  Campbell M.K., Farrell S.O., Biochemistry, Eighth Edition. Cengage Learning, 2015.  Buchanan B.B., Gruissem W., Jones R.L., Biochemistry & Molecular Biology of Plants. John Wiley & Sons, Ltd, 2015. | |
| Forms and conditions of credit:  - attendance on the lecture  - final report from the laboratory | |

**3.**

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| Course: **Biological invasions** | |
| Course Instructor: Edyta Jermakowicz, PhD  Email: edytabot@uwb.edu.pl | |
| Language: English | |
| Semester: **winter/summer** | Number of hours (total): **30**  \*Lecture: **10**  \*Laboratory/field course: **20** |
| ECTS: **6** |
| Substantive content:  Principles of invasion biology and ecology – terminology and definitions, mode and source of introduction, ecology  History of plants and animals migration.  Theories and concepts of invasion biology  Factors (natural and anthropogenic) influencing spread and establishment of alien species  Survey of the most dangerous plant and fungi invaders and their biology and ecology  Survey of the most dangerous animal invaders and their biology and ecology  Ecological and economic impact of biological invasions  Management of biological invasions | |
| Literature:  Tokarska-Guzik B. 2005. The establishment and spread of alien plant species (kenophytes) in the flora of Poland. Uniwersytet Sląski, Katowice.  Elton C.S. 1958. The Ecology of Invasions by Animals and Plants.  More references will be proposed during course. | |
| Forms and conditions of credit:  - attendance on the lecture  - final report from the laboratory and field course | |

**4.**

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| Course: **Butterfly ecology and conservation** | |
| Course Instructor: Marcin Sielezniew, Professor UwB  Email: marcins@uwb.edu.pl | |
| Language: English | |
| Semester: **summer** | Number of hours (total): **30**  \*Lecture: **10**  \*Field course: **20** |
| ECTS: **6** |
| Substantive content:  Butterflies are a model group in ecology and conservation of insects. The aim of the lectures is to familiarize students with diversity and ecology of butterflies in Poland with special reference to Large Blue butterflies which larvae are social parasites of red ants. Participation in field courses will give opportunity to visit some selected sites interesting because of the butterfly fauna as well as overall biodiversity and also to know research methodology.  Butterflies and moths: classification, systematics and evolution of Lepidoptera;  Morphology, anatomy and development;  Wing colouration, camouflage, aposematism, mimicry;  Behaviour: thermoregulation, territoriality, courtship;  Life histories: oviposition, host-plants, aphytophagy, myrmecophily, natural enemies;  Dispersal abilities, population structure, migrations;  Butterfly diversity in NE Poland on the background of national and European fauna;  Methods of butterfly studies and monitoring (e.g. mark-release-recapture, transect counts);  Natural and anthropogenic threats for butterfly fauna (including impact of climate change);  Conservation management: examples from Poland and Europe. | |
| Literature:  Settele J, Shreeve T, Konvička M, Van Dyck H (eds) (2009) Ecology of butterflies in Europe. CUP, Cambridge.  Van Swaay C, Cuttelod A, Collins S, Maes D, Lopez Munguira M, Šašić M, Settele J, Verovnik R, Verstrael T, Warren M, Wiemers M, Wynhof I (2010) European red list of butterflies. Publications Office of the European Union, Luxembourg.  Selected journal articles. | |
| Forms and conditions of credit:  - presence at lectures  - final report from the field course | |

**5.**

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| Course: **Computational biology** | |
| Course Coordinator: Tomasz Włodarczyk, PhD  Email: t.wlodar@uwb.edu.pl | |
| Language: English | |
| Semester: **winter/summer** | Number of hours (total): **30**  \*Lecture: **15**  \*Laboratory: **15** |
| ECTS: **6** |
| Substantive content:  The course shows the capacity and limitations of using modelling techniques in biology. Starting with the simple equations describing population dynamics, it will be demonstrated how manipulating model parameters translates into biologically relevant outcomes. Students have to find optimal or nearly optimal solutions to exemplar problems reflecting real evolutionary processes. Moreover, using random path paradigm students simulate organism movement trajectories and learn how to represent them graphically. Students also learn how to handle big databases which result from high throughput methods in used genomics and metabolomics studies. The necessary theory is outlined during lectures, giving the background for the practical part of the course. This includes calculus, probability theory and algorithm construction. The potential of machine learning for solving problems in biology and medicine is also presented. | |
| Literature:  Haddock, S. H. D., Dunn, C. W., & Sinauer Associates. (2018). Practical computing for biologists. Sunderland, MA: Sinauer Associates.  Alon U., An introduction to systems biology. Design principles of biological circuits. Chapman&Hall/CRC, 2007.  Koutrouli M, Karatzas E, Paez-Espino D and Pavlopoulos GA (2020) A Guide to Conquer the Biological Network Era Using Graph Theory. Front. Bioeng. Biotechnol. 8:34. doi: 10.3389/fbioe.2020.00034 | |
| Forms and conditions of credit:  - attendance on the lecture  - tasks completion | |

**6.**

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| Course: **Ecology** | |
| Course Instructor: Paweł Brzęk, PhD, Paweł Mirski, PhD, Łukasz Ołdakowski, PhD, Adam Hermaniuk, PhD  Email: brzek@uwb.edu.pl, p.mirski@uwb.edu.pl, lukasold@uwb.edu.pl, adamher@uwb.edu.pl | |
| Language: English | |
| Semester: **winter/summer** | Number of hours (total): **30**  \*Lecture: **15**  \*Laboratory/field course: **15** |
| ECTS: **6** |
| Substantive content:  Definition of ecology, problems studied by ecology, scientific methods applied in ecology.  Biosphere: Earth as habitat for life; energy flow and matter cycles in biosphere; productivity and decomposition.  Biomes, ecosystems, ecological succession. Ecological processes shaping dynamics of plant and animal communities.  Basic trophic interactions.  Factors and processes (especially disturbance regimes) that regulates the structure and function of vegetation types and their variation.  Population – demography, structure, growth patterns.  Optimalization of foraging strategy  Climate change: causes and effects.  Methods in phytosociology and plant demography.  The survey of plant communities and factors influencing their structure and function. | |
| Literature:  Wilmer P., Stone G., Johnston I. 2005. Environmental physiology of animals. Oxford: Blackwell Science.  Moss B. 2001. Ecology of fresh waters. Blackwell Science, 557 pp. | |
| Forms and conditions of credit:  - attendance on the lectures  - final report from the laboratory | |

**7.**

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| Course: **Freshwater biology** | |
| Course Coordinator: Maciej Karpowicz, PhD  Email: m.karpowicz@uwb.edu.pl | |
| Language: English | |
| Semester: **winter/summer** | Number of hours (total): **30**  \*Lecture: **15**  \*Laboratory: **15** |
| ECTS: **6** |
| Substantive content:  Freshwater resources, hydrologic cycle, special structure of water; gradients of light, temperature and oxygen in lakes; mixis;  Individual in limnic and lenitic waters: adaptations, temperature and oxygen impact, sinking and swimming;  Environmental resources, chemistry of waters and its influence on organisms, mineral substances, dissolved and particular organic matter;  Ecology of population: density, seasonal variability, growth rate, spatial structure, *r* and *K* strategy in water animals, colonization of new sites;  Ecology of communities: interrelations between populations, competition, mechanical interactions, predators, life cycles, categories of populations (guilds, taxonomical, functional), „top-down” and „bottom-up” control, biomanipulation;  Species diversity: indices, biocoenotic laws, hypotheses of: intermediate disturbances, theory of redundant species;  Biocoenoses of pelagial: characteristics, role in water ecosystems, phytoplankton: diatoms, cyanobacteria, green algae; zooplankton: rotifers, ciliates, crustaceans; bacterioplankton;  Biocoenoses of lake littoral: neuston, phyton, psammon, pelon, xylon and zoon; characteristics of arenal zones; ecology of macrobenthos;  Communities of organisms in running waters: characterstics, fish riverlands; „river continuum” concept;  Ecology of water ecosystems: flow of energy and matter, cycles of carbon, nitrogen, phosphorus and silicon;  Eutrophication: reasons, sources of nutrients, internal loading; eutrophication consequences, method of assessment, prevention; lake susceptibility to degradation;  Threat from civilization: urbanization, alien species, introductions and invasions; impact of climate change;  Protection of water ecosystems: processes of self-purification, recultivation, protection of water flora and fauna; | |
| Literature:  Moss B. 2001. Ecology of fresh waters. Blackwell Science, 557 pp.  Lampert, W., Sommer, U. 2007. Lilmnoecology. Oxford University Press. | |
| Forms and conditions of credit:  - attendance on the lecture  - final report from the laboratory | |

**8.**

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| Course: **Genetics** | |
| Course Instructor: Agata Banaszek, PhD  Email: banaszek@uwb.edu.pl | |
| Language: English | |
| Semester: **winter/summer** | Number of hours (total): **30**  \*Lecture: **15**  \*Laboratory: **15** |
| ECTS: **6** |
| Substantive content:  Basic laws of inheritance (Mendel laws). The structure and behavior of chromosome during mitosis and meiosis. The difference between classical genetics and epigenetics.  The inheritance of linked genes. Linkage and mapping. Genetic variation.  Sex inheritance and sex linkage. Lyon hypothesis. Sex chromosomes and sex reversal.  Quantitative traits. The relationship between genotype and fenotype. Twin studies. Human skin color and the genetic mechanisms of inheritance  DNA structure and the flow of genetic information in the cell. The genetic code. Molecular basis of point mutations. Types of point mutations and their effects in proteins. Metabolic blocks and diseases.  Chromosomal mutations, types and examples. The mutations on chromosome number and structure. Human aneuploidy. Polyploidy in evolution of cultivated plants.  Biotechnology and genetic engineering. Basic applications of genetic engineering methods: vaccines, genetic tests, genetically modified plants and animals, transgenic mice, gene therapy. | |
| Literature:  Griffiths, Wessler, Lewontin et al. 2000. An Introduction to genetic analysis. Freeman, USA.  Elseth G. D., Baumgardner K. D. 1984. Genetics. Addison-Wesley Publishing Company, USA. | |
| Forms and conditions of credit:  - attendance on the lectures and labs  - work evaluation at the laboratories – solving genetic problems and tasks  - written exam – short questions previously presented to students | |

**9.**

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| Course: **Mechanisms of evolution** | |
| Course Instructor: Agnieszka Bona, PhD | |
| Language: English | |
| Semester: **summer** | Number of hours (total): **30**  \*Lecture: **6**  \*Laboratory: **24** |
| ECTS: **6** |
| Substantive content:   1. Sources of variation. Methods for determining variation in populations. 2. Assumptions of Hardy-Weinberg equilibrium. 3. Genetic drift and its consequences in small and large populations. Bottleneck and founder effect. 4. Natural selection: directional, stabilizing, disruptive and apostatic selection. 5. How do new species arise? The process and modes of speciation. 6. Species concepts and limitations in their use. 7. Human evolution: fossil records and molecular evidence. | |
| Literature:   1. Antón SC, Potts R, Aiello LC. 2014. Evolution of early Homo: An integrated biological perspective. *Science*, 345(6192). 2. Futuyma DJ. 2005. Evolution. Sinauer, Sunderland USA. 3. Sobel JM, Chen GF, Watt LR, Schemske DW. 2010. The biology of speciation. *Evolution: International Journal of organic evolution*, *64*(2), 295-315. | |
| Forms and conditions of credit:  - attendance on the lecture  - active participation in laboratory work | |

**10.**

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| Course: **Molecular techniques in biology** | |
| Course coordinator: Magdalena Czajkowska, PhD  Email: magdacz@uwb.edu.pl | |
| Language: English | |
| Semester: **winter/summer** | Number of hours (total): **30**  \*Lecture: **10**  \*Laboratory: **20** |
| ECTS: **6** |
| Substantive content:  Main rules of work in Molecular Biology Laboratory  Practice of pipetting  DNA extraction  Gel electrophoresis  Molecular species identification:  PCR – amplification of *cyt b* gene  Clean-up of PCR products  Sequencing reaction  Purification of sequencing reaction products with the ExTerminator kit (A&A Biotechnology)  Separation of sequencing products on a 3130 Genetic Analyzer (Applied Biosystems)  NCBI website and BLAST tool  DNA sampling (invasine and noninvasice) (L)  Principles and methods of DNA isolation (L)  Primer design and PCR setup and types (L)  Genetic methods based on fragment length polymorphism (L)  Genetic techniques based on DNA sequencing, including Next Generation Sequencing (L) | |
| Literature:  Carson S., Miller H.B., Witherow D.S. Molecular Biology Techniques: A Classroom Laboratory Manual, 3th ed. 2012. Elsevier.  Tagu D., Moussard C. Techniques for Molecular Biology. 2006. CRC Press.  Ream W., Field K.G., Molecular Biology Techniques: An intensive Laboratory Course. 1999. Academic Press. Elsevier.  Allison L.A. Fundamental Molecular Biology, 2ed. 2012. Wiley-Blackwell.  Freeland J.R. Molecular ecology. 2011. Wiley-Blackwell.  Avise J.C. Molecular Markers, Natural History, and Evolution. 2004. Sinauer, Sunderland, MA.  Avise, J.C. (ed.).  2010.  Molecular Ecology and Evolution: the Organismal Side. World Scientific Publishing, Singapore | |
| Forms and conditions of credit:  - attendance on the lecture  - active participation in laboratory work. | |

**11.**

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| Course: **Plant physiology** | |
| Course Instructor: prof. Iwona Ciereszko  Email: icier@uwb.edu.pl | |
| Language: English | |
| Semester: **summer** | Number of hours (total): **30**  \*Lecture: **10**  \*Laboratory: **20** |
| ECTS: **6** |
| Substantive content:  1. Introduction to plant physiology  2. Osmotic adjustment and water balance of plants  3. Mineral nutrition of plants  4. Photosynthesis: physiological and ecological considerations  5. Respiratory metabolism  6. Translocation in plants  7. Growth processes and plant development  8. Seeds: production, dormancy, storage  9. Plant hormones  10. Stress physiology: plants response to environmental factors  11. Movements of plants  12. Plant regeneration processes, cultures *in vitro* | |
| Literature:  Handbook of Photosynthesis 2005. Second Edition, Pessarakli M (ed.) https://nishat2013.files.wordpress.com/2013/11/handbook-of-photosynthesis.pdf  Taiz L., Zeiger E. 2006. Plant Physiology. 4th. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts (or other editions)  The Arabidopsis Book, CR Somerville, EM Meyerowitz (eds.), American Society of Plant Biologists, Rockville, http://www.arabidopsisbook.org/topical/ | |
| Forms and conditions of credit:  - attendance on the lecture  - attendance on the laboratory  - final report from the laboratory | |

**12.**

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| Course: **Population and conservation genetics** | |
| Course Instructor: Agata Banaszek, PhD  Email: banaszek@uwb.edu.pl | |
| Language: English | |
| Semester: **summer** | Number of hours (total): **30**  \*Lecture: **15**  \*Laboratory: **15** |
| ECTS: **6** |
| Substantive content:  The frequencies of genotypes and alleles. The calculation of the allele frequencies in cases of complete dominance. Eugenics in the light of population genetics. The heterozygosities and other indices of genetic variability  Hardy – Weinberg genetic equilibrium. The use of HW law for genetic profiling. Forensic genetics for protection of the endangered species. The CITES convention  The effects of low numbers in populations. Genetic drift, inbreeding and inbreeding depression, mutational meltdown. The calculation of inbreeding coefficient from pedigrees for individuals and for populations  F statistics – the differentiation of populations, the gene flow and inbreeding  Protection plans, solving taxonomical problems. The species concept and practical approach to the problem. The barcoding idea.  Phylogeography and the units for protection within the species. The idea of ESU evolutionary significant unit and MU management unit  The minimum size of the viable population. IUCN categories and criteria for endangered species. The QTLs in calculation of the viable size | |
| Literature:  Ayala F.J., 1982. Population and evolutionary genetics: a primer. The Benjamin/Cummings Publ. Comp.  Frankham et al. 2002. Conservation Genetics. Oxford University Press.  The articles recommended by the course instructor | |
| Forms and conditions of credit:  - attendance on the lectures and labs  - work evaluation at the laboratories – solving genetic problems and tasks  - written exam – short questions previously presented to students | |

**13.**

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| Course: **Toxicology** | |
| Course Instructor: prof. Andrzej Bajguz, Alicja Piotrowska-Niczyporuk, PhD  Email: abajguz@uwb.edu.pl, alicjap@uwb.edu.pl | |
| Language: English | |
| Semester: **winter/summer** | Number of hours (total): **30**  \*Lecture: **15**  \*Laboratory: **15** |
| ECTS: **6** |
| Substantive content:  General principles of toxicology (history and scope, classification of poisons).  Route of toxicant uptake – doses and concentrations.  Factors affecting toxic responses: absorption, distribution and excretion of toxicants.  Mechanisms of toxicity.  Biotransformation and toxicity of selected inorganic and organic compounds.  Plant and animal toxic compounds, their effect on human health.  Toxicology of narcotics. | |
| Literature:  Curtis Klaassen & John B. Watkins III, Casarett & Doull’s Essentials of Toxicology. Second Edition. The McGraw-Hill Companies, Inc, 2010.  Byung-Mu Lee & Sam Kacew & Hyung Sik Kim, Lu’s Basic Toxicology Fundamentals, Target Organs, and Risk Assessment. Seventh Edition. CRC Press, Taylor & Francis Group, 2018. | |
| Forms and conditions of credit:  - attendance on the lecture  - final report from the laboratory | |

**14.**

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| Course: **Water protection** | |
| Course Instructor: Magdalena Grabowska, Professor UwB  Email: magra@uwb.edu.pl | |
| Language: English | |
| Semester: **winter/summer** | Number of hours (total): **30**  \*Lecture: **6**  \*Laboratory/field courses: **24** |
| ECTS: **6** |
| Substantive content:  Sources of water pollution.  Drinking water treatment.  Wastewater treatment.  Role of organisms in the biological processes of drinking water treatment and wastewater treatment.  Domestic and UE water and wastewater legal regulations  Visits to the water treatment plant. | |
| Literature:  Legal regulations and statistics on water protection.  Paul E. & Liu Y. 2012. Biological Sludge Minimization and Biomaterials/Bioenergy Recovery Technologies. John Wiley & Sons Inc.  Water chemistry. An introduction to the chemistry of natural and engineered aquatic systems. 2011. Brezonik P.L., Arnold W.A. (eds.). Oxford University Press. | |
| Forms and conditions of credit:  - attendance on the lecture  - final report from the laboratory/field courses | |