LOSCHMIDT LABORATORIES

1. Introductory lecture

Organisation of the course

Outline

- Introduction of course
- Content of course and practical classes
- Lecturing and evaluation
- Recommended literature
- Biotechnology at MU
- *Excursion in LL*

Introduction of the course

EXTENSIVE MULTIDISCIPLINARITY

PREREQUISITES:

- basic knowledge of microbiology, molecular biology, biochemistry, immunology and genetics

COURSE FOCUSE:

- the specific aspects of **modern biotechnology**
- examples of **up to date applications** (industry, agriculture, pharmacy, biomedicine and environmental protection)
- the role of modern biotechnology in **sustainable living**

Sustainability

- **concept of sustainability**

  with the aim to promote a necessary "... development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

* *World Commission on Environment and Development, 1987*

Sustainability

- reduce **waste** production and environmental impact
- reduce consumption of **resources** (e.g., raw materials, energy, air, water)
- increase the **recycling** and use of **renewable materials** (e.g., biomass)

Biotechnology

- **KEY TECHNOLOGY** of 21st century

ENVIRONMENTAL ASPECTS

- **natural** processes (bioprocesses)
- **sustainable** and resource efficient

ECONOMICAL ASPECTS

- **1/3 of worldwide production** derived from bioprocesses
- biotechnology **market 300 billion EUR***

* *Route to the Knowledge-Based Bioeconomy, 2007*

LECTURES

Organisation info

Content of the course

2. Introduction to Molecular Biotechnology

METHODOLOGICAL LECTURES

3. Methods of gene manipulations
4. Protein Engineering
5. Metabolic Engineering I.
6. Metabolic Engineering II.
7. Microfludics, Lab on a Chip

TECHNOLOGICAL LECTURES

8. Molecular Biotechnology in Industry
9. Molecular Biotechnology in Agriculture
10. Molecular Biotechnology in Medicine I.
11. Molecular Biotechnology in Medicine II.
12. Environmental molecular biotechnology

Lecturers

Doc. RNDr. Zbyněk Prokop, Ph.D. (UČO 23696)

- protein engineering, microfluidics
- biotechnological applications
- Loschmidt Laboratories, leader of research team
- co-founder of Enantis – 1st biotech spin-off at MU

Mgr. Pavel Dvořák, Ph.D. (UČO 151419)

- protein and metabolic engineering
- molecular biology and biotechnology
- Loschmidt Laboratories, research specialist

Lecturers

Mgr. Sarka Bidmanova, Ph.D. (UČO 77580)

- bioanalytical devices for military and environment
- immobilization and characterization of enzymes
- Enantis and Loschmidt Laboratories, research specialist

Mgr. Táňa Koudeláková, Ph.D.

- molekulární biologie a proteinové inženýrství
- řízená evoluce, enzymové biotechnologie
- Loschmidt Laboratories, research specialist

Instructions

- bring printed copy of the slides as **handouts** for notes

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- bring printed copy of the slides as **handouts** for notes
- find all materials including printed version of the slides at **http://is.muni.cz/**
- **be on time**, come at least 5 min before lecture start
- if any problems with the lecture, please, contact lecturers
- be **active** and participate in **discussions**

Lecturing system

- powerpoint slides as well as recommended literature in **English**
- lecturing, discussions and examination in **Czech**
- **2 hrs per week**
- **lecture part I. (45 min)**

  BREAK (5 -10 min)

  lecture part II. (45 min)

Activities and Evaluation

- **active discussions** during lessons
- **reading the original literature**
  - review or book chapter for each lecture
  - „Lecture 02 (READING).pdf"
- **progress written tests** during the lecturing period
  - at the beginning of lecture 4., 7., 10., and 12. (duration 15 min)
  - each 10-12 questions from lectures and reading
  - questions can be cumulative with multiple answers
- **final written test** during examination period
  - 50 questions from entire course / 1.5 hour

Recommended literature

- M. Wink (Ed.) 2011: **An Introduction to Molecular Biotechnology**: Fundamentals, Methods and Applications, 2nd Edition, Willey-Blackwell
- B. R. Glick, J. J. Pasternak, C. L. Patten 2011: **Molecular Biotechnology**: Principles and Applications of Recombinant DNA, 4th Edition, ASM Press
- J. M. Walker, R. Rapley 2009: **Molecular biology and biotechnology**, 5th Edition, RSC Publishing

PRACTICAL LESSONS

Organisation info

Content of practicals

1. Design of recombinant systems (LL, MU)
2. Fermentation of recombinant microorganisms (LL, MU)
3. Preparation of enzymatic biosensor (Enantis)
4. Biocatalytic preparation of pharmaceutical precursor (Enantis)
5. Biodegradation of environmental pollutant by recombinant bacterium (LL, MU)
6. Preparation and testing of microfluidic chip (LL, MU)
7. Preparation and transformation of liposoms (VRI)
8. Analysis of liposoms by DLS, TEM etc. (VRI)

Instructors

Loschmidt laboratories, MU
Veronika Liskova, M.Sc. (UČO 233293)
Pavel Dvořák, M.Sc. (UČO 151419)
Lukáš Chrást, M.Sc. (UČO 269981)
Tomáš Buryška, M.Sc. (UČO 323660)

Enantis, Ltd.
Šárka Bidmanová, Ph.D.
Veronika Štěpánková, Ph.D.

Veterinary Research Institute
PharmDr. Josef Mašek, Ph.D.
Ing. Štěpán Koudelka, Ph.D.
MVDr. Pavel Kulich, Ph.D.
RNDr. Jana Plocková

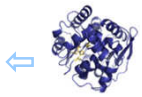
Lecturing system

- **interactive synopsis** available on IS
- 2 hrs per week (STARTS on Wednesday 7/10, A13 entrance 2.floor)
- **CAPACITY**: two groups of 10 students (9:00 – 12:00, 13:00 – 15:00)
- **LANGUAGE**: materials EN, spoken language CZ, protocols and essays either EN or CZ
- **ABSENCE (max. 1)**: official excuse in IS + substitute activity - written essay EN or CZ, two A4 pages, 1.5 spaced, TNR 12 (*template on IS*)
- **LECTURE ORGANISATION**
  - assignment (**HOMEWORK**)
  - theoretical introduction given by lecturer
  - experimental work in the laboratory
  - **protocol submitted in one week** after each practical (*template on IS*)

Loschmidt Laboratories, MU

R&D BIOTECHNOLOGICAL APPLICATIONS

BIOCATALYSIS

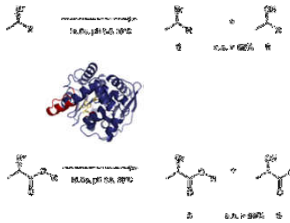


BIOSENSING

BIODEGRADATION

Biocatalysis

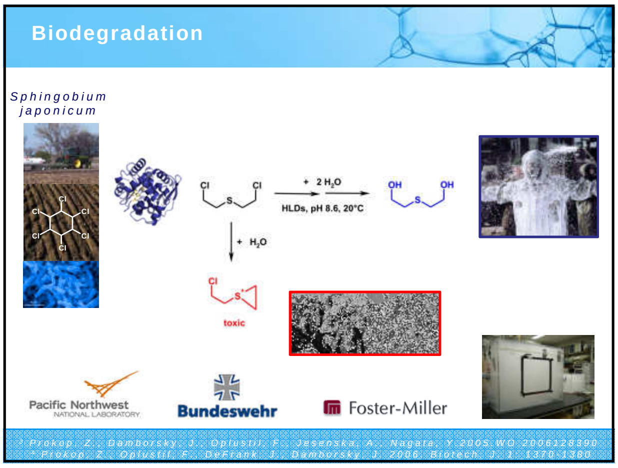
Bradyrhisobium japonicum

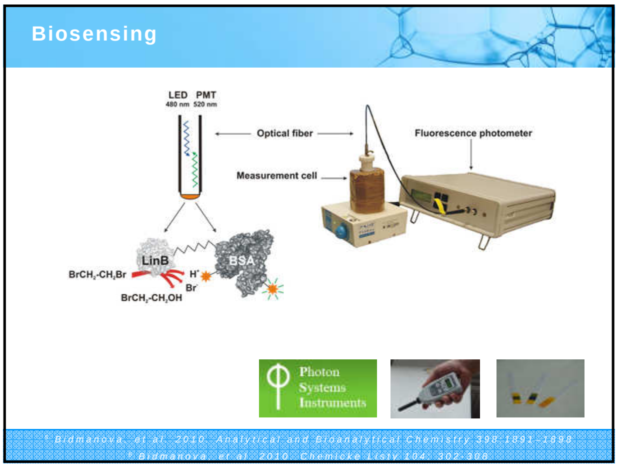


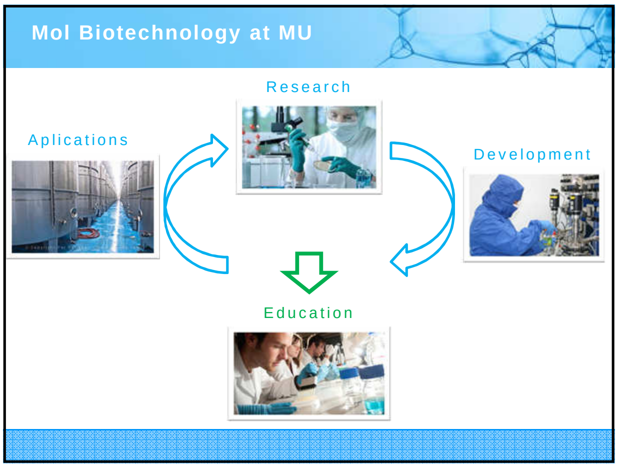
Drugs

Feromones

Prokop Z., Damborsky J., Nagata Y., Janssen D.B. 2004. WO 2006079238.
Prokop Z., Sato Y., Brezovsky J., Mozga T., Chaloupkova R., Koudelakova T., Jerabek P., Stepankova V., Natsume R., van Leeuwen J.G., Janssen D.B., Damborsky J. 2010. Angew. Chem. Int. Ed. 49: 6111-6115.

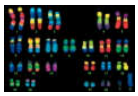
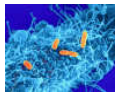

Biodegradation
Sphingobium japonicum
Cl
+ 2 H_2O
HLDs, pH 8.6, 20°C
OH
S
+ H_2O
toxic
Pacific Northwest
NATIONAL LABORATORY
Bundeswehr
Foster-Miller
[3] Prokop, Z., Damborsky, J., Oplustil, F., Jesenska, A., Nagata, Y 2005 WO 2006128390
[4] Prokop, Z., Oplustil, F., DeFrank, J., Damborsky, J. 2006. Biotech. J. 1: 1370-1380


Biosensing
LED PMT
480 nm 520 nm
Optical fiber
Fluorescence photometer
Measurement cell
LinB
BSA
$BrCH_2$-CH_2Br
$BrCH_2$-CH_2OH
H^+
Br^-
Photon
Systems
Instruments
[5] Bidmanova, et al. 2010. Analytical and Bioanalytical Chemistry 398:1891–1898
[6] Bidmanova, et al. 2010. Chemicke Listy 104: 302-308


Mol Biotechnology at MU
Research
Aplications
Development
Education

Molekulární biotechnologie (Bi7430)

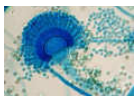
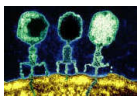
- Období: podzim (každoročně)
- Rozsah: přednáška 2 hodiny/týden, cvičení 2 hodiny/týden
- Přednášky: Doc. Prokop, Dr. Dvořák, Dr. Bidmanová
- Cvičení: Dr. Bidmanová, Dr. Beerens, Dr. Štěpánková, Mgr. Buryška, Mgr. Chrást
- Osnova:
  - proteinové a metabolické inženýrství
  - genetické inženýrství rostlin a živočichů
  - molekulární diagnostika a moderní vakcíny
  - buněčná a genová terapie a regenerativní medicína
  - molekulární biotechnologie v průmyslu a zemědělství


Mikrobiologie Bi5710

- Období: podzim
- Rozsah: přednáška 2 hodiny/týden
- Vyučující: Mgr. Šárka Bidmanová, Ph.D.
- Osnova:
  - principy obecné a aplikované mikrobiologie
  - odlišnosti mezi prokaryotickými a eukaryotickými mikroorganismy
  - vzájemné vztahy mezi mikroorganismy a vnějším prostředím
  - nejvýznamnější bakterie, archea, kvasinky, vláknité houby a viry

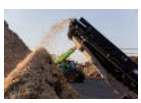


Mikrobiologické exkurze Bi6161

- Období: jaro
- Rozsah: 4 dvou- až pětihodinové exkurze
- Vyučující: Mgr. Šárka Bidmanová, Ph.D.
- Exkurze:
  - Pivovar Starobrno – http://www.starobrno.cz/
  - Erba Lachema – https://www.erbalachema.com/
  - Čistírna odpadních vod – http://www.vodarenska.cz/
  - Kompostárna – http://www.kompostarna-blansko.cz/



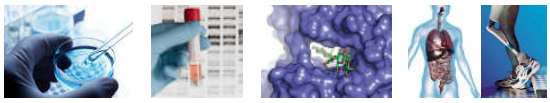



Biotechnologické exkurze Bi7171

- Období: podzim
- Rozsah: 4 jednodenní exkurze (8.2.-11.2.2015)
- Vyučující: Mgr. Šárka Bidmanová, Ph.D.
- Exkurze:
  - Biotechnologické centrum INBIT – www.jic.cz/inbit
  - Bioveta – www.bioveta.cz
  - BioVendor – www.biovendor.cz
  - Contipro Group – www.contipro.com

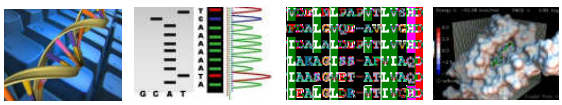
Proteinové inženýrství Bi7410

- Období: jaro
- Rozsah: přednáška 1 hodina/týden
- Vyučující: Mgr. Radka Chaloupková, Ph.D.
- Osnova:
  - strukturně-funkční vztahy proteinů
  - metody exprese a purifikace rekombinantních proteinů
  - metody strukturní a funkční analýzy proteinů
  - racionální design, semi-racionální design a řízená evoluce
  - příklady využití proteinového inženýrství



Bioinformatika Bi5000+Bi9060+Bi9061

- Období: podzim
- Rozsah: přednáška 2 hodiny/týden, cvičení 2 hodiny/týden
- Vyučující: prof. Mgr. Jiří Damborský, Dr., doc. RNDr. Roman Pantůček, Ph.D.,
- Osnova:
  - bioinformatické databáze a jejich prohledávání
  - analýza nukleotidových a proteinových sekvencí
  - hledání a identifikace genů
  - analýza a předpověď struktury proteinů



Strukturní biologie Bi9410+9410c

- Období: podzim
- Rozsah: přednáška 2 hodiny/týden, cvičení 2 hodiny/týden
- Vyučující: Mgr. Jan Brezovský, Ph.D.
- Osnova:
  - struktura, stabilita a dynamika biologických makromolekul
  - makromolekulární interakce a komplexy
  - stanovení a předpověď struktury, identifikace důležitých oblastí
  - stanovení vlivu mutace na strukturu a funkci proteinu
  - aplikace v biologickém výzkumu, návrhu léčiv a biokatalyzátorů