

Pharmaceutical Biotechnology

Code: ChE-436

Fall semester 2025/26

MER Dr. Horst Pick



Horst PICK

Fields of expertises

- **Biotechnology**
- **Genetics**
- **Microbiology**

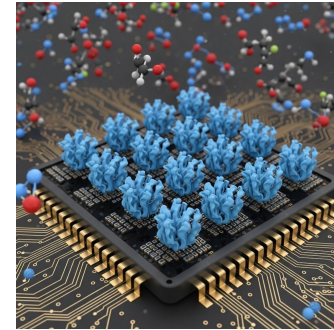
Involvement in EPFL spin-offs



1. ARKAIYA
Probiotics

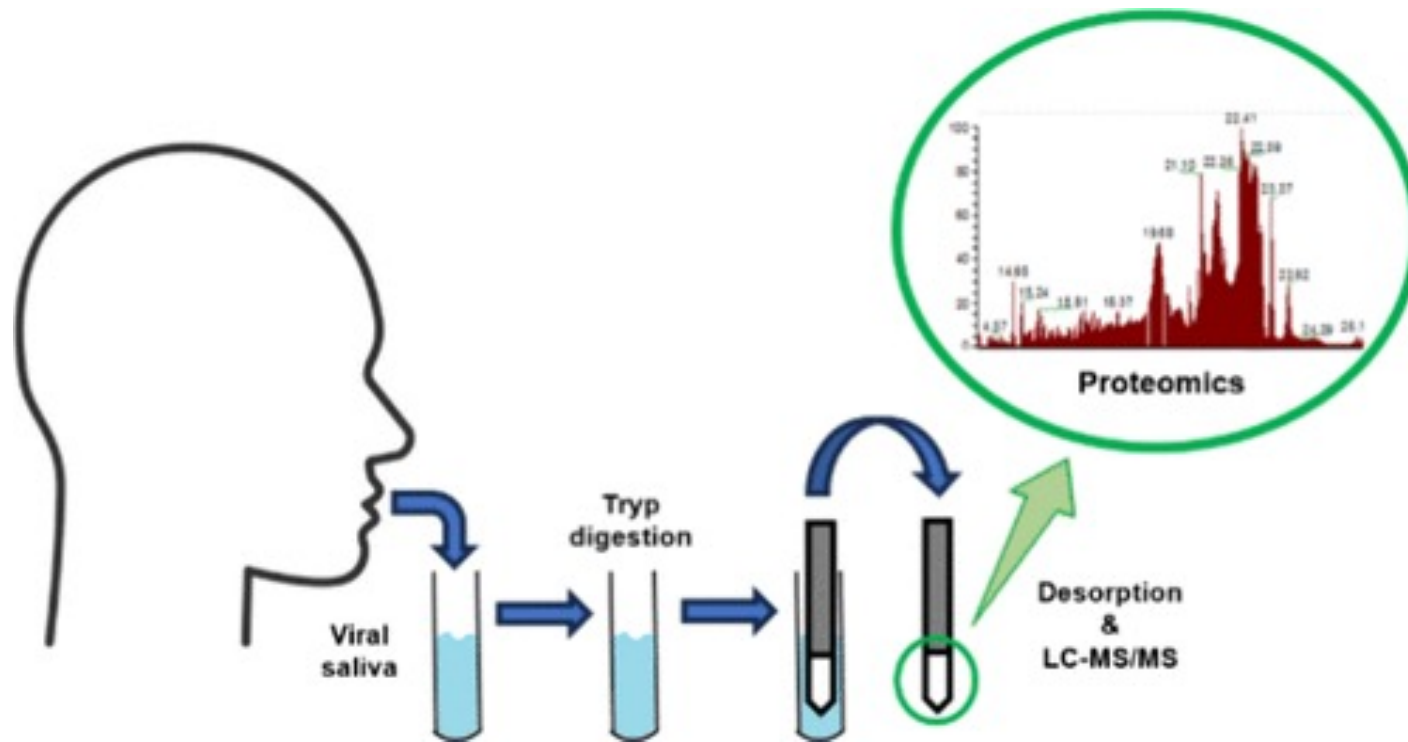


2. ALGALTEK
Nutrients, Cosmetics, Pharmaceuticals
from algae



3. SENSORA
Detection of
cancer volatiles

Protein biomarkers in human saliva for disease detection



Anal. Chem. 2024, 96, 14, 5363–5367

Assistants

- Rebecca Neezer
- Andrea Melgar Aguilar



What is the course about?

- General information
- Schedule
- Course content
- Exercises
- Exam

Human disease database

- Almost 18,000 specific diseases (Global categories: cancer, genetic, infectious, metabolic, and rare diseases)
- [J Med Libr Assoc.](#) 2018 Jan; 106(1): 140–141.

Pharmaceutical Biotechnology

“If one understands the cause of a disease,
one can identify ways to treat it”

Pharmaceutical Biotechnology

- Uses **living cells** and **cell-derived materials** to **produce pharmaceutical products** for the **diagnosis, treatment and prevention of diseases.**

Teaching

- Interactive
- Commitment

Pharmaceutical Biotechnology

- **When? Wednesday**

8h¹⁵ h – 10 h Lecture

10¹⁵ h - 11 h Exercise hour



SENSORA



HAYA
Therapeutics

AMAL
Therapeutics



bioneris

LONZA

Geneuro



abionic

MaxiVAX

MedPEP

Economic importance of Biotechnology in Switzerland

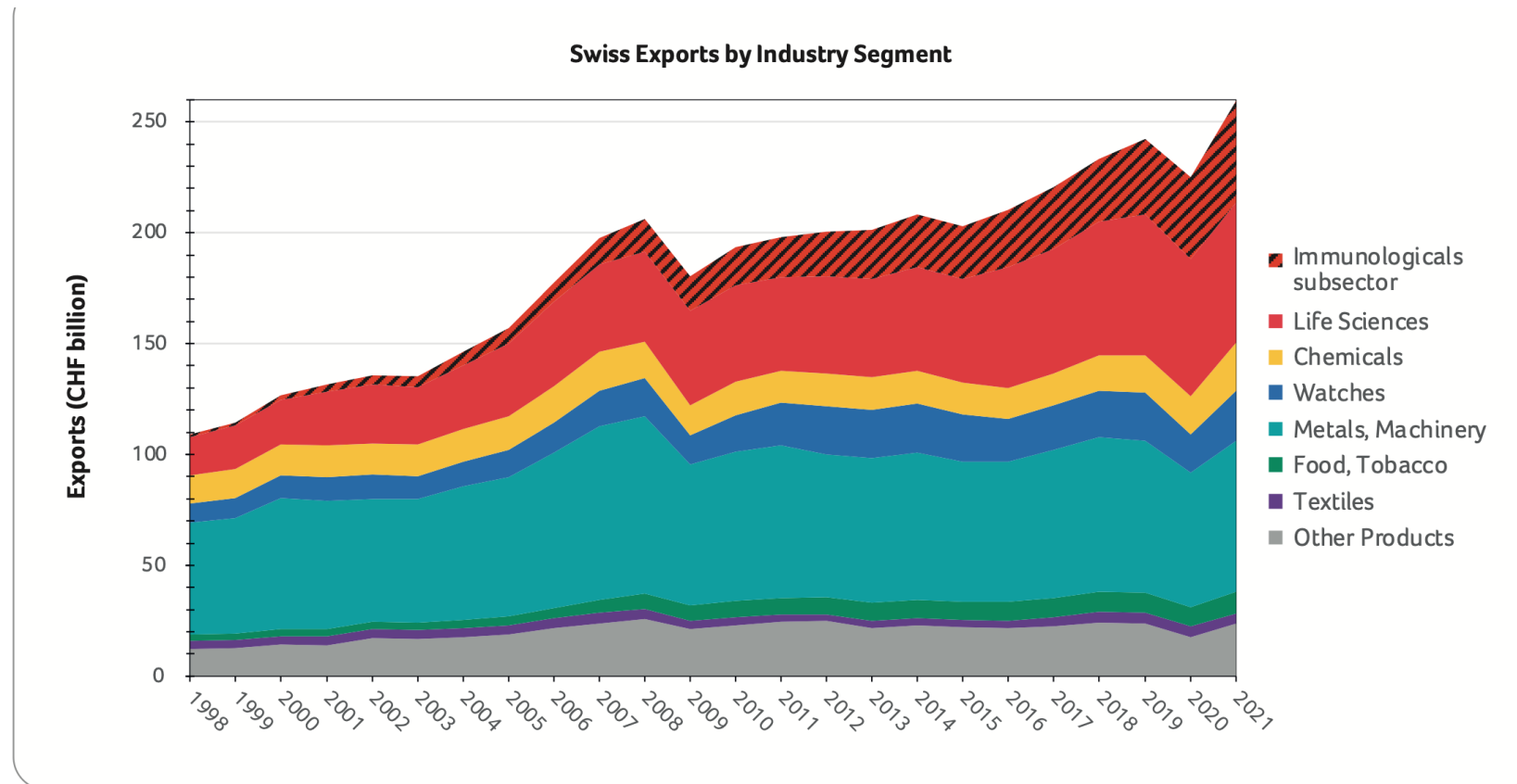
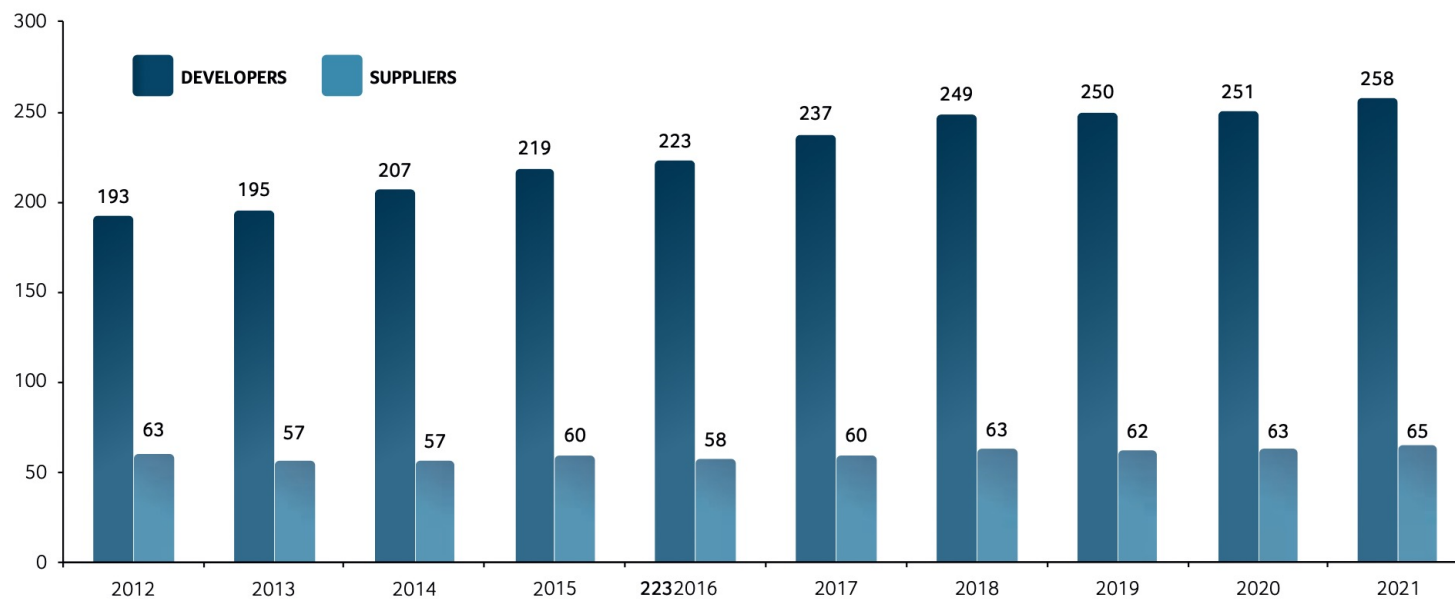


Figure 1: Annual Swiss exports according to industry sector demonstrate the increasing importance of the life sciences industries (pharmaceuticals, vitamins and diagnostics). This sector alone contributed 42% to the total Swiss exports in 2021 (Data: scienceindustries/Federal Customs Administration 2022, Swiss IMPEX database).

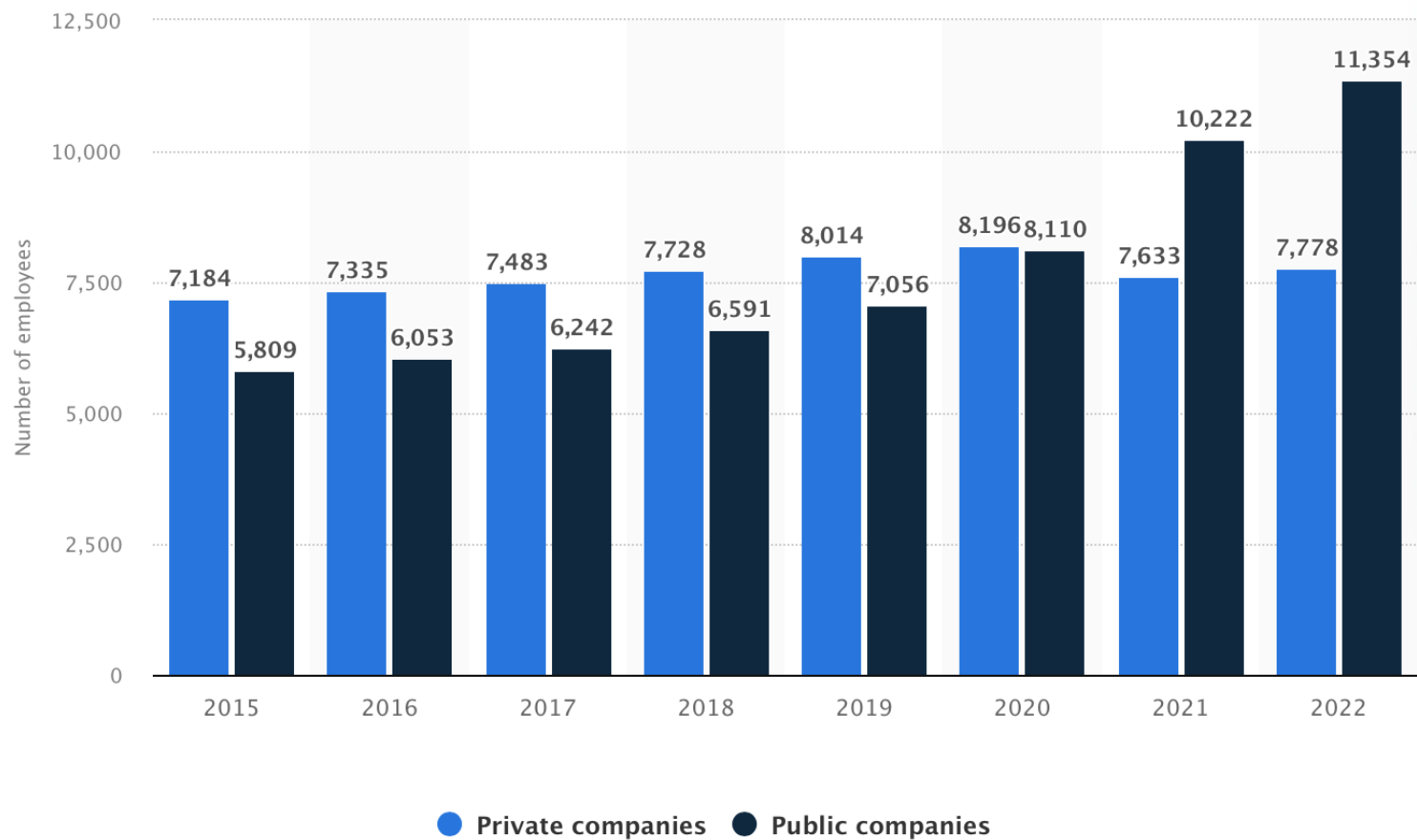
Economic importance of Biotechnology in Switzerland

Number of biotech companies in Switzerland 2011-2021



Source: Swiss Biotech Association, website information, EY

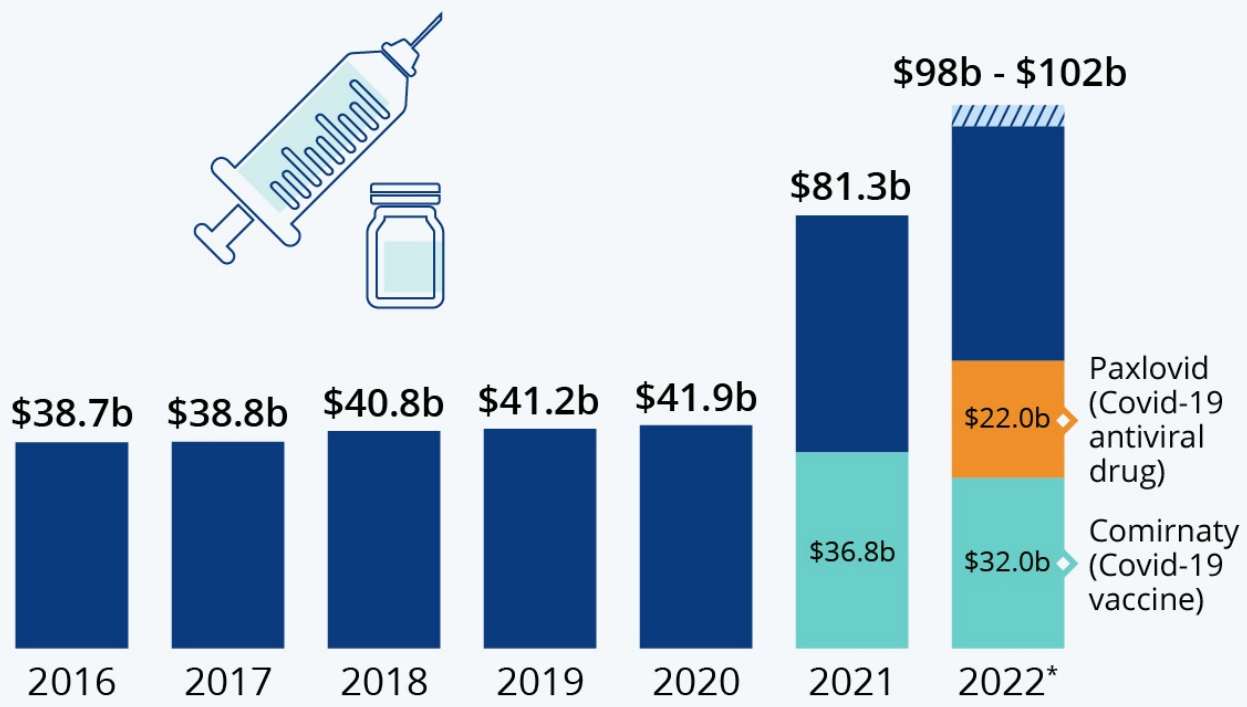
Economic importance of Biotechnology in Switzerland



The Biotech Effect: New impulses for Pharmaceutical Technologies

Pfizer Revenue Boosted by Covid-19 Drugs

Pfizer's annual revenue since 2016



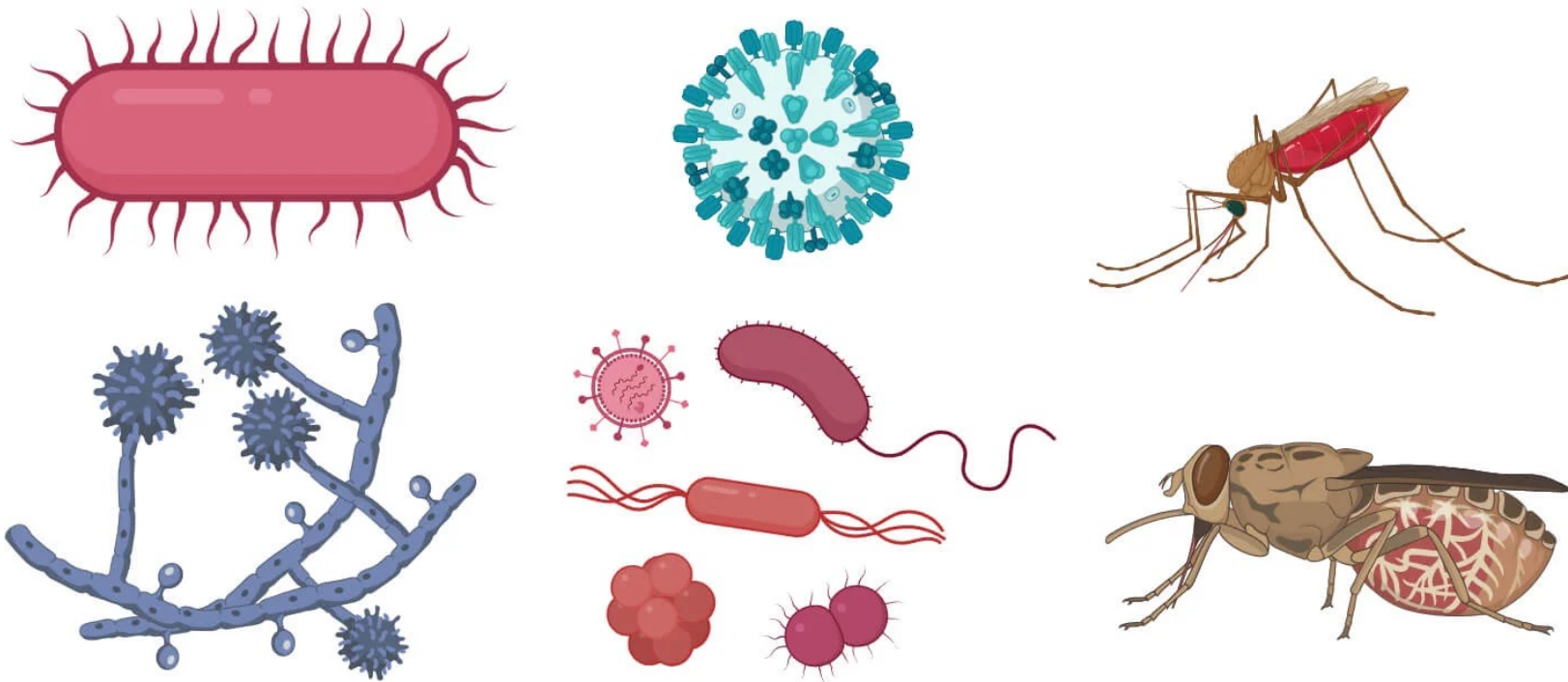
* official guidance given February 8, 2022
Source: Pfizer

Course contents



Chapter 1: Infectious diseases

Infectious Diseases

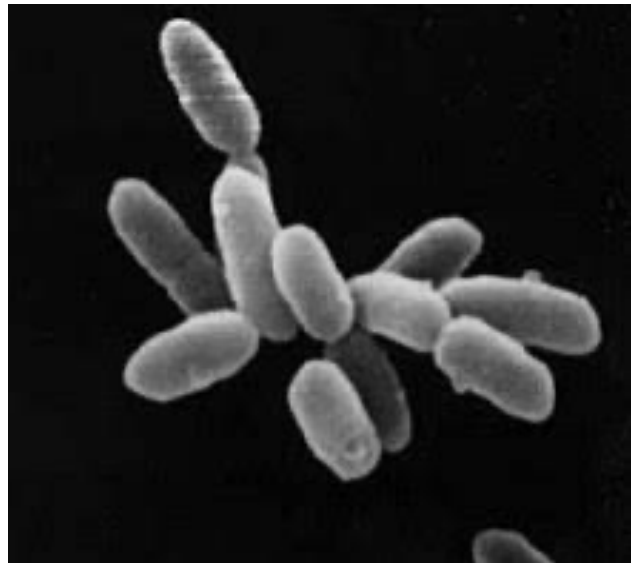


Viruses/Bacteria

- General overview on viruses and bacteria
- Structure/composition
- Overview on the human microbiome



Dr. Matthias Tinzl-Zechner



- Probiotics

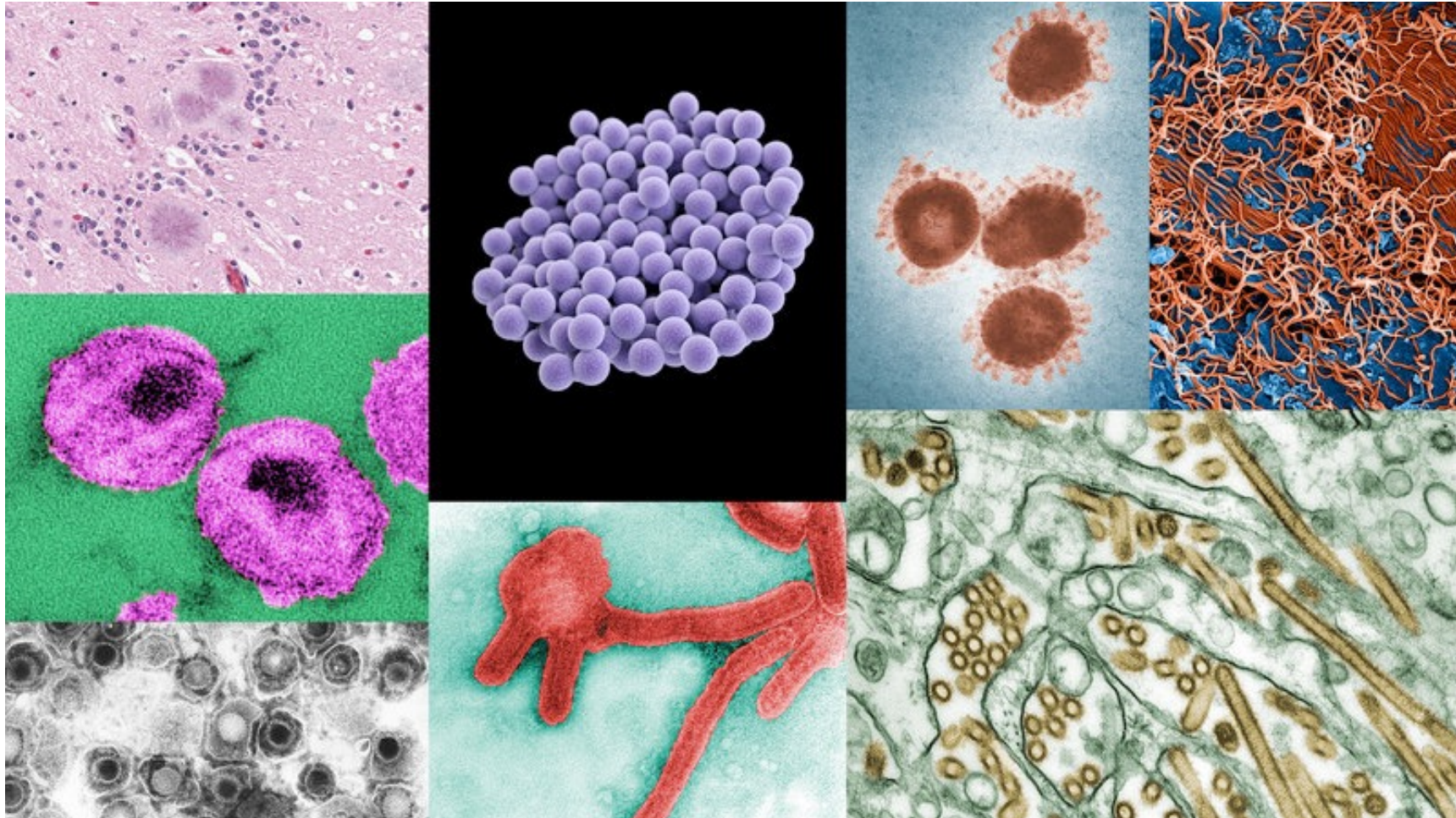


Dr. Hannah Kleyer



- Microbial and enzymatic plastic degradation

- Infectious diseases transmitted by animals



Smallpox

- Eradicated 1980



Syphilis

- sheep



Susan Lindsley/CDC



MERS Middle east respiratory syndrome

- Outbreak in 2013 in Saudi Arabia. Death rate 35 %



Nipah virus

- First identified in 1999 in south part of Malaysia.
- World Health Organization (WHO) regards this virus as one of its priority pathogens
- Death may occur in 40-75 % of the cases
- No vaccine available



Influenza Pandemic

H1N1

1918-1920

Suspected cases: 500 Mio

Deaths: 20 - 50 Mio

COVID-19 Pandemic

SARS-CoV-2

2020 - 2023

Reported cases: 676 Mio

Deaths: 6.88 Mio

10.03.2023

John Hopkins University

Influenza Pandemic H1N1 1918-1920

COVID-19 Pandemic SARS-CoV-2 2020 - ?



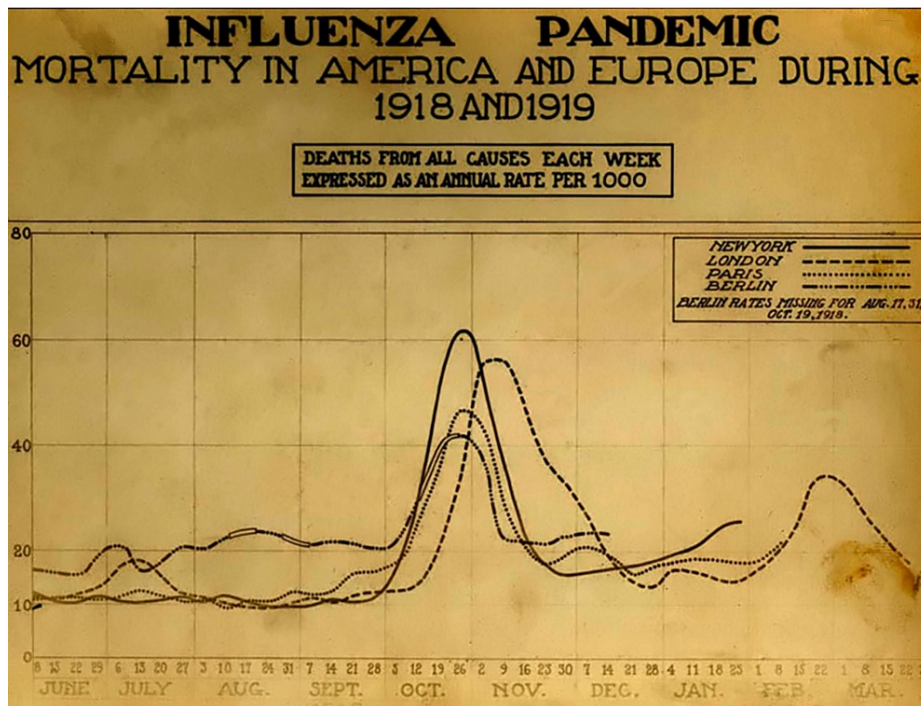
Influenza Pandemic H1N1 1918-1920



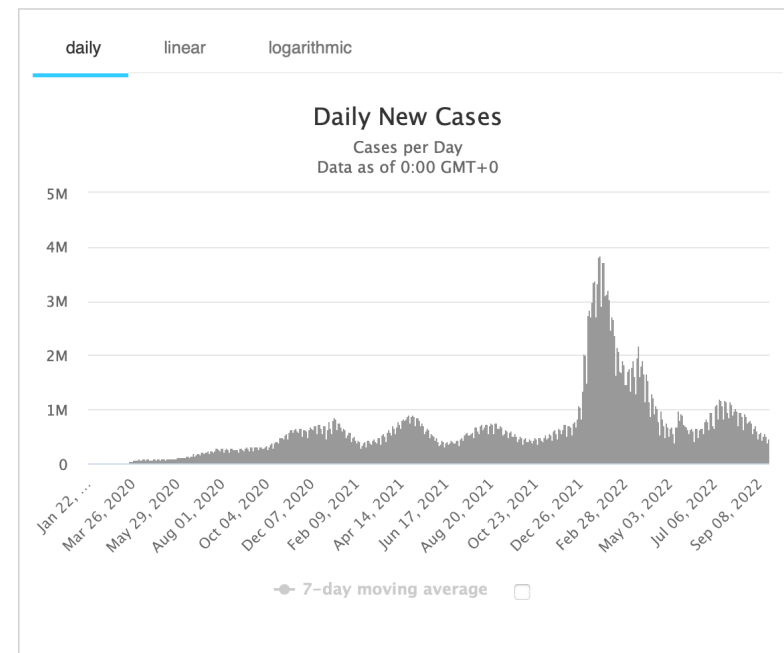
COVID-19 Pandemic SARS-CoV-2 2020 - ?



Influenza Pandemic H1N1 1918-1920



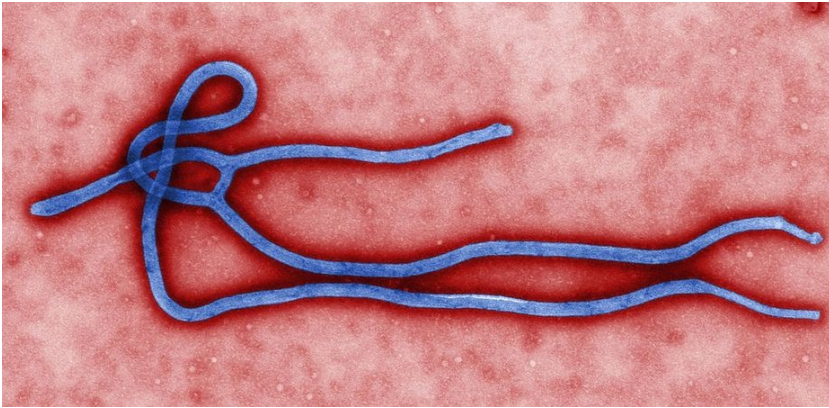
COVID-19 Pandemic SARS-CoV-2 2020 - ?



22.09.2022

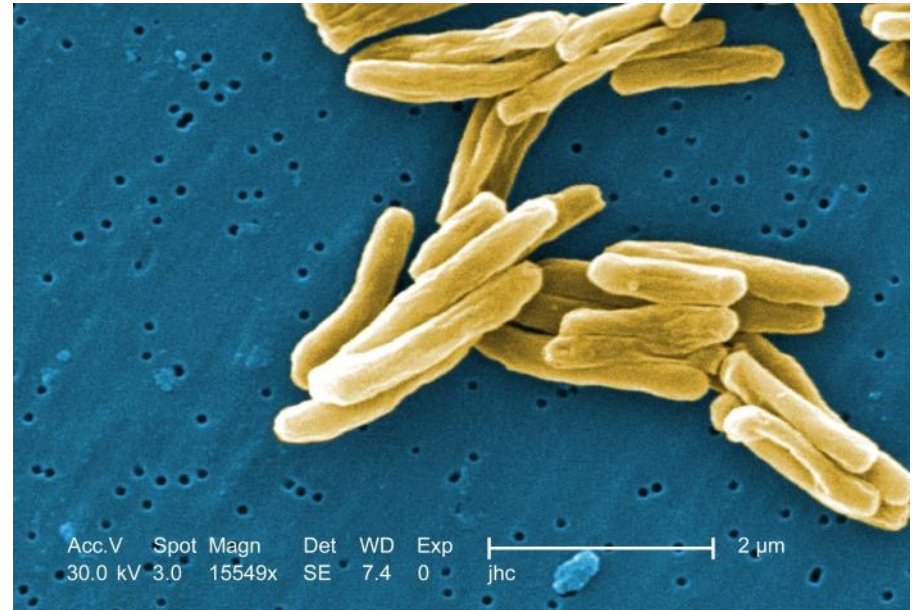
John Hopkins University:

Viruses/Bacteria



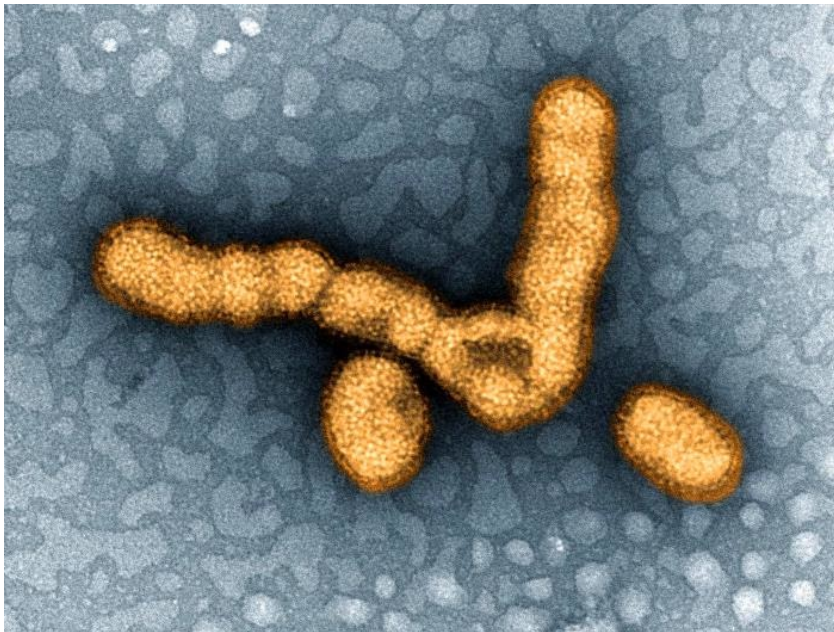
Ebola virus

(CDC/Cynthia Goldsmith/Public Health Image Library)



Mycobacterium tuberculosis

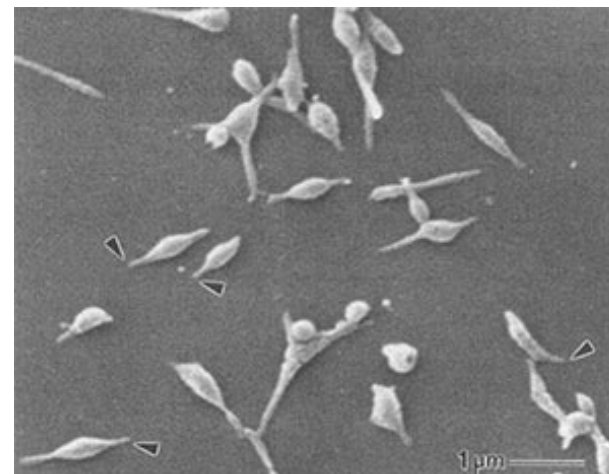
(Public health library PHI)



H1N1 influenza virus

“Swine flu”

National Institute of Allergies and Infectious Diseases (NIAID)



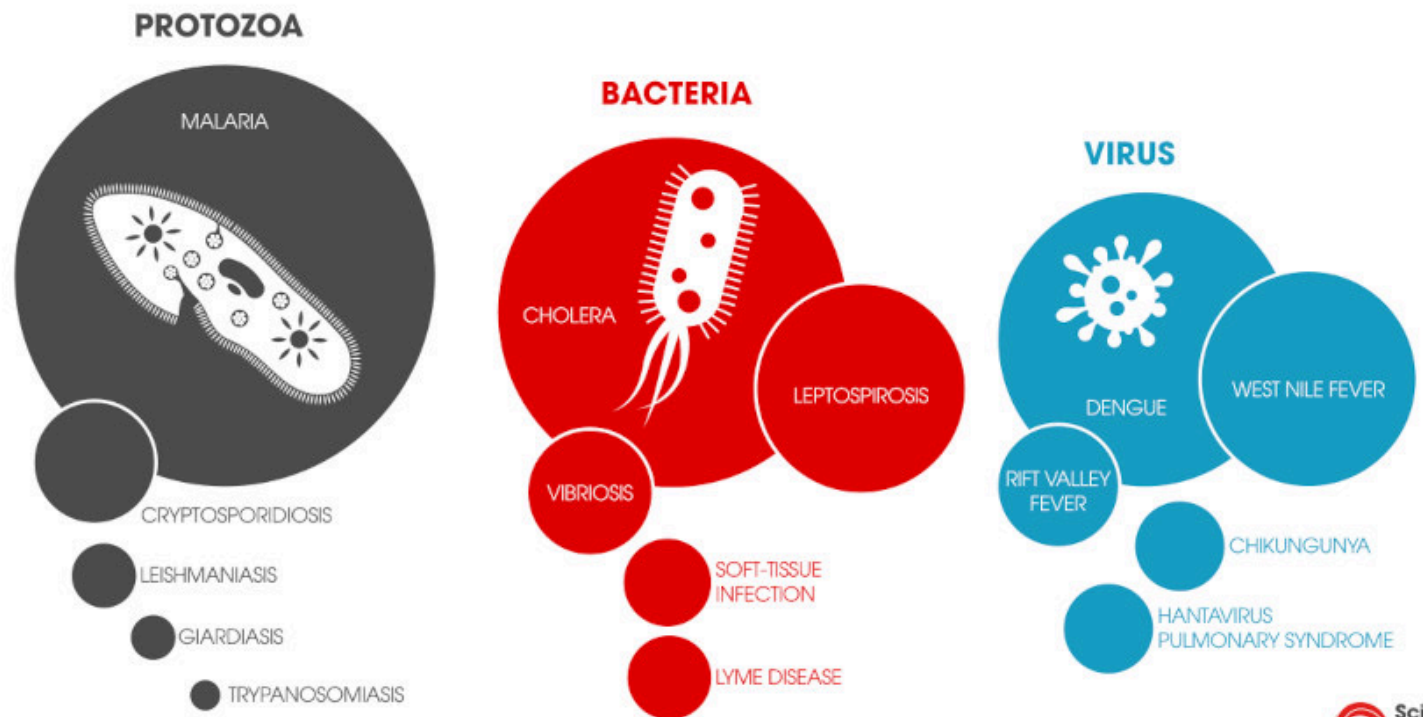
Mycoplasma pneumoniae

(Waites, Talkington *Clin Microbiol Rev.* 2004;17:697–728)

Infectious diseases and climate change

- [Nature Climate Change](#) volume 12, pages 869–875 (2022)

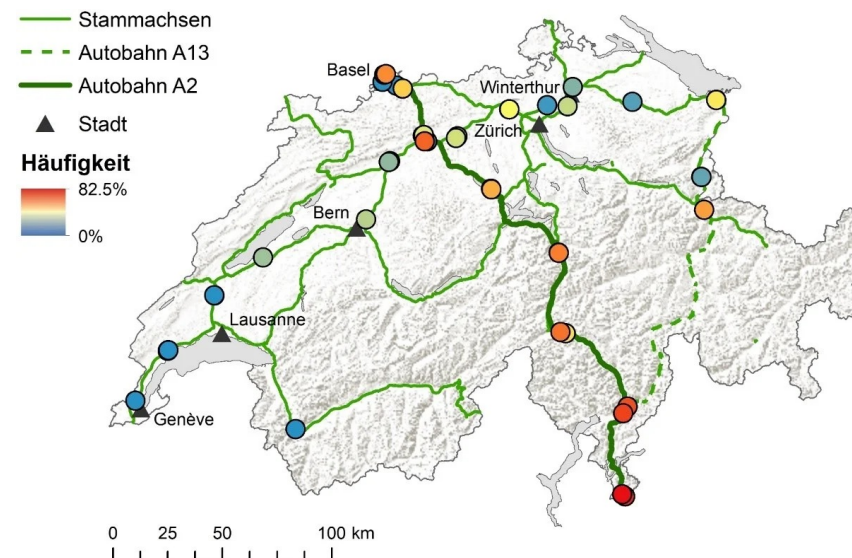
Infectious diseases most aggravated by climatic hazards



Source: Mora et al. Nature Climate Change, 2022

Climate change: Infectious diseases are shifting from south to north

- Asian Tiger Mosquito
- Can transmit pathogenic viruses (e.g. Dengue, Zika)
- Since 2007 (Chiasso/Tessin)



Permafrost as a potential pathogen reservoir?

- Pithovirus sibericum that was isolated from a 30,000-year-old sample of permafrost in 2014.
- Characterization of 13 new viruses isolated from seven different ancient Siberian permafrost samples. [Viruses](#). 2023 Feb; 15(2): 564.



Vaccine development

Different types of vaccines

- Live attenuated vaccine
- Inactivated/Killed vaccine
- Subunit vaccine/recombinant vaccine
- DNA/RNA vaccine
- Cancer vaccines
- Etc.



Prophylactic cancer vaccines

- **Human papillomavirus (HPV) vaccine/
cervical cancer**



Therapeutic cancer vaccines



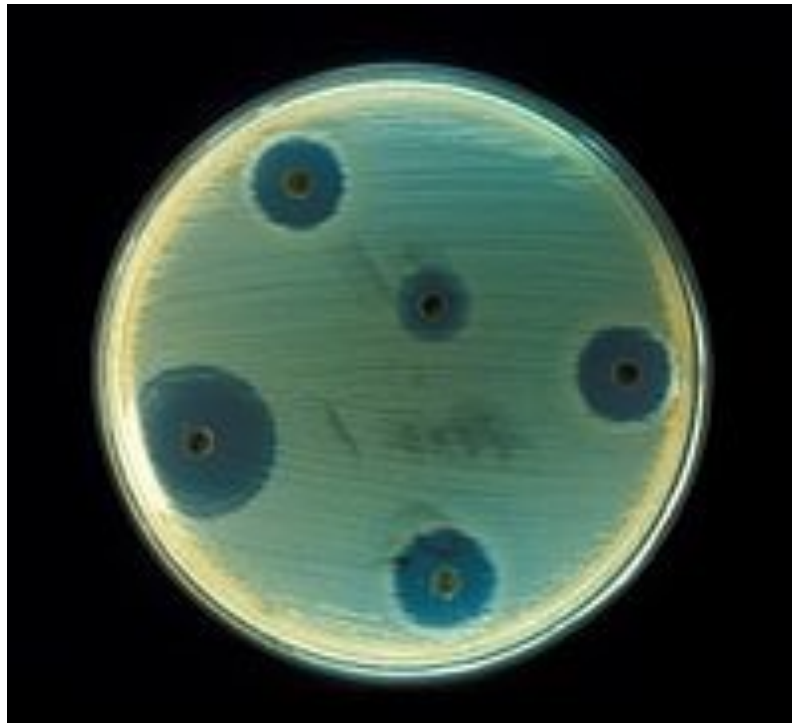
Dr Madiha Derouazi



Julien Grogg,
Director of Clinical Operations

Antibiotics

- Antibiotic resistances/Multi-resistances
- Sources for new antibiotics?



GERMION Therapeutics



Dr. Jan Romano de Gea

- Development of novel antibiotics

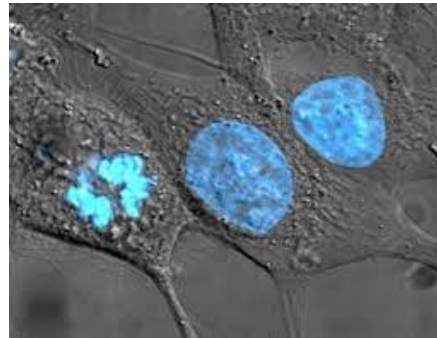
Chapter 2

- Production of biopharmaceuticals using cell technologies
- Gene therapy technologies



Basics of animal cell culture

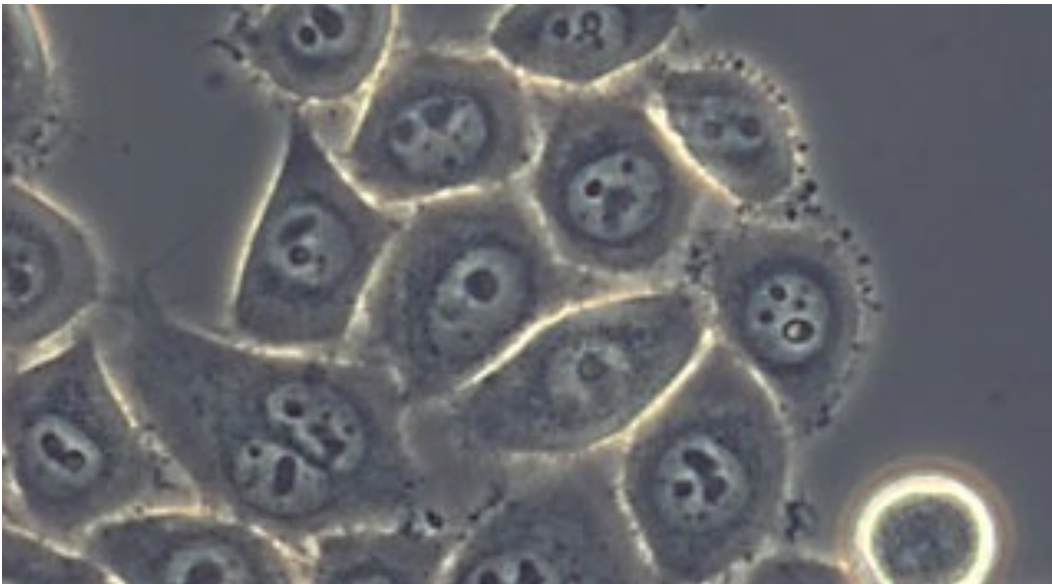
- Media components etc.



Animal cell culture

- Primary cells
- Cell lines
- Immortalized cells

HeLa cells (immortalized tumor cells)



Henrietta Lacks
(1920-1951)

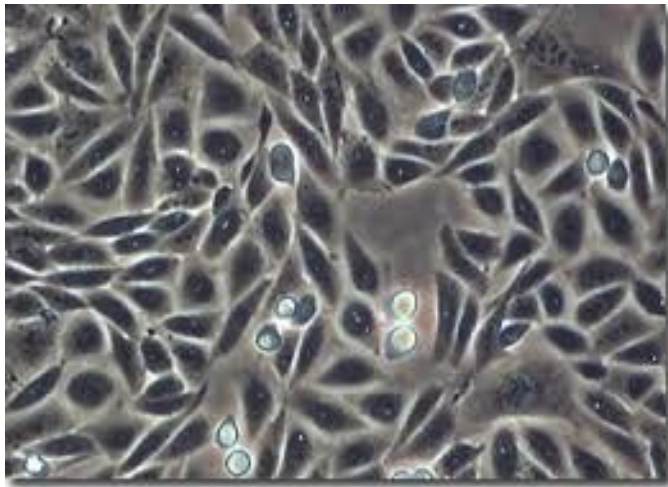
Chinese Hamster Ovary cells (CHO)

- Wildtype chinese hamster

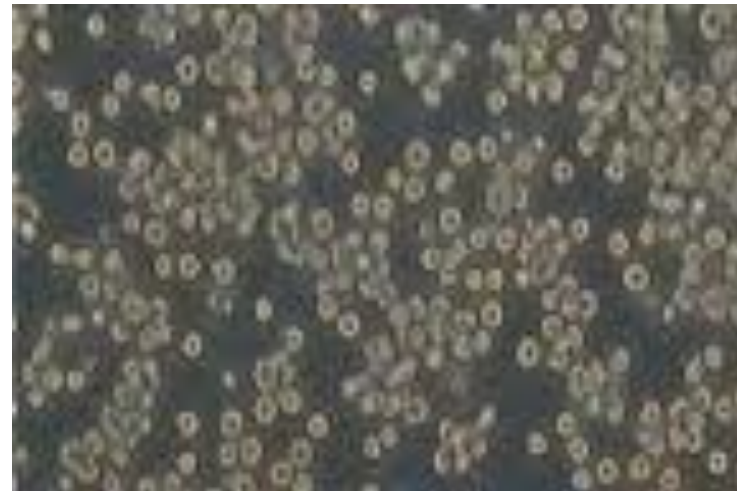


Chinese Hamster Ovary cells (CHO)

- Major host cell type for pharmaceutical protein production



(adherent growth)



(suspension growth)

Manufacturing cell line specialist

Lonza

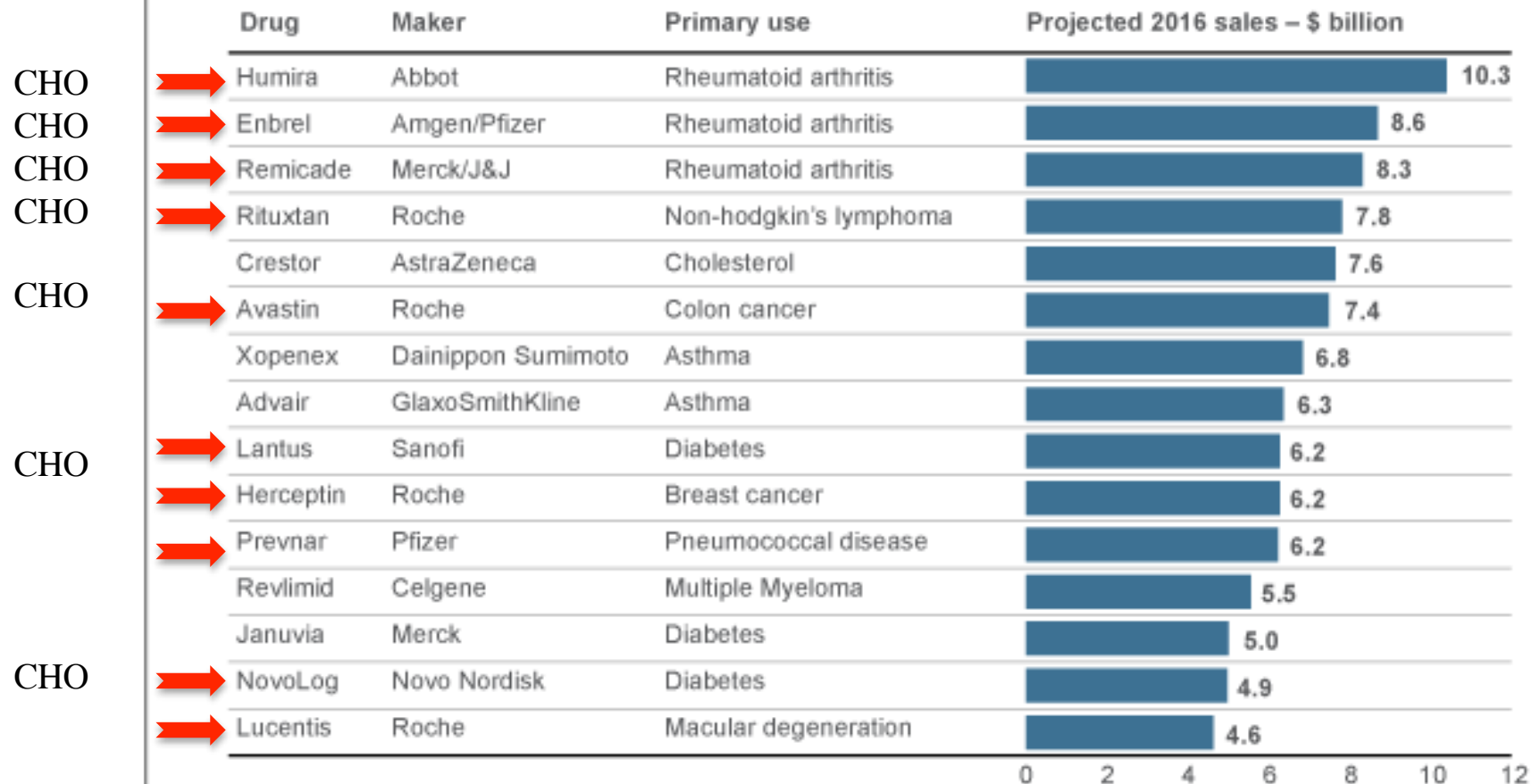


Tommaso Mattiolo

Biologicals are the future

Top projected drugs by sales in 2016

Pfizer Inc's Lipitor, the world's top-selling prescription drug of all time with peak annual sales of about \$13 billion, is about to face competition from cheap generics. Here are the medicines expected to be the world's top sellers by 2016

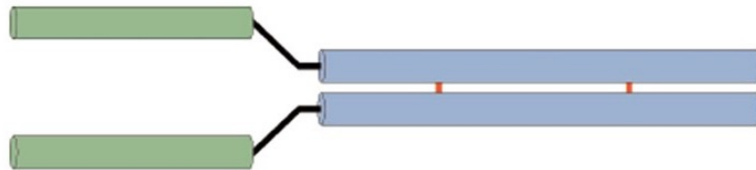


Source: Thomson Reuters Forecast

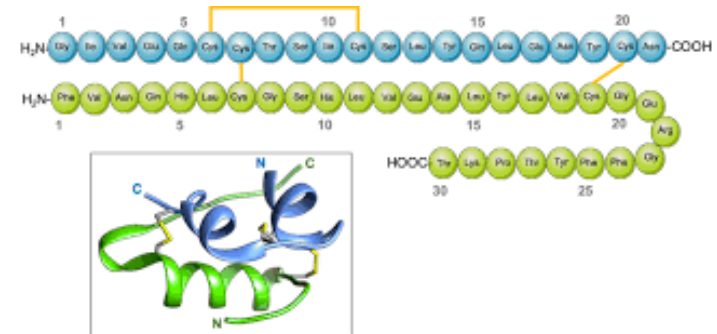


Therapeutic proteins

TNFRII-Fc



Enbrel 150 kDa

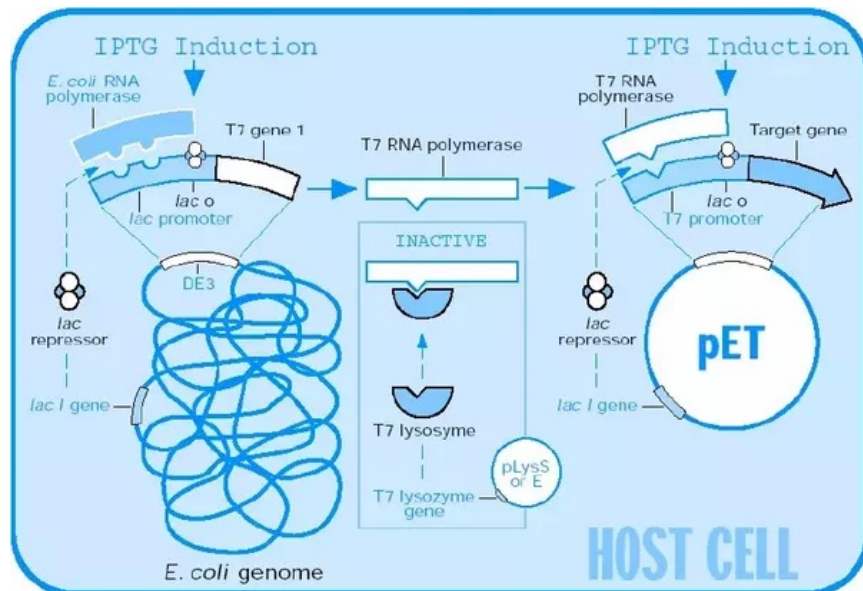


Insulin 5.7 kDa

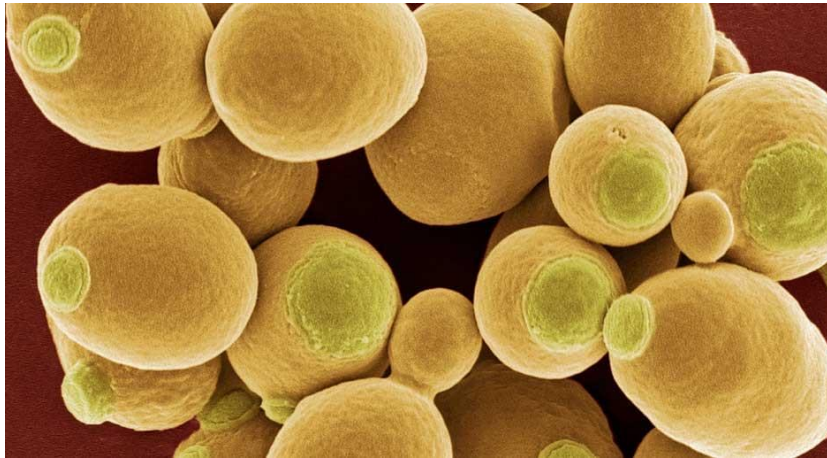
- Modified [from Scientific Reports](#) volume 8, Article number: 7327 (2018)

Recombinant pharmaceutical protein expression in *E. coli*

- Inducible expression
- Which type of proteins can be expressed in *E. coli*?
- Advantages/Disadvantages of therapeutic protein expression in *E. coli*



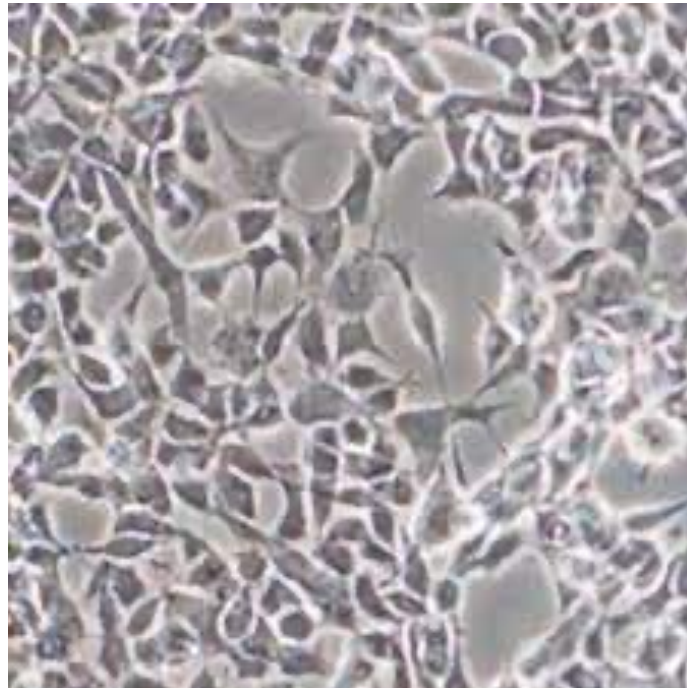
Recombinant therapeutic protein expression in yeast



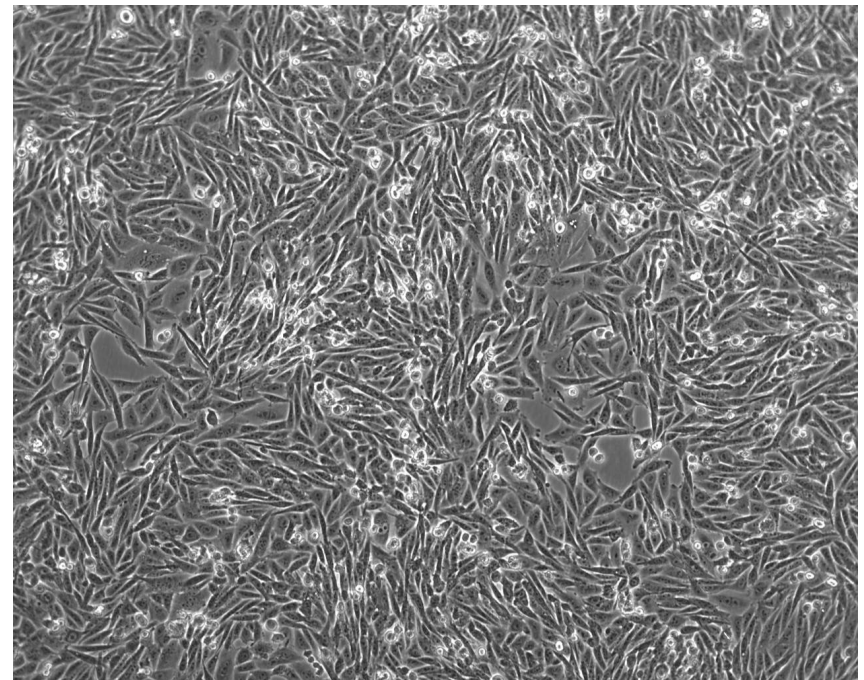
- *Saccharomyces cerevisiae*
- *Pichia pastoris*
- Synthetic biology approaches/glycoengineering

Recombinant therapeutic protein expression in mammalian cells

- HEK293
- CHO
- others



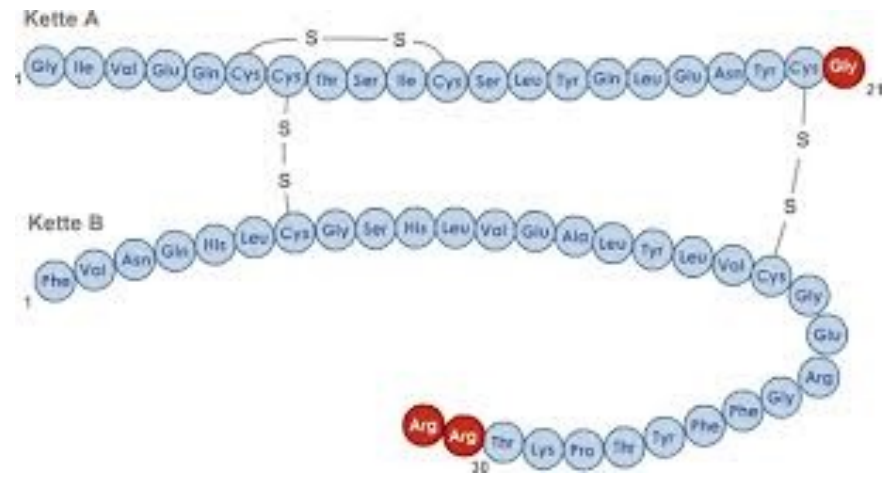
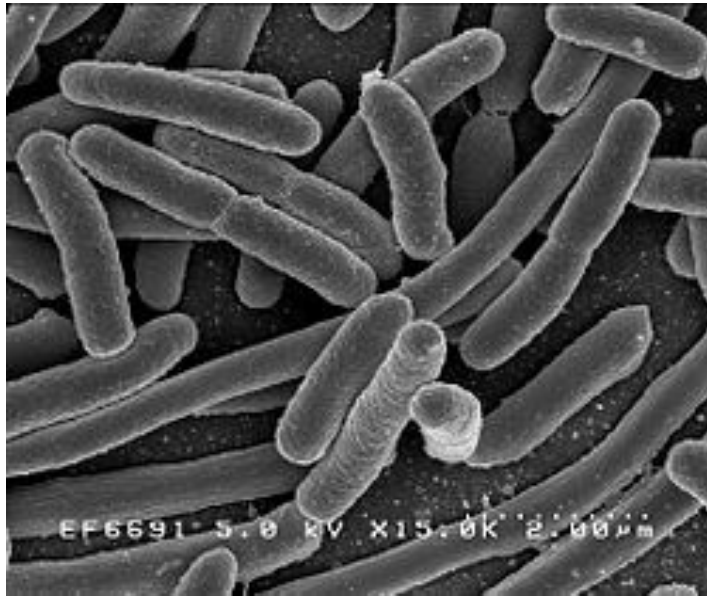
HEK293



CHO

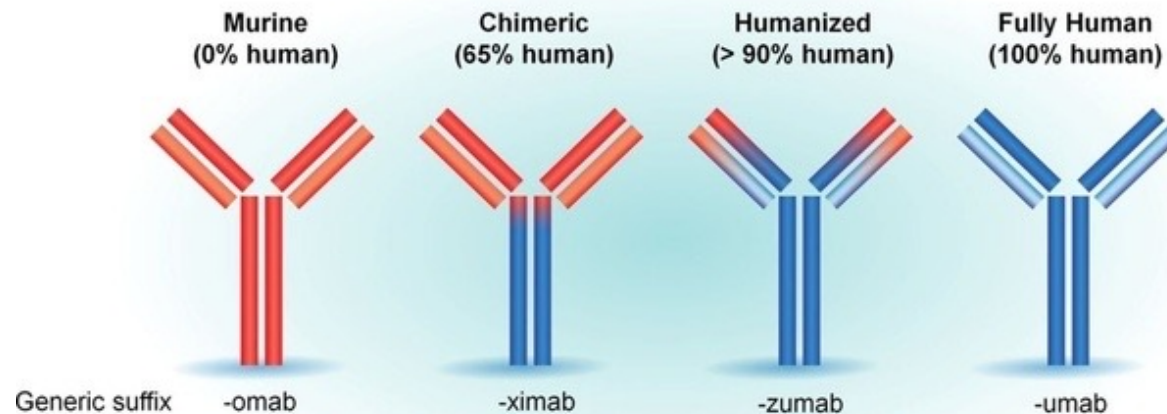
Diabetes

- Insulin production in E. coli



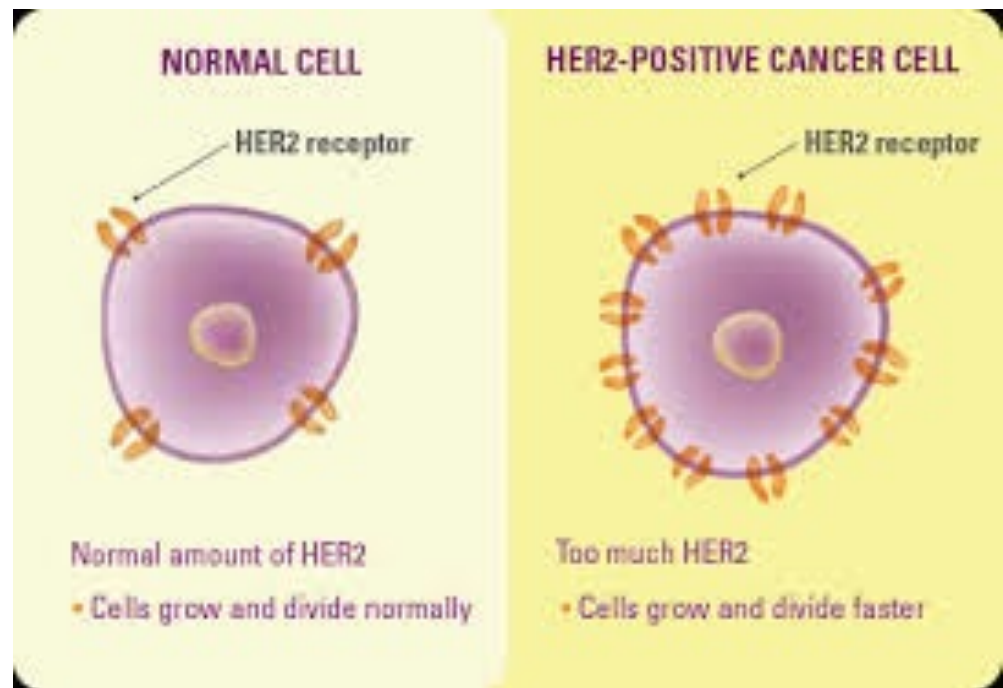
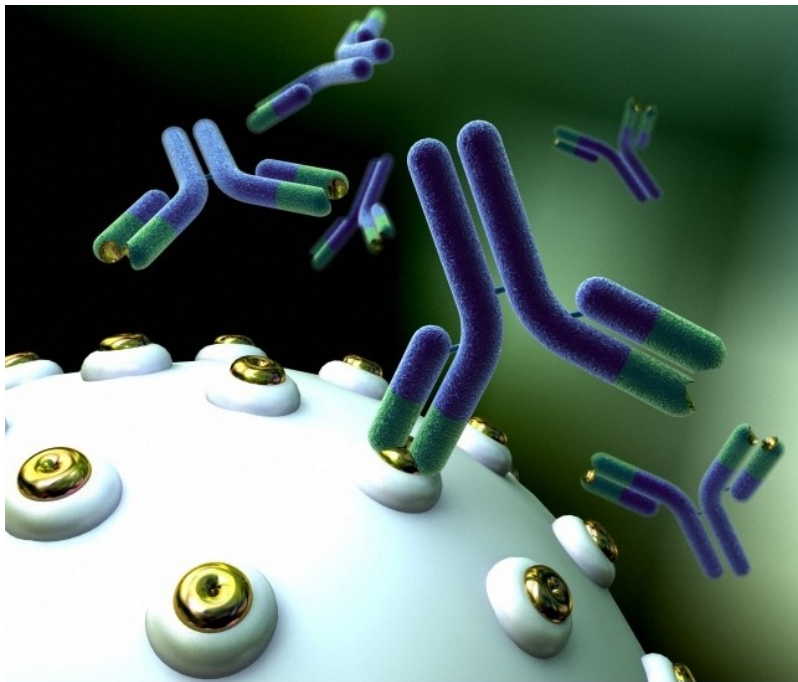
Monoclonal antibodies

- Phage display, Hybridoma technology
- Humanized antibodies
- Nanobodies



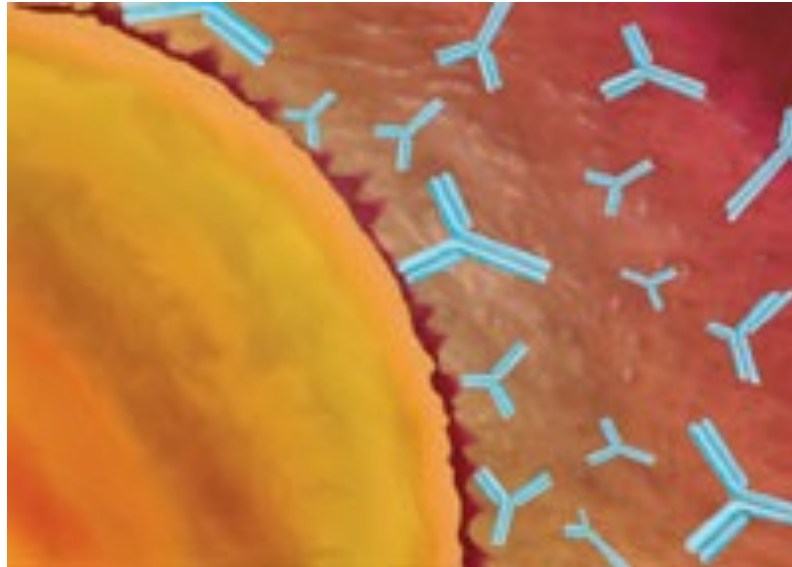
Therapeutic monoclonal antibodies

- Humanized monoclonal antibody (HERCEPTIN/Roche) HER2 positive breast



CHO cells for monoclonal antibody production

- Recombinant monoclonal antibody production
- Herceptin (Roche/Genentech), estimated worldwide sale **2012**: \$6.08 billion/**2022**: \$2.2 billion



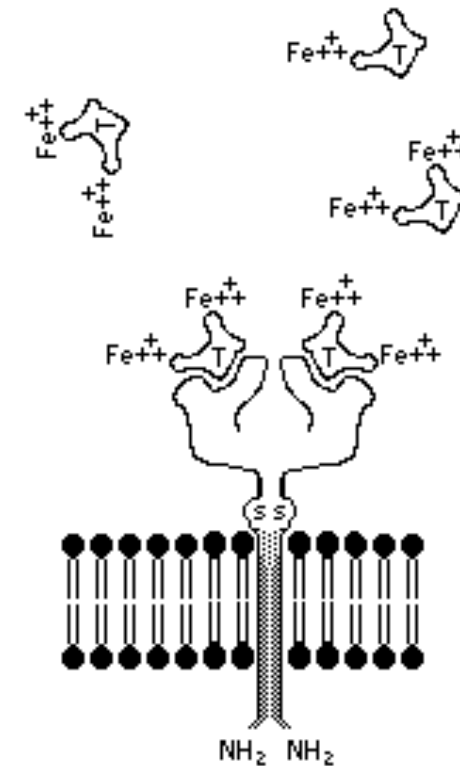
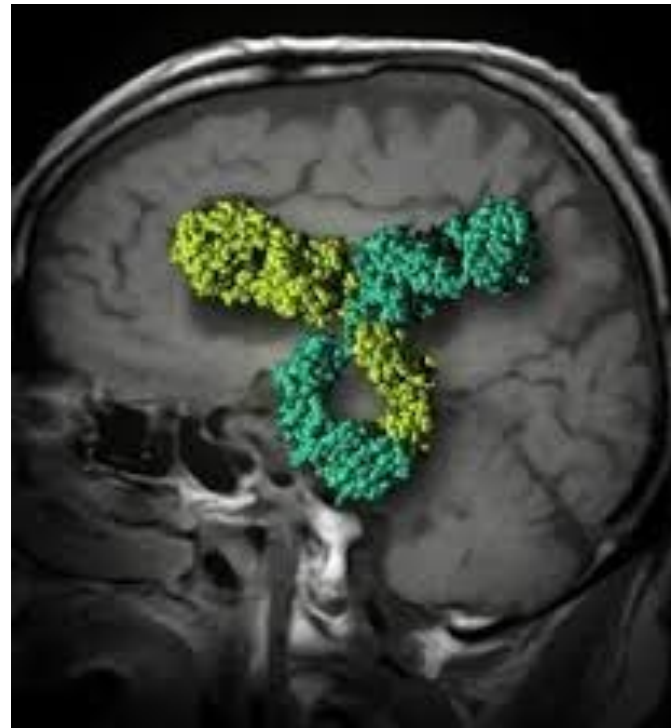


- Dr. Yves Kremer
- Clinical stage biopharmaceutical company
- Precision medicine: Neurodegenerative diseases (Alzheimer, Parkinson)
- Products: Vaccines, antibodies, small molecule drugs



Engineered therapeutic proteins

- Bispecific antibodies/Genentech



Presentation Adaptyv Biosystems

- Next-generation of therapeutic protein engineering
- Employing Artificial Intelligence for protein design

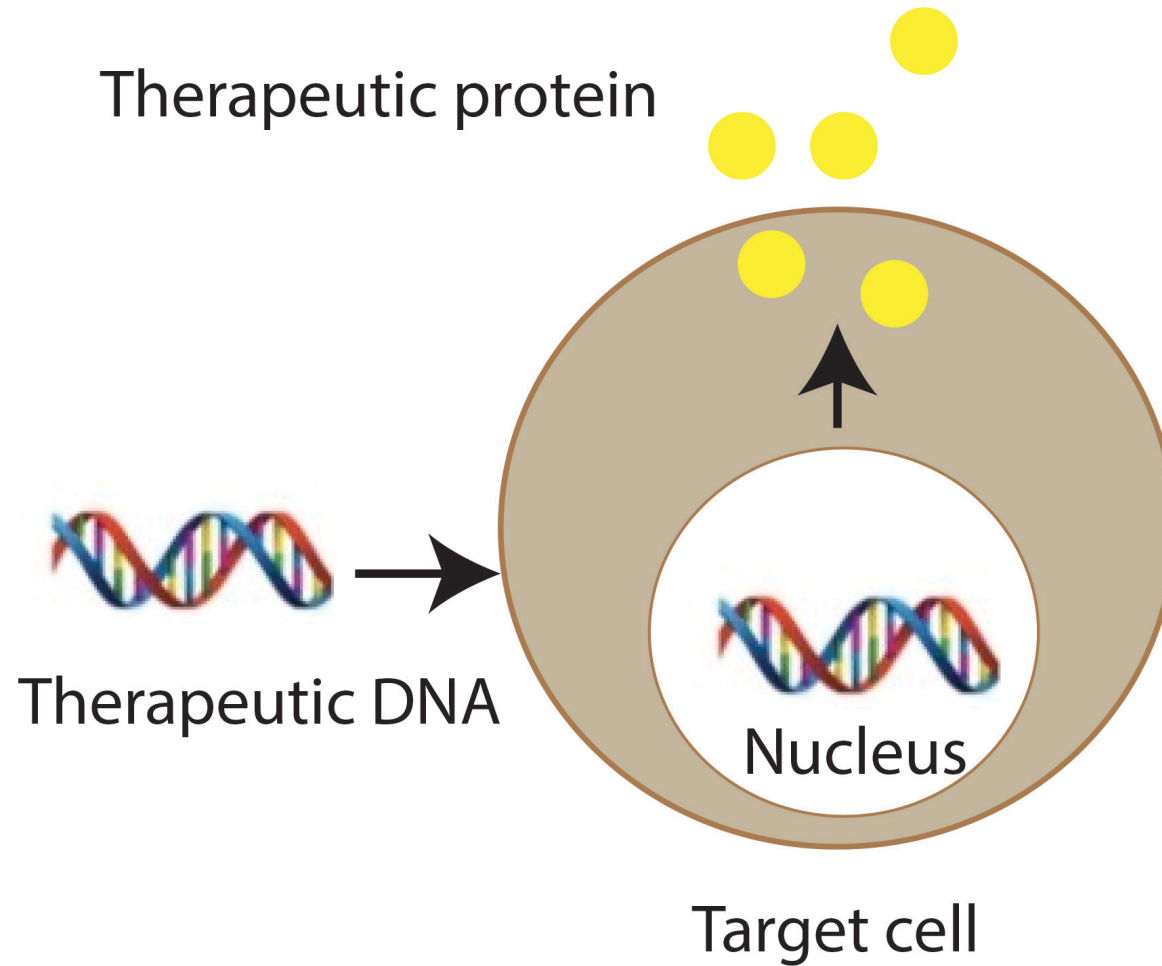


Julian Englert

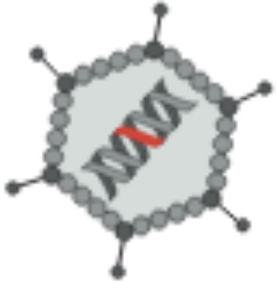
Gene Therapy



Principle of Gene Therapy



Gene Therapy



Glybera (UniCure, Netherlands)

Lipoprotein lipase deficiency

Cost of treatment: 1600 000 \$ (2012)

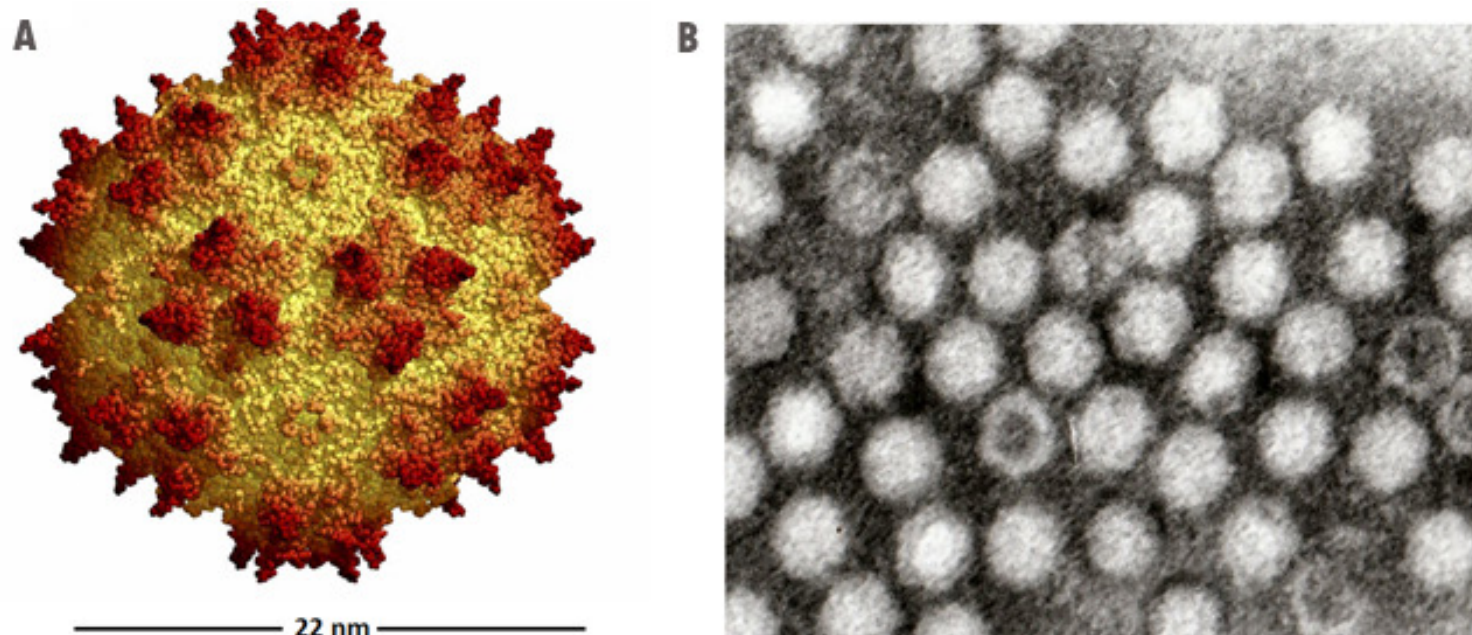
1000 000 \$ (2015)

EMA approved: 2012, withdrawn 2017



Adeno-associated viruses

- Viral vectors for gene therapy



- **Figure 1. Adeno-Associated Virus (AAV) Structure and Genome map. A: A cartoon showing simulated AAV size and 3-D structure; B: A picture showing electron microscopy of purified AAV vector.**

HAYA Therapeutics

- Dr. Daniel Blessing
- RNA therapeutics for cell reprogramming in disease states (e.g. Heart Failure)



Transgenic plants



Ellyso (Pfizer + Protalix BioTherapeutics): First plant-made recombinant biological approved

- Approved by FDA 2010
- Genetically engineered carrot cells



Elelyso: Enzyme replacement therapy

PROTALIX
Biotherapeutics

elelyso™



(Gaucher's disease)



Transgenic animals



Approval for a transgenic animal drug

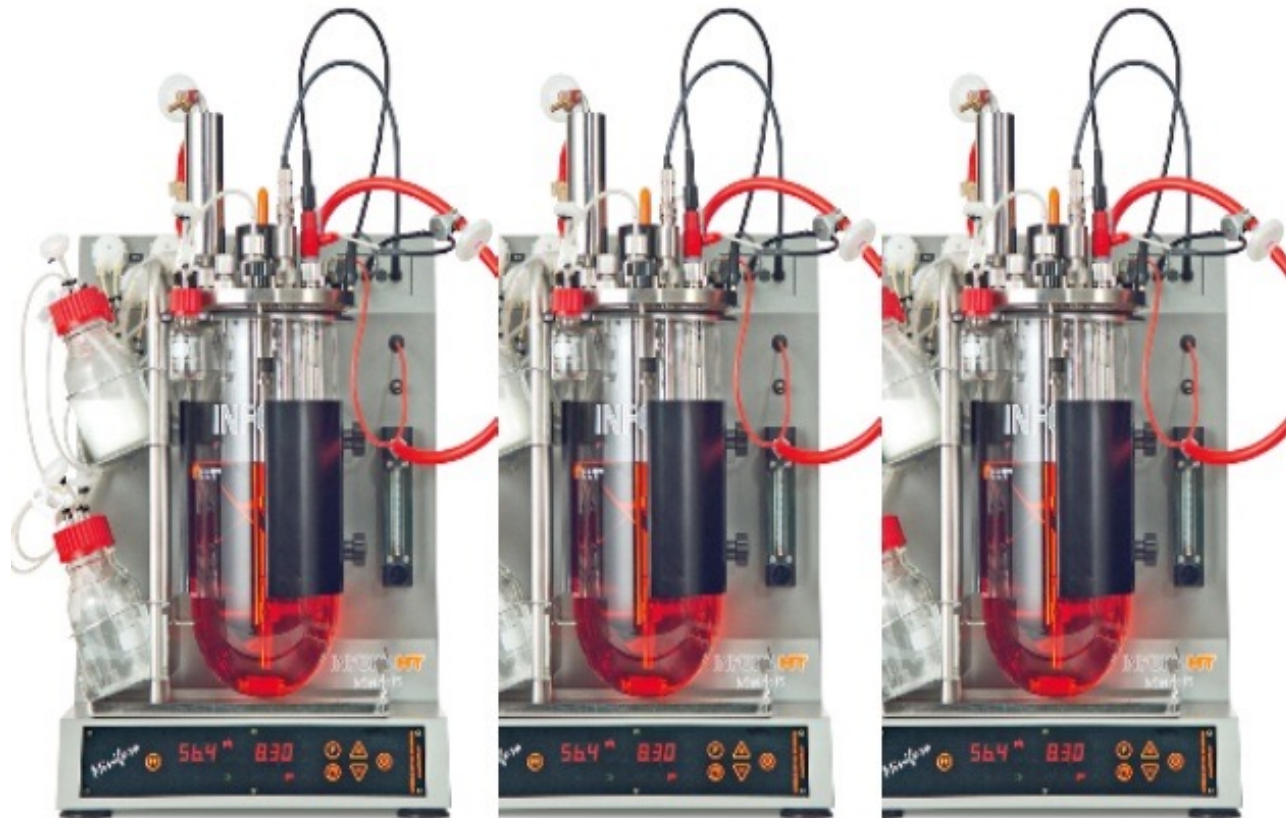
- EU 2006/ US 2009



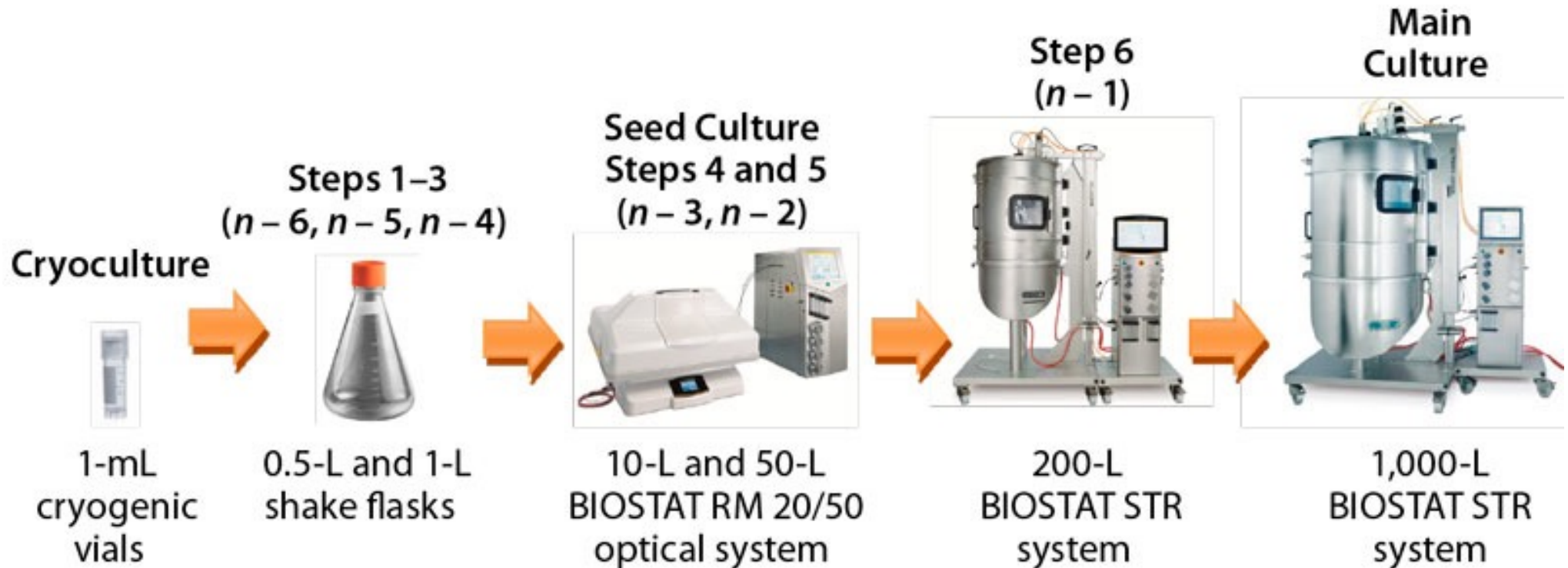
Antithrombin

Chapter 3: Bioreactors

- Large scale recombinant protein production



Fed-batch culture



Orbital shaken bioreactors: The future



Therapeutic protein production



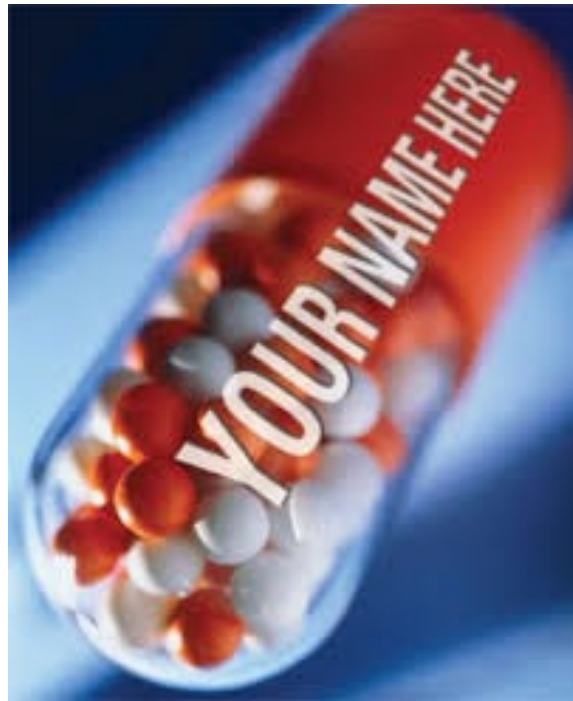
Your protein expression needs from animal cells?

*We bring to you the highest value in quantity,
short time lines and quality*



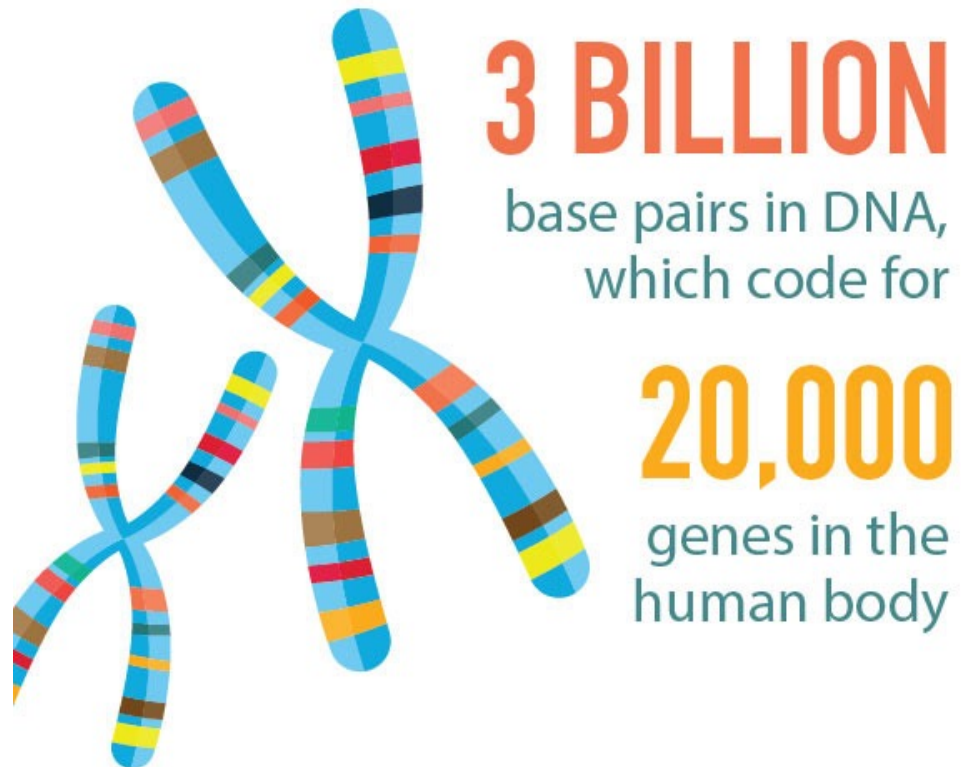
Dr. Joeri Kint

Chapter 4: Personalized Medicine/Precision Medicine

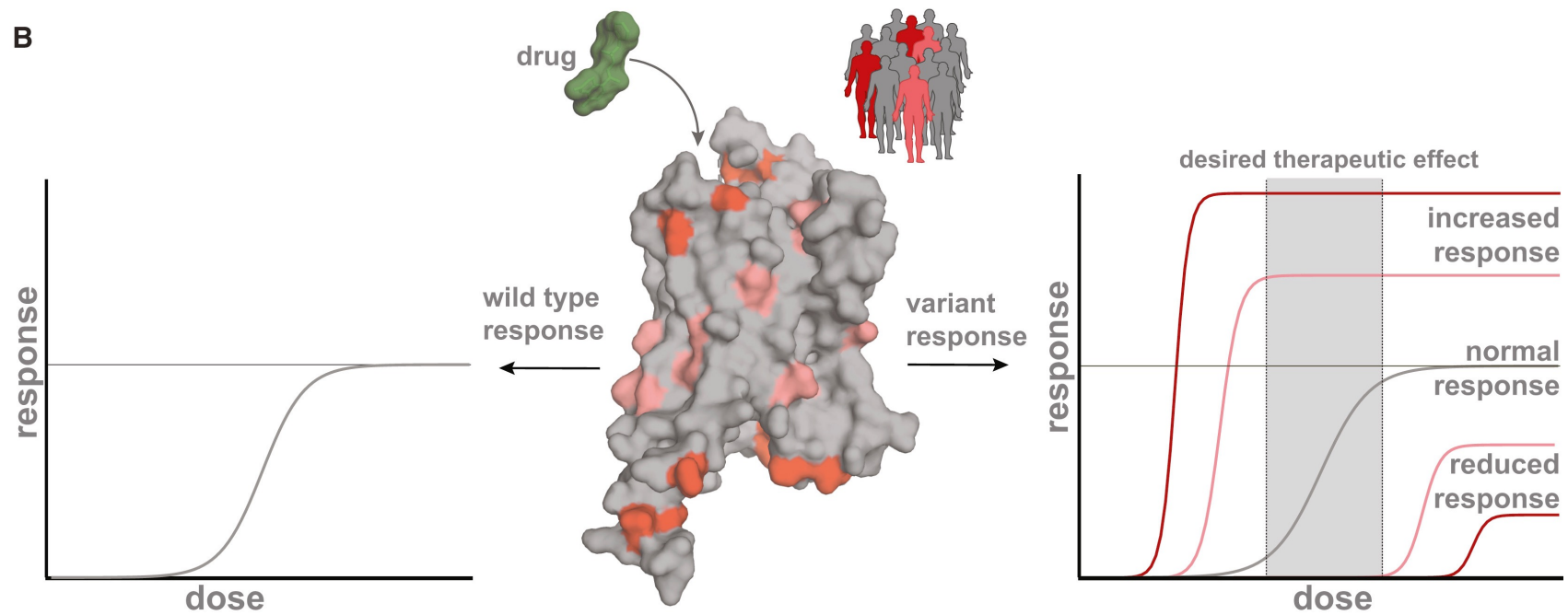


4.1 Collection of human genome sequence data

VITAL STATISTICS: Personalized Medicine



4.2 Single nucleotide polymorphisms (SNPs)



Sophia Genetics

- Rolle
- Data-Driven Medicine

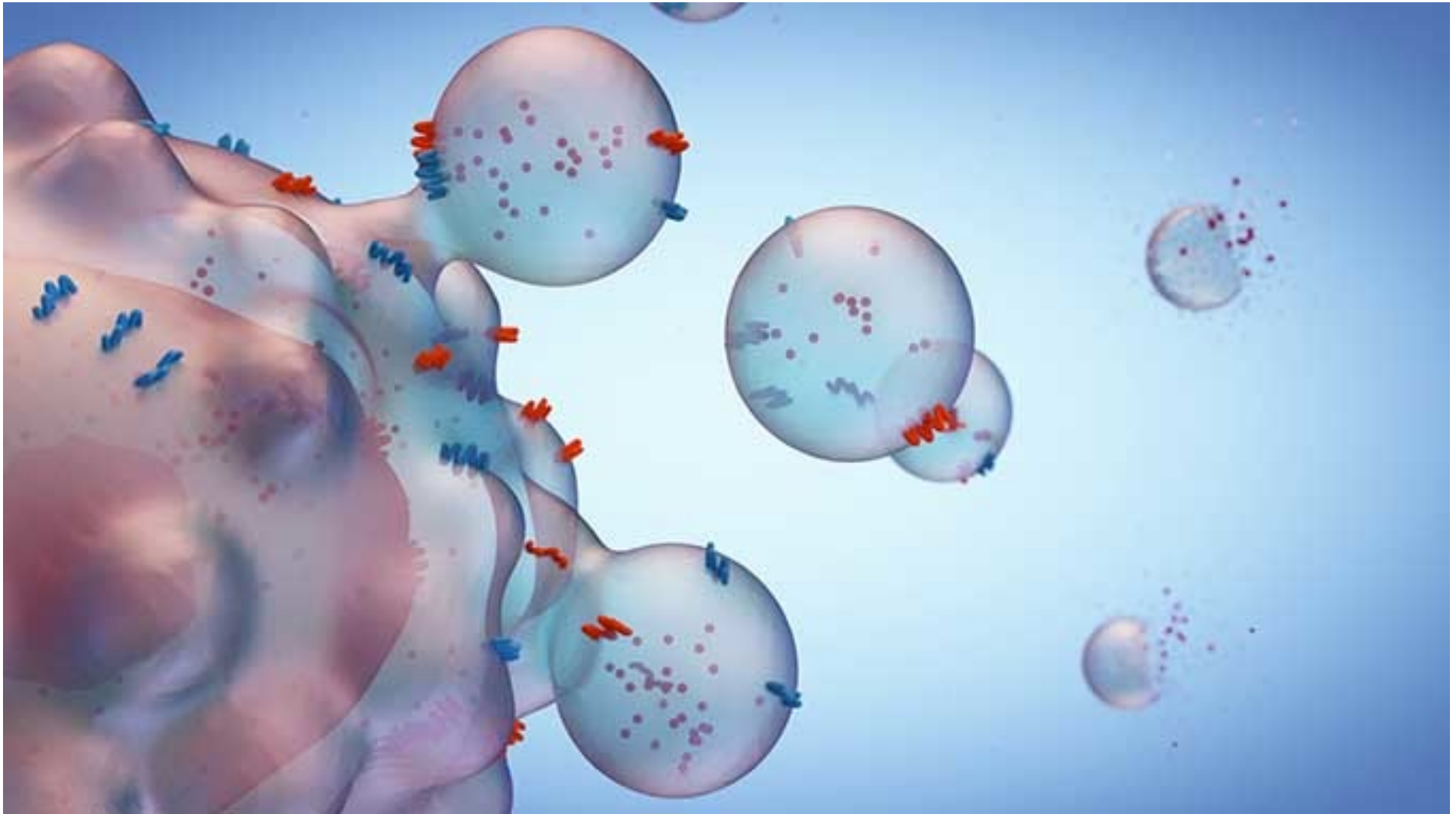


Dr. Romain Gosselin

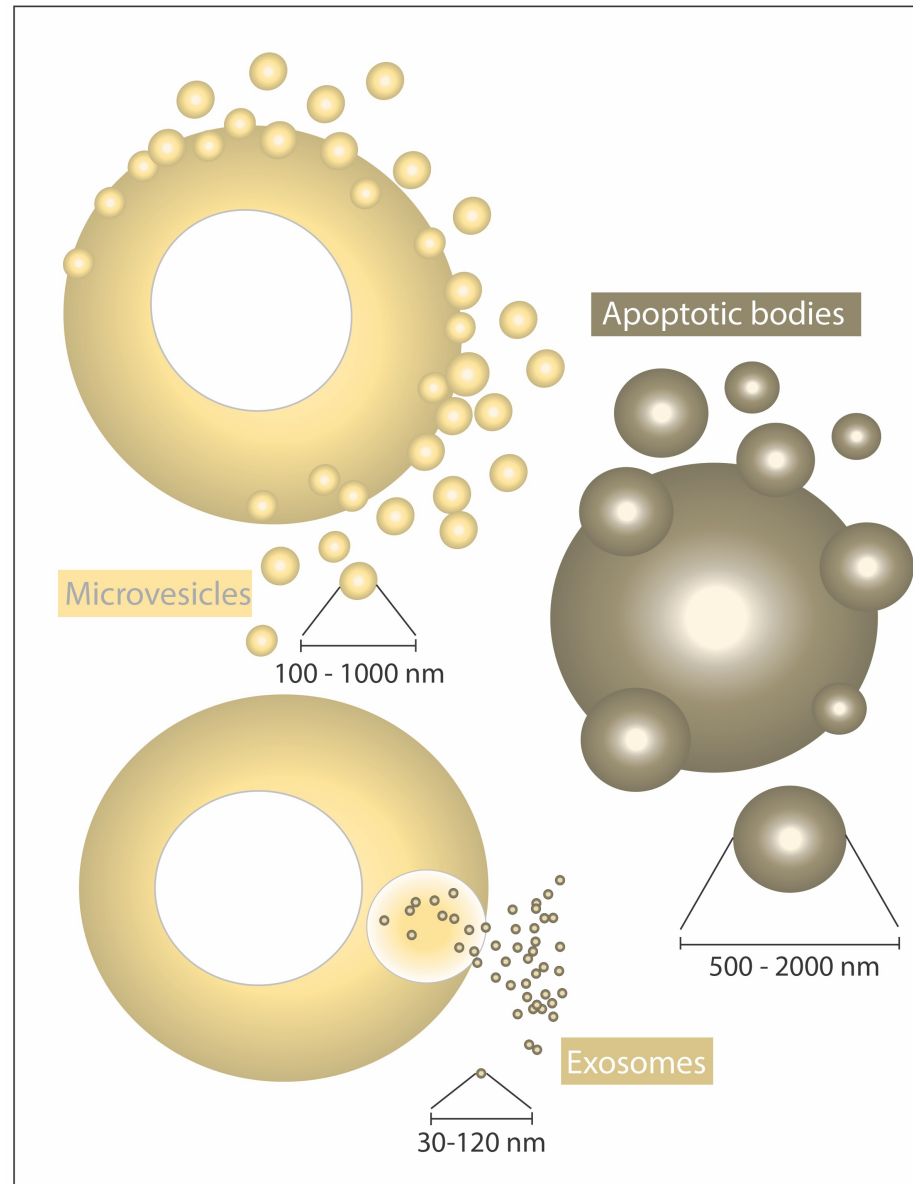
- Project manager: Precision medicine at CHUV



4.3 New diagnostic tools: “Liquid biopsy”



New diagnostic tools: “Liquid biopsy”





Diagnostic tools

- Dr. Iwan Maerki
- Early detection of Sepsis



Diagnostic tools

SENSORA

- Detection of cancer by volatiles in sweat
- Alessandro Fulciniti

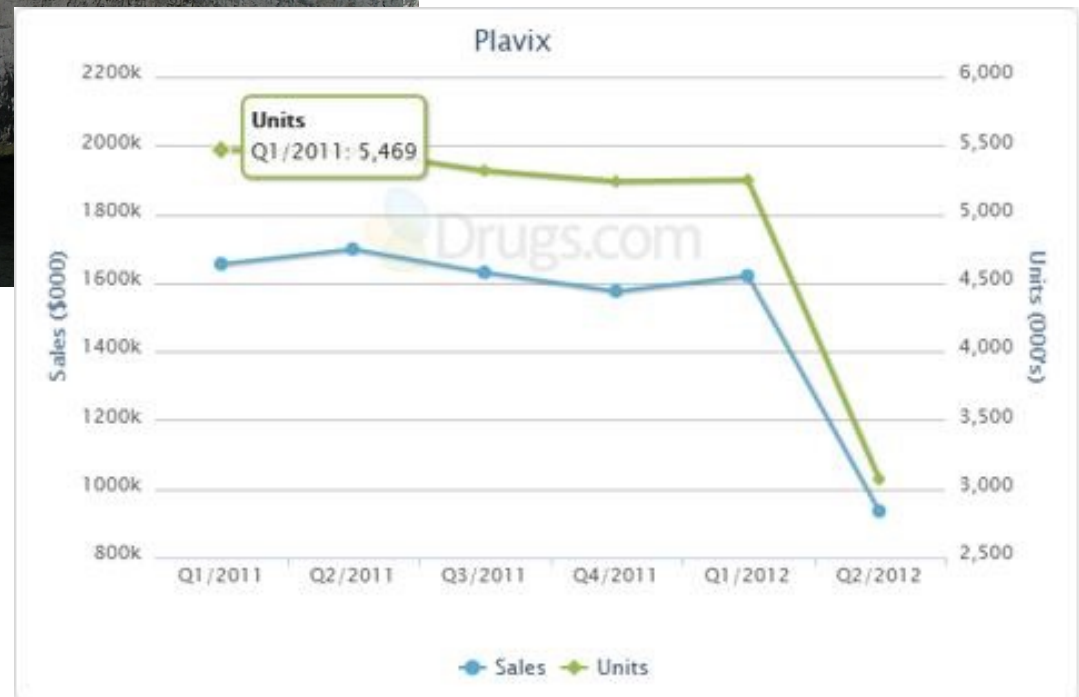
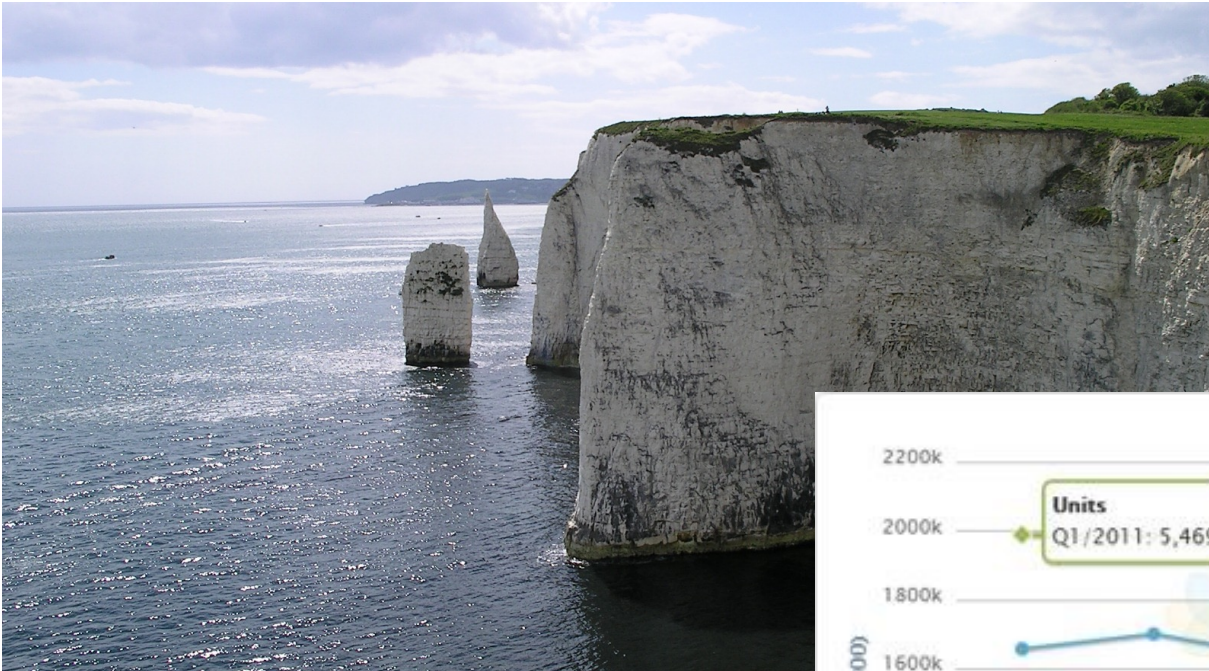


Chapter 5

- Patents



Patent cliff



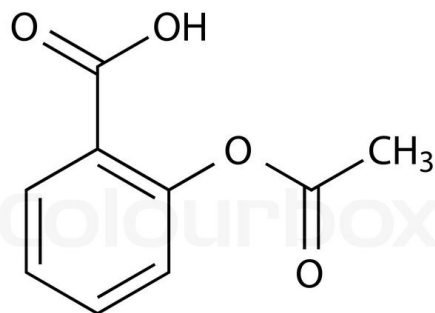
Ever-greening

- Retaining profits from patents



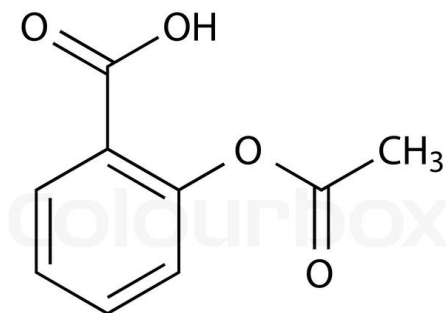
Generic drugs

- Aspirin



Acetylsalicylic acid

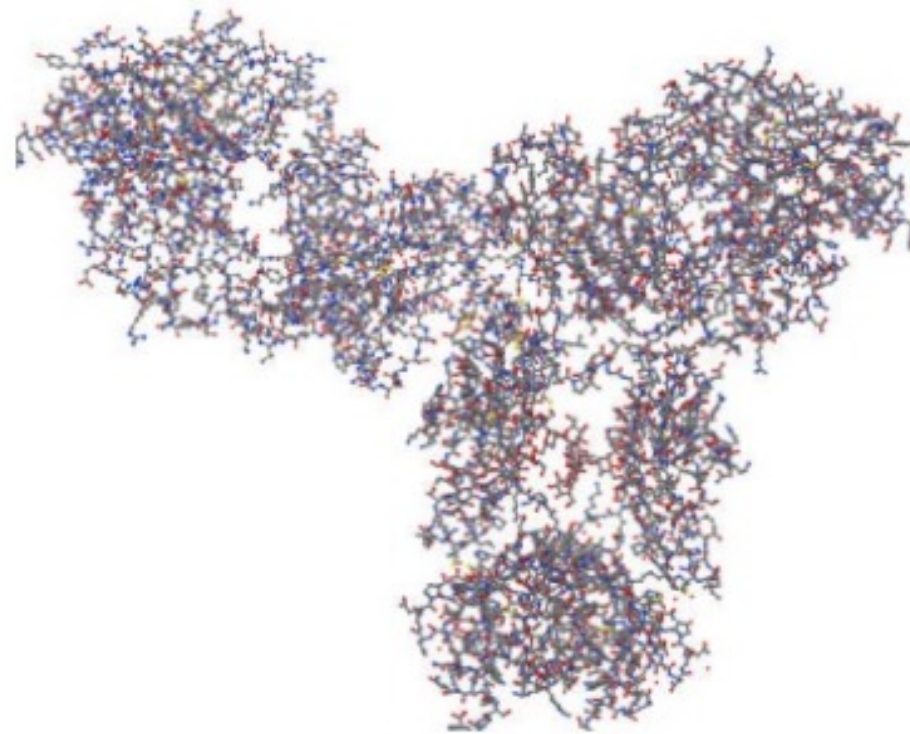
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Acetylsalicylic acid

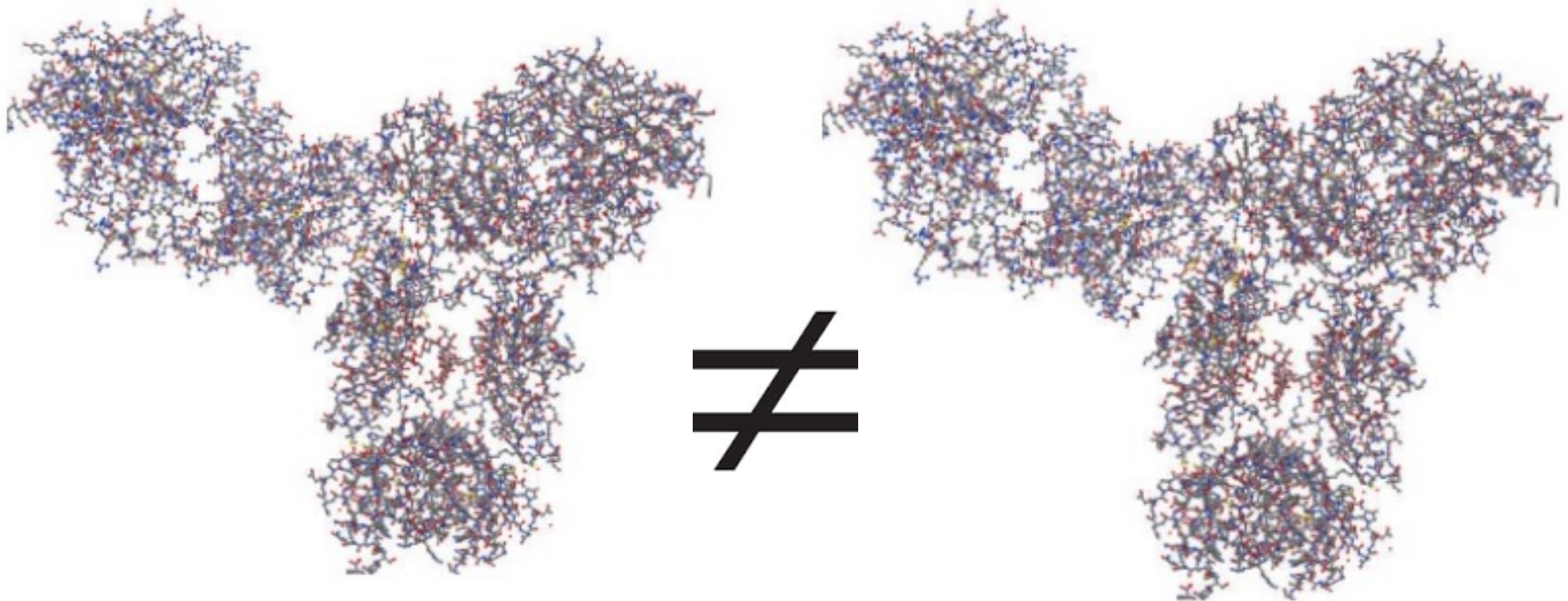
Biologicals versus drugs

- Bigger, more complex



Biosimilars

- Similar but not identical



Small molecule drugs



- GPCR receptors
- Allosteric modulators



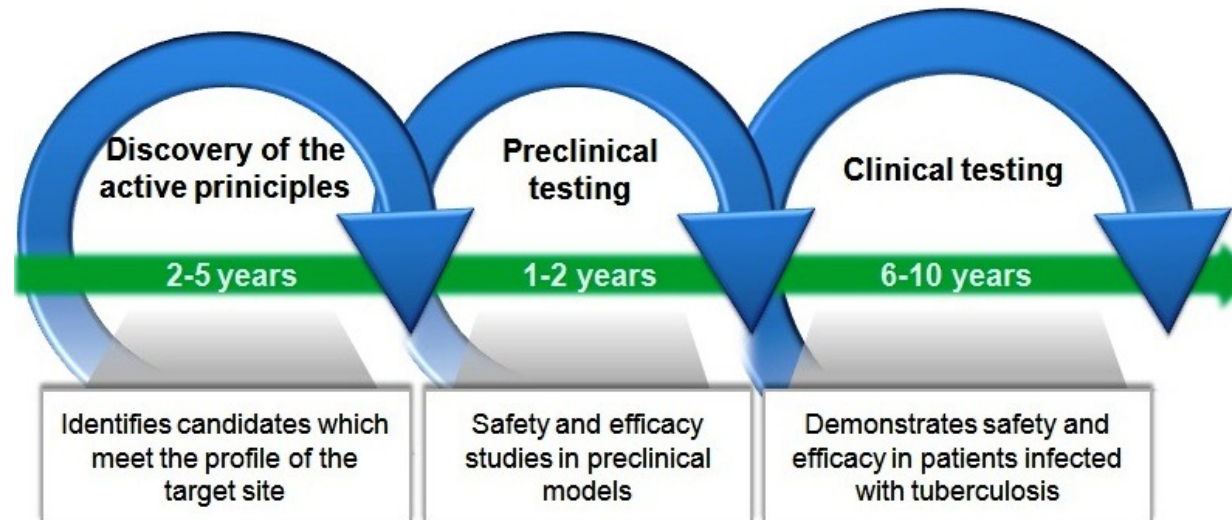
Dr. Dominik Schelshorn

Chapter 6

- Regulatory issues in Pharmaceutical Biotechnology

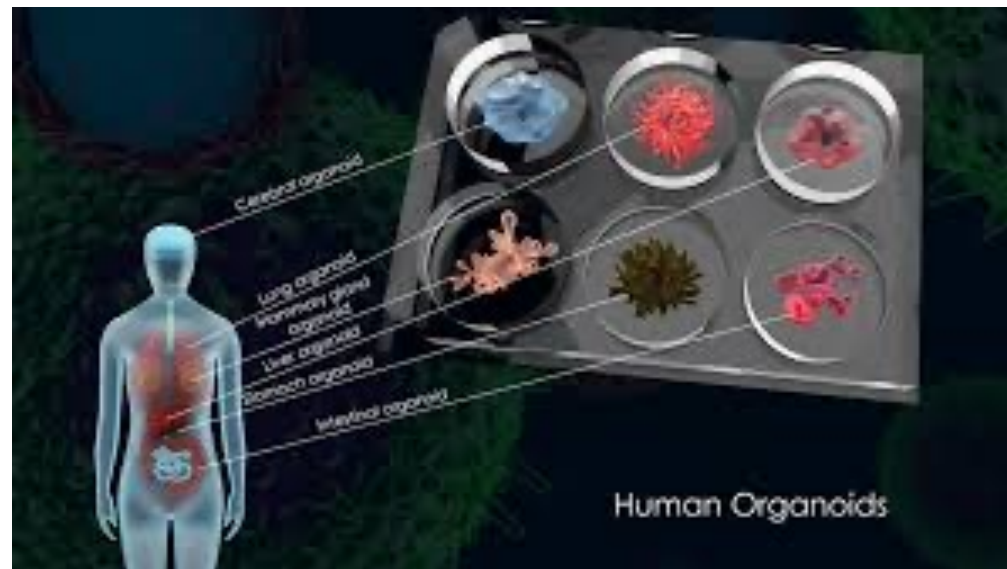


Stages of clinical trials



DOPPL

- Doppl SA is a leader in engineering industry-standard organoids



Guest speakers

- Dr. Dominik Schelshorn



- Dr. Yves Kremer



- Dr. Jan Romano de Gea

GERMION

- Angela Madurga



Guest speakers

- Dr. Iwan Maerki
- Alessandro *Fulciniti*
- Dr. Miguel Payro
- Dr. Hannah Kleyer
- Dr. Tommaso Mattiolo
- Dr. Matthias Tinzl-Zechner



SENSORA



Nestlé

Lonza



Nestlé

Guest speakers

- Alessandro Fulciniti

SENSORA

- Julien Grogg, MSc



MaxiVAX

- Dr. Daniel Blessing

HAYA
Therapeutics

- Dr. Romain Gosselin

CHUV

Exercises

- Short summaries of the last lesson
- Exercises via Moodle/Company presentations
- Quiz in class

No classes

- 20. Oct - 24. Oct
- No class on Wednesday Oct. 22

Exam

- Written exam, duration 3 hours (January 2026)

Biotechnology Lab

Code: [ChE-433](#)

- Start: Spring semester 2026



Biotechnology Lab

Code: [ChE-433](#)

- Start: Spring semester 2026



Biotechnology Lab

Code: [ChE-433](#)



Biotechnology Lab

Code: ChE-433



Questions?