**Module**  
**Biodesign: Ways to Active Pharmaceutical Ingredients**

**Code**  
MSLS_V2_1

**Degree Programme**  
Master of Science in Life Sciences (MSLS)

**ECTS Credits**  
5

**Workload**  
150 h: Contact 60 h; Self-study 90 h

**Module Coordinator**

- **Name**: Prof. Dr. Vera Luginbühl
- **Phone**: +41 (0)58 934 56 70
- **Email**: vera.luginbuehl@zhaw.ch
- **Address**: ZHAW Zürcher Hochschule für Angewandte Wissenschaften  
  Life Sciences and Facility Management  
  Campus Reidbach  
  Postfach  
  CH-8820 Wädenswil

**Lecturers**

- Prof. Dr. Karin Kovar
- Prof. Dr. Jack Rohrer
- Prof. Dr. Martin Sievers
- Guest lecturers

**Entry Requirements**
The particular Master’s module builds on a standard Bachelor’s level courses which convey basic knowledge in the following fields (see also textbooks given in brackets):

- Microbiology (Fuchs G. and H.-G. Schlegel., Allgemeine Mikrobiologie. 8th Ed., Georg Thieme Verlag)
- Molecular biology
- Pharmacology (Hein L., Mohr K., and Lüllmann H., 2008. Taschenatlas der Pharmakologie, Georg Thieme Verlag)

**Learning Outcomes and Competences**

After completing the module students will be able to

- evaluate the therapeutic and the market potential of biopharmaceuticals based on pharmacological, pharmaco economical and pharmacovigilance data
- explain the principle methods and strategies of the drug discovery process and evaluate the advantages and disadvantages of different technologies
- select for each DNA sequence a suitable expression system and to adapt a DNA-sequence allowing an optimal protein production in terms of productivity, quality, safety and cost-effectiveness
- understand how to modify expression strains (yeasts, insect cells) to achieve a targeted glycosylation pattern
- apply acquired theoretical knowledge of all standard techniques to construct a system for production of recombinant proteins and enzymes, including cellular or secreted proteins, the anchoring of proteins on cellular surfaces, and the humanisation of monoclonal antibodies
**Module Content**

As most lifestyle diseases are still treated symptomatically and no effective therapies exist for other common diseases, the search for new drugs is on-going. Candidate molecules and lead structures can be found in the biosphere, redesigned by computing methods or adapted to mimic known physiologically active molecules. Often these molecules are of protein nature and can be produced by recombinant DNA technology. Therefore there is an increasing demand of new and optimised expression systems using different production organisms. Afterwards a transfer to biotechnological production processes is required.

The following topics will be covered:

- definition and classification of biopharmaceuticals, pharmacology of biopharmaceuticals
- biopharmaceutical sales, market analysis and global changes in the health care sector
- pharmacology of novel biopharmaceuticals and pharmacovigilance
- strategies in drug discovery: combinatorial chemistry, (ultra) high-throughput-screening, omics-technologies, computer-aided drug design
- use and evaluation of different production systems to find new drugs
- construction of vectors, adaptation of codon usage for the expression host, optimisation of transcription and translation as well as fusion of gene sequences
- design of expression systems for glycosylated proteins, proteins with disulfide bonds, secreted proteins or membrane proteins
- theoretical background for the production of humanised antibodies
- strategies for the design of assays to compare expression hosts
- principles of high-throughput clone/library screening methods
- decision criteria: requirements of the end-product, manufacturing procedure and costs
- basics of synthetic biology
- best practice for screening of production clones
- adaption of production strains used for biotechnological manufacture in industrial scale to maximise productivity (titre, yield) or product quality

**Teaching / Learning Methods**

- contact lessons
- group work
- case studies
- literature and database search
- computer-aided design

**Assessment of Learning Outcome**

- Written exam 45%
- Literature study 40%
- Poster 15%

**Bibliography**

- Hartner, F. S., C. Ruth, D. Langenegger, P. Hyka, G. P. Lin-Cereghino, J. Lin-

- Knablein J.2005. Modern Biopharmaceuticals, Volumes 1 to 4, Wiley

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