Master of Science (M.Sc.)
in
Biotechnology
(Genetic Engineering and Computational Biology)

Combination of distance learning and at-facility-study

For holders of bachelors with background either in
- Biology, Chemistry, etc. or
- Computer Engineering etc.

Study Program

MEGBI Education Department
2009

Institute for Genetic Engineering, Ecology and Health (IGEEH)
Karlsruhe, Germany, http://www.zgoeg.de

Middle East Genetics and Biotechnology Institute (MEGBI)
Tripoli, Lebanon, www.zgoeg.de/MEGBI

In cooperation with Jinan University, Tripoli, www.jinan.edu.lb

بسم الله الرحمن الرحيم

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Author of Document:
Samir Mourad, M.Sc. (Computer Science) M.Sc. (Electrical Engineering), email: mourad@zgoeg.de, Tel. 00961 70 196048 (Lebanon) or 0049 (0)160 440 3852 (Germany)

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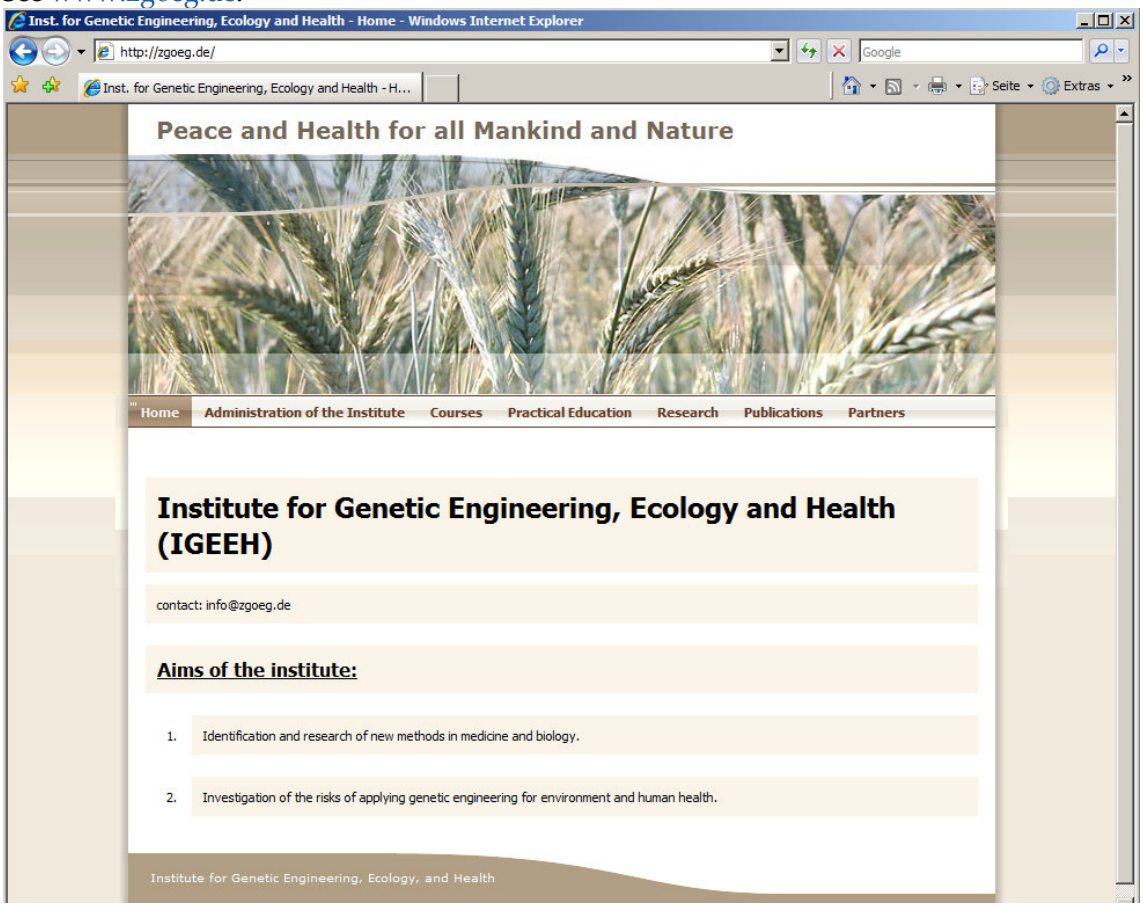
1 The institution

1.1 Stucture of the German association „Verein für Gentechnik, Ökologie und Gesundheit (VGÖG) e.V.“ (Institute of Genetic Engineering, Ecology and Health – IGEEH)

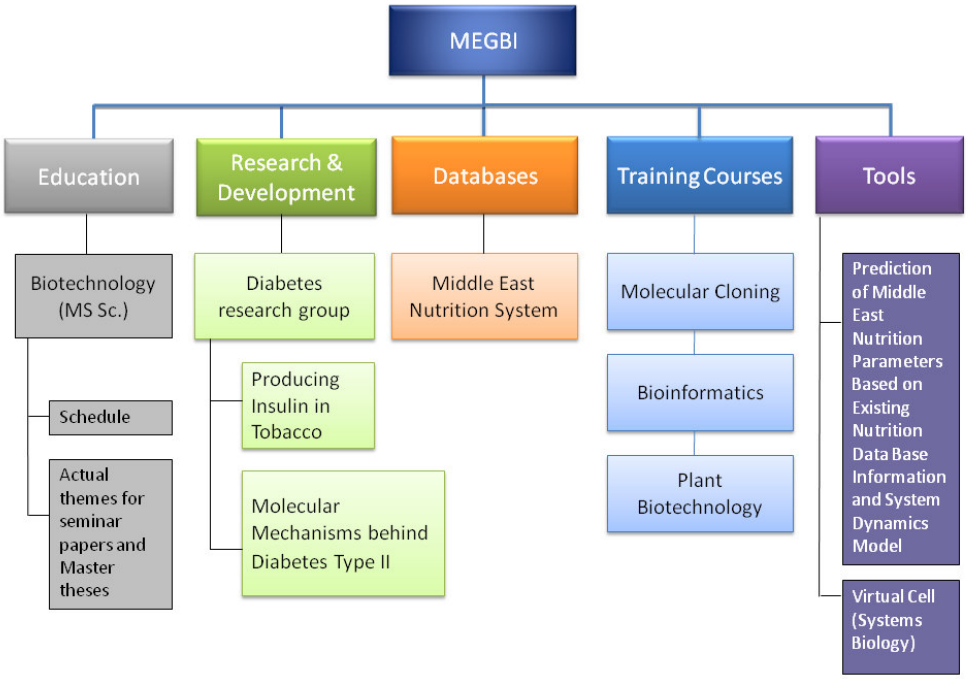
See www.zgoeg.de:



Chairman of IGEEH: Samir Mourad (MS Sc. in Computer Science, MS Sc. in Electrical Engineering)

1.2 Stucture of Middle East Genetics and Biotechnology Institute (MEGBI)

MEGBI is the Lebanese branch of the German association „Verein für Gentechnik, Ökologie und Gesundheit e.V:“ (Institute of Genetic Engineering, Ecology and Health – IGEEH)
See www.zgoeg.de/MEGBI



2 General Information about the Master Program in Biotechnology

The Master Program consists of 4 semesters (two years). There are theoretical parts which can be learned at home, and practical parts which have to be done at MEGBI facility (currently in Jinan University complex, Tripoli, Lebanon). For the theoretical parts the students have only to come to the examines. The Master Program is suitable for
holders of bachelor in computer sciences or engineering sciences (BS Eng.)
holders of bachelor in chemistry, biology or similar sciences (BS Nat. Sc.)

2.1 Examines

Examines can be done two times in the year – in October (after summer semester) and in March (after winter semester). The following list describes the facilities where the examines for the study can be done:

City	Institution	Tel./email
Tripoli, Lebanon	Jinan University complex	00961 70 196048
Karlsruhe, Germany	VGÖG e.V. (IGEEH), Gerwigstr. 43, D-76131 Karlsruhe, Germany	info@zgoeg.de

But the students can also contact local institutions at their home city and ask them if they want to cooperate with MEGBI to supervise examines. In this case please contact the MEGBI administration.

2.2 Costs

Theoretical courses per correspondence (exams at MEGBI site in Tripoli or at IGEEH site in Karlsruhe, Germany), practical courses at MEGBI site in Tripoli
Duration: 4 semesters (2 years), **300 USD per year**

3 FAQs („Frequently asked questions“)

3.1 Begin of the study

The begin of the semester is October and April.
But every one can take part in the study at any time, only the examines and the pryctical parts have specific points of time.

3.2 Inscription

Per Email: info@zgoeg.de

3.3 Further questions

Per Email: info@zgoeg.de

4 Study plan

Block	*Courses*	*Credits*
Chemistry + Biology (Theory) Weight: 25,5/100	Biochemistry	3
	Microbiology I + II	3 + 3 = 6
	Molecular Biology I + II	3 + 3 =6
	Classical Genetics	1,5
	Biotechnology and Genetic Engineering	3 + 3 =6
	Pharmacology and Toxicology	3
Computer Science + Bioinformatics (Theory) Weight: 19,5/100	Life Science Databases and Analysis Tools	1,5
	Basics of Informatics I – III	3 + 3 + 1,5
	Molecular Modeling	3
	Immunological Bioinformatics	3
	Combinatorial Optimization	1,5
	Software Engineering	3
	Object Oriented Programming (in C++ and Java)	3
	Relational Databases	1,5
Bioinformatics Laboratory (Practical Course) Weight: 4,5/100	Working with Databases	1,5
	Programming of Bioinformatic Tools	1,5
	Working with Molecular Modeling Tools	1,5
Molecular Biology Laboratory (Practical Course) Weight: 4,5/100	Molecular Cloning	3
	Plant genetic engineering	1,5
Management (Theory) Weight: 6/100	Project Management	1,5
	Business Planning and Finacial Controlling	1,5
	Safety Regulations in Genetic Engineering	1,5
	Strategic Research Planning	1,5
Research Work Weight: 20/80	Master thesis (the whole 4th semester)	20
		Total: 80

Each semester an average of 20 credits can be done.

5 Outline and Content of courses

5.1 Chemistry + Biology (Theory)

5.1.1 Biochemistry

5.1.1.1 Outline (Short Description)

Biochemistry is the study of the chemical processes in living organisms. It deals with the structure and function of cellular components, such as proteins, carbohydrates, lipids, nucleic acids, and other biomolecules.
Although there are a vast number of different biomolecules, many are complex and large molecules (called *polymers*) that are composed of similar repeating subunits (called *monomers*). Each class of polymeric biomolecule has a different set of subunit types.[1] For example, a protein is a polymer whose subunits are selected from a set of 20 or more amino acids. Biochemistry studies the chemical properties of important biological molecules, like proteins, in particular the chemistry of enzyme-catalyzed reactions.
The biochemistry of cell metabolism and the endocrine system has been extensively described. Other areas of biochemistry include the genetic code (DNA, RNA), protein synthesis, cell membrane transport, and signal transduction.

5.1.1.2 Content

Preface
WHY CHEMICAL LOGIC?
UPDATES
INTRODUCTION TO BIOCHEMISTRY
BIOCHEMISTRY/MOLECULAR BIOLOGY DICTIONARIES
REVIEW: THE CELL
PERMISSIONS

Chapter 1: LIPID STRUCTURE
Lipid Structure
Lipids in Water : Structure
Dynamics of Membrane Lipids
SUPPLEMENT: MOLECULAR MECHANICS AND DYNAMICS
REVIEW THERMODYNAMICS
Lipids in Water: Thermodynamics
Why do Single Chain Amphiphiles form Micelles not Bilayers, and Double Chain Amphiphiles from Bilayers and not Micelles?
Lipids as Biological Signals
Lipid Structure: Literature Learning Module

Chapter 2: PROTEIN STRUCTURE
The Structure and Property of Amino Acids
Composition, Sequence and Conformational Analyis of Proteins;
Understanding Protein Conformation
Proteins Folding - In Vivo and In Vitro
Laboratory Determination of ΔG^{o} for Protein Folding/Unfolding
Thermodynamics and IMF's in Protein Stability

Predicting Protein Properties Using Computational Biology and Bioinformatics - Proteomics
Protein Aggregates - Not Just Junk
Protein Structure: Literature Learning Module

Chapter 3: CARBOHYDRATES
Monosaccharides and Disssacharides
Complex Oligosaccharides
Jeopardy | (scrambled list of all Jeopardy answers for which you supply the correct question)
Glycoproteins: Biosynthesis and Function

Chapter 4: DNA, GENOMICS, AND PROTEOMICS
The Structure of DNA
The Central Dogma of Biology
The Language of DNA
Genomes and Other Omes (not Gnomes)

Chapter 5: BINDING
Reversible Binding I: Equations and Curves
Reversible Binding II: Experimental Binding Curves, Kd, and Error Analysis
A Model Binding System: Myoglobin. Hemoglobin, and Dioxygen
Binding and the Control of Gene Transcription:
New Methods in Drug Development
Binding: Literature Learning Module

Chapter 6: TRANSPORT AND KINETICS
Passive and Facilitated Diffusion
Steady State and Rapid Equilibrium Kinetics
Models of Enzyme Inhibition
More Complicated Enzymes
Transport and Kinetics: Literature Learning Module

Chapter 7: CATALYSIS
REVIEW: ORGANIC CHEMISTRY
Methods of catalysis
Mechanisms of enzyme-catalyzed reactions
Cofactors and Electron Pushing: Sources and Sinks
Enzyme catalyzed reactions in organic solvents
Ribozymes and the RNA World
Catalysis: Literature Learning Module

Chapter 8: OXIDATION/PHOSPHORYLATION
The Chemistry of Dioxygen
Biological Oxidation Reactions - Dehydrogenases, Mono and Dioxygenases, and Oxidases
ATP and Oxidative Phosphorylation Reactions
Photosynthesis: The Light Reaction
Oxidation/Phosphorylation: Literature Learning Module

Chapter 9: SIGNAL TRANSDUCTION

Energy Transduction: Uses of ATP
Signal Transduction: Neurochemistry
Signal Transduction at Cell Membranes: Protein Kinases/Phosphatases
Apoptosis - Programmed Cell Death and Signal Transduction
Memory and Learning in Aplysis

5.1.1.3 Literature

Free web books:

- http://employees.csbsju.edu/hjakubowski/classes/ch331/bcintro/default.html
- http://en.wikibooks.org/wiki/Biochemistry
- See http://www.argosbiotech.de/600/textbooks/molbiol.htm
- Berg, Tymoczko, **Stryer**, Biochemistry, 5th ed., as free online version: http://bcs.whfreeman.com/biochem5/

5.1.2 Microbiology I + II

5.1.2.1 Outline (Short Description)

Microbiology is the study of organisms that at some point in their life exist as single cells and contain a nucleic acid genome that can replicate. Many organisms fall into this definition including algae, fungi, protozoa, bacteria and archaea. Together these organisms have a profound impact on the biosphere, making up the majority of life both in number and total mass. Many illnesses are caused by infection with microbes and understanding these infections has lead to cures and better treatments. The emergence of new infectious agents will spur continued interest in microbiology. Many more microbes grow harmlessly in the environment, taking advantage of chemicals and/or sunlight to grow. Research into these microbes has also helped us understand the basic framework of life and revealed the basic fundamental rules that govern living systems. In the past microbes have been used in experiments to answer many scientific questions and they will continue to serve as excellent

tools of inquiry in the future. A significant number of these discoveries have lead to important applications in many areas of human endeavor.[1]
The first part of this course is an overview to general microbiology.
The rest of the course is the field of medical microbiology:
IMMUNOLOGY, BACTERIOLOGY, VIROLOGY, PARASITOLOGY, MYCOLOGY, INFECTIOUS DISEASE

5.1.2.2 Content

1. Overview: Biology of Microorganisms (have an idea about the chapter titles of "The Microbial World"[2], see http://www.microbiologytext.com/ (only some chapters are free) or "Brock Biology of Microorganisms").

Chapter 1 The Relevance and History of Microbiology , see
Chapter 2 Cell structure and organization, see
Chapter 3 Viral Structure and function
Chapter 4 The Central Dogma
Chapter 5 Microbial Nutrition
Chapter 6 Microbial Growth
Chapter 7 Control of Microbes
Chapter 8 Metabolism
Chapter 9 Photosynthesis
Chapter 10 Anabolism
Chapter 11 Regulation of Metabolism
Chapter 12 Genomics and genetics
Chapter 13 Bacterial Viruses
Chapter 14 Host-Microbe Interactions
Chapter 15 Animal defenses against microbes,
Chapter 16 Treatment and prevention of disease

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[1] Description is from summary of first chapter of "The Microbial World" (http://www.microbiologytext.com/index.php?module=Book&func=displayarticle&art_id=35)
[2] for content overview of "The Microbial World" see Apprendix of this study information.

Chapter 17 Bacterial Pathogens
Chapter 18 Eukaryotic Pathogens
Chapter 19 Viral Pathogens
Chapter 20 Evolution: Implications for microbiology
Chapter 21 Eukaryotic Microbial Diversity
Chapter 22 Archaeal Diversity
Chapter 23 Bacterial Diversity
Chapter 24 Microbial Ecology ,
Chapter 25 Applied Microbiology

2. IMMUNOLOGY

Immunology is the study of our protection from foreign macromolecules or invading organisms and our responses to them. These invaders include viruses, bacteria, protozoa or even larger parasites. In addition, we develop immune responses against our own proteins (and other molecules) in autoimmunity and against our own aberrant cells in tumor immunity.

Our first line of defense against foreign organisms are barrier tissues such as the skin that stop the entry of organism into our bodies. If, however, these barrier layers are penetrated, the body contains cells that respond rapidly to the presence of the invader. These cells include macrophages and neutrophils that engulf foreign organisms and kill them without the need for antibodies. Immediate challenge also comes from soluble molecules that deprive the invading organism of essential nutrients (such as iron) and from certain molecules that are found on the surfaces of epithelia, in secretions (such as tears and saliva) and in the blood stream. This form of immunity is the innate or non-specific immune system that is continually ready to respond to invasion.

A second line of defense is the specific or adaptive immune system which may take days to respond to a primary invasion (that is infection by an organism that has not hitherto been seen). In the specific immune system, we see the production of antibodies (soluble proteins that bind to foreign antigens) and cell-mediated responses in which specific cells recognize foreign pathogens and destroy them. In the case of viruses or tumors, this response is also vital to the recognition and destruction of virally-infected or tumorigenic cells. The response to a second round of infection is often more rapid than to the primary infection because of the activation of memory B and T cells. We shall see how cells of the immune system interact with one another by a variety of signal molecules so that a coordinated response may be mounted. These signals may be proteins such as lymphokines which are produced by cells of the lymphoid system, cytokines and chemokines that are produced by other cells in an immune response, and which stimulate cells of the immune system.

CHAPTER ONE INNATE (NON-SPECIFIC) IMMUNITY	The non-specific or innate immune system: Anatomical barriers, secretory molecules and cellular components
CHAPTER TWO COMPLEMENT	The complement system consists of more than 20 proteins in serum capable of lysing antibody-coated cells
CHAPTER THREE ANTIGENS	Antigens are substances that induce a specific immune response and subsequently react with the products of a specific immune response

CHAPTER FOUR THE STRUCTURE AND FUNCTION OF IMMUNOGLOBULINS - ANTIBODIES	Immunoglobulins are protein molecules that are produced by plasma cells in response to an antigen and which function as antibodies.
CHAPTER FIVE CLASSES OF IMMUNOGLOBULINS: ISOTYPES AND ALLOTYPES	Isotypes are antigenic determinants that characterize classes and subclasses of antibody heavy chains and types and subtypes of light chains
CHAPTER SIX THE GENETICS OF IDIOTYPES	The organization and expression of the immunoglobulin gene families
CHAPTER SEVEN ANTIBODY-ANTIGEN REACTIONS AND TEST FOR THESE REACTIONS	The nature of antigen/antibody reactions - Antibody affinity and avidity - The basis for antibody specificity and cross reactivity - The principles of commonly used tests for antigen/antibody reactions
CHAPTER EIGHT ANTIBODY FORMATION	Characteristics of the specific immune response - Primary and secondary antibody responses - The molecular events involved in class switching and membrane immunoglobulin expression
CHAPTER NINE CELLS INVOLVED IN IMMUNE RESPONSES	An overview of the types of cell interactions and molecules required for specific immunity.
CHAPTER TEN MAJOR HISTOCOMPATIBILITY COMPLEX	The structure and function of cell surface molecules involved in immune cell interactions: major histocompatibility complex molecules, the T cell receptor (TCR), the CD3 complex, and accessory and costimulatory molecules.
CHAPTER ELEVEN RESPONSE TO ANTIGEN	Different types of antigen recognized by T and B cells. Cell biology and significance of different pathways for antigen processing and presentation by class I and class II MHC. Experimental basis for self MHC restriction. Role of the thymus in determining T cell receptor repertoire. Superantigens as anomalous antigens
CHAPTER TWELVE CELL-MEDIATED IMMUNITY Cell-cell interactions in specific immune responses	Helper T cell-B cell interactions for antibody formation against hapten-conjugated proteins and complex proteins. Thymus- independent antigens

CHAPTER THIRTEEN IMMUNOREGULATION	Subpopulations of helper T cells: Th1 and Th2. Cytokines and class (isotype) switching. Cytokine activation of macrophages and functions. Maturation and mechanism of killing by cytolytic T lymphocytes (CTL). Characteristics of killing mechanisms of other cytolytic cells Immunoregulatory processes
CHAPTER FOURTEEN IMMUNIZATION	Passive and active immunization. Applications and problems of artificial and natural means of immunization. Modern approaches to immunization
CHAPTER FIFTEEN MAJOR HISTOCOMPATIBILITY COMPLEX - GENETICS AND ROLE IN TRANSPLANTATION	MHC loci and their products. Genetic basis of MHC heterogeneity in populations. Distribution of MHC molecules on different cells. How MHC antigens are detected (tissue typing). Role of MHC in Transplantation, immune functions and disease
CHAPTER SIXTEEN TOLERANCE AND AUTOIMMUNITY	Concept and significance of tolerance. Factors that determine induction of tolerance. Mechanism of tolerance induction. Concepts of autoimmunity and disease. Features of major autoimmune diseases. Theories of etiology of autoimmune disease
CHAPTER SEVENTEEN HYPERSENSITIVITY STATES	Classification of hypersensitivity reactions. Diseases associated with hypersensitivity reactions. Mechanisms of damage in hypersensitivity reactions. Methods for diagnosing conditions due to hypersensitivity. Modes of treating disease due to hypersensitivity and their rationale
CHAPTER EIGHTEEN TUMOR IMMUNOLOGY	Evidence for immune reactivity to tumor. Changes in cellular characteristics due to malignancy. Host components which affect tumor progression. Tumor cell components which protect it from the immune system. Rationale for tumor immunotherapy and know the approaches
CHAPTER NINETEEN IMMUNODEFICIENCIES	Primary and secondary immunodeficiencies. Immunodeficiencies in AIDS and other conditions. Major primary immunodeficiencies and their features. Relationship between site of lesion and resulting immunodeficiency. Diagnostic tests for different immunodeficiencies

3. BACTERIOLOGY

Bacteria, along with blue-green algae, are prokaryotic cells. That is, in contrast to eukaryotic cells, they have no nucleus; rather the genetic material is restricted to an area of the cytoplasm called the nucleoid. Prokaryotic cells also do not have cytoplasmic compartment such as mitochondria and lysosomes that are found in eukaryotes. However, a structure that is found in prokaryotes but not in eukaryotic animal cells is the cell wall which allows bacteria to resist osmotic stress. These cell walls differ in complexity and bacteria are usually

divided into two major groups, the gram-positive and gram-negative organisms, which reflect their cell wall structure. The possession of this cell wall, which is not a constituent of animal cells, gives rise to the different antibiotic sensitivities of prokaryotic and eukaryotic cells. Prokaryotes and eukaryotes also differ in some important metabolic pathways, particularly in their energy metabolism and many bacterial species can adopt an anaerobic existence.

In this section, we shall look at the structure of typical bacterial cells and the ways in which they liberate energy from complex organic molecules. Various aspects of bacterial structure and metabolism are the basis of bacterial identification and taxonomy. Bacteria are constantly accumulating mutational changes and their environment imposes a strong selective pressure on them. Thus, they constantly and rapidly evolve. In addition, they exchange genetic information, usually between members of the same species but occasionally between members of different species. We shall see how this occurs.

Bacteria have parasites, the viruses called bacteriophages which are obligate intracellular parasites that multiply inside bacteria by making use of some or all of the host biosynthetic machinery. Eventually, these lyze the infected bacterial cell liberating new infection phage particles. The interrelationships of bacteria and the phages will be investigated.

Finally, we shall look at general aspects of bacterial pathogenesis, that is how bacteria damage the host organism, before surveying a variety of human diseases that are caused by bacteria.

CHAPTER ONE The Bacterial Cell	An introduction to the structure of the bacterial cell
CHAPTER TWO Culture and Identification of Infectious Agents	Bacterial identification in the diagnostic laboratory versus taxonomy. Taxonomic characterization of bacteria. Approaches to rapid diagnosis
CHAPTER THREE Nutrition, Growth and Energy Metabolism	Anaerobic and aerobic metabolism. Metabolism of sugars and fatty acids
CHAPTER FOUR Cell Envelope, spores and Macromolecular Biosynthesis	Structure and synthesis of the cell walls of gram-positive and gram negative bacteria
CHAPTER FIVE Antibiotics - Cell Envelope	The mode of action of beta-lactam antibiotics
CHAPTER SIX Antibiotics - Protein Synthesis, Nucleic Acid Synthesis and Metabolism	The mode of action of antibacterial chemotherapeutic agents. Antibiotic susceptibility testing. The mechanisms by which bacteria express resistance to antibiotics
CHAPTER SEVEN Bacteriophage	The general composition and structure of bacteriophage. The infectious process and the lytic multiplication cycle. The lysogenic cycle and its regulation
CHAPTER EIGHT Exchange of Genetic Information	The mechanisms of gene transfer in bacteria. The nature of transposable genetic elements and plasmids. The significance of gene transfer, transposable genetic elements and plasmids

CHAPTER NINE Genetic Regulatory Mechanisms	The structure and transcription of bacterial genes. The molecular mechanisms that bacteria use to regulate gene activity. Inducible and repressible operons. The molecular mechanisms involved in catabolite repression and attenuation. The ways bacteria regulate enzyme activity
CHAPTER TEN General Aspects of Bacterial Pathogenesis	Exotoxins and endotoxins, transmission, adhesion, immunopathology
CHAPTER ELEVEN Enterobacteriaceae	Enterobacteriaceae, Vibrio, Campylobacter and Helicobacter
CHAPTER TWELVE Streptococci	Groups A, B and D streptococcus, pathogenesis, diagnosis
CHAPTER THIRTEEN Streptococcus pneumoniae and Staphylococci	Streptococcus and pneumonia, Staphylococcus infections, food poisoning, toxic shock
CHAPTER FOURTEEN Neisseria and Spirochetes	Syphilis, Lyme disease, leptospirosis, gonorrhea, meningitis
CHAPTER FIFTEEN Anaerobes and Pseudomonas - Opportunistic Infections	Clostridia, gas-gangrene, tetanus, botulism, pseudomonads
CHAPTER SIXTEEN Mycobacteria, Corynebacteria and Legionella	Mycobacterial diseases: tuberculois, Legionaires' disease, diphtheria, leprosy
CHAPTER SEVENTEEN Zoonoses	Listeria, Francisella, Brucella, Bacillus and Yersinia Plague, Anthrax, Brucellosis, Listeriosis
CHAPTER EIGHTEEN Bordetella and Haemophilus	Whooping cough, Hib disease
CHAPTER NINETEEN Mycoplasma and Uroplasma	The morphological and physiological characteristics of the mycoplasmas. Pathogenesis of mycoplasma infections. Clinical syndromes associated with and the epidemiology, diagnosis and treatment of mycoplasma infections
CHAPTER TWENTY Chlamydia	Developmental cycle of chlamydia. Pathogenesis, epidemiology and clinical syndromes associated with chlamydia.
CHAPTER TWENTY ONE Rickettsia	Interactions of the Rickettsia, Ehrlichia, Coxiella and Bartonella with the host cell. Pathogenesis, epidemiology and clinical syndromes associated with Rickettsia, Ehrlichia, Coxiella and Bartonella. Methods for treatment, prevention and control of rickettsial diseases.

4. VIROLOGY

Virology is the study of viruses, complexes of nucleic acids and proteins that have the capacity for replication in animal, plant and bacterial cells. To replicate themselves, viruses usurp functions of the host cells on which they are parasites. The viral parasite causes changes in the cell, particularly its antigenicity; moreover, directing the host cell's metabolism to the production of new virus particles may cause cellular death. Virally-induced cell death, changes in antigenicity and the response of the host to the presence of the virus leads to the manifestations of viral disease.
Viruses come in two basic types, those that have a genome of DNA and those that have a genome of RNA.

CHAPTER ONE DEFINITIONS, CLASSIFICATION, MORPHOLOGY AND CHEMISTRY	An introduction to viruses, their nature, structure and classification
CHAPTER TWO VIRUS REPLICATION STRATEGIES	Principal events involved in replication: Adsorption, penetration, uncoating nucleic acid and protein synthesis, assembly, maturation and release
CHAPTER THREE DNA VIRUS REPLICATION STRATEGIES	Replicative strategies employed by animal DNA viruses. Identification of virus prototypes associated with different DNA virus replication schemes
CHAPTER FOUR RNA VIRUS REPLICATION STRATEGIES	Replicative strategies employed by animal RNA viruses. Identification of virus prototypes associated with different RNA virus replication schemes
CHAPTER FIVE VIRAL GENETICS	Introduction to animal virus genetics
CHAPTER SIX ONCOGENIC VIRUSES	Viruses that cause cancer and the mechanisms by which they do so: DNA cancer viruses (polyoma, herpes, papilloma, hepatitis, adenovirus). RNA cancer viruses (retroviruses)
CHAPTER SEVEN HUMAN IMMUNODEFICIENCY VIRUS	The biology of the virus that causes AIDS
CHAPTER EIGHT MOLECULAR APPROACHES TO THE DEVELOPMENT OF VIRAL VACCINES	History of vaccines especially smallpox and polio. New methods: subunit vaccines, anti-idiotype and DNA vaccines
CHAPTER NINE VIRAL CHEMOTHERAPY	Drugs that have been used against viruses: Nucleoside analogs, reverse transcriptase inhibitors, protease inhibitors

CHAPTER TEN - PART ONE PICORNAVIRUSES: ENTEROVIRUSES **CHAPTER TEN - PART TWO** PICORNAVIRUSES: RHINOVIRUSES **CHAPTER TEN - PART THREE** REPLICATION OF POLIO AND OTHER PICORNAVIRUSES	Picornaviruses: Small RNA viruses that cause infections of the alimentary tract including polio (enteroviruses) and of the upper respiratory tract (rhinoviruses)
CHAPTER ELEVEN HERPESVIRUS	The structure of herpes viruses. The diseases caused by herpes simplex types 1 and 2, cytomegalovirus, varicella-zoster virus, Epstein-Barr virus and other herpes types.
CHAPTER TWELVE VIRUS-HOST INTERACTIONS	Host specific and nonspecific defense mechanisms involved in resistance to and recovery from virus infections. Role of interferon in viral infections. Mechanisms by which interferon exerts its antiviral activity. Contributions of various host defense mechanisms in viral infections
CHAPTER THIRTEEN INFLUENZA VIRUS	Influenza virus structure and properties. Viral pathogenesis and disease, genetics, epidemiology, prevention and treatment
CHAPTER FOURTEEN Mumps, Measles	Structure and properties of measles and mumps viruses. Viral pathogenesis and disease, epidemiology, prevention and treatment
CHAPTER FIFTEEN RUBELLA	Structure and properties of rubella virus. German Measles pathogenesis and disease, epidemiology, prevention and treatment
CHAPTER SIXTEEN PARAINFLUENZA, RESPIRATORY SYNCYTIAL AND ADENO VIRUS	Viruses that cause respiratory disease
CHAPTER SEVENTEEN ROTAVIRUSES AND OTHER AGENTS OF VIRAL GASTROENTERITIS	Viruses that cause alimentary tract infections
CHAPTER EIGHTEEN HEPATITIS VIRUSES	The structure and replication of hepatitis A to E
CHAPTER NINETEEN - PART ONE HEPATITIS A AND E (Infectious and enteric non-A, non- B) **CHAPTER NINETEEN - PART TWO** HEPATITIS B, C, D AND G (Serum hepatitis, non A, non-B hepatitis and Delta Antigen)	The diseases that are caused by the hepatitis viruses
CHAPTER TWENTY RABIES	Rhabdoviruses and the disease of rabies

CHAPTER TWENTY ONE ARBOVIRUSES	Arbovirus encephalitis, febrile and hemorrhagic disease. Rodent borne hemorrhagic fever, hemorrhagic fever with renal syndrome and hantavirus pulmonary syndrome. Other filovirus-associated hemorrhagic fevers
CHAPTER TWENTY TWO VIRAL DISEASES TRANSMITTED BY VERTEBRATES	
CHAPTER TWENTY THREE CONVENTIONAL AND UNCONVENTIONAL AGENTS (SLOW VIRAL DISEASES)	Slow viral diseases of the central nervous system. Progressive multifocal leukoencephalopathy. Sub-acute sclerosing panencephalitis (measles virus) Prion diseases: Kuru, Creutzfeld-Jakob disease
CHAPTER TWENTY FOUR BACTERIOPHAGE	Structure of bacteriophage. The infectious process and the lytic multiplication cycle. The lysogenic cycle and ist regulation.
CHAPTER TWENTY FIVE CORONAVIRUSES - COLDS AND SARS	The viruses that cause about one third of common colds and the newly described severe acute respiratory syndrome
CHAPTER TWENTY SIX PARVOVIRUSES AND FIFTH DISEASE	Childhood rash disease

5. PARASITOLOGY

Parasites are organisms that obtain food and shelter by living on or within another organism. The parasite derives all benefits from association and the host may either not be harmed or may suffer the consequences of this association, a parasite disease. The parasite is termed obligate when it can live only in association with a host or it is classified as facultative when it can live both in or on a host as well as in a free form. Parasites which live inside the body are termed endoparasites whereas those which exist on the body surface are called ectoparasites. Parasites that cause harm to the host are pathogenic parasites while those that benefit from the host without causing it any harm are known as commensals.
In this section, we shall investigate a variety of parasites of medical importance ranging in size from protozoans such as the amebae and trypanosomes to multicellular worms and flukes. We shall also look at some arthropod parasites. Diseases caused by these organisms include amebic dysentary, sleeping sickness, malaria, river-blindness and elephantiasis.

CHAPTER ONE Intestinal and Luminal Protozoa	Amebiasis (amebic dysentery, amebic hepatitis), Giardiasis (lambliasis): Epidemiology, morbidity and mortality. Morphology of the organisms. Life cycles, hosts and vectors. Disease, symptoms and pathogenesis. Diagnosis Prevention and control
CHAPTER TWO Blood Protozoa	Trypanosomiasis, Leishmaniasis, Malaria, Babesiosis, Toxoplasmosis, Pneumocystsis pneumonia

CHAPTER THREE The Molecular Biology of Trypanosomiasis	African and American Trypanosomes. The diseases that they cause. The molecular basis of antigen variation. The mode of action of trypanocidal drugs
CHAPTER FOUR Nematodes	Intestinal helminths: Epidemiology, morbidity and mortality. Morphology of the organism. Life cycle, hosts and vectors. Disease, symptoms and pathogenesis. Diagnosis. Prevention and control
CHAPTER FIVE Cestodes	The tapeworms: Their epidemiology and life cycles. The diseases that they cause: diagnosis, prevention and control
CHAPTER SIX Trematodes	Schistosomiasis (Bilharziasis), Fasciolopsis buski (Giant intestinal fluke), Clonorchis sinensis (Chinese Liver Fluke), Paragonimus westermani (Lung Fluke)
CHAPTER SEVEN PART ONE Arthropods	Fleas, lice, chiggers, bot flies and ticks
CHAPTER SEVEN PART TWO Ticks	

6. MYCOLOGY

Fungi are eukaryotic organisms that do not contain chlorophyll, but have cell walls, filamentous structures, and produce spores. These organisms grow as saprophytes and decompose dead organic matter. There are between 100,000 to 200,000 species depending on how they are classified. About 300 species are presently known to be pathogenic for man. There are four types of mycotic diseases:
1. Hypersensitivity - an allergic reaction to molds and spores.
2. Mycotoxicoses - poisoning of man and animals by feeds and food products contaminated by fungi which produce toxins from the grain substrate.
3. Mycetismus- the ingestion of preformed toxin (mushroom poisoning).
4. Infection
In this section, we shall be concerned only with the last type.

CHAPTER ONE Introduction	Classification of fungi, morphology, diagnosis, treatment, clinical classification of mycoses
CHAPTER TWO Actinomycetes	Actinomycosis, nocardiosis, streptomycetes
CHAPTER THREE Yeasts	Candidiasis, Cryptococcosis
CHAPTER FOUR Superficial Mycoses	Ringworm (Tinea): Ecology, etiology, therapy
CHAPTER FIVE Filamentous Fungi	Chromoblastomycosis, mycetomas (fungous tumors), zygomycosis, aspergillosis
CHAPTER SIX Dimorphic Fungi	Blastomycosis, histoplasmosis, coccidioidomycosis, paracoccidioidomycosis, Sporotrichosis
CHAPTER SEVEN Opportunistic mycoses	Diseases that occur in the immunocompromised patient

7. INFECTIOUS DISEASE

The role of specific microorganisms in infectious disease.
CHAPTER ONE Introduction
CHAPTER TWO Upper respiratory tract infections and infections of the head and neck
CHAPTER THREE Lower respiratory tract infections
CHAPTER FOUR Infections of the skin and its appendages, muscle and bone
CHAPTER FIVE Mycobacterial infections
CHAPTER SIX Gastrointestinal tract infections
CHAPTER SEVEN Urinary tract infections
CHAPTER EIGHT Sexually transmitted diseases
CHAPTER NINE Sepsis
CHAPTER TEN central nervous system infections
CHAPTER ELEVEN Infectious disease emergencies

8. Microbial Methods

26-2 Culturing Bacteria
26-3 Counting microorganisms
26-4 Visualizing microbes
26-5 Microbial molecular biology
26-6 Gel electrophoresis
26-7 Restriction enzymes
26-8 Plasmids
26-9 Cloning
26-10 Transformation and electroporation
26-11 DNA sequencing
26-12 Genomics
26-13 DNA arrays (hybridization)

5.1.2.3 Literature

For Overview and Microbial Methods:

- Madigan, Matinko, Parker; Brock Biology of Microorganisms, 10th edition
- The Microbial World, see http://www.microbiologytext.com/ (only some chapters are free)

For Medical Microbial chapters (Immunology, Bacteriology, Virology, Parasitology, Mycology, Infectious disease):

- http://pathmicro.med.sc.edu/book/welcome.htm

5.1.3 Molecular Biology I + II

5.1.3.1 Outline

Molecular Biology describes the structures, genetics, interactions and processes in the cell at a molecular level. It includes "molecular genetics".

5.1.3.2 Content

1. Cells and Viruses - Overview

A: **Cellular Organization**

Prokaryotic Cells
Eukaryotic Cells

B: **Biomembranes**

Phospholipids
Cholesterol and Steroids
Glycoproteins and Glycolipids
Blood Group Antigens

C: **The Nucleus**

Chromosomes and Karyotype
Chromosome Numbers
Sex Chromosomes
Banding Pattern of Human Chromosomes

D: **Cytoplasmic Organelles**

E: **Viruses**

Baltimore Classification of Viruses
Virus Structure
The Life Cycle of Viruses
Mechanism of HIV Entry into the Host Cell

F: **Bacteriophages**

The Life Cycle of Lambda Phages

G: **Anthrax**

2. Protein Structure and Function

A: **Building Blocks - Amino Acids**

The Twenty Amino Acids of Proteins
pH and pK_a

B: **Peptides**

C: **Secondary Structure**

Hydrogen Bond
Alpha Helix
Beta Strand, Beta Sheet and Beta Barrel
Protein Motifs

D: **Three-Dimensional Structure**

E: **Enzymes**

Classification of Enzymes
Catalytic Mechanisms of Enzymes

F: **Membrane Proteins**

G-protein-Coupled Receptors
Immunoglobulin Family
Ion Channels
Transport Proteins
Membrane Attached Proteins

G: **Miscellaneous Proteins**

3. Nucleic Acids, Genomes and Proteomics

A: **Building Blocks - Nucleotides**

Cellular Nucleotides and Nucleosides
The Nucleic Acid Chain

B: **DNA Structure**

DNA's B Form, A Form and Z Form

C: **RNA Structure and Function**

Structure of tRNA
Ribosome
Ribozyme
Small RNA Molecules

D: **Chromatin Structure**

Histones and Nucleosomes
Conformation of Chromatin Fibers

E: **The Genetic Code**

Cracking the Genetic Code
mRNA
Order in the Genetic Code
Non-standard Genetic Codes

F: **Genes**

β-globin Gene and Gene Family
Duplicated Genes

G: **Repetitive DNA Sequences**

Tandem Repeats
Interspersed Repeats
Jefferson, Alleged Sons and Microsatellites

H: **Genomes and Proteomics**

The Genome of Hepatitis B virus
The HIV Genome

The *E. coli* Genome
The Yeast Genome
The Genomes of Mitochondria and Chloroplasts

Site of Interest: DNA Learning Center - From Cold Spring Harbor Lab.

4. Gene Transcription

A: **Overview of Gene Expression**

B: **Overview of Transcription**

RNA Polymerases

C: **Gene's Regulatory Elements**

Promoter
The *lac* Operon Promoter
The *IL-2* Promoter
Enhancer
Silencer
Response Elements

D: **Transcription Mechanisms in Prokaryotes**

Transcriptional Termination in Prokaryotes
Regulation of *lac* Operon Transcription
Activation of *glnA* Transcription by NTRC

E: **Transcription Mechanisms in Eukaryotes**

Assembly of the Pre-Initiation Complex
RNA processing: Introns, Exons and Splicing

F: **Motif Structures of Transcription Factors**

Zinc Finger
Helix-Turn-Helix
Leucine Zipper
Helix-Loop-Helix

G: **Histone Acetylation and DNA Methylation**

CREB Binding Protein (CBP) and p300
Transcriptional Regulation by Histone Acetylation and Deacetylation

H: **Regulation of Transcription Factors**

Regulation of *lac* Repressor
Regulation of λ Repressor (cI)
Regulation of NF-κB
p53

I: **Transcription of RNA Genes**

J: **Genomic Replications of Viruses**

Mechanism of Reverse Transcription
Generation of Retroviral Genomic RNA

5. Posttranscriptional Processes

A: **RNA Processing**

RNA Splicing
RNA Editing

B: **Nuclear Transport**

The Role of HIV rev Protein
NFAT, Calcineurin and Immunosuppression

C: **Synthesis of Proteins**

Initiation Signal of Protein Synthesis
Frameshift
Gene Overlapping
Translation by tRNA
Procedure of Protein Synthesis

D: **Sorting of Proteins**

Transport into Rough ER
Transport into and Across Golgi
Transport to Lysosome

E: **Synthesis of Lipids**

F: **Endocytosis and Exocytosis**

6. Cell Signaling and Apoptosis

A: **Overview**

B: **Signaling via Hydrophobic Molecules**

C: **Signaling via Ion Channels**

D: **Signaling via G-Protein-Coupled Receptors**

G Proteins
G Protein Effectors

E: **Signaling via Cell Surface Enzymes**

Receptor Tyrosine Kinases
Receptor Serine/Threonine Kinases
Non-receptor Tyrosine Kinases
Ras and Other Small G Proteins

F: **Intracellular Signaling**

Signaling by cAMP
Signaling by NF-κB
Signaling by STAT
The MAPK Signaling Pathway

G: **Apoptosis**

TRAIL
Mitochondria, Apoptosis and Aging

7. DNA Replication, Mutation and Repair

A: **Overview of DNA Replication**

B: **Mechanism of DNA Replication**

Synthesis of DNA

C: **Telomerase and Aging**

D: **Topoisomerases**

E: **Mutation and Consequences**

F: **Mutation Mechanisms**

Mutation by UV light
Mutation by Chemical Agents
Mutation by Replication Errors
DNA Methylation and CpG Island

G: **DNA Repair Mechanisms**

8. Cell Division and System Development

A: **Cell Cycle**

Initiation and Termination Mechanism of the S phase

B: **Mitosis**

MPF and the Initiation of Mitosis
Termination Mechanism of Mitosis

C: **Meiosis**

D: **DNA Recombination**

Homologous Recombination
The Holliday Model of DNA Crossover
Gene Conversion
Unequal Crossover
Site-specific Recombination

Transpositional Recombination

E: **Chromosome Abnormality**

F: **Mechanisms of Development**

Stem Cells

G: **Formation of Tissues**

H: **The Immune System**

Interleukins
Interferons
Tumor Necrosis Factors
Chemokines

9. Biotechnology and Bioinformatics (Introduction)

A: **DNA Cloning**

DNA Recombination Technology
Cloning Vectors

B: **Genomic Library and cDNA Library**

C: **Gel Electrophoresis**

D: **Blotting Methods and Applications**

E: **Polymerase Chain Reaction (PCR)**

F: **DNA Sequencing**

G: **Site-Directed Mutagenesis**

H: **Production of Recombinant Proteins**

I: **Organism Cloning**

J: **Bioinformatics**

K: **DNA Microarrays and SAGE**

Sites of interest: 2. Protocol Online; 2. Molecular Biology Protocols - From Highveld.com

10. Genes and Diseases

A: **Gene Mapping**

B: **Cloning Disease Genes**

C: **Gene Therapy**

D: **Cancer**

Breast Cancer
Cervical Cancer
Colorectal Cancer
Leukemia
Liver Cancer
Lung Cancer
Prostate Cancer
Skin Cancer

E: **Alzheimer's Disease**

F: **Obesity and Diabetes**

G: **Monogenetic Diseases**

H: **Other Diseases**

Allergy
Asthma
Atherosclerosis
Cardiomyopathy
Epilepsy
Essential Tremor
Hypertension
Long QT Syndrome
Osteoarthritis
Osteoporosis
Parkinson's Disease
Rheumatoid Arthritis

Site of interest: Online Mendelian Inheritance in Man (OMIM) - From NCBI

11. Molecular Mechanisms of Learning and Memory

A: **Introduction**

B: **Nerve Impulses**

C: **Ion Channels**

D: **Synaptic Transmission**

E: **Learning - Overview**

F: **The Pavlovian Conditioning**

G: **Hebbian Type of Learning**

H: **Holographic Memory**

I: **Comprehension**

5.1.3.3 Literature

- Molecular Biology Web Book[3], http://www.web-books.com/MoBio/
- Lodish et al., Molecular Cell Biology (MCB), 5th ed., free web version: http://bcs.whfreeman.com/lodish5e

5.1.4 Classical Genetics

5.1.4.1 Outline (Short Description)

The principles of inheritance in plants and animals are presented with special attention devoted to the specific aspects of human heredity. The goal of this course is to give the student a broad background in the science of heredity. The course includes the general topics of history of genetics, Mendelian genetics and population genetics.

5.1.4.2 Content

1. Overview of Genetics
2. Mendelian Inheritance
3. Reproduction and Chromosome Transmission
4. Extensions of Mendelian Inheritance
5. Linkage and Genetic Mapping
6. Genetic Transfer and Mapping in Bacteria and Bacteriophages
7. Non-Mendelian Inheritance
8. Population Genetics

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[3] Concise explanation of important concepts, Hundreds of links to free review articles for in-depth understanding.

5.1.4.3 Literature

Online free lectures:

- http://departments.ozarks.edu/msc/Biology/genlec.htm
- Other:
- Brooker, James. 1999. Genetics: Analysis and Principles. Benjamin Cummings Publishers, San Francisco, CA.

5.1.5 Biotechnology and Genetic Engineering

5.1.5.1 Outline

Biotechnology is one of the major technologies of the twenty-first century. Its wide-ranging, multi-disciplinary activities include recombinant DNA techniques, cloning and the application of microbiology to the production of goods from bread to antibiotics.

5.1.5.2 Content

1. Principles of Genetic Engineering
    - The DNA
    - Modification of DNA
    - Polymerase Chain Reaction (PCR)
    - Cloning in E.coli
    -
2. Microbial Systems
    - Gene expression in prokaryotes
    - Cloning in yeast
3. Cloning in higher systems
    - Gene expression in cell lines of mammals
    - Expression vectors for animal systems
    - Transgenesis
    - Gene therapy
    - Plant genetic engineering
4. Cell culture and fermentation
    - Biological Agent Production
    - Bioreactors
    - Biotransformation and enzyme reaction
    - Isolation and opening of cells
    - Isolation of biological agents
    - Renaturation of Proteins
    - Monoclonal Antibodies
5. Recombinant Agents
    - Requirements of EU to genetic engineered products
    - Biotechnological and genetic engineered production of insulin
    - Genetic engineered production of fibrinolytika and anticoagulancies

- Blood coagulation factors
- Genetic engineered erythropoetin preparations
- Desoxyribonucleases
- Cytokines
- Monoclonal and recombinant antibodies
- Inhibiting nuclein acids

6. Molecular Diagnostics

- Restriction fragment length polymorphism
- Mapping of the human genome
- Identification of genes causing inherited diseases
- Genetic diseases
- Molecular cancer diagnostic
- Diagnosis of infectious diseases
- DNA fingerprinting

7. Molecular Biological Approaches for Finding New Agents

- The hybrid vector system from yeast
- In-vitro-evolution: Construction of new agents by chance
- Molecular Biological Combinatorics
-

8. Safety Regulations for Genetic Engineering Facilities

5.1.5.3 Literature

- The content is from the German text book "Biotechnik Gentechnik".

- Basic Biotechnology[4], 3rd Edition , Edited by Colin Ratledge, *University of Hull,* Bjorn Kristiansen, *EU Biotech Consulting, Norway ,* **Paperback,** (ISBN-13: 9780521549585 | ISBN-10: 0521549582), DOI: 10.2277/0521549582
- For books in this field see: http://www.bio-link.org/books.htm
- **Genetic Engineering of Plants: Agricultural Research Opportunities and Policy Concerns** (1984) Free download: http://www.nap.edu/openbook.php?isbn=0309034345
- (NAS Colloquium) Genetic Engineering of Viruses and Viral Vectors, Free download: http://www.nap.edu/catalog.php?record_id=5708
- Biotechnology Education Program Support: http://ellyndaugherty.com/BiotechEd/

5.1.6 Pharmacology and Toxicology

5.1.6.1 Outline (Short Description)

Pharmacology (from Greek φάρμακον, *pharmakon*, "drug"; and -λογία, *-logia*) is the study of drug action.[1] More specifically it is the study of the interactions that occur between a living

[4] 1. Public perception of biotechnology J. E. Smith; 2. Biochemistry and physiology of growth and metabolism Colin Ratledge; 3. Stoichiometry and kinetics of microbial growth from a thermodynamic perspective J. J. Heijnen; 4. Genome management and analysis: prokaryotes Colin R. Harwood and Anil Wipat; 5. Genetic engineering: yeasts and filamentous fungi David B. Archer, Donald A. MacKenzie and David J. Jeenes; 6. Microbial process kinetics Jens Nielsen; 7. Bioreactor design Yusuf Chisti; 8. Mass transfer Henk J. Noorman; 9. Downstream processing Marcel Ottens, Johannes A. Wesselingh and Luuk A. M. van der Wielen; 10. Measurement, monitoring, modelling and control Bernhard Sonnleitner; 11. Process economics Bjørn Kristiansen; 12. High throughput screening and process optimisation Steven D. Doig, Frank Baganz and Gary J Lye; 13. The business of biotechnology Jason Rushton and Chris Evans; 14. Amino acids L. Eggeling, W. Pfefferle and H. Sahm; 15. Organic acids Christian P. Kubicek and Levente Karaffa; 16. Microbial polysaccharides and single cell oils James P. Wynn; 17. Environmental applications Philippe Vandevivere and Willy Verstraete; 18. Production of antibiotics by fermentation Derek J. Hook; 19. Strategies of cultivation Sven-Olof Enfors; 20. Enzyme biotechnology Randy M. Berka and Joel R. Cherry; 21. Recombinant proteins of high value Georg-B. Kresse; 22. Insect and mammalian cell culture C. J. Hewitt, B. Isailovic, N. T. Mukwena and A. W. Nienow; 23. Plant cell biotechnology Robert Verpoorte and Hens J.G. ten Hoopen; 24. Biotransformations Pedro Fernandes and Joaquim M. S. Cabral; 25. Immunochemical applications M. Clarke.

organism and exogenous chemicals that alter normal biochemical function. If substances have medicinal properties, they are considered **pharmaceuticals**. The field encompasses drug composition and properties, interactions, toxicology, therapy, and medical applications and antipathogenic capabilities. Pharmacology is not synonymous with pharmacy, which is the name used for a profession, though in common usage the two terms are confused at times. Pharmacology deals with how drugs interact within biological systems to affect function. It is the study of drugs, of the body's reaction to drugs, the sources of drugs, their nature, and their properties. In contrast, pharmacy is a medical science concerned with the safe and effective use of medicines.

Pharmacology as a scientific discipline did not further advance until the mid-19th century amid the great biomedical resurgence of that period.[3] Before the second half of the nineteenth century, the remarkable potency and specificity of the actions of drugs such as morphine, quinine and digitalis were explained vaguely and with reference to extraordinary chemical powers and affinities to certain organs or tissues.[4] The first pharmacology department was set up by Buchheim in 1847, in recognition of the need to understand how therapeutic drugs and poisons produced their effects.[3]

Pharmacology as a chemical science is practiced by pharmacologists. Subdisciplines include

- *clinical pharmacology* - the medical field of medication effects on humans
- *neuro-* and *psychopharmacology* (effects of medication on behavior and nervous system functioning),
- *pharmacogenetics* (clinical testing of genetic variation that gives rise to differing response to drugs)
- *pharmacogenomics* (application of genomic technologies to new drug discovery and further characterization of older drugs)
- *pharmacoepidemiology* (study of effects of drugs in large numbers of people)
- *toxicology* study of harmful effects of drugs
- theoretical pharmacology
- posology - how medicines are dosed
- *pharmacognosy* - deriving medicines from plants

5.1.6.2 Content

Chapter 1: General Principles--Introduction

Chapter 2: Pharmacokinetics

Chapter 3: Pharmacodynamics

Chapter 4: Autonomic Introduction

Chapter 5: Adrenergic Drugs

Chapter 6: Cholinergic Drugs

Unit Drug List

Unit Practice Exams

Chapter 7: Antihypertensive Drugs

Chapter 8: Antiarrhythmic Drugs

Chapter 9: Antianginal Drugs

Chapter 10: Management of Congestive Heart Failure

Chapter 11: Management of Hyperlipidemic States

Unit Drug List

Chapter 12: Sedative Hypnotic Drugs

Chapter 13: Opioid Analgesics

Opioids: Advanced Concepts

Chapter 14: General Anesthetics

Anesthesia Fundamentals

Cardiac Anesthesiology

Pulmonary Anesthesiology: Research Issues

Chapter 16: Antipsychotic Drugs
Chapter 17: Antidepressant Drugs
Chapter 18: AntiParkinson's Disease Drugs
Chapter 19: AntiSeizure Agents

Chapter 20: Neuromuscular Blocking Drugs

Electrophysiology Review

Chapter 21: Histamine

Chapter 22: Serotonin Pharmacology

Chapter 23: Ergot Alkaloid Pharmacology

Chapter 24: Vasoactive Peptide Pharmacology

Chapter 25: Pulmonary Pharmacology (Asthma)

Chapter 26: Renal Pharmacology

Chapter 27: Gastrointestinal Drugs

Chapter 28: Adrenocorticosteroids

Chapter 29: Management of Diabetes

Chapter 30: Management of Thyroid Disorders

Chapter 31: Gonadal Physiology and Pharmacology

Chapter 32: Hypothalamic Physiology and Pharmacology

Chapter 33: Chemotherapy: Introduction & General Principles

Chapter 34: Anticancer Drugs

Chapter 35: Antibacterial Agents

Chapter 36: Antiviral Drugs

Chapter 37: Antifungal Agents

Chapter 38: Antiparasitic Drugs

Chapter 39: Management of Coagulation Disorders

Chapter 40: Immunopharmacology

Chapter 41: Anti-inflammatory Drugs

5.1.6.3 Literature

Medical Pharmacology and Disease-Based Integrated Instruction - Programmed Study: Pharmacology Content, Practice Questions, Practice Exams; Michael Gordon, Ph.D., site developer; email: Michael Gordon. Free online at: http://www.pharmacology2000.com/

5.2 Computer Science + Bioinformatics (Theory)

5.2.1 Basics of Computer Sciences I – III

5.2.1.1 Outline (Short Description)

In this three semesters during course the basics of computer science are teached.
Computer science deals with anything that has to do with computers. However, due to the ultra fast technical development within the last 20 or 30 years, computer science today covers many more issues than just computers.
This development of computer science mirrors the growing number of new university courses like General Computer Science, Media Informatics, Technical Computer Sciences, Networking, Internet, etc.

5.2.1.2 Content

- Computer algorithms
- Automates
- Theory of Programming Languages
- Operating Systems
- Computer Architecture
- Artificial Intelligence
- Networking
- Internet
- Communication Technology
- Databases Storage & Design
- Software Design & Engineering
- Graphics & Visualization

5.2.1.3 Literature

- Computer Science: An Overview (10th Edition) by J. Glenn Brookshear or any other available Basic Computer Science book(s) covering the above mentioned things
- How to design programms http://www.htdp.org/
- Structure and Intepretation of Computer programs, the book and video lectures are freely available on line http://mitpress.mit.edu/sicp/

5.2.2 Software Engineering

5.2.2.1 Outline (Short Description)

Software engineering is the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software, and the study of these approaches. That is the application of engineering to software.
Software engineering is related to the disciplines of computer science, project management, and systems engineering.

5.2.2.2 Content

- Software requirements
- Software design : The design of software is usually done with Computer-Aided Software Engineering (CASE) tools and use standards for the format, such as the Unified Modeling Language (UML).

- Software development
- Software testing
- Software maintenance
- Software configuration management
- Software engineering management, see also project management
- Software development process
- Software engineering tools, see Computer Aided Software Engineering
- Software quality

5.2.2.3 Literature

- Pressman, Roger S (2005). *Software Engineering: A Practitioner's Approach* (6th ed. ed.). Boston, Mass: McGraw-Hill. ISBN 0072853182.
- Sommerville, Ian (2007) [1982]. *Software Engineering* (8th ed. ed.). Harlow, England: Pearson Education. ISBN 0-321-31379-8. http://www.pearsoned.co.uk/HigherEducation/Booksby/Sommerville/.
- Jalote, Pankaj (2005) [1991]. *An Integrated Approach to Software Engineering* (3th ed. ed.). Springer. ISBN 0-387-20881-X. http://www.springer.com/east/home?SGWisbn=5-102-22-52090005-0&changeHeader=true.
- Ghezzi, Carlo (2003) [1991]. *Fundamentals of Software Engineering* (2nd (International) ed. ed.). Pearson Education @ Prentice-Hall.

5.2.2.4 Links

- A Student's Guide to Software Engineering Projects - a free online guide for students taking SE project courses, http://studentprojectguide.info/

5.2.3 Combinatorial Optimization

5.2.3.1 Outline (Short Description)

Combinatorial optimization is a branch of optimization. Its domain is optimization problems where the set of feasible solutions is discrete or can be reduced to a discrete one, and the goal is to find the best possible solution.
It is a branch of applied mathematics and computer science, related to operations research, algorithm theory and computational complexity theory that sits at the intersection of several fields, including artificial intelligence, mathematics and software engineering.

5.2.3.2 Content

- Shortest paths and trees
- Linear Programming
- General Integer Programming
- Duality and Relaxation
- Problems, algorithms and runtime

5.2.3.3 Literature

- Nemhauser, Wolsey; *Integer and Combinatorial Optimization*
- Alexander Schrijver; *A Course in Combinatorial Optimization* February 1, 2006, http://homepages.cwi.nl/~lex/files/dict.pdf

5.2.4 Object Oriented Programming (in C++ and Java)

5.2.4.1 Outline (Short Description)

Object-oriented programming (**OOP**) is a programming paradigm that uses "objects" and their interactions to design applications and computer programs. Programming techniques may include features such as encapsulation, modularity, polymorphism, and inheritance.
The most important object-orientated landuages include C++ and Java. In this course the concepts of these two languages are considered to have a base for bioinformatic and software laboratory where programming is undergone.

5.2.4.2 Content

- Java
- C++

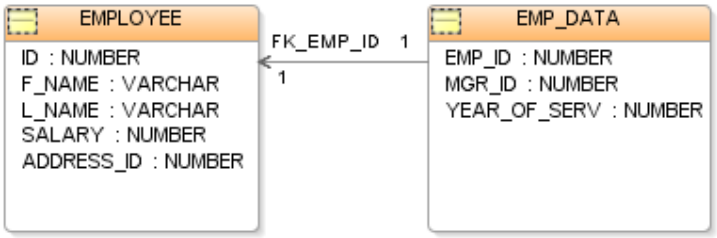
5.2.4.3 Literature

- Schach, Stephen (2006). *Object-Oriented and Classical Software Engineering, Seventh Edition*. McGraw-Hill. ISBN 0-073-19126-4.
-

5.2.5 Relational Databases

5.2.5.1 Outline (Short Description)

A **relational database** is a database that groups data using common attributes found in the data set. The resulting "clumps" of organized data are much easier for people to understand. For example, a data set containing all the real estate transactions in a town can be grouped by the year the transaction occurred; or it can be grouped by the sale price of the transaction; or it can be grouped by the buyer's last name; and so on.
Such a grouping uses the relational model (a technical term for this schema). Hence such a database is called a "relational database."



The software used to do this grouping is called a relational database management system. The term "relational database" often refers to this type of software.
This course considers the concepts of relational databases and also its implementation for example in SQL or MySQL.

5.2.5.2 Content

1. Information systems
2. Relational Theory
    - Tables, Records, and Columns
    - Table Design
    - Normalization
    - Declarative Referntial Integrity

- SQL
- Joining Tables

3. Using SQL Manipulate the Database
4. Development of database systems

5.2.5.3 Literature

- Online Database Course: http://education-portal.com/relational_database_fundamentals_online_course.html

5.2.6 Life Science Databases and Analysis Tools

5.2.6.1 Outline (Short Description)

This course gives an overview to the most important databases in life sciences: Research Articles Database, DNA databases, protein databases and others. The content of these databases is considered and how to use them.

5.2.6.2 Content

1. NCBI (USA)
   - Sequence Databases, Structure Database
   - Literature Database (PubMed)
   - Analyse Tools (Alignment: BLAST, …)
2. EBI (Europe)
   - …
3. KEGG&DDBJ (Japan)
   -

5.2.6.3 Literature

- H.Rashidi, *Bioinformatics Basics. Applications in Biological Sciences and Medicine*
- …

5.2.7 Molecular Modelling

5.2.7.1 Outline (Short Description)

Molecular modelling is a collective term that refers to theoretical methods and computational techniques to model or mimic the behaviour of molecules. The techniques are used in the fields of computational chemistry, computational biology and materials science for studying molecular systems ranging from small chemical systems to large biological molecules and material assemblies. The simplest calculations can be performed by hand, but inevitably computers are required to perform molecular modelling of any reasonably sized system. The common feature of molecular modelling techniques is the atomistic level description of the molecular systems; the lowest level of information is individual atoms (or a small group of atoms). This is in contrast to quantum chemistry (also known as electronic structure calculations) where electrons are considered explicitly. The benefit of molecular modelling is that it reduces the complexity of the system, allowing many more particles (atoms) to be considered during simulations.

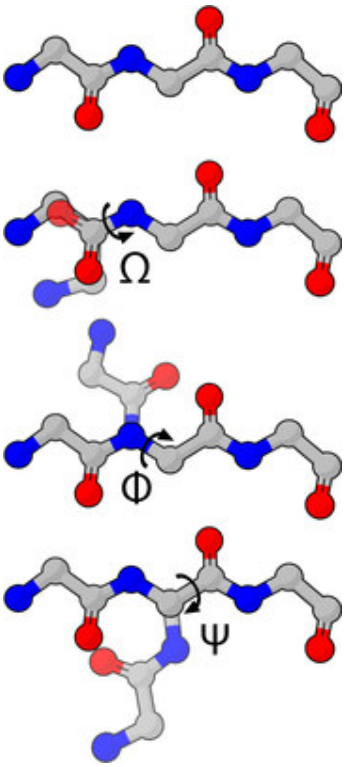


Fig.:
The backbone dihedral angles are included in the molecular model of a protein.

5.2.7.2 Content

1. USEFUL CONCEPTS IN MOLECULAR MODELLING

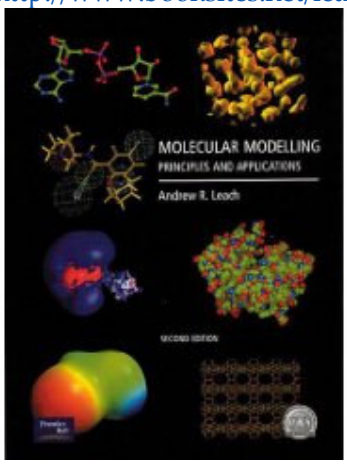
1.1 Introduction
1.2 Coordinate systems
1.3 Potential energy surfaces
1.4 Molecular graphics
1.5 Surfaces
1.6 Computer hardware and software
1.7 Units of length and energy
1.8 The molecular modelling literature
1.9 The Internet
1.10 Mathematical concepts
  1.10.1 Series expansions
  1.10.2 Vectors
  1.10.3 Matrices, eigenvectors and eigenvalues
  1.10.4 Complex numbers
  1.10.5 Lagrange multipliers
  1.10.6 Multiple integrals
  1.10.7 Some basic elements of statistics
  1.10.8 The Fourier series, Fourier transform and fast-Fourier transform

2. AN INTRODUCTION TO COMPUTATIONAL QUANTUM MECHANICS
3. ADVANCED AB INITIO METHODS, DENSITY FUNCTIONAL THEORY AND SOLID-STATE QUANTUM MECHANICS
4. EMPIRICAL FORCE FIELD MODELS: MOLECULAR MECHANICS
5. ENERGY MINIMISATION AND RELATED METHODS FOR EXPLORING THE ENERGY SURFACE
6. COMPUTER SIMULATION METHODS
7. MOLECULAR DYNAMICS SIMULATION METHODS

8. MONTE CARLO SIMULATION METHODS
9. CONFORMATIONAL ANALYSIS
10. PROTEIN STRUCTURE PREDICTION, SEQUENCE ANALYSIS AND PROTEIN FOLDING
11. FOUR CHALLENGES IN MOLECULAR MODELLING: FREE ENERGIES, SOLVATION, REACTIONS AND SOLID-STATE DEFECTS
12. THE USE OF MOLECULAR MODELLING AND CHEMOINFORMATICS TO DISCOVER AND DESIGN NEW MOLECULES

5.2.7.3 Literature

- Leach; *Molecular Modelling – Principles and Application*, 2nd Edition, 2001; see http://www.booksites.net/leach2/molecular/molecular_modelling_2.html



5.2.8 Immunological Bioinformatics

5.2.8.1 Outline (Short Description)

Computational immunology is a field of science that encompasses high-throughput genomic and bioinformatics approaches to immunology. The field's main aim is to convert immunological data into computational problems, solve these problems using mathematical and computational approaches and then convert these results into immunologically meaningful interpretations.
The explosive growth of bioinformatics techniques and applications in the post-genomics era has radically transformed immunology research. This has led to a comparable growth in the field of computation immunology, or immunoinformatics.

5.2.8.2 Content

- Immune Systems and Systems Biology
- Contemporary challenges to the Immune System
- Sequence Analyses in Immunology
- Methods Applied in Immunological Bioinformatics
- DNA Microarrays in Immunology
- Prediction of Cytotoxic T Cell (MHC Class I) Epitopes
- Antigen Processing in the MHC Class I Pathway

- Prediction of Helper T Cell (MHC Class II) Epitopes
- Processing of MHC Class II Epitopes
- B Cell Epitopes
- Vaccine Design
- Web-Based Tools for Vaccine Design
- MHC Polymorphism
- Predicting Immunogenicity: An Integrative Approach

5.2.8.3 Literature

- Lund, Nielsen, Lundegaard, Kesmir, Brunak; *Immunological Bioinformatics*
- Getting started with immunoinformatics: http://www.ploscompbiol.org/article/info%3Adoi%2F10.1371%2Fjournal.pcbi.1000128

5.3 Bioinformatics Laboratory (Practical Courses)

5.3.1 Working with Life Science Databases

5.3.1.1 Outline (Short Description)

In this practical course each student gets a specific task to investigate a specific protein or gene. He/she has to search for information in the databases he/she had learned in the theoretical course "Life Science Databases and Analysis Tools".
The information has to be gathered and presented in a 20 minutes speech.

5.3.1.2 Content

- 1st day (8 – 16 hr): Giving the tasks to groups of 2 students, beginning of database search in the Computer Lab.
- 2nd day (8 – 16 hr): Continuing Database Search in the Computer Lab; Working out the results to a power point presentation.
- 3rd day: (8 – 12 hr) All groups: Presentation of results

5.3.2 Programming of Bioinformatic Tools

5.3.2.1 Outline (Short Description)

In this practical course each student gets a specific task to implement a function in an actual MEGBI Tool Development Project. The programming language is C++ or Java – depending on the MEGBI Tool.

5.3.2.2 Content

1st day (12 – 16 hr): Giving the tasks to groups of 2 students, beginning of programming in the computer lab.
2nd day (8 – 16 hr): Continuing Programming in the Computer Lab; Working out the results to a power point presentation.
3rd day: (8 – 16 hr) All groups: Presentation of results

5.3.2.3 Literature

See on www.zgoeg.de/MEGBI descriptions of actual MEGBI Tools

5.3.3 Working with Molecular Modelling Tools

5.3.3.1 Outline (Short Description)

In this course the molecular modling tools VMD and BallView are considered in deep.

5.3.3.2 Content

- BallView Tutorial
- VMD Tutorial

5.3.3.3 Literature/Links

- BALLView, www.ballview.org
- VMD, http://www.ks.uiuc.edu/Research/vmd/
- Protein Data Bank, http://www.rcsb.org/pdb/
- CHARMM, http://www.charmm.org/
- Amber, http://amber.scripps.edu/

5.3.3.4 Other useful Links

Software

- PyMol, http://pymol.sourceforge.net/
- Gromacs, http://www.gromacs.org/
- Xmgr, http://plasma-gate.weizmann.ac.il/Xmgr/
- Molecular Modeling Open Source Toolkit: http://dirac.cnrs-orleans.fr/MMTK/
- Molecular Modelling Tutorial using MD, http://www.nmr.chem.uu.nl/~abonvin/tutorials/MD-Data/index.html
- http://www.intute.ac.uk/cgi-bin/redir.pl?url=http://dirac.cnrs-orleans.fr/MMTK/&handle=20031115-211912

Molecular Dynamics

- Groningen MD tutorial, http://md.chem.rug.nl/education/mdcourse/index.html
- The folding@home project, http://www.stanford.edu/group/pandegroup/folding/

Solvents

- Water structure and behaviour, http://www.lsbu.ac.uk/water/
- Water and its importance in biochemistry, http://www.bris.ac.uk/Depts/Chemistry/MOTM/water/water.htm
- Methanol, http://en.wikipedia.org/wiki/Methanol
- DMSO, http://en.wikipedia.org/wiki/Dimethyl_sulfoxide

Unix systems

- Unix for beginners, http://www.nmr.chem.uu.nl/~abonvin/tutorials/MD-Data/unix/unix.html
- Unix summary, http://www.nmr.chem.uu.nl/~abonvin/tutorials/MD-Data/unix/node15.html

5.4 Molecular Biology Laboratory (Practical Courses)

5.4.1 Molecular Cloning Training Course

5.4.1.1 Outline (Short Description)

In this course some fundamental techniques for working with DNA are trained. The duration of this course is 5 days.
Molecular biological and genetical experimental strategies are used today for many tasks in agriculture, pharmaceutical and medical sciences. For this the goal of this course block is to teach basic techniques in this field.
The techniques learned in this course block will be used, insha Allah, to clone a human SRY gene, starting with the isolation of the DNA, with PCR and then compiling a plasmid vector. In one of the next courses, this vector shall be used to transform a plant.
Learning goals:

- Gene isolation
- PCR
- Methods to produce and analyse recombinant DNA (Elektrophoresis, Plasmid technology, Restriction enzymes)

5.4.1.2 Content

1 Introduction to Theory and Methods 17

1.1 Molecular cloning 17

1.2 DNA 19

1.3 PCR (Polymerase chain reaction) 21

1.4 Restriction enzymes 29

1.5 Cloning vector 33

1.6 Ligase 34

1.7 Plasmid preparation 39

1.8 Separating DNA with Gel Electrophoresis 40

2 Experimental Part: Cloning of SRY gene 43

2.1 Isolation of human cells and amplification of SRY gene with PCR (2nd day) 43

2.2 Gel purification of PCR product (2nd day) 45

2.3 Ligation of PCR product in pGEM-T Easy (Promega) (2nd day) 46

2.4 Transformation of E.coli JM109 by plasmid DNA carrying SRY gene (3rd day) 48

2.5 Screening Transformants for Inserts: Preselection of transformants (4th day) 51

2.6 Isolation of recombinant plasmid from E.coli cells with Qiagen Miniprep kit (5th day) 51

2.7 Restriction digestion: cutting out the recombinant DNA (SRY gene) from plasmid and visualization on agarose gel (5th day) 55

Mon	8 – 12	Theoretical background of the training course and methods, Discussion of the workflow of the training course
	13 – 18	Preparation of plates for bacteria (LB plates with ampicillin/IPTG/X-

		Gal, SOC medium)
Tue	8 – 12	DNA isolation, primer design for PCR
	13 – 18	PCR to isolate SRY gene
Wed	8 – 12	Agarose gel to check the PCR and isolate the PCR product
	13 – 18	Ligation of SRY gene in pGEM-T, Transformation in E.coli and plating (overnight growth)
Thu	8 – 12	Screening of E.coli colonies, inoculation of minipreps (overnight growth)
	13 – 18	Sight seeing tour (history and antique culture area in Byblos)
Fri	8 – 12	Miniprep of the plasmid DNA (Isolation of recombinant plasmid from E.coli cells)
	14 – 19	Restriction digest and Agarose Gel, Discussion

5.4.1.3 Literature

MEGBI Training Course „Molecular Cloning“, see
http://www.zgoeg.de/MEGBI/downloads/doc_download/5-megbi-course-cloning

5.4.2 Plant genetic engineering

5.4.2.1 Outline (Short Description)

This is a relatively simple plant transformation experiment. Students are working with whole plant material and are not required to measure small quantities, yet they can see evidence of transformed plant cells (plant cells that have genes from bacterial plasmids). The experiment can be extended for further work with the transformed cells and/or transgenic plants.
This is a laboratory suitable for students who are familiar with the basic principles of plant cell structure, tissue culture, sterile technique, and cell transformation (bacterial infection, plasmid vectors, marker genes, selection medium, and enzyme activity assays).

5.4.2.2 Content

In the plant transformation experiment described here, you will see a good model for moving genes into plant cells. By incubating small pieces of tobacco leaf with certain bacterial cells (*Agrobacterium tumefaciens*) under specific conditions, the bacteria cells will infect the plant tissue and certain plasmid genes will move from the bacteria cells, into the nuclei of plant cells. The plasmid DNA will become part of the plant cells' own DNA. When this happens and the transformed plant cells are regenerated into a plant, the plant is known as a "transgenic" plant.
Time table of course:

- DAY 1 (full period lab)
- DAY 3 (15 minutes)
- DAY 5 (15-30 minutes, wait 1-3 hours, or overnight, and then 15 minutes again)
- check tissue cultures in 3-7 days and again in 7-14 days

5.4.2.3 Literature

MEGBI- Research Document „Insulin Producing in Tobacco“,
Chapter 3 “Trainings course: CELL TRANSFORMATION IN TOBACCO LEAF DISKS”,
http://www.zgoeg.de/MEGBI/downloads/doc_download/2-megbi-research-tobacco-bioreactor ,
pp. 69-74

5.5 Management (Theory)

5.5.1 Project Management

5.5.1.1 Outline (Short Description)

إدارة المشروعات (بالإنجليزية: Project Management) هو تخصّص يتعلّق بتنظيم وإدارة الموارد، مثل الموارد البشريّة، بالطريقة التي تمكّن إنجاز المشروع باحترام مضمونه المحدد وبمراعاة عوامل الجودة والتوقيت والتكلفة.

تعريف المشروع

المشروع هنا هو عملية أو نشاط مقيد بزمن، أي له تاريخ بداية و تاريخ نهاية، يتم القيام به مرة واحدة من أجل تقديم منتج ما أو خدمة ما بهدف تحقيق تغيير مفيد أو إيجاد قيمة مضافة.

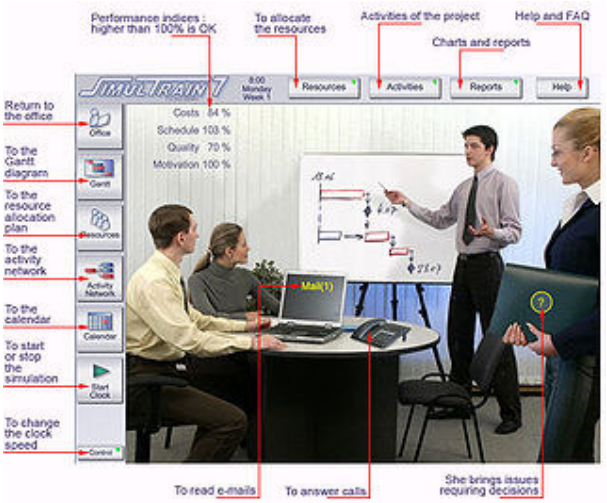
وهناك تعارض ما بين خاصية كون المشروع أمرا مؤقتا لمرة واحدة، وبين ما تتسم به العمليات الإدارية أو التشغيلية التي تجري بشكل دائم أو شبه دائم من أجل تقديم نفس المنتج أو الخدمة مرارا وتكرارا. ولا تتطلب إدارة المشروعات بالضرورة نفس المتطلبات التي تتطلبها إدارة العمليات الإدارية والتشغيلية الدائمة، سواء من ناحية المهارات الفنية المطلوبة أو فلسفة العمل، ومن ثم فقد نشأت الحاجة إلى بلورة إدارة المشروعات.

المصاعب والتحديات

التحدي الأول لإدارة المشروعات هو ضمان أن يتم إنجاز المشروع مع الالتزام بقيود محددة، أما التحدي الثاني الأكثر طموحا فهو تحقيق الوضع الأمثل والأنسب –أو ما يعرف بالاستمثال (بالإنجليزية: Optimization) - فيما يتعلق بتخصيص المدخلات المطلوبة من أجل ملاقاة الأهداف المحددة سابقا. هناك تعريف مناسب للمشروع على إنه : مجموعة من الأنشطة التي تستخدم الموارد (سواء المال أو البشر أو الخامات أو الطاقة أو المساحة أو الترتيبات أو الاتصالات أو الجودة أو المخاطر أو ما إلى ذلك) من أجل تحقيق أهداف محددة سابقا.

دورة حياة المشروع
مرحلة التأسيس
مرحلة التخطيط
مرحلة التنفيذ
مرحلة المراقبة و التحكم
مرحلة إنهاء المشروع

Project management is the discipline of planning, organizing and managing resources to bring about the successful completion of specific project goals and objectives.



SimulTrain : Example of a Project Management Simulator.

A project is a finite endeavor (having specific start and completion dates) undertaken to create a unique product or service which brings about beneficial change or added value. This finite characteristic of projects stands in sharp contrast to processes, or operations, which are permanent or semi-permanent functional work to repetitively produce the same product or service. In practice, the management of these two systems is often found to be quite different, and as such requires the development of distinct technical skills and the adoption of separate management philosophy, which is the subject of this article.

The primary challenge of project management is to achieve all of the project goals and objectives while honoring the project constraints. Typical constraints are scope, time and budget. The secondary—and more ambitious—challenge is to optimize the allocation and integration of inputs necessary to meet pre-defined objectives. A project is a carefully defined set of activities that use resources (money, people, materials, energy, space, provisions, communication, motivation, etc.) to achieve the project goals and objectives.

5.5.1.2 Content

1. Project management approaches
   - The traditional approach
   - Critical Chain Project Management
   - Extreme Project Management
   - Event chain methodology
   - PRINCE2
   - Process-based management
   - Rational Unified Process
2. Project development stages
   - Initiation
   - Planning and design
   - Executing
   - Monitoring and Controlling
   - Closing
   - Project control systems
3. Project management topics
   - Project managers

- Project Management Triangle
- Work Breakdown Structure
- Project Management Framework
- Project control variables
- International standards

5.5.1.3 Literature

- Chatfield, Carl. "A short course in project management", Microsoft.
- NASA (2001). NASA NPR 9501.2D. May 23, 2001.
- The Project Management Institute (PMI)
- The International Project Management Association (IPMA)
- The Open Project Management Methodology (an Open Knowledge Project)
- Association for the Advancement of Cost Engineering International (AACE)
- Max Wideman's "Open Source" Comparative Glossary of Project Management Terms
- Global Alliance for Project Performance Standards (GAPPS) Open source competency standards for project managers
- http://www.learningtree.com/courses/287.htm

5.5.2 Business Planning and Finacial Controlling

5.5.2.1 Outline (Short Description)

A successful business generates enough cash to cover costs and make a profit.
A profit is the difference between sales and costs. Most businesses are not expected to be profitable from day one, but they are expected to have a plan outlining when they are likely to become profitable: **prepare a business plan**.
Your plan should include a **break-even analysis**. This is an estimate of when the price of your product or service will equal the cost required to produce it. The calculation of the cost to produce an item, or provide a service, should include a percentage of all your projected overheads, including premises, bills and labour. Indicating in your plan when you will reach the break-even point is important - as soon as you pass it, your business will start to make a profit.
Cashflow is the balance of all the money flowing into and out of your business. While a business can survive for a short time without sales or profits, without cash it will die. So it is necessary to have a **cashflow management**.
Businesses should also have proper financial controls. Keeping accurate records helps you fulfil your legal requirements. It will also help you monitor your financial position and keep a tight control on costs: **financial and management accounts**.

5.5.2.2 Content

1. **How to prepare a business plan**

   It is essential to have a realistic, working business plan when you're starting up a business.
   A business plan is a written document that describes a business, its objectives, its strategies, the market it is in and its financial forecasts. It has many functions, from securing external funding to measuring success within your business.
   It will be shown how to prepare a high-quality plan using a number of easy-to-follow steps.
2. **Cashflow management: the basics**

3. **Financial and management accounts: the basics**

5.5.2.3 Literature

- http://www.businesslink.gov.uk/bdotg/action/detail?type=RESOURCES&itemId=1074297949

5.5.3 Safety Regulations in Genetic Engineering

5.5.3.1 Outline (Short Description)

In this course the required safety aspects of a genetic engineering laboratory or facility are considered. This knowledge is important for project leaders, deputies for biological safety, governmental controlling and inspection personality.

5.5.3.2 Content

- Safety Classes and Safety Evaluation
- Application and Approval
- Safety Control Measures
- Biological Safety in Plant Genetic Engineering
- Legal Responsibilities

5.5.3.3 Literature

- Biosafety Regulations in China, http://www.unescobkk.org/fileadmin/user_upload/shs/BiosafetyRegs/CHINA_Safety_Administration_Regulation_on_Genetic_Engineering.pdf
- (German) Buschhausen, Deitenbeck (Hrsg.); *Sicherheit in der Gentechnik*

5.5.4 Technology Policy and Strategic Research Planning

5.5.4.1 Outline (Short Description)

It is described how research planning is done, that means which fields have to be undergone acually to garant the wealth of the society.

5.5.4.2 Content

- Basics of Technology Policy
- Key Technologies

5.5.4.3 Literature

- http://vaef.de/vortragErstesForum.html

5.6 Research Work

5.6.1 Master thesis (the whole 4th semester)

The student will be working insha Allah in a MEGBI research project. This is either a computational biology task or a laboratory task. The duration of the research work is 6 month with daily 8 hours of work.

6 Apprendix

6.1 The content of book “The microbial world”

Chapter 1 The Relevance and History of Microbiology

Chapter 2 Cell structure and organization

Chapter 3 Viral Structure and function
3-1 Introduction
3-2 Viruses face several common obstacles that they must overcome to successfully replicate
3-3 Viruses often have common structures
3-4 The genome of viruses can be DNA or RNA
3-5 Viruses are classified by the nature of their viral nucleic acid
3-6 The life cycle of a virus is divided into several phases
3-7 To infect cells, viruses first need to attach to them.
3-8 Bacterial viruses almost always enter cells by injecting their nucleic acid.
3-9 Entry of eukaryotic viruses can involve penetration at the membrane or use of natural uptake pathways.
3-10 Viruses are lytic or lysogenic
3-11 The lytic cycle requires copying of the nucleic acid genome.
3-12 Viruses regulate viral protein production in a manner consistent with their host
3-13 After the parts of the virus are synthesized, they assemble into complete virions.
3-14 The lytic cycle ends with release of the finished virions from the cell.
3-15 Summary
Chapter 4 The Central Dogma
4-1 Introduction
4-2 The DNA sequence directs the synthesis of proteins
4-3 DNA Replication uses a collection of proteins called a replication complex
4-4 After replication, the two copies of the chromosome move to opposite ends of the microbe
4-5 Not all DNA in the prokaryotic cell is chromosomal: the specific case of plasmids
4-6 Plasmids can vary in size and number
4-7 Errors can occur in DNA replication that create potential mutations
4-8 Errors in DNA can also occur outside of replication
4-9 SOS repair can fix serious errors in the DNA, but is error prone
4-10 Recombination repair can accurately fix large errors in the DNA
4-11 There are more complicated mutations: deletions, duplications, and amplifications

4-12 Mobile genetic elements can also cause mutations in the chromosome
4-13 Genetic changes do not become fixed in the DNA until they are copied
4-14 Transcription involves the copying of DNA into RNA
4-15 The level of mRNA is a common regulatory point in prokaryotes
4-16 Prokaryotic mRNAs are typically more than one gene long
4-17 Differential transcription and stability of mRNA can also be used as points of regulation
4-18 Translation is the conversion of mRNA into protein at the ribosome
4-19 Translation is initiated at the Shine-Dalgarno sequence and involves formyl methionine (fMet)
4-20 Some interesting facts about translation
4-21 Chapter summary
Chapter 5 Microbial Nutrition
5-1 Introduction
5-2 The cell is made up of a few common elements
5-3 Microbes can be classified based upon their nutritional requirements
5-4 Examples of Nutritional Classifications
5-5 Culture Media
5-6 Media can come in both liquid and solid form.
5-7 Culture media is as varied as the microorganisms that grow in it.
5-8 Media can be classified into several different categories
5-9 Sterilization of media
5-10 Chapter Summary
Chapter 6 Microbial Growth
6-1 Introduction
6-2 Growth for microorganisms is defined as an increase in numbers
6-3 Unicellular microbes grow by cell division
6-4 Cell division is a complex process
6-5 Measurement of cell growth can be accomplished in a number of ways
6-6 Growth in batch culture has four separate phases
6-7 Lag phase is the time before cell growth begins
6-8 In exponential phase, cells begin to divide
6-9 The growth rate in exponential phase can be modeled mathematically
6-10 Cells stop increasing in number during stationary phase
6-11 Cells at some point can no longer sustain themselves and death phase begins
6-12 Continuous culture is an open system where microbes can be maintained in exponential phase
6-13 The environment greatly affects the growth of microbes
6-14 Temperature affects the rate of growth.
6-15 Microbes respond differently to the presence of oxygen.
6-16 The hydrogen ion concentration (pH) affects growth of microbes
6-17 The availability of water or concentration of solutes influences the ability of microbes to grow
6-18 Summary
Chapter 7 Control of Microbes
7-1 Introduction
7-2 Temperature is a common physical method for controlling microbes
7-3 Empirical data can be used to predict the success of a heat treatment
7-4 Some historical methods of heat treatment are still useful in certain situations
7-5 Autoclaving, dry heat and pasteurization are common methods of heat treatment

7-6 Low temperature slows or stops the growth of microbes
7-7 Irradiation damages critical cellular processes, killing microbes
7-8 Filtration physically removes microbes from a solution
7-9 Reducing the water activity of a sample can prevent the growth of microbes
7-10 Chemical treatments act on microbes to prevent their growth
7-11 Antiseptics and disinfectants control microbes on surfaces
7-12 Preservatives control the growth of microbes in foods
7-13 Antibiotics and chemotherapeutic agents help to control pathogenic microbes in the body
7-14 Antimicrobial activity is measured using standard tests
7-15 Summary
Chapter 8 Metabolism
8-1 Introduction
8-2 As are all things, microbes are subject to the laws of thermodynamics
8-3 Free Energy (ΔG) is what cells are after
8-4 Cells often perform useful work through oxidation-reduction reactions (redox reactions)
8-5 Energy in the cell is carried by special molecules
8-6 Enzymes are biological catalysts
8-7 Enzymes are often organized in the cell into functional units
8-8 Bacterial diversity is mainly manifested as catabolic diversity
8-9 Fermentations in microbes share some common properties
8-10 The Embden-Meyerhof-Parnas pathway (EMP) is a very common glycolytic pathway
8-11 For anaerobes, the EMP pathway results in an excess of NADH, which is dealt with by reducing pyruvate to fermentation end products.
8-12 The Entner-Doudoroff pathway is a third common pathway for the catabolism of glucose
8-13 Respiration involves donation of electrons to an inorganic terminal electron acceptor
8-14 Catabolism of sugar (glucose) through respiration involves the tricarboxylic acid cycle
8-15 Catabolism of fats (lipids) uses β-oxidation
8-16 High-energy electrons are converted into ATP using a membrane
8-17 Protons move across the membrane during ETS
8-18 ATP synthesis involves protons moving through ATP synthase
8-19 Many microbes are capable of anaerobic respiration
8-20 Nitrate reduction can generate energy, but not as much as aerobic respiration
8-21 Sulfate reduction is common in anaerobic environments
8-22 Carbonate can also serve as a terminal electron acceptor
8-23 Some microbes can grow completely on inorganic sources of carbon, energy and electrons
8-24 Nitrifying bacteria are chemoautotrophic lithotrophs that use ammonia as a source of energy and electrons.
8-25 Chapter Summary
Chapter 9 Photosynthesis
9-1 Introduction
9-2 Photosynthetic microbes have several common characteristics
9-3 Light is collected by protein complexes containing photopigments
9-4 Chlorophyll is the molecule that collects light and energizes an electron, while carotenoid protects the cell from the damaging effects of light
9-5 The placement of the photopigments is important in the performance of their function
9-6 Light energy is focused at the reaction center

9-7 Photosynthetic microorganisms are classified as oxygenic and anoxygenic
9-8 Purple bacteria are anoxygenic photosynthetics that are metabolically versatile
9-9 Purple bacteria house their photosynthetic apparatus in intracytoplasmic membranes
9-10 The reaction center of purple bacteria is made of three polypeptides and contains many photopigments
9-11 Three systems regulate photosynthesis in the purple bacteria
9-12 The green bacteria are anoxygenic photosynthetics that form a chlorosome
9-13 The reaction center in green bacteria contains an iron-sulfur center
9-14 The cyanobacteria perform oxygenic photosynthesis
9-15 Cyanobacteria contain two reaction centers
9-16 Photosynthesis in cyanobacteria is constitutively expressed
9-17 The energy generated by photosynthesis is used to drive the dark reactions
9-18 Summary
Chapter 10 Anabolism
10-1 Introduction
10-2 Microbes must first find and transport the elements that they need
10-3 Carbon can be assimilated from organic source or synthesized from CO_2
10-4 Nitrogen assimilation can involve the uptake of reduced nitrogen compounds or nitrogen fixation
10-5 Sulfur can come from organic or inorganic sources
10-6 Phosphate enters metabolism by ATP synthesis and substrate-level phosphorylation.
10-7 Metal ions, important components of many enzymes, must be taken up from the environment
10-8 The environment influences the ability of a microbe to make monomers
10-9 Amino acids that are simple in structure have simple biosynthetic pathways
10-10 The synthesis of some amino acids share common steps
10-11 Amino acids with more complex structures have longer biosynthesis pathways
10-12 Nucleotide synthesis is complex and expensive
10-13 Lipid synthesis involves a carrier protein
10-14 Monomers are assembled to form polymers
10-15 Peptidoglycan begins in the cytoplasm and ends in the periplasm
10-16 Synthesized polymers combine in orderly fashion to make cellular stuctures.
10-17 Summary
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11-1 Introduction
11-2 Regulation is a way to respond to a changing environment
11-3 There are common steps in regulation
11-4 Allosteric proteins sense small molecules and change their activity because of them
11-5 Regulation occurs at many different points during gene expression
11-6 Positive and negative regulation involves proteins that bind to DNA
11-7 Attenuation is regulatory mechanism in which translation affects transcription
11-8 Protein activity in prokaryotes is also regulated at the post-transcriptional and translational level
11-9 Expression of the *lac* operon requires the presence of lactose and the absence of glucose
11-10 The tryptophan operon is controlled by repression, attenuation and feedback inhibition
11-11 Sporulation in *Bacillus subtilis* is directed by sigma factors and turned on by a phosphorelay system
11-12 *Vibrio fischeri*i senses cell density using a small diffusible molecule that binds to an activator

11-13 Heat-shock gene expression is controlled by σ factors, mRNA secondary structure, and protein stability
11-14 Nitrogen fixation can be controlled by a positive activator, mRNA stability, and enzyme modification
11-15 Summary
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12-1 Introduction
12-2 Sequence information is obtained by performing enzymatic reactions on small amounts of pure DNA
12-3 What does sequence information look like?
12-4 What conclusions can you draw about the function of the protein product of your new ORF?
12-5 What are the applications of the information gained through genomics?
12-6 In addition to insights about gene products, what else can be learned from studying genomes?
12-7 An introduction to genetics and genetic engineering
12-8 How to find a needle in a hay stack
12-9 Generation of random mutations
12-10 Effects of mutations
12-11 Engineering specific mutations in the lab
12-12 Gene Transfer Systems
12-13 Genetic Mapping
12-14 Complementation Analyses
12-15 There can be complications in complementation analysis
12-16 Gene fusions can be used to make large quantities of a protein or to monitor the regulation of a gene
12-17 Suppressors are second-site mutations that change the phenotype of a mutant to be more like that of the wild type
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13-1 We can monitor bacterial viruses with the naked eye by seeing their effects on the bacterial hosts.
13-2 Lambda phage is a lysogenic virus with double-stranded DNA.
13-3 DNA damage causes lambda to enter the lytic cycle.
13-4 T4 is a large, lytic phage with a large double-stranded DNA genome
13-5 Restriction-modification systems limit the host range of T4.
13-6 Viruses need to pack virions with complete genomes and also provide energy for entry into a new host
13-7 P22 is a lysogenic, double-stranded DNA phage that was important in the development of bacterial genetics.
13-8 P1 is a double-stranded DNA phage with an unusual ability to infect different hosts
13-9 P1 replicates its DNA independently of the host chromosome when in a lysogenic state.
13-10 Qβ is a small, single-stranded RNA virus.
13-11 As an RNA virus, Qβ has special problems to overcome.
13-12 Qβ packs a great deal of information into its small RNA genome.
13-13 M13 has a genome composed of a single-stranded, circular DNA molecule.
13-14 M13 expresses all of its genes at the same time and produces progeny without killing the host cell.
13-15 Some phage lysogens cause their hosts to become pathogenic.

13-16 Summary
Chapter 14 Host-Microbe Interactions
14-1 Introduction
14-2 Microbes that interact with eukaryotes face some common challenges and utilize similar strategies
14-3 Types of host-microbe interactions
14-4 Microbes face many challenges when associating with a host
14-5 Once a microbe detects a host, it then attaches to it
14-6 Microbes may invade deeper into host tissues once attached
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14-8 Pathogenic outcomes
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14-14 *Vibrio fischeri* and squid form a mutualistic relationship under the sea
14-15 Quorum sensing and autoinduction
14-16 The process of autoinduction
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14-18 Euprymna scolopes selects for V. fischeri
14-19 Microbes that live in close association with plants
14-20 How plants recognize the proper rhizobia
14-21 Not all associations between plants and nitrogen-fixing bacteria is as involved as the rhizobial system
14-22 The normal flora of humans
14-23 The skin and eyes as habitats
14-24 The microbial population in the mouth
14-25 The respiratory tract has mostly harmless bacteria, but can contain pathogens.
14-26 The gastrointestinal tract has the largest number and greatest diversity of microbes in our body.
14-27 The urogenital tract
14-28 Benefits of the normal flora
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16-2 As disease became more common, efforts were made to combat them
16-3 Quarantine can be an effective method of limiting the spread of disease
16-4 Good water sanitation can prevent the spread of many gastrointestinal diseases
16-5 Control of insects can prevent the spread of some diseases
16-6 Vaccines train the immune system to fight disease
16-7 Many of the recommended vaccines are live attenuated viruses
16-8 Another common vaccine type are component vaccines
16-9 Some groups are wrongly advocating stopping vaccination
16-10 Antimicrobial compounds directly inhibit or kill pathogens, thus curing infectious diseases
16-11 Bacterial cell wall synthesis enzymes are a common target for antibiotics
16-12 A second class targets the cell membrane, but they are often toxic to humans
16-13 A third class of antibiotics target the 70S ribosome
16-14 A fourth class targets nucleic acid metabolism
16-15 A fifth class of antimicrobials are competitive inhibitors of metabolism
16-16 Resistance to antibiotics has diminished the effectiveness of antibiotics
16-17 The overuse of antibiotics is one reason that drug resistance has developed
16-18 Summary
Chapter 17 Bacterial Pathogens
17-1 Introduction
17-2 A microbe must first find a host
17-3 Once a host is found, a pathogen must colonize (possibly invade) and cause damage
17-4 Pathogens have a collection of properties that are major determinants in pathogenesis
17-5 *Bacillus anthracis* is an endospore forming microbe that can causes a lethal toxic infection called anthrax
17-6 Anthrax toxin and the polypeptide capsule are key aspects of pathogenesis
17-7 *Yersinia pestis* is the causative agent of plague
17-8 *Y. pestis* delivers toxic substances to the host using a type III secretion apparatus and defends itself using LPS
17-9 *Bordetella pertussis* causes whooping cough and was a major killer of children
17-10 Adhesins and toxins are important in the virulence of *Bordetella pertussis*
17-11 Streptococcal diseases are major causes of infectious disease

17-12 The pathogenesis of *S. pyogenes* is understood, while that of *S. pnemoniae* is less clear.
17-13 *Staphylococcus aureus* causes a large number of human infections
17-14 *S. aureus* produces a deadly cocktail of enzymes, polysaccharides, and toxins
17-15 The microbes of the tuberculosis complex are slow-growing pathogens that gradually destroy the host
17-16 Virulence factors of *M. tuberculosis* allow it to survive the host's defenses
17-17 Tetanus and botulism are intoxications caused by clostridia
17-18 The major virulence factors for botulism and tetanus are the toxins produced
17-19 *Helicobacter pylori* is the cause of many ulcers
17-20 *H. pylori* creates a collection of enzymes that allow it to colonize the stomach
17-21 Some *Escherichia coli* strains cause diarrheal diseases by colonizing the intestine, while others are capable of extraintestinal infections.
17-22 Five different strains of *E. coli* cause five different gastointestinal infections
17-23 Other *E. coli* strains are the major cause of urinary tract infections
17-24 *Salmonella enterica* causes a common form of gastroenteritis
17-25 *S. enterica* uses a type III secretion system to deliver a toxic mix of proteins into host cells
17-26 Chlamydia are intracellular pathogens that cause the most common forms of venereal disease
17-27 Chlamydial infection causes a strong immune response that results in tissue damage
17-28 *Treponema pallidum* is the cause of syphilis
17-29 *T. pallidum* cannot survive outside the host
17-30 *T. pallidum* spreads rapidly during infection, but can be cured with antibiotics
17-31 *Neisseria gonorrhoeae* causes the common sexually transmitted disease gonorrhea
17-32 Pili are the major virulence factor for *N. gonorrhoeae*
17-33 *Borrelia burgdorferi* causes the tick-borne Lyme disease
17-34 Little is known about the mechanisms of pathogenesis of *B. burgdorferi*, but the disease can be sucessfully treated with antibiotics
17-35 *Vibrio cholerae* is the cause of cholera
17-36 Pili and cholera toxin are major determinants in pathogenesis
17-37 *Corynebacterium diphtheriae* is the cause of diphtheria
17-38 Diphtheria toxin causes most of the symptoms of diphtheria
17-39 Summary
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18-1 Introduction
18-2 Infection by eukaryotic pathogens is importantly different from infection by bacterial pathogens.
18-3 *Plasmodium* species cause malaria
18-4 Cryptosporidiosis, a gastrointestinal infection, is caused by *Cryptosporidium* species
18-5 Infection with *Giardia intestinalis* causes giardiasis
18-6 Toxoplasmosis is caused by *Toxoplasma gondii*
18-7 Trypanosomes cause two forms of trypanosomiasis
18-8 Superficial fungal infections are bothersome, but normally not serious
18-9 Sporotrichosis is caused by *Sporothrix schenckii*
18-10 Candidiasis is infection with *Candida* species, a yeast
18-11 Histoplasmosis is caused by two closely related species of fungi
18-12 Blastomycosis is caused by *Blastomyces dermatitidis*
18-13 Chapter Summary
Chapter 19 Viral Pathogens

19-1 Introduction
19-2 Rhinovirus is the most common causes of colds
19-3 Rhinoviruses are single-strand RNA viruses that replicate in the cytoplasm of the host cell.
19-4 Adenoviruses also infect the respiratory tract, but can cause illness elsewhere
19-5 The adenovirus is a double-stranded DNA virus with a complex viral capsid
19-6 Influenza virus causes a lower respiratory viral infection with fever
19-7 The influenza viral genome contains eight single-stranded RNAs, which are replicated in the nucleus.
19-8 Human Immunodeficiency virus z(HIV) causes acute immune deficiency syndrome (AIDS).
19-9 HIV contains two copies of a single-stranded RNA that is copied into DNA as part of its replication
19-10 Hepatitis viruses infect the liver
19-11 HAV and HEV are transmitted by enteric routes
19-12 HBV, HCV and HDV are transmitted by blood and other bodily fluids
19-13 Diagnosis of hepatitis depends on blood tests while treatment varies with the specific virus
19-14 Hepatitus viruses have different replication systems
19-15 Herpes viruses cause cold sores and genital herpes
19-16 HSV is a enveloped virus with a double-stranded DNA genome.
19-17 West Nile Virus causes a viral infection that can result in deadly encephalitis
19-18 West Nile Virus (WNV) has a single-stranded RNA genome that is translated as a large polyprotein.
19-19 Ebola virus causes hemorrhagic disease with a high fatality rate
19-20 Ebola is a filamentous virus with a single-stranded RNA genome.
19-21 Satellite viruses are important in some infections.
19-22 Viroids and prions are infectious agents that are very different from viruses.
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Chapter 20 Evolution: Implications for microbiology
20-1 What aspects of evolution are we talking about?
20-2 Organisms are similar because of their common ancestry
20-3 A consequence of common ancestry is residual similarity of species
20-4 Macromolecular sequence data shows how microbes evolve
20-5 Ribosomal RNA genes are useful for determining phylogenetic relationships.
20-6 Sequence analysis supports our view of evolution
20-7 A classification scheme that flows from evolution has many advantages over other methods
20-8 The mechanisms of evolution involve genetic change and natural selection
20-9 Limitations and implications of the classifications of organisms
20-10 The difficulty of classifying microorganisms by their obvious properties
20-11 Molecular phylogeny
20-12 The results of molecular phylogenies - the tree of life
20-13 Mitochondria and chloroplasts originated as bacteria
20-14 Eurakyotes are metabolically similar, but morphologically very different.
20-15 Archaea are fundamentally different from bacteria and eukaryotes
20-16 Bacteria
20-17 Properties in bacteria and their importance to phylogeny
20-18 Summary

Chapter 21 Eukaryotic Microbial Diversity

21-1 Introduction
21-2 Dinoflagellates are photosynthetic eukaryotes found in many fresh water and marine habitats
21-3 Ciliates contain hair-like structures on their surface involved in motility.
21-4 Apicomplexa are obligate parasites that infect many animal species
21-5 Stramenopiles are photosynthetic and nonphotosynthetic microbes whose evolutionary relationship has been shown by molecular analysis
21-6 Rhodophyta are a third group of photosynthetic protists that grow in coastal areas
21-7 Some protists are related to green plants
21-8 Fungi are critical heterotrophs in the environment
21-9 Different species of fungi are classified by morphology, nutrition and molecular data
21-10 *Chytridiomycota* look like protists, but are actually fungi
21-11 Zygomycota can be obligate pathogens or free-living saprophytes that live in moist environments
21-12 *Glomeromycota* form symbiotic relationships with higher plants.
21-13 *Dikaryomycota* are species of fungi that can form cells with two separate nuclei.
21-14 *Ascomycota* create complex networks of fruiting bodies
21-15 Basidiomycota are organized as macrofungi, rusts, and smuts
21-16 Smuts and rusts are important agricultural pathogens
21-17 Yeasts are a morphological stage of some fungi.
21-18 Primitive protists
21-19 Some protozoa are closely related to animals
21-20 Amoeba are unicellular protozoa with a naked outer layer
21-21 Flagellates are motile protozoa with flagella
21-22 Slime molds are unusual organisms that share both protozoan and fungal properties
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Chapter 22 Archaeal Diversity

22-1 Introduction
22-2 Methanogens produce methane as an end product and form a deep branch of the Archaea.
22-3 The reactions of methanogenesis utilize unique cofactors
22-4 The genomic comparisons of and are informative.
22-5 Extreme halophiles can generate energy using bacteriorhodopsin
22-6 Extreme halophiles survive high-salt conditions by having enzymes that function at high concentrations of potassium.
22-7 Bacteriorhodopsin pumps protons across the membrane using a conformational shift activated by light
22-8 Thermoacidophilic archaea grow in high-temperature acidic environments
22-9 Extreme thermophiles grow at temperatures above 75°C
22-10 Many cultured *Crenarchaeota* are hyperthermophilic
22-11 *Kornarchaeota* and *Nanoarchaeota* have been defined 16S rRNA sequences
22-12 Chapter Summary

Chapter 23 Bacterial Diversity

23-1 Introduction
23-2 Proteobacteria
23-3 α subdivision - rhizobia are plant symbionts
23-4 α-subdivision - are dimorphic prosthecate bacteria
23-5 Methanotrophs used methane as their carbon and energy source

23-6 α subdivision - species often colonize plants, not as symbionts, but as pathogens
23-7 Purple non-sulfur bacteria are facultative phototrophs
23-8 α subdivision - (SAR11), a previously unculturable microbe is present at high populations in many environments
23-9 Ammonia oxidizers, mostly members of the β subdivision, only grow using inorganic chemicals.
23-10 are chemoautolithotrophic bacteria that use reduced sulfur compounds as a source of energy
23-11 γ subdivision - enteric bacteria contain species that are important pathogens and are ubiquitous in the environment
23-12 and
23-13 γ subdivision - pseudomonads are a large group of commonly found microbes that grow on organic compounds.
23-14 γ subdivision - SAR86 may be a new kind of primary producer
23-15 δ subdivision - sulfate-reducing bacteria use sulfur compounds as their terminal electron acceptor
23-16 δ subdivision - myxobacteria are social microbes capable of forming fruiting bodies
23-17 δ subdivision - bdellovibrio are fast-moving predators of other microbes
23-18 ε subdivision - some strains are intestinal pathogens
23-19 High GC - mycobacteria are slow-growing microbes with unusual cell walls.
23-20 High GC - are spore-forming, filamentous microbes that are a major source of antibiotics
23-21 Low GC - Staphylococci are common parasites of animals
23-22 Low GC - lactic acid bacteria are fermentative microbes important in many food processes
23-23 Low GC - species are aerobic microbes that form endospores
23-24 Low GC - clostridia are anaerobic, endospore-forming bacteria.
23-25 Low GC - have the unusual combination of photosynthesis and endospore formation
23-26 Low GC - mycoplasma lack a cell wall and are obligate parasites of eukaryotes.
23-27 Cyanobacteria are microbes that carry out oxygenic photosynthesis
23-28 Spirochetes are one of the few groups whose morphology indicates their phylogeny
23-29 and related species contain cells walls lacking peptidoglycan
23-30 are highly resistant to radiation
23-31 are pigmented gliding bacteria
23-32 - green sulfur bacteria
23-33 are gliding photosynthetic microbes
23-34 grow at the highest temperature of any bacteria
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Chapter 25 Applied Microbiology

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25-2 The difference between primary and secondary metabolites
25-3 Pharmaceutical microbiology uses microbes for the production of medically important compounds
25-4 Finding new antibiotics can involve several different approaches
25-5 Enzyme screens can find inhibitors of important pathogenic proteins
25-6 Once a strain is found that produces something desirable, its growth conditions need to be optimized
25-7 Culture conditions must be optimized for large scale production.
25-8 Methods have been developed to detect pathogens in food and for diagnosis of disease
25-9 Wastewater treatment prevents contamination of our environment
25-10 Water purification ensures safe drinking water
25-11 Food microbiology increases understanding of food fermentations and works to prevent spoilage
25-12 Yogurt is a fermentation of milk by lactic acid bacteria
25-13 Cheese production involves milk fermentation, pressing and ripening
25-14 Beer brewing involves alcoholic fermentation by yeast in the presence of barley and hops.
25-15 Wine is an alcoholic fermentation of grapes by yeast
25-16 Bread making uses yeast to create CO_2, which causing the dough to rise
25-17 Vinegar is made by the action of microbes on sugar or starchy material to produce acetic acid
25-18 Sauerkraut involves a fermentation of cabbage by lactic acid bacteria
25-19 Food processes can be spoiled by the action of undesirable microbes
25-20 Enzymes from microorganisms are used in a wide variety of products
25-21 Some vitamins are manufactured using microorganisms
25-22 Some amino acids are manufactured using microorganisms
25-23 Bioconversion involves catalyzing one or several steps of the synthesis of a complex molecule using microorganisms
25-24 Industrial microbiology is also important in agriculture
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