Course: **Freshwater biology**

Course Instructor: **prof. dr hab. Andrzej Górniak, dr hab. inż. Magdalena Grabowska, dr inż. Maciej Karpowicz**

Language: **English**

Semester: **winter/summer**	Number of hours: **30** *Lecture: **15** *Laboratory: **15**

Substantive content:

1. Freshwater resources, hydrologic cycle, special structure of water; gradients of light, temperature and oxygen in lakes; mixis;
2. Individual in limnic and lenitic waters: adaptations, temperature and oxygen impact, sinking and swimming;
3. Environmental resources, chemistry of waters and its influence on organisms, mineral substances, dissolved and particular organic matter;
4. Ecology of population: density, seasonal variability, growth rate, spatial structure, *r* and *K* strategy in water animals, colonization of new sites;
5. 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;
6. Species diversity: indices, biocoenotic laws, hypotheses of: intermediate disturbances, theory of redundant species;
7. Biocoenoses of pelagial: characteristics, role in water ecosystems, phytoplankton: diatoms, cyanobacteria, green algae; zooplankton: rotifers, ciliates, crustaceans; bacterioplankton;
8. Biocoenoses of lake littoral: neuston, phyton, psammon, pelon, xylon and zoon; characteristics of arenal zones; ecology of macrobenthos;
9. Communities of organisms in running waters: characterstics, fish riverlands; „river continuum" concept;
10. Ecology of water ecosystems: flow of energy and matter, cycles of carbon, nitrogen, phosphorus and silicon;
11. Eutrophication: reasons, sources of nutrients, internal loading; eutrophication consequences, method of assessment, prevention; lake susceptibility to degradation;
12. Threat from civilization: urbanization, alien species, introductions and invasions; impact of climate change;
13. Protection of water ecosystems: processes of self-purification, recultivation, protection of water flora and fauna;

Literature:

1. Moss B. 2001. Ecology of fresh waters. Blackwell Science, 557 pp.
2. Lampert, W., Sommer, U. 2007. Lilmnoecology. Oxford University Press.

Forms and conditions of credit:
- attendance on the lecture
- final report from the laboratory

Course: **Animal Physiology**

Course Instructor: **dr Sebastian Maciak**

Language: **English**

Semester: **winter/summer**	Number of hours: **30** *Lecture: **15** *Laboratory: **15**

Substantive content:

1. Basal Metabolic Rate as a fundamental trait of all living organisms. Metabolic rate measurements. Closed respirometry;
2. Experiments with artificial selection as a model systems;
3. The structure and function of different types of cells. The basis for animal's histology. Histological slides preparation;
4. Animal cell growth and cell division rate;
5. 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;
6. The basic microscopy techniques. Cell size measurements;
7. The main genes involved in regulation of cellular metabolism. Metabolic signaling pathways;
8. Cellular aerobic pathways and formation of reactive oxygen species (ROS);
9. Oxidative stress and examples for dietary interventions;
10. Evolution of the cell size as a key factor to develop nowadays maladies as metabolic syndrome, diabetes, or cancer;
11. Peto's paradox and general methods of cancer prevention;
12. Evolutionary context of carcinogenesis and its possible contribution to understanding of mechanisms of cancer initation;
13. The use of animal models in cancer and diabetes research;
14. The clinical aspect of the physiological studies and trends in the individualization of metabolic disease therapies;

Literature:

1. Schmidt-Nielsen K. 1997. Animal Physiology. Adaptation and environment. 5th eds. Cambridge University Press
2. 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

Course: **Biochemistry**

Course Instructor: **dr hab. Andrzej Bajguz, prof. UwB, dr Alicja Piotrowska-Niczyporuk**

Language: **English**

Semester: **winter/summer**	Number of hours: **30** *Lecture: **15** *Laboratory: **15**

Substantive content:

1. Biological oxygenation, types, energetics and meaning: oxidative and non-oxidative decarboxylation of pyruvate, tricarboxylic acids cycle and respiratory chain
2. Biosynthesis ATP – photosynthetic, oxidative and substrate phosphorylation
3. Basic mechanisms regulation of metabolism
4. Nucleic acids – their structure, types and function
5. Amino acids, peptides, proteins – their structure, types and functions
6. Catabolism of proteins, amino acids and nucleotides: deamination, urea cycle, degradation of purines and pyrimidines
7. Enzymes, coenzymes, vitamins – their structure, types, biological and metabolic functions
8. Replication and transcription. Translation and modification of proteins
9. Saccharides and lipids – their structure, types and function
10. Carbohydrate metabolism: glycolysis, gluconeogenesis and pentose phosphate pathway
11. Lipids metabolism: biosynthesis and oxidation of fatty acids
12. Porphyrins – their structure, types and functions

Literature:

1. Tymoczko J.L., Berg J.M., Gatto Jr. G.J., Stryer L., Biochemistry. 8th Edition. W. H. Freeman and Company, 2015.
2. Campbell M.K., Farrell S.O., Biochemistry, Eighth Edition. Cengage Learning, 2015.
3. 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

Course: **Toxicology**	
Course Instructor: **dr hab. Andrzej Bajguz, prof. UwB, dr Alicja Piotrowska-Niczyporuk**	
Language: **English**	
Semester: **winter/summer**	Number of hours: **30** *Lecture: **15** *Laboratory: **15**

Substantive content:

1. General principles of toxicology (history and scope, classification of poisons).
2. Route of toxicant uptake – doses and concentrations.
3. Factors affecting toxic responses: absorption, distribution and excretion of toxicants.
4. Mechanisms of toxicity.
5. Biotransformation and toxicity of selected inorganic and organic compounds.
6. Plant and animal toxic compounds, their effect on human health.
7. Toxicology of narcotics.

Literature:

1. Curtis Klaassen & John B. Watkins III, Casarett & Doull's Essentials of Toxicology. Second Edition. The McGraw-Hill Companies, Inc, 2010**.**
2. 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

Course: **Butterfly ecology and conservation**

Course Instructor: **dr hab. Marcin Sielezniew, prof. UwB**

Language: **English**

Semester: **summer**	Number of hours: **30** *Lecture: **10** *Field course: **20**

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.

1. Butterflies and moths: classification, systematics and evolution of Lepidoptera;
3. Morphology, anatomy and development;
4. Wing colouration, camouflage, aposematism, mimicry;
5. Behaviour: thermoregulation, territoriality, courtship;
6. Life histories: oviposition, host-plants, aphytophagy, myrmecophily, natural enemies;
7. Dispersal abilities, population structure, migrations;
8. Butterfly diversity in NE Poland on the background of national and European fauna;
9. Methods of butterfly studies and monitoring (e.g. mark-release-recapture, transect counts);
10. Natural and anthropogenic threats for butterfly fauna (including impact of climate change);
11. Conservation management: examples from Poland and Europe..

Literature:

1. Settele J, Shreeve T, Konvička M, Van Dyck H (eds) (2009) Ecology of butterflies in Europe. CUP, Cambridge.
2. 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.
3. Selected journal articles.

Forms and conditions of credit:
- presence at lectures
- final report from the field course

Course: **Forensic biology**

Course Instructor: **dr hab. Ada Wróblewska, dr hab. Piotr Zieliński**

Language: **English**

Semester: **winter**	Number of hours: **30** *Lecture: **10** *Laboratory: **20**

Substantive content:

1. Introduction to forensic science (FS) – (History and development of FS; Organization of FS laboratories)
2. Crime Scene Investigation – (Crime scene investigation process; Protocol at the crime scene; Recording the crime scene; Collection of evidences)
3. The nature of evidence – (Classification of evidence: physical, real, known-unknown, individual class; Identification, The DNA typing situations)
4. Microscopy in criminology – (types of microscopes, SEM, microspectrophotometry)
5. Fingerprints – (Origin of fingerprints; Anatomy of Fingerprints; Detection and visualization of fingerprints; comparison of fingerprints)
6. DNA and RNA molecular markers in forensic biology.
7. STR loci and SNP characteristic and usage for forensic DNA profiling.
8. Human mitochondrial genome – forensic testing and interpretation.
9. mRNA and miRNA - potential biomarkers for distinguish bodily fluids, time and cause of death.
10. Plastid DNA as a molecular marker in forensic botany.

Literature:

1. Jay A., K. Mirakovits 2010. Forensic Science – the basics, CRC Press, 557 pp.
2. Li. R. 2015. Forensic biology. CRC Press, Taylor & Fransis Group, London, New York.
3. Gunn A. Essential Forensic Biology. 2nd edition, Willey-Blackwell. England.
4. Goodwin W, Linacre A, Hadi S. 2011. An Introduction to Forensic Genetics. Willey-Blackwell. England.

Forms and conditions of credit:
- attendance on the lecture
- final report from the laboratory

Course: **Biochemistry**	
Course Instructor: **dr hab. Andrzej Bajguz, prof. UwB, dr Alicja Piotrowska-Niczyporuk**	
Language: **English**	
Semester: **winter/summer**	Number of hours: **30** *Lecture: **15** *Laboratory: **15**

Substantive content:

1. General principles of toxicology (history and scope, classification of poisons).
2. Route of toxicant uptake – doses and concentrations.
3. Factors affecting toxic responses: absorption, distribution and excretion of toxicants.
4. Mechanisms of toxicity.
5. Biotransformation and toxicity of selected inorganic and organic compounds.
6. Plant and animal toxic compounds, their effect on human health.
7. Toxicology of narcotics.

Literature:

1. Curtis Klaassen & John B. Watkins III, Casarett & Doull's Essentials of Toxicology. Second Edition. The McGraw-Hill Companies, Inc, 2010**.**
2. 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

Course: **Biological invasions**

Course Instructor: **prof. dr hab. Emilia Brzosko, dr Paweł Mirski, dr Izabela Tałałaj dr Edyta Jermakowicz**

Language: **English**

Semester: **winter/summer**	Number of hours: **30** *Lecture: **10** *Laboratory/field course: **20**

Substantive content:

1. Principles of invasion biology and ecology – terminology and definitions, mode and source of introduction, ecology
2. History of plants and animals migration.
3. Theories and concepts of invasion biology
4. Factors (natural and anthropogenic) influencing spread and establishment of alien species
5. Survey of the most dangerous plant and fungi invaders and their biology and ecology
6. Survey of the most dangerous animal invaders and their biology and ecology
7. Ecological and economic impact of biological invasions
8. Management of biological invasions

Literature:

1. Tokarska-Guzik B. 2005. The establishment and spread of alien plant species (kenophytes) in the flora of Poland. Uniwersytet Sląski, Katowice.
2. Elton C.S. 1958. The Ecology of Invasions by Animals and Plants.
3. More references will be proposed during course.

Forms and conditions of credit:
- attendance on the lecture
- final report from the laboratory and field course

Course: **Genetics**

Course Instructor: **dr hab. Agata Banaszek**

Language: **English**

Semester: **winter/summer**	Number of hours: **30** *Lecture: **15** *Laboratory: **15**

Substantive content:

1. Basic laws of inheritance (Mendel laws). The structure and behavior of chromosome during mitosis and meiosis. The difference between classical genetics and epigenetics.
2. The inheritance of linked genes. Linkage and mapping. Genetic variation.
3. Sex inheritance and sex linkage. Lyon hypothesis. Sex chromosomes and sex reversal.
4. Quantitative traits. The relationship between genotype and fenotype. Twin studies. Human skin color and the genetic mechanisms of inheritance
5. 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.
6. Chromosomal mutations, types and examples. The mutations on chromosome number and structure. Human aneuploidy. Polyploidy in evolution of cultivated plants.
7. Biotechnology and genetic engineering. Basic applications of genetic engineering methods: vaccines, genetic tests, genetically modified plants and animals, transgenic mice, gene therapy.

Literature:

1. Griffiths, Wessler, Lewontin et al. 2000. An Introduction to genetic analysis. Freeman, USA.
2. 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

Course: Ecology

Course Instructor: prof. dr hab. Emilia Brzosko, dr hab. Paweł Brzęk, dr Izabela Tałałaj, dr Edyta Jermakowicz, dr Paweł Mirski, dr Łukasz Ołdakowski, dr Adam Hermaniuk

Language: English

Semester: winter/summer	**Number of hours: 30** ***Lecture: 15** ***Laboratory/field course: 15**

Substantive content:

1. Definition of ecology, problems studied by ecology, scientific methods applied in ecology.
2. Biosphere: Earth as habitat for life; energy flow and matter cycles in biosphere; productivity and decomposition.
3. Biomes, ecosystems, ecological succession. Ecological processes shaping dynamics of plant and animal communities.
4. Basic trophic interactions.
5. Factors and processes (especially disturbance regimes) that regulates the structure and function of vegetation types and their variation in time and space.
6. Population – demography, structure, growth patterns.
7. Evolution of life history strategies in plant and animals (age and size at maturity, clutch size, ageing rate).
8. Ecophysiology: evolution of rate of metabolism, evolution of endothermy. Bergmann's and Allen's rules.
9. Optimalization of foraging strategy
10. Climate change: causes and effects.
11. Methods in phytosociogy and plant demography.
12. The survey of plant communities and factors influencing their structure and function.

Literature:

1. Wilmer P., Stone G., Johnston I. 2005. Environmental physiology of animals. Oxford: Blackwell Science.
2. Moss B. 2001. Ecology of fresh waters. Blackwell Science, 557 pp.

Forms and conditions of credit:
- attendance on the lecture
- final report from the laboratory

Course: **Molecular technics in biology**

Course Instructor: **prof. dr hab. Mirosław Ratkiewicz, dr Magdalena Czajkowska**

Language: **English**

Semester: **winter/summer**	Number of hours: **30** *Lecture (L) : **10** *Laboratory: **20**

Substantive content:

1. Main rules of work in Molecular Biology Laboratory
2. Practice of pipetting
3. DNA extraction
4. Gel electrophoresis
5. 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
6. DNA sampling (invasine and noninvasice) (L)
7. Principles and methods of DNA isolation (L)
8. Primer design and PCR setup and types (L)
9. Genetic methods based on fragment length polymorphism (L)
10. Genetic techniques based on DNA sequencing, including Next Generation Sequencing (L)

Literature:

1. Carson S., Miller H.B., Witherow D.S. Molecular Biology Techniques: A Classroom Laboratory Manual, 3th ed. 2012. Elsevier.
2. Tagu D., Moussard C. Techniques for Molecular Biology. 2006. CRC Press.
3. Ream W., Field K.G., Molecular Biology Techniques: An intensive Laboratory Course. 1999. Academic Press. Elsevier.
4. Allison L.A. Fundamental Molecular Biology, 2ed. 2012. Wiley-Blackwell.
5. Freeland J.R. Molecular ecology. 2011. Wiley-Blackwell.
6. Avise J.C. Molecular Markers, Natural History, and Evolution. 2004. Sinauer, Sunderland, MA.
7. 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.

Course: **Botany**

Course Instructor: **dr hab. Danuta Drzymulska, dr Izabela Tałałaj, dr Edyta Jermakowicz,, dr Paweł Mirski**

Language: **English**

Semester: **winter/summer**	Number of hours: **30** **15 Lecture** **15 Lab/Field course**

Substantive content:

3. Systems of plant classifications. Species, specimen, taxon.
4. Biodiversity of unicellular (prokaryotic and eukaryotic) and multicellular organisms.
5. Origin of thallus and axial plants.
6. Morphology of spore plants, reproduction methods, life cycles, alternation of generations.
7. Algae. Polyphyletic character of group. Characteristic of Cyanophyta, Chrysophyta, Euglenophyta, Chlorophyta, Charophyta, Rhodophyta and Phaeophyta divisions.
8. Terrestrial plants. Development of tissues.
9. Systematic overview of spore plants: Bryophytina, Psilophyta, Psilotophyta, Lycophytina, Sphaenophytina, Pteridophytina.
10. Gymnosperm plants: flower structure, inflorescences, gametophyte, sporophyte, alternation of generations, pollination, fertilization.
11. Systematic overview of contemporary groups of gymnosperms: Cycadopsida, Gingkopsida, Pinopsida.
12. Angiosperms: flower structure, inflorescences, gametophyte, sporophyte, alternation of generations, pollination, fertilization, fruits.
13. Angiosperms: leaves, stems, roots. Ecological groups of plants.
14. Systematic overview of angiosperm families, including systematic overview based on APG system – importance of molecular studies for systematic of angiosperms.
15. Protection of plants in Poland.

Literature:

1. Szweykowska A. Szweykowski J. 2010. Botanika. PWN, Warszawa.
2. Angiosperm Phylogeny Group, An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. 2009. Botanical Journal of the Linnean Society 161: 105-121.

Forms and conditions of credit:
- attendance on the lecture
- final report from the laboratory/field course

Course: **Inventory methods for ungulates**	
Course Instructor: **prof. dr hab. Mirosław Ratkiewicz**	
Language: **English**	
Semester: **winter**	Number of hours: **30** *Lecture: **6** *Field course: **24**

Substantive content:

1. The rules of research in the field.
2. Identification, collection and preservation of biological traces left by different species of mammals in the field.
3. Analysis of the collected data - estimating density of the large mammals (boar, moose, red deer, roe deer, wolf).
4. Observation of the large mammals interacting with their environments.
5. Practical application of traditional and modern methods in the field study of wild mammals.

Literature:

1. Jędrzejewski W., Sidarowicz W. (2010). The art of animal tracking. ZBS PAN.

2. Rezendes P. (1999). Tracking and the Art of Seeing: How to Read Animal Tracks and Sign.

HarperCollins Publishers, Inc., New York.

Forms and conditions of credit:
1. Presence on all field research.
2. A research report.

Course: **Water protection**	
Course Instructor: **dr hab. inż. Magdalena Grabowska**	
Language: **English**	
Semester: **winter/summer**	Number of hours: **30** *Lecture: 6 *Laboratory/field courses: 24

Substantive content:

1. Sources of water pollution.
3. Drinking water treatment.
4. Wastewater treatment.
5. Role of organisms in the biological processes of drinking water treatment and wastewater treatment.
6. Domestic and UE water and wastewater legal regulations
7. Visits to the water treatment plant.

Literature:

1. Chemistry for water protection of the environment. 1998. Pawłowski L., Gonzales M.A., Dudzińska M.R., lacy W.J. (eds). Plenum Press, New York
2. 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

Course: **Plant physiology**

Course Instructor: **dr hab. Iwona Ciereszko, prof. UwB, dr Aleksandra Staszak**

Language: **English**

Semester: **summer**	Number of hours: **30** *Lecture: **10** *Laboratory: **20**

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:

1. Handbook of Photosynthesis 2005. Second Edition, Pessarakli M (ed.) https://nishat2013.files.wordpress.com/2013/11/handbook-of-photosynthesis.pdf
2. Taiz L., Zeiger E. 2006. Plant Physiology. 4th. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts (or other editions)
3. 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