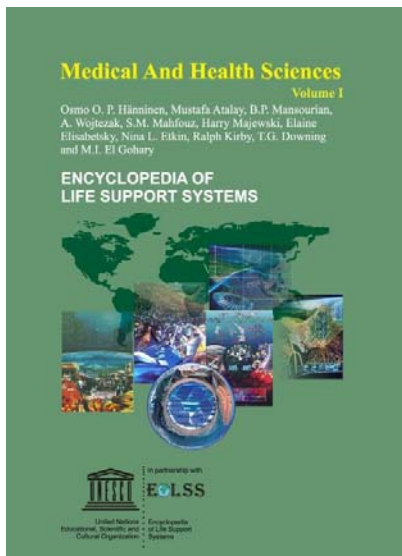


CONTENTS

MEDICAL AND HEALTH SCIENCES



- Medical And Health Sciences - Volume 1**
No. of Pages: 598
ISBN: 978-1-84826-380-2 (eBook)
ISBN: 978-1-84826-830-2 (Print Volume)
- Medical And Health Sciences - Volume 2**
No. of Pages: 468
ISBN: 978-1-84826-381-9 (eBook)
ISBN: 978-1-84826-831-9 (Print Volume)
- Medical And Health Sciences - Volume 3**
No. of Pages: 476
ISBN: 978-1-84826-382-6 (eBook)
ISBN: 978-1-84826-832-6 (Print Volume)
- Medical And Health Sciences - Volume 4**
No. of Pages: 476
ISBN: 978-1-84826-383-3 (eBook)
ISBN: 978-1-84826-833-3 (Print Volume)
- Medical And Health Sciences - Volume 5**
No. of Pages: 424
ISBN: 978-1-84826-384-0 (eBook)
ISBN: 978-1-84826-834-0 (Print Volume)
- Medical And Health Sciences - Volume 6**
No. of Pages: 514
ISBN: 978-1-84826-385-7 (eBook)
ISBN: 978-1-84826-835-7 (Print Volume)
- Medical And Health Sciences - Volume 7**
No. of Pages: 530
ISBN: 978-1-84826-386-4 (eBook)
ISBN: 978-1-84826-836-4 (Print Volume)
- Medical And Health Sciences - Volume 8**
No. of Pages: 518
ISBN: 978-1-84826-387-1 (eBook)
ISBN: 978-1-84826-837-1 (Print Volume)
- Medical And Health Sciences - Volume 9**
No. of Pages: 104
ISBN: 978-1-84826-388-8 (eBook)
ISBN: 978-1-84826-838-8 (Print Volume)
- Medical And Health Sciences - Volume 10**
No. of Pages: 496
ISBN: 978-1-84826-389-5 (eBook)
ISBN: 978-1-84826-839-5 (Print Volume)
- Medical And Health Sciences - Volume 11**
No. of Pages: 522
ISBN: 978-1-84826-390-1 (eBook)
ISBN: 978-1-84826-840-1 (Print Volume)
- Medical And Health Sciences - Volume 12**
No. of Pages: 528
ISBN: 978-1-84826-391-8 (eBook)
ISBN: 978-1-84826-841-8 (Print Volume)
- Medical And Health Sciences - Volume 13**
No. of Pages: 386
ISBN: 978-1-84826-392-5 (eBook)
ISBN: 978-1-84826-842-5 (Print Volume)
- Medical And Health Sciences - Volume 14**
No. of Pages: 434
ISBN: 978-1-84826-393-2 (eBook)
ISBN: 978-1-84826-843-2 (Print Volume)
- Medical And Health Sciences - Volume 15**
No. of Pages: 444
ISBN: 978-1-84826-411-3 (eBook)
ISBN: 978-1-84826-861-6 (Print Volume)
- Medical And Health Sciences - Volume 16**
No. of Pages: 434
ISBN: 978-1-84826-412-0 (eBook)
ISBN: 978-1-84826-862-3 (Print Volume)
- Medical And Health Sciences - Volume 17**
No. of Pages: 434
ISBN: 978-1-84826-413-7 (eBook)
ISBN: 978-1-84826-863-0 (Print Volume)

[For more information of e-book and Print Volume\(s\) order, please click here](#)

[Or contact : eolssunesco@gmail.com](mailto:eolssunesco@gmail.com)

CONTENTS

VOLUME I

Physiology And Maintenance **1**

Osmo Hänninen, *Department of Physiology, University of Kuopio, Finland*

1. Introduction and Background
2. Models in Studies of Physiology
 - 2.1. Micro-Organisms and Algae
 - 2.2. Plants
 - 2.3. Mammalian Cell Lines and Tissue Cultures
 - 2.4. Isolated Organs
 - 2.5. Animals
 - 2.6. Humans
 - 2.7. Communities
3. Cells as Basic Functional Units
 - 3.1. Nucleus and Genes
 - 3.2. Membranes as Multifunctional Systems
4. Blood Circulation
5. Respiration
6. Physical Activity
7. Food Intake and Digestion
8. Defense Mechanisms
9. Excreta and Microflora
10. Bioterrorism
11. Old and New Sensory Systems
12. Nervous Control
 - 12.1. Learning and Memory
 - 12.2. Relaxation and Sleep
 - 12.3. Narcotics: Physiological Background
13. Hormonal Control
14. Reproduction
15. Cell Deaths and Longevity of the Organism
16. At Extremes
 - 16.1. Cold
 - 16.2. Hot (the Sauna Included)
 - 16.3. Acceleration, Aviation, and Space
17. Principles of Oriental Physiology
18. Adaptation to Pollution
 - 18.1. Health of Plants
 - 18.2. Health of Animals
19. Homeodynamic Robustness

General Physiology **48**

Osmo Hänninen, *Department of Physiology, University of Kuopio, Finland*

1. Introduction
2. Variability
3. Functional Reserves
4. Physionome
5. Functional Task Divisions
 - 5.1. Integumentary System
 - 5.2. Respiration
 - 5.3. Circulation
 - 5.4. Digestion and Other Gastrointestinal Functions

- 5.5. Immune System
- 5.6. Endocrine System
- 5.7. Musculoskeletal System
- 5.8. Urinary System
- 5.9. Reproduction
- 5.10. Sensory and Brain Functions
- 6. Sociophysiology

Homeodynamics

84

K. Hartiala, *Pertunkatu, Turku, Finland*

O. Hänninen, *Department of Physiology, University of Kuopio, Finland*

- 1. Introduction
- 2. Feedback and Gain
- 3. Intracellular Homeodynamics
- 4. Homeodynamics of Cell Numbers
- 5. Extracellular Fluid Homeodynamics
- 6. Environmental Temperature and Homeodynamics
- 7. Environmental Chemical Threats and Homeodynamics
- 8. Homeodynamics and Disease
- 9. Ecosystem Homeodynamics

G Protein-Coupled Receptors

101

Tarja Kokkola, *Department of Physiology, University of Kuopio, Finland*

- 1. Introduction
- 2. Turning the system on
- 3. Signaling through several pathways
- 4. What do the receptors do?
 - 4.1. β -Adrenergic receptor
 - 4.2. Vision
 - 4.3. Smell
 - 4.4. Taste
 - 4.5. Viral receptors
- 5. GPCR families
 - 5.1. Class A: Rhodopsin-like receptors
 - 5.2. Class B: Secretin-like receptors
 - 5.3. Class C: Metabotropic glutamate/pheromone receptors
 - 5.4. Other GPCR families
- 6. Receptor regulation
 - 6.1. Uncoupling
 - 6.2. Desensitization
 - 6.2.1. Homologous desensitization
 - 6.2.2. Heterologous desensitization
 - 6.3. Down-regulation
 - 6.4. Dimerization
 - 6.5. Clustering
- 7. GPCRs and human disease
- 8. GPCRs as a gold mine for drug development
- 9. Conclusions

Ionic Channels Of The Excitable Membrane

118

B.V. Krylov, *Pavlov Institute of Physiology, Russian Academy of Sciences, St. Petersburg, Russia*

- 1. Introduction

2. Sodium Channel Protein
 - 2.1. Selectivity Filter
 - 2.2. Gating Mechanism
3. Operating of Voltage-Gated Channel
4. Ligand-Gated Channels
5. Mechanically Activated Channels
6. Membrane Receptor-Ionic Channel Coupling
7. The First-Order Code
 - 7.1. Ionic Mechanisms of Adaptation and Numeric Coding in Nerve Fiber. Roles of Slow Potassium and Sodium Channels
 - 7.2. The Ionic Mechanisms of Frequency Coding in Nerve Fiber

Mechanisms Of Cell Volume Regulation

130

Alexander A. Mongin, *Albany Medical College, Albany, NY, USA*

Sergei N. Orlov, *University Hospital Research Centre (CHUM) and Department of Medicine, Université de Montréal, Montréal, Québec, Canada*

1. Introduction
2. Factors determining cell volume under steady-state conditions
3. Physiological and pathological causes of non-balanced cell volume changes
4. General mechanisms of cell volume regulation under non-steady-state conditions
 - 4.1. Membrane transporters mediating RVD
 - 4.2. Membrane transporters mediating RVI
 - 4.3. Gene transcription changes in response to cell volume alterations
5. Physical and chemical signals generated by cell volume alterations: possible nature of the cell volume sensor(s)
 - 5.1. Mechanical signals and putative mechanosensory membrane domains
 - 5.2. Cell volume-dependent changes in the cytoskeleton
 - 5.3. Changes in concentration of macromolecules—macromolecular crowding
 - 5.4. Intracellular chloride and magnesium
 - 5.5. Intracellular ionic strength
6. Transduction of volume signal
 - 6.1. Intracellular calcium and calmodulin
 - 6.2. G-proteins
 - 6.3. Protein phosphorylation
 - 6.4. Arachidonic acid and products of its metabolism
7. Contribution of volume regulatory mechanisms to cell functions and pathological states
8. Perspectives on the studies of cell volume regulation

Thermoregulation

148

Ryszard Grucza, *Institute of Sport, Warsaw, Poland*

1. Introduction
2. Basic Elements of the Human Thermoregulatory System
 - 2.1. Body Temperatures
 - 2.2. Thermoreceptors and Thermodetectors
 - 2.3. Thermoregulatory Centers
 - 2.4. Thermoregulatory Effectors
3. Body Heat Balance
 - 3.1. Metabolic Heat Production
 - 3.2. Radiation
 - 3.3. Convection
 - 3.4. Conduction
 - 3.5. Evaporation
4. Thermoregulatory Reactions to Heat and Cold
 - 4.1. Skin Blood Flow

- 4.2. Sweating
- 4.3. Nonshivering Thermogenesis and Brown Adipose Tissue
- 4.4. Shivering Thermogenesis
- 5. Body Heat Loads
 - 5.1. Thermal Comfort
 - 5.2. Heat Exposure
 - 5.3. Exercise
 - 5.4. Cold Exposure
- 6. Models of the Human Thermoregulatory System
- 7. Efficiency of Human Thermoregulation
- 8. Gender Differences in Thermoregulation
- 9. Acclimation and Acclimatization
- 10. Thermoregulation in Children
- 11. Other Aspects of Thermoregulation
 - 11.1. Hyperthermia
 - 11.2. Malignant Hyperthermia
 - 11.3. Fever
 - 11.4. Hypothermia

Pain And Protective Reflexes

175

Matti V.O. Närhi, *Department of Physiology, University of Kuopio, Finland*

- 1. Introduction
- 2. Physiological and pathological pain
- 3. Pain definition
- 4. Classification of Pain
- 5. Central Pain Pathways
- 6. Withdrawal Reflex and Avoidance Behavior Induced by Noxious Stimulation
- 7. Regulation of Pain Transmission in the Central Nervous System
- 8. Functional and Structural Changes in the Pain Tracts
- 9. Responses of Peripheral Nociceptors to Tissue Injury and Inflammation

Wound Healing And Regeneration

193

White L.M., *The Ohio State University, Columbus, USA*

Roy S., *The Ohio State University, Columbus, USA*

Gordillo G.M., *The Ohio State University, Columbus, USA*

Kalliainen L.K., *The Ohio State University, Columbus, USA*

Melvin W.S., *The Ohio State University, Columbus, USA*

Ellison E.C., *The Ohio State University, Columbus, USA*

Sen C.K., *The Ohio State University, Columbus, USA*

- 1. Introduction
 - 1.1. Repair vs. Regeneration
 - 1.2. Embryogenesis and Fetal Healing
 - 1.3. Prototypic Wound
 - 1.4. Main Cellular Effectors
 - 1.5. Cytokines and Growth Factors
- 2. Phased Healing Response
 - 2.1. Inflammatory Phase: Hemostasis and Inflammation
 - 2.1.1. Hemostasis
 - 2.1.2. Inflammation
 - 2.2. Migratory Phase: Angiogenesis, Fibroblast Migration and Proliferation, Epithelialization, and Neuronal Repair
 - 2.2.1. Angiogenesis
 - 2.2.2. Fibroblast Migration and Proliferation
 - 2.2.3. Epithelialization

- 2.2.4. Neuronal Repair
- 2.3. Proliferative Phase: Collagen and Proteoglycan Synthesis and Wound Contraction
 - 2.3.1. Collagen and Proteoglycan Synthesis
 - 2.3.2. Wound Contraction
- 2.4. Late Phase: Remodeling
- 3. Pathologic Responses to Wounding
 - 3.1. General Health and Stress
 - 3.2. Nutrition
 - 3.3. Pharmacologic Impediments
 - 3.4. Predisposing Diseases
 - 3.4.1. Diabetes Mellitus
 - 3.4.2. Pressure Sores
 - 3.4.3. Venous Stasis Ulcers
 - 3.5. Overhealing Wounds
- 4. Standard and Emerging Therapies for Enhanced Healing
 - 4.1. Standard Therapeutics
 - 4.2. Emerging Therapeutics
 - 4.2.1. Oxygen Therapy
 - 4.2.2. Exogenous Cytokine Administration
 - 4.2.3. Vacuum-assisted Closure
- 5. Conclusion

Learning And Memory

233

Hojjatallah Alaei, *Department of Physiology, University of Medical Sciences Isfahan, Iran*

- 1. Introduction
- 2. Learning by Classic Conditioning
 - 2.1. Habituation
 - 2.2 Sensitization
 - 2.3. Long-Term Potentiation (LTP) and Long-Term Depression
- 3. Memory
 - 3.1. Short Term Memory (STM)
 - 3.2 Long Term Memory (LTM)
 - 3.3. Consolidation of Memory
- 4. Neural Mechanisms of Memory
 - 4.1. Mechanism Involved in Short Term Memory
 - 4.2. Mechanisms Involved in Long Term Memory
- 5. Brain Areas Involved in Memory
- 6. Amnesia

Positron Emission Tomography: Molecular Imaging Of Biological Processes

248

Juhani Knuuti, *Turku University Central Hospital, Finland*

Heikki Minn, *Turku University Central Hospital, Finland*

Juha Rinne, *Turku University Central Hospital, Finland*

- 1. Introduction: Principles of PET
- 2. Radiochemistry
- 3. Drug Development, Radiolabeled Drugs, and PET
 - 3.1. Pharmacodynamic Studies
 - 3.2. Pharmacokinetic Studies
- 4. Brain Receptors and Neurotransmission
- 5. Perfusion Imaging
- 6. Metabolic Imaging
 - 6.1. Glucose Metabolism
 - 6.2. Free Fatty Acid (FFA) Metabolism
 - 6.3. Oxidative Metabolism

7. Clinical Applications of PET
 - 7.1. PET in Oncology
 - 7.2. Metabolic Imaging
 - 7.3. PET in Brain Diseases
8. Imaging Gene Expression in vivo using PET

Comparative Physiology **265**
 Esa Hohtola, *University of Oulu, Finland*

1. Introduction: Diversity of Animals
2. Size, Scaling and Allometry
3. Physiological Adaptation and Phenotypic Plasticity
4. Adaptation and Phylogeny
5. Major Evolutionary Steps in Vertebrate Physiological Adaptation

Enzymes: The Biological Catalysts Of Life **279**
 Pekka Mäntsälä, *University of Turku, Department of Biochemistry, Finland*
 Jarmo Niemi, *University of Turku, Department of Biochemistry, Finland*

1. Introduction
2. Enzymes as Biological Catalysts
 - 2.1. Factors Affecting Activity
 - 2.2. Active Site
 - 2.3. Enzyme Kinetics
 - 2.4. Specificity
 - 2.5. Mechanism of Action
 - 2.6. Regulation of Enzyme Activities
3. Cofactors
4. Enzymes in the Cell
5. Enzyme Turnover
6. Enzyme Nomenclature
 - 6.1. Reaction Types
 - 6.2. Isoenzymes
7. Clinical and Biotechnological Applications of Enzymes
 - 7.1. Clinical Enzymology
 - 7.2. Biotechnological Applications

Concept Of Enzyme Catalysis **299**
 Kalervo Airas, *Department of Biochemistry, University of Turku, Finland*

1. Background
2. Enzyme Specificity
3. General Features to Increase the Reaction Rate
4. Basic Catalytic Mechanisms
5. Stabilization of the Transition State
6. Transition State Analogs
7. Enzymic and Metabolic Equilibria

Index **309**

About EOLSS **317**

VOLUME II

On The Determination Of Enzyme Structure, Function, And Mechanism

1

Glumoff T., *University of Oulu, Finland*

1. Introduction
2. Structure Determination Techniques
 - 2.1. X-ray Crystallography
 - 2.1.1. General
 - 2.1.2. Crystallization of Enzymes
 - 2.1.3. X-ray Diffraction Experiments
 - 2.1.4. The Phase Problem
 - 2.1.5. Crystallographic Calculations
 - 2.2. Nuclear Magnetic Resonance Spectroscopy (NMR)
3. Relationship of Enzyme Structure with Enzyme Chemistry and Mechanism
 - 3.1. General
 - 3.2. Case: Lignin Peroxidase
4. Future Considerations

Enzymes Of Digestion

14

Senol Dane, *Atatürk University, Medical Faculty, Department of Physiology, Erzurum, Turkey*

Osmo Hänninen, *Department of Physiology, University of Kuopio, Finland*

1. Introduction
2. Hydrolysis
3. Enzymes of Digestion According to their Sites of Secretion
 - 3.1. Ptyalin (α - amylase)
 - 3.2. Lingual Lipase
 - 3.3. Enzymes Secreted from Gastric Glands
 - 3.3.1. Pepsin
 - 3.3.2. Gastric Lipase
 - 3.4. Pancreatic Digestive Enzymes
 - 3.4.1. Amylase
 - 3.4.2. Lipase
 - 3.4.3. Phospholipase A2
 - 3.4.4. Carboxylesterase
 - 3.4.5. Endopeptidases
 - 3.4.6. Carboxypeptidases
 - 3.4.7. Nucleases
 - 3.5. Enzymes of Intestinal Mucosa
 - 3.5.1. Aminopeptidases
 - 3.5.2. Dipeptidases
 - 3.5.3. Diesterases
 - 3.5.4. Nucleotidases
 - 3.5.5. Oligo- and disaccharidases
4. Conclusion

Metabolism Of Oxygen

30

Mika Venojärvi, *Department of Physiology, Institute of Biomedicine University of Kuopio, Kuopio, Finland and Medical Laboratory Technology, Turku University of Applied Sciences, Turku, Finland.*

1. Introduction
2. Oxygen chemistry
 - 2.1. Oxygen molecule
 - 2.2. Singlet oxygen
 - 2.3. Superoxide, hydrogen peroxide and hydroxyl radical

- 2.4. Carbon dioxide and monoxide
- 2.5. Sulfuric acid-sulfurdioxide
- 2.6. Nitrogen and its oxides
- 3. Mitochondria and oxygen
 - 3.1. Oxidative phosphorylation
 - 3.2. Mitochondrial superoxide synthesis and its elimination
- 4. Oxygen activation by cytochrome P450
- 5. Peroxisomes
- 6. Vascular endothelium and xanthine oxidase
- 7. Reactive metabolites as bullets of phagocytes
 - 7.1. NADPH oxidase
 - 7.2. Hypochloric acid
- 8. Oxygen damages of biomolecules
 - 8.1. Protein oxidation
 - 8.2. Lipid peroxidation
 - 8.3. DNA oxidation
 - 8.4. Tissue anoxia
 - 8.5. Anoxic necrosis
- 9. Sensing oxygen levels
 - 9.1. Chemoreceptors
 - 9.2. Glutathione cycle
- 10. Oxygen in genome regulation

Protection Against Oxidative Stress

51

J. Lappalainen, *University of Kuopio, Finland*

M. Atalay, *Department of Physiology, University of Kuopio, Finland*

- 1. Introduction and General Considerations
- 2. Reactive Oxygen Species and their Formation
- 3. Oxidative Damage and Physiological Significance of Reactive Oxygen Species
- 4. Oxidative Stress in Disease
- 5. Antioxidant Defence Mechanisms
 - 5.1. Superoxide Dismutase
 - 5.2. Catalase
 - 5.3. Glutathione and Glutathione-related Enzymes
 - 5.4. Thioredoxin
 - 5.5. Vitamin E
 - 5.6. Vitamin C
 - 5.7. Lipoic Acid
 - 5.8. N-Acetyl-L-cysteine
 - 5.9. Ubiquinone
 - 5.10. Other Antioxidants
- 6. Antioxidant Supplementation and Oxidative Stress
- 7. Exercise as a Protective Tool against Oxidative Stress

Physiological Regulation Of Gene Activity By Oxygen (O₂)

75

Juha-Pekka Pursiheimo, *Turku Centre for Biotechnology, Turku, Finland*

- 1. Introduction
- 2. HIF: transcriptional regulator of hypoxic responses
- 3. Oxygen-dependent regulation of HIF
 - 3.1. Oxygen-dependent regulation of HIF α stability
 - 3.2. Oxygen-dependent regulation of HIF transcriptional activity
- 4. Reactive Oxygen Species (ROS) and cellular responses
- 5. Oxygen and disease progression
 - 5.1. Solid tumors
 - 5.2. Myocardial Ischemia

- 5.3. Alveolar cell death
- 5.4. Reperfusion injury

Biotransformation Of Xenobiotics And Hormones

87

Osmo Hänninen, *Department of Physiology, University of Kuopio, Finland*

- 1. Introduction
- 2. Absorption of Xenobiotics
- 3. Detoxication and Bioactivation
 - 3.1. Oxidation of Xenobiotics
 - 3.1.1. Cytochrome P-450
 - 3.1.2. Other Oxidases
 - 3.2. Reduction
 - 3.3. Hydrolysis
 - 3.4. Conjugation Reactions
 - 3.4.1. Glucuronide Synthesis
 - 3.4.2. Amino Acid Conjugations
 - 3.4.3. Glutathione Conjugations
 - 3.4.4. Sulfonic Acid Conjugations
 - 3.4.5. Acetylation and Methylation
- 4. Excretion of Metabolites

Biomonitoring Of Environmental Pollution

108

Sergei Kotelevtsev, *Moscow State University, Moscow, Russia*

Valerii Tonkopii, *Russian Academy of Sciences, St. Petersburg, Russia*

Osmo Hänninen, *University of Kuopio, Finland*

- 1. Introduction and Background
- 2. Biomarker Molecules
 - 2.1. Genomic and mRNA Analyses
 - 2.2. Proteomics: Enzymes and Other Proteins
- 3. Models Used in Biomonitoring
 - 3.1. Cell Cultures
 - 3.2. Tests with Invertebrates
 - 3.3. Populations and Wild Vertebrates
 - 3.4. Caged Organisms
- 4. Biomonitoring of the Quality of Air
- 5. Soil Pollution
- 6. Pollution and Biomonitoring of Water Resources
- 7. Biomonitoring of Textile Safety
- 8. Human and Animal Diseases in the Biomonitoring of Environmental Pollution
- 9. Attempts at Pollutant Bioidentification
 - 9.1. Heavy Metals
 - 9.2. Organophosphates
 - 9.3. Organochlorines
 - 9.4. Cyanides
 - 9.5. Pyrethroids
- 10. Chemical Analysis of Pollutants and Biomonitoring

Industrial Use Of Enzymes

130

Matti Leisola, *Helsinki University of Technology, Finland*

Jouni Jokela, *Helsinki University of Technology, Finland*

Ossi Pastinen, *Helsinki University of Technology, Finland*

Ossi Turunen, *Helsinki University of Technology, Finland*

Hans E. Schoemaker, *DSM Research, The Netherlands*

- 1. Historical Background

2. Enzyme Classification
3. Enzyme Production
 - 3.1. Microbial Production Strains
 - 3.2. Enzyme Production by Microbial Fermentation
4. Protein Engineering
5. Enzyme Technology
6. Large-Scale Enzyme Applications
 - 6.1. Detergents
 - 6.2. Starch Hydrolysis and Fructose Production
 - 6.3. Drinks
 - 6.4. Textiles
 - 6.5. Animal Feed
 - 6.6. Baking
 - 6.7. Pulp and Paper
 - 6.8. Leather
7. Specialty Enzymes
 - 7.1. Enzymes in Analytics
 - 7.2. Enzymes in Personal Care Products
 - 7.3. Enzymes in DNA Technology
8. Enzymes in Fine Chemical Production
 - 8.1. Enantiomerically Pure Amino Acids and Aspartame
 - 8.2. Rare Sugars
 - 8.3. Semisynthetic Penicillins
 - 8.4. Lipase-Based Reactions
 - 8.5. Asymmetric Synthesis
 - 8.6. Enzymatic Oligosaccharide Synthesis
9. Future Trends in Industrial Enzymology

Nutrition And Digestion

154

A-L. Rauma, *University of Joensuu, Faculty of Education, Savonlinna, Finland*

I. Haapala, *University of Kuopio, Department of Public Health and General Practice, Kuopio, Finland*

1. Nutrition
 - 1.1. Body Composition
 - 1.2. Nutritional Needs
 - 1.3. Over and Undernutrition
 - 1.4. Nutritional Genomics
2. Digestion
 - 2.1. Digestion of Macronutrients
 - 2.2. Digestion of Micronutrients
 - 2.3. Malabsorption
 - 2.4. Intestinal Microflora

Autotrophic, Heterotrophic And Other Nutritional Patterns

166

Seppo Turunen, *Department of Physiology, University of Kuopio, Finland*

1. Introduction: Different Life Forms
2. Origin of Life and Energy Sources
3. Early Chemotrophic Life
4. Early Phototrophic Autotrophism
5. First Steps towards Karyotes: From Heterotrophism to Nucleus and Mitosis
6. From Endosymbiosis to Chloroplasts and Mitochondria
7. Towards Multicellularism and Task Divisions within Organisms
8. Organisms in Ecosystems—Symbiosis

Nutritional Needs

189

Anna-Liisa Rauma, *University of Joensuu, Savonlinna, Finland*
 Irja Haapala, *University of Kuopio, Kuopio, Finland*

1. Nutritional Needs and Dietary Recommendations
 - 1.1. Developing Dietary Reference Values
 - 1.2. Risk Assessment and Nutrient Safety
 - 1.3. Dietary Reference Values Defined and Interpreted
2. Nutritional Needs
 - 2.1. Macronutrients
 - 2.2. Energy Balance
 - 2.3. Micronutrients
 - 2.3.1. Dietary Antioxidants
3. Non-Nutrient Dietary Substances

Alimentary Systems In Some Homeothermic Vertebrates

210

Seppo Haaranen, *Department of Physiology, University of Kuopio, Finland*
 Osmo Hänninen, *Department of Physiology, University of Kuopio, Finland*

1. Introduction
2. General Structure of Digestive Tract
 - 2.1. Mouth
 - 2.2. Stomach
 - 2.3. Intestine
 - 2.4. Liver and Pancreas
 - 2.5. Microbes Contribute to Digestion
3. Carnivores
 - 3.1. Cat and Dog
4. Herbivores
 - 4.1. Rabbits
 - 4.2. Guinea Pigs
 - 4.3. Horses
 - 4.4. Cow and Other Ruminants
5. Birds

Intestinal Microflora

231

Erkki Eerola, *Turku University. Department of Medical Microbiology, Turku, Finland.*
 Wen Hua Ling, *Zhongshan University. Department of Clinical Nutrition, Guangzhou, PR-China*

1. Introduction—Composition of the Intestinal Flora
2. Microbial Ecology of the Intestinal Flora
3. Effects of the Intestinal Flora
4. Bacterial Enzymes
5. Methods of Studying the Intestinal Flora
6. Intestinal Flora and Immune Defense
7. Future Aspects

Fatty Acids In Human Metabolism **243**

E. Tvrzická, *4th Department of Medicine, 1st Faculty of Medicine, Charles University, Prague, Czech Republic*

A. Žák, *4th Department of Medicine, 1st Faculty of Medicine, Charles University, Prague, Czech Republic*

M. Vecka, *4th Department of Medicine, 1st Faculty of Medicine, Charles University, Prague, Czech Republic*

B. Staňková, *4th Department of Medicine, 1st Faculty of Medicine, Charles University, Prague, Czech Republic*

1. Introduction
2. Physico-Chemical Properties of Fatty Acids
3. Biosynthesis of Fatty Acids
4. Classification and Biological Function of Fatty Acids
5. Fatty Acids as Constitutional Components of Lipids
6. Physiological Roles of Fatty Acids
7. Milk Lipids and Developing Brain
8. Pathophysiology of Fatty Acids
9. Therapeutic Use of Polyunsaturated Fatty Acids

Vegetarianism And Vegan Diet **271**

Anna-Liisa Rauma, *University of Joensuu, Savonlinna, Finland*

1. Introduction
2. Food Safety and Various Eating Patterns
3. Plant-Based Dietary Patterns and Physiological Health Promotion
4. Plant-Only Diets and Health Risk Control
5. Dietary Guidelines for Vegetarians
6. Divergence in Values About Eating

Sterols, Especially Cholesterol And Phytosterols, In Human Metabolism **283**

M. Vecka, *4th Department of Medicine, 1st Faculty of Medicine, Charles University, Prague, Czech Republic*

A. Žák, *4th Department of Medicine, 1st Faculty of Medicine, Charles University, Prague, Czech Republic*

E. Tvrzická, *4th Department of Medicine, 1st Faculty of Medicine, Charles University, Prague, Czech Republic*

1. Introduction
2. Nutrition and Digestion of Sterols
 - 2.1. Sterols in the Diet
 - 2.1.1. Cholesterol
 - 2.1.2. Non-cholesterol Sterols
 - 2.2. Mechanism of Sterol Absorption
 - 2.2.1. Micellar Phase
 - 2.2.2. Enterocytar Phase
3. Sterols in the Human Body
 - 3.1. Turnover of Sterols
 - 3.2. Sterols in the Plasma
 - 3.2.1. Cholesterol Level in Plasma
 - 3.2.2. Concentrations of Non-cholesterol Sterols in Plasma
 - 3.3. Lipoprotein Metabolism
 - 3.4. Cellular Homeodynamics of Cholesterol
 - 3.4.1. Cholesterol Biosynthesis
 - 3.4.2. Cellular Trafficking of Cholesterol
 - 3.4.3. Cholesterol from and to the Cell

4. Clinical and Pathobiochemical Significance of Sterols	
4.1. Genetic Defects and Non-cholesterol Sterols	
4.2. Cholesterol	
4.2.1 Function of Cholesterol	
4.2.2. Enzymatic Modification of Cholesterol - Esters, Bile Acids, and Steroid Hormones	
4.2.3. Oxy-sterol Formation from Cholesterol	
4.2.4. Covalent Modification of Proteins with Cholesterol	
4.2.5. Cholesterol as a Ligand for Sterol Sensing Domain	
4.2.6. Function of the Biosynthetic Precursors of Cholesterol	
4.3. Phytosterols	
4.3.1. Beneficial Effects of Phytosterols	
4.3.2. Adverse Effects of Phytosterols	
4.4. Cholestanol	
5. Sterol Analysis	
5.1. Analytical Aspects	
5.1.1. Free Sterols	
5.1.2. Steryl Esters	
5.1.3. Steryl Glycosides and their Esters	
5.2. Nutritional Aspects of Sterol Analysis	
6. Conclusion	
Index	303
About EOLSS	311

VOLUME III

Renal Excretion	1
<i>László Rosivall, Department of Pathophysiology, Semmelweis University, Hungary</i>	
<i>Shahrokh MirzaHosseini, Semmelweis University, Faculty of Medicine, Institute of Pathophysiology, Nephrology Research and Training Center, Hungarian Academy of Sciences. Avicenna College, International Education Center, Budapest, Hungary.</i>	

1. Introduction
2. Functional Anatomy and Histology of the Kidneys
3. Nephron
 - 3.1. Glomerulus
 - 3.2. Tubules
4. Renal Blood Vessels
5. Bladder and Urination
6. Urine Composition

Renal General Functions	11
<i>László Rosivall, Department of Pathophysiology, Faculty of Medicine, Semmelweis University, Hungary, and Hungarian Academy of Sciences and Semmelweis University Nephrology Research Group.</i>	
<i>Shahrokh MirzaHosseini, Avicenna International College, Budapest, Hungary.</i>	

1. Introduction
2. Renal General Functions
3. Body Fluid Compartments
4. Juxtaglomerular Apparatus (JGA) Releases Renin
5. Glomerular Ultrafiltration (GFR) and Its Determination
6. Composition of the Glomerular Filtrate
7. Tubular Filtrate Processing
 - 7.1. Reabsorption

7.2. Tubular Excretion

Water And Ion Balance And Imbalance **22**
László Rosivall, *Department of Pathophysiology, Faculty of Medicine, Semmelweis University, Hungary*
Hungarian Academy of Sciences and Semmelweis University Nephrology Research Group Budapest, Hungary
Shahrokh MirzaHosseini, *Avicenna International College, Budapest, Hungary*

1. Introduction
2. Water Balance
3. Water Deprivation
4. Minimum Daily Water Intake
5. Antidiuretic Hormone
6. Synthesis and Mechanism of Action of ADH
7. Ion Imbalances
 - 7.1. Hyponatremia
 - 7.2. Hypernatremia
 - 7.3. Hypokalemia
 - 7.4. Hyperkalemia

Excretion Of Wastes And Pathophysiology **30**
László Rosivall, *Department of Pathophysiology, Faculty of Medicine, Semmelweis University, Hungary*
Hungarian Academy of Sciences and Semmelweis University Nephrology Research Group Budapest, Hungary
Shahrokh Mirza Hosseini, *Avicenna International College, Budapest, Hungary*

1. Introduction
2. Excretion of Creatinine
3. Excretion of Urea
4. Renal Failure
 - 4.1. Acute Renal Failure (ARF)
 - 4.1.1. Parenchymal Acute Renal Failure
 - 4.2. Chronic Renal Failure (CRF)

Comparative Aspects Of Renal Excretion In Vertebrates **42**
László Rosivall, *Department of Pathophysiology, Faculty of Medicine, Semmelweis University, Hungary*
Hungarian Academy of Sciences and Semmelweis University Nephrology Research Group Budapest, Hungary
Shahrokh MirzaHosseini, *Avicenna International College, Budapest, Hungary*

1. Introduction
2. Fishes
 - 2.1. Hagfishes
 - 2.2. Lampreys
 - 2.3. Elasmobranchs
 - 2.4. Marine Teleosts
 - 2.5. Freshwater Teleosts
 - 2.6. Euryhaline Teleosts
3. Amphibians
4. Reptiles
5. Birds

Endocrinology **47**
Juhani Leppäluoto, *Department of Physiology, University of Oulu, Finland*

1. Introduction

2. Main Hormones and their Functions
 - 2.1. Thyroxine and Thyroid Gland
 - 2.2. Adrenal Glands and Hormones
 - 2.2.1. Adrenal Cortical Hormones
 - 2.2.2. Adrenal Medulla
 - 2.3. Parathyroid Hormones, Calcium and D-vitamin
 - 2.3.1. Parathyroid Gland and Parathyroid Hormone (PTH)
 - 2.3.2. D-vitamin
 - 2.3.3. Osteoporosis
 - 2.4. Pituitary Hormones
 - 2.4.1. Growth Hormone
 - 2.4.2. Prolactin
 - 2.4.3. ACTH, other Pro-opiomelanocortin Derived Hormones and Enkephalins
 - 2.4.4. Glycoprotein Hormones
 - 2.4.5. Hormones of Posterior Pituitary
 - 2.5. How Does Body Regulate Blood Sugar Concentration?
 - 2.5.1. Insulin
 - 2.5.2. Glucagon
 - 2.5.3. Diabetes Mellitus
 - 2.6. Reproductive Hormones
 - 2.6.1. Women
 - 2.6.2. Male Reproductive Hormones
 - 2.7. Gastrointestinal Hormones
3. Tissue Hormones
 - 3.1. Eicosanoids
 - 3.2. Vasoactive Tissue Hormones

General Features Of Hormonal Coordination

66

Jorma Paranko, Institute of Biomedicine, Department of Anatomy, University of Turku, Finland
Osmo Hänninen, Department of Physiology, University of Kuopio, Finland

1. Introduction
2. Chemical nature of hormones
 - 2.1. Peptide and protein hormones
 - 2.2. Amino acid and fatty acid derivatives
 - 2.3. Cholesterol-derived hormones
3. Hormone transport in blood
4. Hormones as universal and specific regulators
5. Hormone receptors
 - 5.1. Cell surface receptors
 - 5.1.1. G-protein coupled receptors (GPCRs)
 - 5.1.1.1. cAMP signalling
 - 5.1.1.2. cGMP signalling
 - 5.1.1.3. IP3 and DAG signalling
 - 5.1.2. Protein tyrosine kinase-linked receptors (PTKRs)
 - 5.2. Intracellular and nuclear receptors
 - 5.3. Silent receptors
 - 5.4. Orphan nuclear receptors
 - 5.5. Receptor isoforms
 - 5.6. Receptor recycling and degradation
 - 5.7. Receptor desensitization
 - 5.8. Receptor mutations
6. Feedback systems
7. Decay of hormones
8. Endocrine disruptors
9. Evolution of hormones

Glucocorticoids And Brain **86**
 Natalia E. Ordyan, *Pavlov Institute of Physiology, Russian Academy of Sciences, St.-Petersburg, Russia.*
 Vera G. Shalyapina, *Pavlov Institute of Physiology, Russian Academy of Sciences, St.-Petersburg, Russia.*

1. Introduction
2. Action Mechanisms of Glucocorticoids
3. Corticosteroid Receptors
4. Neural and Neuroendocrine Control of Glucocorticoid Secretion
5. Glucocorticoids as a Biological Substrate of Reward
6. Role of Glucocorticoids in Affective Illness
7. Neurotoxicity of Glucocorticoids

Melatonin-The Hormone Of Darkness **97**
 O. Vakkuri, *Department of Physiology, University of Oulu, Finland.*

1. Introduction
2. Melatonin as Pineal Hormone of Darkness
3. Melatonin in Other Tissues
4. Circadian Secretion Pattern of Melatonin
5. Seasonal Secretion of Melatonin
6. Metabolism of Melatonin
7. Melatonin Receptors
8. Biological Action Profile of Melatonin
 - 8.1. Melatonin and Sleep
 - 8.2. Melatonin as Antioxidant and Cancer
 - 8.3. Melatonin, Mental Health and Aging
9. Future Perspectives
10. Conclusions

Heart As An Endocrine Organ **110**
 Olli Vuolteenaho, *Department of Physiology, Medical Faculty, Biocenter Oulu, University of Oulu, Finland*

1. Introduction
2. Adaptation of the Heart to Increased Load
3. Discovery of Cardiac Hormones
4. Physiological Effects of Cardiac Natriuretic Peptides (ANP and BNP)
5. Natriuretic Peptide Receptors
6. Regulation of ANP and BNP
7. Therapeutic Use of Cardiac Hormones
8. Diagnostic Use of Cardiac Hormones

Hormones And Cold: Integration Of Endocrinology, Morphology, Physiology And Behaviour **118**
 Juhani Leppäluoto, *Department of Physiology, University of Oulu, Finland*

1. Introduction
2. Why did a tropical man move to cold climate areas?
3. Does modern man experience cold?
4. Physiological heat production
 - 4.1. Muscle activity and heat production
 - 4.2. Nonshivering thermogenesis and hormones
5. Thyroid hormones in cold
6. Catecholamines and brown adipose tissue
7. Frost bites

- 7.1. Pathophysiology of frozen tissues
- 7.2. Treatment principles

Respiration **130**

Y.J. Salorinne, *Department of Clinical Physiology and Nuclear Medicine, Helsinki University Hospital and Helsinki University Medical Faculty, Helsinki, Finland*
P. Haapalahti, *Department of Clinical Physiology and Nuclear Medicine, Helsinki University Hospital and Helsinki University Medical Faculty, Helsinki, Finland*

- 1. Introduction
- 2. Four Types of Surfaces for Gas Exchange
 - 2.1. Body Surfaces
 - 2.2. Gills
 - 2.3. Tracheal System
 - 2.4. Lungs
- 3. Air Quality and Respiration
- 4. Human Lung Pathophysiology
- 5. Oxygen Delivery
- 6. Haemoglobin Engineering
- 7. Control of Breathing

Respiratory Structures And Gas Exchange **145**

Y.J. Salorinne, *Department of Clinical Physiology and Nuclear Medicine, Helsinki University Hospital and Helsinki University Medical Faculty, Finland*
P. Haapalahti, *Department of Clinical Physiology and Nuclear Medicine, Helsinki University Hospital and Helsinki University Medical Faculty, Finland*

- 1. Introduction
- 2. Lung Structure and Volumes
- 3. Terminal Respiratory Unit
- 4. Pulmonary and Alveolar Ventilation
- 5. Gas Exchange
- 6. Distribution of Ventilation and Perfusion
- 7. Mismatch of Ventilation and Perfusion
- 8. Smoking and Respiration

Dynamics And Control Of Respiration **163**

G.G. Isaev, *Laboratory of Respiratory Physiology, Pavlov Institute of Physiology, Russian Academy of Sciences, St. Petersburg, Russia*
Y.J. Salorinne, *Department of Clinical Physiology and Nuclear Medicine, Helsinki University Hospital and Helsinki University Medical Faculty, Finland*
P. Haapalahti, *Department of Clinical Physiology and Nuclear Medicine, Helsinki University Hospital and Helsinki University Medical Faculty, Finland*

- 1. Introduction
- 2. Dynamics of Respiration
- 3. Control of Respiration

Oxygen And Carbon Dioxide Transport **173**

Y.J. Salorinne, *Department of Clinical Physiology and Nuclear Medicine, Helsinki University Hospital and Helsinki University Medical Faculty, Helsinki, Finland.*
P. Haapalahti, *Department of Clinical Physiology and Nuclear Medicine, Helsinki University Hospital and Helsinki University Medical Faculty, Helsinki, Finland.*

- 1. Introduction

2. Oxygen Hemoglobin Dissociation Curve
3. Oxygen Delivery
4. Carbon Dioxide Transport

Blood Circulation: Its Dynamics And Physiological Control

179

Emil Monos, *Institute of Human Physiology, Semmelweis University Budapest, Hungary.*

1. Introduction
2. Functional Organization of the Circulatory System
 - 2.1. The Two Separate Pumps of the Circulation: Left Heart and Right Heart
 - 2.2. Functional Units of Systemic Blood Vessels Coupled in Series
 - 2.3. Blood Vessels Coupled in Parallel
 - 2.4. Structural Properties of the Vascular Wall
3. List of Physiological Functions Coupled to the Vascular System
4. Hemodynamics: Biomechanical Characteristics of the Circulation
 - 4.1. Biomechanical Properties of the Blood: Blood Rheology
 - 4.2. Biomechanics of the Vascular Wall: Stress, Strain, Elasticity
 - 4.3. Blood Pressure and Flow: Vascular Resistance
 - 4.4. Biomechanics of the Heart: the Cardiac Cycle
5. Physiological Control of Circulation
 - 5.1. Local Control Mechanisms
 - 5.2. Systemic Control Mechanisms
6. Hints to Maintain Healthy Circulatory Functions

Arterial Blood Supply And Tissue Needs

206

György L Nádasy, *Experimental Research and Human Physiological Institute, Semmelweis Medical University, Budapest, Hungary*

1. Introduction
2. Elementary Hemodynamics and Wall Mechanics
 - 2.1. Laminar and Turbulent Flow
 - 2.2. Hydrodynamic Resistance
 - 2.3. Blood Viscosity
 - 2.4. Parameters of Artery Wall Elasticity
3. Biological Design of Arteries
 - 3.1. Arterial Tree
 - 3.2. Geometric Design of Arterial Segments
 - 3.3. Arterial Viscoelasticity. Effects of Smooth Muscle Contraction-relaxation
 - 3.4. Histologic Design
 - 3.5. Angiogenesis, Remodeling of Arteries
4. Cytophysiology of Artery Wall Components
 - 4.1. Arterial Smooth Muscle Cells
 - 4.2. Endothelial Cell
 - 4.3. Connective Tissue
5. Pressure in Arteries
 - 5.1. Measurement of Arterial Pressure
 - 5.2. Arterial Pressure Curve
 - 5.3. Values of Arterial Blood Pressure
 - 5.4. Arterial Pressure Wave
6. Blood Flow in Arteries
 - 6.1. Measurement of Arterial Blood Flow
 - 6.2. Pulsatile Flow
7. Different Segments of the Arterial Tree
 - 7.1. Windkessel Arteries
 - 7.2. Distributing (large muscular) Arteries
 - 7.3. Resistance Arteries

8. Control of Arterial Contractility
 - 8.1. Neural Control
 - 8.2. Endocrine Control
 - 8.3. Local Control of Arteries
 - 8.4. Myogenic Control of Arteries
 - 8.5. Endothelial Control of Arteries
 - 8.6. Basal Tone
9. Organ Blood Flows and Needs
 - 9.1. Distribution and Redistribution of Cardiac Output
 - 9.2. Coronary Circulation
 - 9.3. Brain Circulation
 - 9.4. Skeletal Muscle Circulation
 - 9.5. Skin Circulation
 - 9.6. Splanchnic Circulation
 - 9.7. Renal Circulation
 - 9.8. Pulmonary Circulation
 - 9.9. Uterine and Fetal Circulations
10. Blood Pressure Control
11. Pathophysiology of Arteries
 - 11.1. Ageing
 - 11.2. Arteriosclerosis
 - 11.3. Thrombosis
 - 11.4. Embolus
 - 11.5. Hypertension
 - 11.6. Diabetic Vasculopathy
 - 11.7. Circulatory Shock
 - 11.8. Aneurysms
 - 11.9. Ischemia

Venous System

245

Emil Monos, *Semmelweis University Budapest, Hungary*

1. Introduction
2. Survey of Physiological Functions of the Venous System
 - 2.1. Collecting Blood Conduit Network System with Unidirectional Valves
 - 2.2. Selective Barrier Function
 - 2.3. Regulated Capacitance Function: Adaptive Distribution of the Circulating Blood Volume
 - 2.4. Maintenance of the Filling Pressure of the Heart
 - 2.5. Supporting Orthostatic Tolerance
 - 2.6. Postcapillary Resistance
 - 2.7. Angiogenesis
 - 2.8. Synthesis of Bioactive Substances in the Vein Wall
 - 2.9. Immune Functions: Organ-Specific Distribution of Circulating Effector Lymphocytes
 - 2.10. Cooperation between Venular Endothelium and Polymorphonuclear Leukocytes (PMNL)
 - 2.11. Inhibition of Thromboembolic Reactions
 - 2.12. Special Regional Functions
3. Central Venous Pressure
4. Aspects of Maintaining Healthy Venous Functions

Microcirculation

260

Sergey A. Polenov, *Pavlov Institute of Physiology, St. Petersburg, Russia*

1. Introduction
2. Classification and Structure of Microvessels
3. Control of Microcirculation
 - 3.1. General Considerations

- 3.2. Local Control
 - 3.2.1. Myogenic Control
 - 3.2.2. Metabolic Control
 - 3.2.3. Flow-Induced Vasodilation
 - 3.2.4. Autoregulation
 - 3.2.5. Active Hyperemia
 - 3.2.6. Reactive Hyperemia
- 3.3. Neurohumoral Control
 - 3.3.1. Sympathetic Adrenergic Control
 - 3.3.2. Parasympathetic Cholinergic Control
 - 3.3.3. Local Effector Function of Afferent Neurones
 - 3.3.4. Endothelium-Derived Vasoactive Substances
 - 3.3.5. Circulatory Hormones
 - 3.3.6. Blood-Borne Substances
- 4. Transmicrovascular Exchange
- 5. Microcirculation and Pathology

Hemorheology And Hemodynamics

285

Oguz K. Baskurt, *Department of Physiology, Akdeniz University Faculty of Medicine, Antalya, Turkey*
 Herbert J. Meiselman, *Department of Physiology and Biophysics, USC School of Medicine, Los Angeles, USA*

- 1. Introduction
 - 1.1. Historical Perspectives
 - 1.2. Principles of Rheology
 - 1.3. Definition of Hemorheology
- 2. Rheology of Blood
 - 2.1. Structure of Blood
 - 2.2. Blood Viscosity, ex vivo
 - 2.3. Determinants of Blood Fluidity
 - 2.3.1. Plasma Viscosity
 - 2.3.2. Hematocrit Value
 - 2.3.3. Contribution of Red Blood Cell Rheologic Behavior to Blood Fluidity
 - 2.4. Red Blood Cell Deformability
 - 2.5. Red Blood Cell Aggregation
 - 2.6. Contribution of White Blood Cells to Blood Flow at Tissue Level
- 3. Clinical Aspects of Blood Rheology
 - 3.1. Hematocrit as a Determinant of Whole Blood Viscosity
 - 3.2. Pathologic Alterations of Red Blood Cell Mechanical Properties
 - 3.2.1. Effects on Red Blood Cell Deformability
 - 3.2.2. Effects on Red Blood Cell Aggregability
 - 3.2.3. Role of Oxidant Stress in Hemorheological Disturbances
 - 3.2.4. Role of White Blood Cell Activation in Hemorheological Disturbances
- 4. Role of Hemorheology in Hemodynamics
 - 4.1. Flow Behavior of Blood in Cylindrical Tubes
 - 4.2. Flow Behavior of Blood in vivo
 - 4.2.1. Role of Red Blood Cell Deformability
 - 4.2.2. Role of Phase Separation and Red Blood Cell Aggregation
 - 4.2.3. Role of Vascular Control Mechanisms
- 4.3. Importance of Hemorheological Factors for Tissue Perfusion

Index

309

About EOLSS

319

VOLUME IV

Locomotion In Sedentary Societies

1

O. Hänninen, *Department of Physiology, University of Kuopio, Finland*
 M. Atalay, *Department of Physiology, University of Kuopio, Finland*

1. Introduction
2. Physiological Responses to Exercise
 - 2.1. Gliding Filaments
 - 2.2. Measurement of leisure-time physical load
 - 2.2.1 Absolute Intensity
 - 2.2.2 Relative Intensity
3. Physical Activity and Health
 - 3.1. Quantity of Recommended Physical Activity
 - 3.1.1 Exercise Training and Exercise Prescriptions
 - 3.2. Benefits of Outdoor Activities
 - 3.3. Physical Exercise and Ageing
 - 3.4. Physical Exercise and Disease
 - 3.4.1 Cardiovascular Disease
 - 3.4.2 Diabetes
 - 3.4.3 Cancer
 - 3.4.4 Physical Activity and the Physically Disabled
 - 3.4.5 Obesity
4. Ergonomy in the Information Society
 - 4.1. Static Sitting
 - 4.2. Dynamic Sitting and Exercises
5. Nutrition and Musculoskeletal System
 - 5.1. Building of Bones and Tendons
 - 5.2. Building of Muscles and Nerves
6. Negative Effects of Training
 - 6.1. Over-training
 - 6.2. Soreness, Abrasions and Traumas
7. Doping

Muscle Energy Metabolism

26

Atalay M., *University of Kuopio, Finland*
 Hänninen O.O.P., *University of Kuopio, Finland*

1. Introduction and General Considerations
2. Phosphate Bond Energy
3. Anaerobic Energy Metabolism
4. Mitochondria and Aerobic Metabolism
 - 4.1. Mitochondrial Oxidative Phosphorylation
 - 4.2. Citric Acid Cycle
5. Metabolism of Glucose and Glycogen in Muscle Fibers
6. Fatty Acids and Triglycerides as an Energy Source
 - 6.1. Fatty Acid Oxidation
7. Skeletal Muscle Fiber Type and Aerobic and Glycolytic Capacity
8. Muscular Fatigue and Mitochondrial Respiration
 - 8.1. Sources of Free Radicals in Skeletal Muscle
9. Aerobic and Anaerobic Thresholds
10. Metabolic Profiles of Cardiac Muscle in Action
11. Metabolism in Smooth Muscle

Excitation-Contraction Coupling In Skeletal Muscle**47**László Csernoch, *Department of Physiology, Medical and Health Science Center, University of Debrecen, Debrecen, Hungary.*László Kovács, *Department of Physiology, Medical and Health Science Center, University of Debrecen, Debrecen, Hungary.*

1. Introduction
2. Voltage sensor of ECC
 - 2.1. Voltage dependence
 - 2.2. Intra-membrane charge movement
 - 2.3. Molecular identification of the voltage sensor
3. Calcium release channel of the SR
 - 3.1. RyR isoforms in skeletal muscle
 - 3.2. Endogenous regulators of RyR
 - 3.3. Pharmacological modulators of ECC
4. Control of sarcoplasmic calcium release
 - 4.1. Calcium-induced calcium release
 - 4.2. Mechanical coupling of DHPR-s and RYR-s
 - 4.3. Dual control of SR calcium release
 - 4.4. Time course of SR permeability increase during excitation
 - 4.5. Current understanding of the events in ECC
5. Altered ECC in disease

Sensory-Motor Posture Control In Lumbar Disorders**66**V. Leinonen, *Department of Neurosurgery, Kuopio University Hospital, Finland*

1. Introduction
2. Motor Control
 - 2.1. Focused Attention
 - 2.1.1 Voluntary Control of Movements
 - 2.2. Subsidiary Movements
 - 2.2.1. Anticipatory Movements
 - 2.2.2 Automatic Motor Programs
 - 2.3. Cooperation of Voluntary and Subsidiary Control
 - 2.4. Proprioception
 - 2.4.1 Pain and Proprioception
3. Postural Control
4. Motor Control of the Lumbar Spine
 - 4.1. Function of the Lumbar Spine
 - 4.1.1 Segmental
 - 4.1.2. Kinetic Chain
 - 4.1.3. Feedback Control
 - 4.1.4. Feed-forward Control
5. Lumbar Disorders
 - 5.1. Classification of Lumbar Disorders
 - 5.2. Pathophysiology
 - 5.2.1 Disc Herniation
 - 5.2.2 Lumbar Spinal Stenosis
6. Pain and Motor Control
7. Future Perspectives

Physiological Basis Of Exercise**81**Mustafa Gül, *Atatürk University, Erzurum, Turkey*Osmo Hänninen, *University of Kuopio, Finland*

1. Introduction

2. Skeletal Muscle
 - 2.1. Sliding Filaments
 - 2.2. Skeletal Muscle Fiber Types
 - 2.3. Muscle Fitness
 - 2.4. Adaptation of the Skeletal Muscle to Exercise
 - 2.4.1. Adaptation to Endurance Exercise
 - 2.4.2. Adaptation to Short-Duration, High-Intensity Exercise
 - 2.5. Energy Metabolism of the Skeletal Muscle
 - 2.5.1. Alactic Mechanisms
 - 2.5.2. Glycolysis
 - 2.5.3. Oxidative Phosphorylation
 - 2.5.4. Recovery and Oxygen Debt
3. Cardiovascular Adaptation due to Exercise
 - 3.1. Muscle Blood Flow During Exercise
 - 3.2. Cardiac Functions
 - 3.2.1. Heart Rate
 - 3.2.2. Stroke Volume
 - 3.2.3. Cardiac Output
 - 3.3. Blood Pressure
 - 3.4. Changes in Blood During Exercise
 - 3.5. $\dot{V}O_{2\max}$, the Best Measure of Cardiovascular Capacity
4. Respiratory Regulation During Exercise
 - 4.1. Increased Alveolar-Capillary PO₂ Gradient, Blood Flow, and CO₂ Removal
 - 4.2. Changes in Respiratory Quotient (RQ) During Exercise
 - 4.3. Control of Ventilation During Exercise
 - 4.4. Exercise Capacity Limiting Factor
5. Fatigue
6. Conclusion

Lumbar Muscle Function And Dysfunction In Low Back Pain

110

Markku Kankaanpää, *Department of Physical Medicine and Rehabilitation, Kuopio University Hospital, and Department of Physiology, University of Kuopio, Finland*

1. Anatomy and Function of the Trunk Extensor and Flexor Muscles
 - 1.1. Functional Properties of Lumbar Spine
 - 1.2. Anatomy of Lumbar and Abdominal Muscles
 - 1.3. Control Properties of Lumbar and Abdominal Muscles
2. Epidemiological Aspects of LBP
 - 2.1. Physical Risk Factors of LBP
3. Structural and Pathophysiological Aspects in LBP
4. Lumbar Muscle Dysfunction in LBP
 - 4.1. Loss of Strength
 - 4.2. Excessive Lumbar Muscle Fatigue
 - 4.3. Loss of Co-ordination and Muscle Control
 - 4.4. Active Rehabilitation and Back Extensor Muscle Functional Assessment

Gait, Limbs And Limping

122

R.J. Ronkko, *Department of Physiology, University of Kuopio, Finland*
 Kankaanpää Markku, *Department of Physical Medicine and Rehabilitation, Kuopio University Hospital, Kuopio, Finland*
 Olavi Airaksinen, *Department of Physical Medicine and Rehabilitation, Kuopio University Hospital, Kuopio, Finland*

1. Introduction
2. Bipedal being
3. Balance

4. Limping
5. Overweight and osteoarthritis
6. Joint pains
 - 6.1. Toes
 - 6.2. Ankles
 - 6.3. Knees
 - 6.4. Hips and pelvis
 - 6.5. Back, lordosis, kyphosis and scoliosis
 - 6.6. Neck/shoulder pain and headache
 - 6.7. Arms
7. Exercise, prevention of limping and maintaining motility
8. Conclusions

Functional Morphological And Physiological Aspects Of Human Locomotion And Posture 140

Witte H., *Technische Universität, Ilmenau, Germany, and Friedrich-Schiller-Universität, Jena, Germany*

Klauer G., *Friedrich-Schiller-Universität, Jena, Germany*

Schumann N.P., *Friedrich-Schiller-Universität, Jena, Germany*

Scholle H.C., *Friedrich-Schiller-Universität, Jena, Germany*

1. Introduction: the Common Mammalian Heritage
2. Subsystems of Human Locomotor Apparatus and Mechanical Constraints of their Phylogeny
3. Mechanisms to Drive the Mechanics
4. Sensory Input
5. Muscular Recruitment During Locomotion
6. Locomotion and Postural Motor Control
7. Postural Motor Control and Sitting

Sedentary Life - Source Of Multiple Health Problems

165

Reijo Koskelo, *Department of Physiology, University of Kuopio, Finland*

Nina Zaproudina, *Department of Physiology, University of Kuopio, Finland*

Osmo Hänninen, *Department of Physiology, University of Kuopio, Finland*

1. Introduction
2. Physiology and Pathophysiology of Sitting
3. Dynamism to Sitting
4. Mental Strain and Sitting
5. Sitting at Schools
6. Deterioration of Muscle Fitness and Everyday Life
7. Osteoporosis
8. Metabolic Problems in Sedentary Life

Neuromuscular Activities In Extreme Temperatures

181

Alexander Yu. Meigal, *Petrozavodsk State University, Russia*

1. Thermoregulatory Activity of the Motor System
 - 1.1. Cold Shivering and Thermoregulatory Muscle Tonus
 - 1.2. Spinal and Supraspinal Mechanisms of Cold Shivering
 - 1.3. Behavioral Thermoregulation
 - 1.4. Factors that Can Influence Thermoregulatory Activity of the Motor System
2. Muscle Performance in Cold and Hot Conditions
3. Manual Performance in Cold
4. Skilled Motor Performance in Extreme Temperatures
 - 4.1. Accurate Movements and Precise Posture in the Cold and Hot Conditions
 - 4.2. Voluntary Suppression of Cold Shivering

Neurophysiology

197

Simo S. Oja, *University of Tampere Medical School, Finland, and Tampere University Hospital, Finland*
 Pirjo Saransaari, *University of Tampere Medical School, Finland, and Tampere University Hospital, Finland*

1. Introduction and Overview of the Nervous System
2. Sensory Functions
 - 2.1. Peripheral Receptors
 - 2.2. Somatosensory Pathways
 - 2.3. Processing of Visual Information
 - 2.4. Auditory Sensations
 - 2.5. Taste and Smell
3. Motor Functions
 - 3.1. Cerebral Cortex and Motor Activities
 - 3.2. Basal Ganglia
 - 3.3. Cerebellum
4. Integrative Functions
 - 4.1. Hypothalamus
 - 4.2. Reticular Formation
 - 4.3. Limbic System
 - 4.4. Association Areas
 - 4.5. Learning and Memory

Structural Neurobiology

224

Simo S. Oja, *The Centre for Laboratory Medicine, Tampere University Hospital, Finland*
 Pirjo Saransaari, *The Centre for Laboratory Medicine, Tampere University Hospital, Finland*

1. Neural Plasma Membranes and Membrane Proteins
2. Neural Lipids
3. Myelin
4. Cell Adhesion Molecules
5. Cytoskeleton

Autonomous Neural Regulation

236

T. Laitinen, *Departments of Physiology and Clinical Physiology, University of Kuopio and Kuopio University Hospital, Kuopio, Finland*

1. Introduction
2. Sympathetic and parasympathetic divisions of the autonomic nervous system
3. Autonomic neurotransmitters
4. Autonomic nervous functions
 - 4.1. Autonomous regulation of heart and blood vessels
 - 4.2. Regulation of arterial blood pressure
 - 4.3. Autonomous neural regulation during postural changes and physical activity
 - 4.4. Autonomous regulation of the gastrointestinal system
5. Changes in autonomous regulation
 - 5.1. Changes in autonomous neural regulation with aging
 - 5.2. Association between gender and autonomous neural regulation
 - 5.3. Association between body constitution and autonomous neural regulation
 - 5.4. Association between physical fitness and autonomous neural regulation
 - 5.5. Clinical significance of autonomous Dysregulation

Neurons, Action Potentials, And Synapses

250

Simo S. Oja, *University of Tampere Medical School, Finland, and Tampere University Hospital, Finland*
 Pirjo Saransaari, *University of Tampere Medical School, Finland, and Tampere University Hospital, Finland*

1. Introduction
 - 1.1. Nerve Cells
 - 1.2. Glial Cells
2. Resting Membrane Potential
3. Action Potential
4. Synapses
5. Neurotransmitter Actions
6. Neuromuscular Junctions
7. Synaptic Receptors
8. Intracellular Messengers

Neurotransmitters And Modulators

267

Simo S. Oja, *The Centre for Laboratory Medicine, Tampere University Hospital, Finland*
 Pirjo Saransaari, *The Centre for Laboratory Medicine, Tampere University Hospital, Finland*

1. Introduction
2. Acetylcholine
3. Synthesis and Breakdown of Amine Transmitters
4. Dopamine
5. 5-Hydroxytryptamine
6. Histamine
7. Purine Transmitters
8. Synthesis, Breakdown and Transport of Amino Acid Transmitters
9. Glutamate
 - 9.1. Ionotropic Glutamate Receptors
 - 9.2. Metabotropic Glutamate Receptors
 - 9.3. Glutamate Receptors and Neuronal Damage
10. γ -Aminobutyrate (GABA)
 - 10.1. GABA_A Receptors
 - 10.2. GABA_B Receptors
11. Glycine
12. Peptide Transmitters and Modulators
13. Nitric Oxide and Carbon Monoxide

Phantom Pain

290

Richard Rokyta, *Charles University, 3rd Faculty of Medicine, Department of Normal, Pathological and Clinical Physiology, Prague, Czech Republic.*
 Anna Yamamotovam, *Charles University, 3rd Faculty of Medicine, Department of Normal, Pathological and Clinical Physiology, Prague, Czech Republic.*

1. Introduction
2. The Possible explanation of mechanisms of phantom pain.
 - 2.1 Peripheral mechanisms
 - 2.2 Central mechanisms
 - 2.3 Psychological mechanisms
3. The treatment of phantom pain.
 - 3.1 Noninvasive therapy
 - 3.2 Invasive therapy

Biological Rhythms	299
Tarja Porkka-Heiskanen, <i>Institute of Biomedicine, University of Helsinki, Finland</i>	
Jarmo T. Laitinen, <i>Department of Physiology, University of Kuopio, Finland</i>	

1. Introduction
2. Circadian Rhythms are Endogenous
3. Entrainment
4. Rhythms in Plants
5. Rhythms in Animals
6. Suprachiasmatic Nucleus (SCN)
7. Projections from the SCN
8. Rhythms outside the SCN
9. Clock Genes
10. Measurement of the Circadian Rhythms
11. Melatonin
12. Human Performance and Circadian Rhythm
13. Jet Lag
14. Shift Work
15. Seasonal Depression

Index	311
--------------	------------

About EOLSS	319
--------------------	------------

VOLUME V

Sleep	1
Dag Stenberg, <i>Institute of Biomedicine/Physiology, University of Helsinki, Finland</i>	

1. Introduction
2. Definition of Sleep
3. Amount and Timing of Sleep
4. Sleep Stages and the Structure of Nocturnal Sleep
5. Regulation of Sleep
 - 5.1. Sleep Need and Homeostasis
 - 5.2. Circadian Regulation of Sleep
 - 5.3. Overall Regulation of Sleep
6. Disorders of Sleep
 - 6.1. Insufficient Sleep—Insomnia
 - 6.2. Excessive Sleep - Hypersomnia - Excessive Daytime Sleepiness
 - 6.3. Narcolepsy
 - 6.4. Sleep Apnea
 - 6.5. Parasomnias
7. Brain and Sleep
 - 7.1. Classical Concepts
 - 7.1.1. Hypothalamus
 - 7.1.2. Reticular Formation
 - 7.1.3. Encéphale Isolé, Cerveu Isolé and the REM Sleep Generator of the Pons
 - 7.2. Neuronal Activity during Sleep
 - 7.3. Waking Centers
 - 7.3.1. Locus Coeruleus and Noradrenaline
 - 7.3.2. Posterior Hypothalamus and Histamine
 - 7.3.3. Midline Neurons and Serotonin
 - 7.3.4. Basal Forebrain, Pontomesencephalic Nuclei and Acetylcholine
 - 7.3.5. Lateral Hypothalamus and Hypocretin/Orexin
 - 7.3.6. Dopamine System

- 7.4. Sleep Center
 - 7.4.1. VLPO and GABA
 - 7.4.2. Other GABA-ergic Mechanisms
- 7.5. Sleep-Promoting Factors
 - 7.5.1. Hypnotoxin Theory
 - 7.5.2. Sleep-Inducing and Sleep-Promoting Factors
 - 7.5.3. Adenosine
- 8. Why We Sleep
 - 8.1. Vital Function of Sleep
 - 8.1.1. Temperature Control
 - 8.1.2. Energy
 - 8.1.3. Transmitter Depletion
 - 8.1.4. Hypnotoxins
 - 8.1.5. Synaptic Maintenance
 - 8.2. Brain and Body Functions Improved by Sleep
 - 8.2.1. Learning and Memory
 - 8.2.2. Development and Plasticity

Regulation Of Food Intake

29

Osmo Hänninen, *University of Kuopio, Finland*

- 1. Introduction
- 2. Sensory Signals and Food Intake
- 3. Gastrointestinal Neural Signals and Food Intake
- 4. Gastrointestinal Hormones and Food Intake
- 5. Nutrient Blood Levels in Regulation
- 6. Sympathetic Nervous System and Obesity
- 7. Adipose Tissue Feedback in Regulation
- 8. Food Intake and Centers in the Brain
- 9. Psyche and Nutrition
- 10. Regulation of Drinking
- 11. Social Eating and Drinking
- 12. Culture and Selecting Foods
- 13. Physical Activity and Food Intake
- 14. Eating and Drinking Disorders

Stress And Coping

48

Richard Rokyta, *Charles University, 3rd Faculty of Medicine, Department of Normal, Pathological and Clinical Physiology, Prague, Czech Republic*

Anna Yamamotova, *Charles University, 3rd Faculty of Medicine, Department of Normal, Pathological and Clinical Physiology, Prague, Czech Republic*

- 1. Introduction
- 2. General adaptation syndrome
 - 2.1. Alarm reaction
 - 2.2. Resistance
 - 2.3. Exhaustion
- 3. Anatomy of stress and physiological mechanisms
 - 3.1. Hypothalamic-pituitary-adrenal axis
 - 3.2. Sympathetic-adrenal-medullary axis
 - 3.3. Feedback control
 - 3.4. Stress hormones
 - 3.5. Stress-induced analgesia
- 4. Differences in stress response
 - 4.1. Interindividual differences
 - 4.2. Age differences

- 4.3. Gender differences
- 4.4. Previous stress history and methodological aspects
- 5. Stress and diseases
 - 5.1 Gastric ulcers
 - 5.2 Cardiovascular diseases
 - 5.3 Immune system
 - 5.4 Depression and post-traumatic stress disorder
- 6. Coping and defense

The Neurophysiological Basis Of Pleasure

70

Richard Rokyta, *Charles University, 3rd Faculty of Medicine, Department of Normal, Pathological and Clinical Physiology, Prague, Czech Republic*

Anna Yamamotova, *Charles University, 3rd Faculty of Medicine, Department of Normal, Pathological and Clinical Physiology, Prague, Czech Republic*

- 1. Introduction
- 2. Needs for pleasure
 - 2.1. Centers for Pleasure
 - 2.2. Neuroanatomy of the Reward Cascade
 - 2.3. Cloninger's Typology
- 3. Reward Deficiency Syndrome
 - 3.1. Dopamine Receptors
 - 3.2. Addictive Behavior
 - 3.3. Alcoholism
 - 3.4. Treatment of the Reward Deficiency Syndrome
 - 3.5. Drug Abuse
- 4. Love
 - 4.1. Neurophysiology of Love
 - 4.2. Chemistry of Love
 - 4.3. Sexual and Passion Behavior
 - 4.4. Pleasure and Pain

Plant Physiology And Environment: An Introduction

84

Jari P.T. Valkonen, *Swedish University of Agricultural Sciences, Uppsala, Sweden, and Plant Pathology, University of Helsinki, Finland.*

- 1. Basic Physiology of Plants
- 2. Environmental Factors Affecting Plant Physiology
- 3. Molecular Genetic Approaches to Study and Affect Plant Physiology

Water Relations In Plants

90

Kurt Fagerstedt, *Helsinki University, Finland*

- 1. Importance of Water to All Living Beings
- 2. Water Potential: What Does it Contain?
- 3. Absorption of Soil Water by Plant Roots (and Other Parts)
- 4. What Else is There in Soil Moisture?
- 5. Soil Conditions Affect Plants Greatly
- 6. Root Nodules and Mycorrhizae Affect Nutrient and Water Uptake by Roots
- 7. Root Pressure and Guttation
- 8. Structure of the Water-Conducting Systems in Plants: Xylem and Phloem Sap
- 9. Water Transport Inside the Plant
- 10. Stomatal Regulation of Water Evaporation
- 11. Adaptation to Drought
- 12. Transport of Water and Organic Compounds in the Phloem

The Functions Of Chlorophylls In Photosynthesis**107**Paavo H. Hynninen, *University of Helsinki, Finland*Tuomo S. Leppäkaskes, *University of Helsinki, Finland*

1. Introduction
 - 1.1. Importance of Photosynthesis for Life on Earth
 - 1.2. Discovering the Total Reaction of Plant Photosynthesis
 - 1.3. General Principles of the Mechanism of Photosynthesis
2. Structures, Properties and Natural Occurrence of Chlorophylls
3. Chlorophylls as Redox Pigments in the Photosynthetic Reaction Centers
 - 3.1. Structure of the Reaction-Center Complex of Photosynthetic Purple Bacteria
 - 3.2. Organization of Chlorophyll and Other Coenzymes in the Photosynthetic Reaction-Centers of Oxygenic Organisms
 - 3.3. Earlier Studies of the Chlorophyll Special-Pair as Reaction-Center Chlorophyll
 - 3.4. Chlorophyll Enolates and 13^2 (S)-Epimers as Potential Reaction-Center Pigments
4. Functions of Chlorophylls in the Light-Harvesting Antenna Systems
 - 4.1. Organization of Chlorophylls and Carotenoids in Various Light-Harvesting Complexes
 - 4.2. Mechanisms of Energy Transfer in Photosynthetic Systems
5. Opportunities Offered by Chlorophyll and Photosynthesis Research

Biological Nitrogen Fixation With Emphasis On Legumes**144**Kristina Lindström, *University of Helsinki, Finland*

1. Nitrogen-Fixing Organisms
2. Importance of Nitrogen Fixation
 - 2.1. Inputs to the Ecosystems
 - 2.2. Methods to Measure Nitrogen Fixation
3. The Rhizobium–Legume Symbiosis
 - 3.1. The Rhizobia
 - 3.2. Establishment of the Symbiosis
 - 3.3. Functioning of the Root Nodule
4. Evolution and Ecology
5. Applications
 - 5.1. Agronomy and Forestry
 - 5.2. Biotechnology
6. Future prospects

Roles Of Plant Growth Regulating Substances**168**Zin-Huang Liu, *Department of Biological Sciences, National Sun Yat-sen University, Kaohsiung, Taiwan*Wen-Shaw Chen, *Department of Biological Sciences, National Sun Yat-sen University, Kaohsiung, Taiwan*Chang-Hung Chou, *Graduate Institute of Tropical Agriculture and International Cooperation, National Pingtung University Science and Technology, Taiwan*

1. Introduction
2. Indole-3-Acetic Acid
 - 2.1. IAA Biosynthesis
 - 2.2. Physiological Role of IAA
 - 2.3. IAA Mode of Action
3. Gibberellins
 - 3.1. GA Biosynthesis
 - 3.2. Physiological Role of GA
 - 3.3. GA Mode of Action
4. Abscisic Acid
 - 4.1. ABA Biosynthesis
 - 4.2. Physiological Roles of ABA

- 4.3. Mode of ABA Action
5. Cytokinins
 - 5.1. Cytokinin Biosynthesis
 - 5.2. Physiological Role of Cytokinins
 - 5.3. Mode of Action of Cytokinin
6. Ethylene
 - 6.1. Ethylene Biosynthesis
 - 6.2. Physiological Role of Ethylene
 - 6.3. Mode of Action of Ethylene
7. Conclusion

Biochemical Interactions Among Plants: Allelopathy As Ecosystem Regulator **188**
 Chang Hung Chou, *Graduate Institute of Ecology and Evolutionary Biology, China Medical University, Taichung 404, Taiwan*

1. Introduction
2. Allelopathic Interactions in Plant Communities of Natural Ecosystems
 - 2.1. Grassland Communities
 - 2.1.1. Mechanism of Dominant Vegetation
 - 2.1.2. Mechanism of Plant Succession
 - 2.1.3. Invasion Mechanism of Alien Species
 - 2.2. Fern Community
 - 2.3. Forest Communities
 - 2.3.1. Dominance of Woody Vegetation in Arid and Semiarid Zones
 - 2.3.2. Dominance of Woody Trees in Humid Zones
 - 2.3.3. Invasion of Trees into Grassland
3. Allelopathy in Aquatic Ecosystem
4. Allelopathic Interactions in Agroecosystems
 - 4.1. Autointoxication Causing Yield Reduction of Continuous Monoculture of Crops
 - 4.1.1. Rice Plants
 - 4.1.2. Sugarcane Plantation
 - 4.1.3. Asparagus Plants
 - 4.2. Allelopathic Effect on Crop Productivity
 - 4.2.1. Agronomic Crops
 - 4.2.2. Conventional- and No-tillage Crops
 - 4.3. Allelopathic Regulation of Understory Species in Forest Plantation
5. Allelopathy in Sustainable Agriculture
 - 5.1. Interaction in Agronomic Crops Inter-cropping
 - 5.2. Interaction in Pasture and Forest Inter-cropping
 - 5.3. Interaction in Cover Grass and Orchard Trees Inter-cropping
6. Allelopathy in Relation to Environmental Complexity
 - 6.1. Drought Stress
 - 6.2. Nutrient Deficiency
 - 6.3. Dynamics of Allelopathic Compounds in Soils
7. Future Allelopathic Research
 - 7.1. Allelopathic Compounds in Rhizosphere Soils
 - 7.2. Application of Naturally Occurring Allelopathic Compounds to Agricultural Practice
 - 7.3. Approach of Molecular Biotechnology to Allelopathy
8. Conclusions

Phenology Of Trees And Other Plants In The Boreal Zone Under Climatic Warming **207**
 Heikki Hämmäinen, *Department of Ecology and Systematics, University of Helsinki, Finland*

1. Climatic Adaptation of Plants in Boreal Zone
2. Trees and Shrubs
 - 2.1. Regulation of the Annual Cycle

- 2.1.1. Phenology of Bud Burst
- 2.1.2. Phenology of Growth Cessation
- 2.2. Effects of Climatic Warming during Overwintering
 - 2.2.1. Timing of Dehardening and Bud Burst
 - 2.2.2. Timing of Growth Cessation and Hardening
- 2.3. Effects of Climatic Warming During Growing Season
- 3. Herbs and Grasses

Environmental Pollution And Function Of Plant Leaves

218

Elina J. Oksanen, *University of Kuopio, Finland*

- 1. Introduction
 - 1.1. Global Change
 - 1.2. Phytotoxic Air Pollutants
- 2. Ozone as Environmental Pollutant
 - 2.1. Ozone Formation and Concentrations
 - 2.2. Critical Ozone Doses for Plants
- 3. Plant Responses to Ozone
 - 3.1. Ozone Uptake by Plants
 - 3.2. Biochemical Responses
 - 3.2.1. Antioxidative Systems Affording Protection from Ozone
 - 3.2.2. Other Biochemical Defense Systems
 - 3.2.3. Ozone-Induced Increase in Phenolic Compounds
 - 3.3. Physiological Responses
 - 3.3.1. Photosynthesis and Respiration
 - 3.3.2. Stomatal Conductance
 - 3.3.3. Growth and Carbon Allocation
 - 3.4. Structural Responses and Visible Injuries
 - 3.4.1. Structural Responses
 - 3.4.2. Visible Injuries in Foliage
 - 3.4.3. Role of Ethylene in Formation of Visible Injuries
 - 3.4.4. Programmed Cell Death
 - 3.5. Ozone and Forest Trees
 - 3.5.1. Impact on Forest Ecosystems
 - 3.5.2. Effects of Ambient Ozone on European Forests
 - 3.5.3. Effects of Ambient Ozone on Forest Trees in North America
 - 3.5.4. Sensitivity of Young Seedlings versus Mature Trees
 - 3.5.5. Birch is a Sensitive Model Plant in Ozone Research
- 4. Combined Action of Air Pollutants and Other Environmental and Climatic Factors in Plants
 - 4.1. Air Pollutant Interactions
 - 4.1.1. Ozone and CO₂ Interactions
 - 4.2. Environmental Interactions
 - 4.2.1. Impact of Water Conditions on Plant Responses
 - 4.2.2. Role of Nutrient Availability in Plant Responses
 - 4.2.3. Impact of Temperature on Plant Responses
 - 4.2.4. Impact of Light Regimes on Plant Responses
 - 4.2.5. Interactions with Biotic Stress Factors
 - 4.3. Disturbed Seasonality due to Global Change

Plant–Insect Interactions And Pollution

243

Jarmo Holopainen, *University of Kuopio and Agrifood Research Finland, Jokiainen, Finland*

- 1. Introduction
- 2. Ecosystem and Host Plant Level Disturbances in Polluted Areas
- 3. Responses of Various Plant Feeder Groups to Environmental Changes
- 4. Effects of the Most Important Air Pollutants on Plant-Feeding Insects

- 4.1. Sulfur Dioxide
- 4.2. Oxides of Nitrogen
- 4.3. Ozone
- 4.4. Fluorides
- 4.5. Heavy Metals, Acid Rain, and Pollutant Mixtures
5. Effects of Elevated CO₂ on Plant-Feeding Insects
6. Consequences of Rising Temperature for Insect–Plant Interactions
7. Effects of Enhanced UV-B Radiation on Plant-Feeding Insects
8. Plant Pathogens and Nematodes in Relation to Air Pollution
9. Relative Importance of Pollutants and Global Change Factors on Herbivorous Insect Populations

Index **259**

About EOLSS **267**

VOLUME VI

Global Perspectives In Health	1
<i>Boutros-Pierre Mansourian, Former Director, Research Policy and Strategy Co-ordination, World Health Organization, Geneva, Switzerland</i>	

1. Introduction
2. Definitions and Concepts
3. Critical questions in health
 - 3.1. Factors that determine health
 - 3.2. How to care for health
 - 3.3. Global health outlook
4. The measurement of health
 - 4.1. The concept of “health”
 - 4.2. Measurement and decision-making
 - 4.3. The concept of the indicator
 - 4.4. The scope and taxonomy of indicators
 - 4.4.1. The WHO classification of indicators
 - 4.4.2. The need for a taxonomy
 - 4.4.3. A possible taxonomy of indicators
 - 4.5. The design and validation of indicators
 - 4.5.1. Indicator design
 - 4.5.2. Validation of indicators
 - 4.5.3. A new paradigm for the design and validation of health indicators
 - 4.5.3.1. Problem-Oriented Approach
 - 4.5.3.2. Conceptual Modeling
 - 4.5.3.3. Indicator Production
 - 4.5.3.4. Data Availability
 - 4.5.3.5. Validation
 - 4.6. The “indicator family” concept
 - 4.7. The “indicator system” concept
5. Health in a global context
 - 5.1. Health and overall development
 - 5.2. Essential health-related services
 - 5.2.1. Immunization
 - 5.2.2. Childhood illness
 - 5.2.3. Reproductive issues
 - 5.2.4. Nutrition issues
 - 5.2.5. School health and nutrition
 - 5.2.6. Re-emerging or new communicable diseases

- 5.2.7. Non-communicable diseases
- 5.2.8. Infrastructural issues
- 5.3. Health, health care, and health system performance
 - 5.3.1. Inequalities in health
 - 5.3.2. Improving health care financing
 - 5.3.2.1. Pooling of Risks
 - 5.3.2.2. Securing Adequate Levels of Financing
 - 5.3.2.3. Containing Costs and Fiscal Discipline
 - 5.3.2.4. Improving Budget Practices and Resource Allocation
- 6. A Synopsis of Health Issues
 - 6.1. Determinants of health and their interactions
 - 6.1.1. Genetic factors
 - 6.1.2. Biology, ecology, and health
 - 6.1.3. Environmental determinants
 - 6.1.4. Socio-economic determinants
 - 6.1.4.1. General Health Determinants
 - 6.1.4.2. Health Interventions
 - 6.2. Epidemiology: health and disease in populations
 - 6.2.1. Health information systems
 - 6.2.2. Health-related indicators
 - 6.2.3. Epidemiology and surveillance
 - 6.2.4. Family health
 - 6.2.5. Mental health
 - 6.2.6. Control of communicable diseases
 - 6.2.7. Control of non-communicable diseases
 - 6.3. Health care systems
 - 6.3.1. Primary health care
 - 6.3.2. Quality assurance in health care
 - 6.3.3. Preventive, diagnostic, and therapeutic technologies
 - 6.3.4. Health technology assessment
 - 6.3.5. Health telematics and its societal implications
 - 6.3.6. Domiciliary, palliative, and terminal care
 - 6.4. Ethical issues in health
 - 6.4.1. Bioethics and biotechnology
 - 6.4.2. Codes of conduct and ethical guidelines
 - 6.4.3. Autonomy and informed consent
 - 6.4.4. Health, ethics, equity, and human dignity
 - 6.5. New challenges in global health
 - 6.5.1. Global aging
 - 6.5.2. Urban growth and health
 - 6.5.3. Climate change and health
 - 6.5.4. Health in border areas
 - 6.5.5. Disasters and conflicts
 - 6.5.6. Challenges in vaccination
- 7. Conclusion

Determinants Of Health And Their Interactions

53

B. McA. Sayers, *Imperial College of Science, Technology and Medicine, London, SW7 2AZ, UK*

- 1. Introduction
- 2. The major determinants of health
- 3. Indicators
 - 3.1 The "indicator family" concept
 - 3.2 Design of indicators as families of indicators
 - 3.3 The integrated indicator "system" concept
- 4. Data for indicators
 - 4.1 Aggregation and disaggregation of data

5. Interactions

Determinants On Health And Their Interactions Genetic Factors **73**

V.R. Oviatt, *Crail, Scotland, UK*

1. Genetics and the Gene
2. Genetic Diseases
 - 2.1. A Simply Inherited Disease
 - 2.2. Chromosomal Aberrations
 - 2.3. Polygenic Inheritance
3. Diagnosis and Treatment
 - 3.1. Genetic Mapping
 - 3.2. Gene Therapy (Gene Transfer, Gene Replacement)
 - 3.3. Genetic Counseling
 - 3.4. The Human Genome Project
4. Genetic Engineering
 - 4.1. Technology
 - 4.2. Applications
5. Future, Ethics and Policy Issues

Biology, Ecology And Health **83**

Andrew A. Arata, *Alexandria, Virginia, USA*

1. Introduction
2. Evolutionary Adaptations
3. Patterns of Migration
4. Domestication of Livestock and Human Cohabitation
5. Ecological Modifications and Biodiversity
6. Final Considerations

Environmental Determinants Of Health **98**

Ken Gnanakan, *ACTS Academy of Higher Education, Bangalore, India*

1. Introduction
2. Domestic Environment
 - 2.1. Water and Sanitation
 - 2.2. Domestic Pests
 - 2.3. Food Contamination
 - 2.4. Air Pollution from Domestic Sources
 - 2.5. Tuberculosis
3. Local Environment
 - 3.1. Air Pollution
 - 3.1.1. Suspended Particulate Matter
 - 3.1.2. Air Pollutants
 - 3.1.3. Toxic Air Pollutants
 - 3.2. Hazardous Waste
 - 3.2.1. Plastics
 - 3.2.2. Asbestos
 - 3.3. Water Pollution
 - 3.3.1. Domestic Wastes and Sewage
 - 3.3.2. Industrial Wastes and Effluents
 - 3.4. Diseases Associated with Polluted Water
4. Global Factors
 - 4.1. Ozone Depletion
 - 4.1.1. The Ozone Hole

- 4.1.2. Ozone Depletion
- 4.2. Global Warming
 - 4.2.1. Causes of Global Warming
 - 4.2.2. Health Implications
- 4.3. Acid Rain
 - 4.3.1. Global Menace of Acid Rain
 - 4.3.2. Health Hazards
- 5. Conclusion

An Economic View Upon The Determinants Of Health

118

R. Leidl, *Ludwig Maximilians-University, Munich and GSF-National Research Center for Environment and Health, Institute for Health Economics and Health Care Management, Germany*

- 1. Introduction
- 2. General Health Determinants
 - 2.1. Framework Conditions
 - 2.2. Individual Health Determinants
- 3. Health Interventions
 - 3.1. The Health Care System
 - 3.2. Measures and Programs in the Process of Health and Disease
 - 3.3. Health Management
- 4. Outlook

Epidemiology: Health And Disease In Populations

133

Richard H. Morrow, *International Health, Division of Community Health and Health Systems, Johns Hopkins University School of Hygiene and Public Health, Baltimore, Maryland, USA*

- 1. What is Epidemiology?
- 2. Purposes of Epidemiology
- 3. Defining and Measuring Health and Disease
 - 3.1. Disease Nomenclature and Classification
 - 3.2. Counting Disease
 - 3.3. Severity of Disease
 - 3.3.1. Mortality
 - 3.3.2. Morbidity
 - 3.3.3. Composite Measures Combining Morbidity and Mortality
- 4. Descriptive Epidemiology
 - 4.1. Infectious Disease Triad
 - 4.2. Descriptive Epidemiology Triad
 - 4.3. Health Indicators
- 5. Epidemiological Approaches to Understanding Causal Relations
 - 5.1. Concept of Cause
 - 5.2. Study Designs to Investigate Causal Relationships
 - 5.2.1. Cohort Study Design
 - 5.2.2. Case-Control Study Design
 - 5.2.3. Complicating Factors
- 6. Experimental Epidemiology: The Randomized Trial
- 7. Epidemiology for Health Systems: Use in Policy, Planning, and Assessment
- 8. The Future of Epidemiology

Health Information Systems

167

R.B. Panerai, *Department of Medical Physics, University of Leicester, U.K.*

- 1. What is a Health Information System?
- 2. Health Information Systems and Health Development
- 3. The Structure of Health Information Systems

- 3.1. Data Collection
- 3.2. Data Coding
- 3.3. Data Input
- 3.4. Data Processing and Storage
- 3.5. System Outputs
- 3.6. Information Access and Distribution
- 4. Towards Action-Led Health Information Systems
- 5. Educational Requirements

Health-Related Indicators **186**

J-M. Robine, *Senior Research Fellow, INSERM, University of Montpellier 1, France*
 C. Jagger, *University of Leicester, United Kingdom*
 Euro-REVES Group*

- 1. Introduction
 - 1.1. Different Perspectives on Health
 - 1.2. Different Approaches to Health Status Assessment
 - 1.3. The Multi-Dimensional Nature of Health and Morbidity
- 2. A Reference Framework to Health-Related Indicators
 - 2.1. The Bio-Medical Approach
 - 2.2. The Functional Approach
 - 2.3. The Perceptual Approach
 - 2.4. The Specificity of the Dimension of Mental Health
- 3. From Conceptual Framework to Indicators - Health State Expectancies
 - 3.1. A General Model of Health Transitions
 - 3.2. Extending the General Model to Different Health Concepts
 - 3.3. Further Characteristics of Health State Expectancies
- 4. Conclusion

Epidemiology And Surveillance **206**

Muthu Subramanian, *Former Director, World Health Organization, Geneva, Switzerland*

- 1. Introduction
- 2. Evolution of Surveillance
 - 2.1. Historical Trends
 - 2.2. Modern Concepts
- 3. Definition, Purpose, and Objective of Surveillance
- 4. Elements of Surveillance
- 5. Organizations and Functions of Surveillance Systems
- 6. Surveillance and Research
- 7. Emerging Disease Threats and International Surveillance

Family Health **220**

Michel Manciaux, *Emeritus Professor of Social Pediatrics and Public Health, School of Public Health, University of Nancy, France*
 Mark A. Belsey, *Former Advisor in Maternal and Child Health and Family Health, World Health Organization, Geneva, Switzerland*

- 1. Introduction
- 2. Family, Families
- 3. Family as a Life-Support System
 - 3.1. Family Life Cycle
 - 3.2. Reproductive Function
 - 3.3. Productive Function
 - 3.4. Other Functions
 - 3.5. Gender Roles

4. Family as a Health-Support System
 - 4.1. The Family as a Unit of Health
 - 4.2. The Family as a Unit for Care
 - 4.3. Helping Families towards Health Promotion
 - 4.4. Supporting Family Health
5. Family Health, Family Care
 - 5.1. Health Care in Relation to Age and Function of Family Members
 - 5.1.1. Reproductive Health
 - 5.1.2. Maternal and Child Health
 - 5.1.3. School Health
 - 5.1.4. Adolescent Health
 - 5.1.5. Adult Health
 - 5.1.6. Health of the Elderly
 - 5.2. Vulnerable Families
 - 5.3. Family Violence
 - 5.4. Indicators of Family Health
6. Conclusion

Mental Health

242

Assen Jablensky, *Professor of Psychiatry, The University of Western Australia, Australia*
 Robert E. Kendell, *Professor of Psychiatry, Edinburgh, Scotland, EH10 5AT, United Kingdom*
 Aleksandar Janca, *Professor of Psychiatry, The University of Western Australia, Australia*

1. Introduction
2. The Social and Economic Cost of Mental Illness
3. Classification and Diagnosis of Mental Disorders
4. The Symptoms and Sequelae of Mental Illness
 - 4.1. Symptoms
 - 4.2. Impairment, Disability, and Handicap Associated with Mental Illness
5. Epidemiology of Mental Disorders
 - 5.1. Prevalence, Incidence, and Lifetime Risk
 - 5.2. Cultural and Temporal Variation
6. The Multifactorial Causation of Mental Disorders
 - 6.1. Genetic Vulnerability and Gene–Environment Interactions
 - 6.2. The Complexity of Brain Structure and Function
7. Common Psychosocial Risk Factors
 - 7.1. Gender and Mental Health
 - 7.2. Poverty and Deprivation
 - 7.3. Social Change and Mental Health
 - 7.4. Migration
8. Treatment and Prevention of Mental Disorders
 - 8.1. Treatment
 - 8.2. Management of Psychiatric Disorders within Primary Health Care
 - 8.3. Prevention
 - 8.4. Rehabilitation
 - 8.5. Countering the Stigma of Mental Illness

Prevention And Control Of Communicable Diseases

259

David L. Heymann, *Executive Director, Communicable Diseases, World Health Organization, Geneva, Switzerland*

1. Introduction
2. Infectious Diseases Causing High Mortality
 - 2.1. Acute Respiratory Infections
 - 2.1.1. Pneumonia
 - 2.1.2. Influenza

- 2.2. HIV/AIDS
- 2.3. Diarrheal Diseases
- 2.4. Cholera
- 2.5. Escherichia coli O157:H7
- 2.6. Rotavirus
- 2.7. Salmonella
- 2.8. Malaria
- 2.9. Measles
- 2.10. Neonatal Tetanus
- 2.11. Tuberculosis
3. Infectious Diseases Causing Disability
 - 3.1. African Trypanosomiasis (Sleeping Sickness)
 - 3.2. Chagas Disease (American Trypanosomiasis)
 - 3.3. Dracunculiasis (Guinea-Worm Disease)
 - 3.4. Leishmaniasis
 - 3.5. Leprosy
 - 3.6. Lymphatic Filariasis (Elephantiasis)
 - 3.7. Onchocerciasis (River Blindness)
 - 3.8. Pertussis (Whooping Cough)
 - 3.9. Poliomyelitis
 - 3.10. Schistosomiasis (Bilharziasis)
 - 3.11. Sexually Transmitted Infections
 - 3.12. Smallpox
 - 3.13. Trachoma
4. Emerging and Reemerging Infections
 - 4.1. Buruli Ulcer
 - 4.2. Creutzfeldt-Jakob Disease
 - 4.3. Diphtheria
 - 4.4. Japanese Encephalitis
 - 4.5. Legionellosis
 - 4.6. Meningococcal Disease
 - 4.7. Plague
 - 4.8. Viral Hemorrhagic Fevers
 - 4.8.1. Dengue/Dengue Hemorrhagic Fever
 - 4.8.2. Ebola
 - 4.8.3. Lassa Fever
 - 4.8.4. Marburg
 - 4.8.5. Rift Valley Fever
 - 4.8.6. Yellow Fever
 - 4.8.7. Sine Nombre/Hendra/Nipah
 - 4.9. Viral Hepatitis
5. Causes of the Renewed Spread of Infectious Diseases
6. Limiting the Spread and Consequences of Infectious Diseases
7. Conclusion

Prevention And Control Of Noncommunicable Diseases

284

N.P. Napalkov, *Director Emeritus, Petrov Institute of Oncology, St. Petersburg, Russian Federation*

1. Introduction
2. Chronic Noncommunicable Diseases and World Health
 - 2.1. Epidemiological (Health) Transition
 - 2.2. Cardiovascular and Cerebrovascular Diseases
 - 2.3. Cancer
 - 2.4. Chronic Obstructive Pulmonary Diseases
 - 2.5. Diabetes
 - 2.6. Mental and Neurological Disorders
3. Economic and Social Implications of the Emerging Epidemics of Noncommunicable Diseases

4. General Principles and Main Components of the Control of Noncommunicable Diseases

Health Care Systems **302**

Andrzej M. Wojtczak, *Institute for International Medical Education, New York, USA*

1. Health Policies and Systems
2. Primary Health Care
3. Family Health
4. Economics of Health Care
 - 4.1. Health Care Costs
 - 4.1.1. Health Care as a Citizen's Right
 - 4.1.2. The Aging Population
 - 4.1.3. Expansion of Technology
 - 4.1.4. Variable Patterns of Practice
 - 4.1.5. Cost-Control Strategies
 - 4.1.6. Supply-Side Strategies
 - 4.1.7. Public versus Private Funding
 - 4.1.8. Private Insurance
 - 4.1.9. Market versus State Regulation
 - 4.2. Health Care Reforms
 - 4.2.1. Implementation of Health Care Reforms
 - 4.2.2. Allocating Resources Effectively
 - 4.2.3. Payment Shifts
 - 4.2.4. Independent Hospital Boards
 - 4.2.5. Competition
 - 4.2.6. Patient Rights
 - 4.2.7. Decentralization
 - 4.2.8. Impediments to Health Care Reform
 - 4.2.9. Costs of Transition
5. Health Information Systems
6. Long-Term and Domiciliary Care
7. Palliative and Terminal Care
8. Quality Assurance in Health Care
9. Diagnostic, Therapeutic, and Rehabilitation Technology
 - 9.1. Ethical Issues
10. Genetics and Tissue Engineering
 - 10.1. Genetic Services

Primary Health Care: The Key to Health for All **337**

Anthony Piel, *Secretary of the International Conference on Primary Health Care, U.S.A.*

1. Background: Emergence of a Right to Health
2. Experience: Emergence of a Set of Principles
3. Authorship and Choice of a Name
4. A Short, Formal Definition of PHC
5. Attributes and Content of PHC
6. Community Determination of Basic Needs Related to Health
7. Determination of Health Targets for HFA/PHC
8. Practical Implementation of PHC
9. Who Pays for What, and Who Benefits?
10. Health for All and PHC after the Year 2000

Index **349**

About EOLSS **357**

VOLUME VII

Quality Assurance **1**

Jerzy Szczerban, Professor of Surgery, Medical University of Warsaw, Poland

1. Introduction
2. Terminology
3. Background
4. Quality Assurance in Developing Countries
5. Scope of Quality Assurance
6. Health Care Quality Parameters
7. Standards
8. Consumer Movements
9. Patient Satisfaction as an Indicator of Quality
10. Approaches to Quality Assurance
11. Utilization of Health Services
12. Research on Quality Assurance
13. Information
14. Organized Quality Assurance Systems: Managed Care
15. Contention
16. Competition

Preventive, Therapeutic, and Diagnostic Technologies. Development and Perspectives **18**

Claus Chr. Heuck, University of Düsseldorf, Department of Laboratory Medicine, Düsseldorf, Germany. Presently on leave to the World Health Organization, Geneva, Switzerland

1. Introduction
2. Preventive Medicine
3. Therapeutics
4. Surgical Cure
5. Diagnostic Technologies
6. Perspectives

Health Technology Assessment: Sustaining Equity in Health Care **27**

Arminee Kazanjian, Department of Health Care and Epidemiology, University of British Columbia, Canada

1. Introduction
2. The Development of Health Technology Assessment
3. Establishing effectiveness evidence
4. The Appropriate Role for Health Technology Assessment
5. Current Developments: Strategic HTA
 - 5.1 The Comprehensive Framework
6. HTA in Decision-making: An illustrated model
 - 6.1 Framework Dimensions
 - 6.1.1 Identifying the Population at Risk
 - 6.1.2 Estimating Population Impact
 - 6.1.3 Economic Concerns
 - 6.1.4 Social Context
 - 6.1.5. Other Considerations
7. Looking Ahead

Health Telematics and its Societal Implications **52**

Gerhard W. Brauer, Associate Professor, School of Health Information Science, University of Victoria, Canada

1. Introduction

2. Background
 - 2.1. ABC of Basic Telematics
 - 2.2. Definition of Health Telematics
 - 2.3. Origins of Health Telematics
 - 2.4. Role of Health Telematics
3. Health Telematics Applications
 - 3.1. Telecommunication
 - 3.2. Telemedicine
 - 3.2.1. Telematics for Relief of Professional Isolation
 - 3.2.2. Teleconsultation
 - 3.2.3. Telemetry and Telemonitoring
 - 3.2.4. Telepathology
 - 3.2.5. Teledermatology
 - 3.2.6. Telematics for Triage
 - 3.3. Medical Imaging
 - 3.3.1. Image Capture and Digitization
 - 3.3.2. Digital Diagnostic Imaging
 - 3.3.3. Benefits of Digital Diagnostic Imaging
 - 3.3.4. Some Types of Medical Imaging
 - 3.3.5. Tele-imaging
 - 3.4. Tele-education
 - 3.4.1. Continuing Education
 - 3.4.2. Community Health Education
4. Societal Implications of Health Telematics
 - 4.1. Benefits
 - 4.2. Critical Success Factors
 - 4.3. Culture and Language
 - 4.4. Ethics
 - 4.5. Totalitarian Informatics

Domiciliary, Palliative, and Terminal Care

75

Yoram Singer, *Palliative Care Unit, Division of Health in the Community, Faculty for the Health Sciences, Ben Gurion University of the Negev, Beer Sheva, Israel*

1. Introduction
2. Palliative Care . . . When to Begin?
 - 2.1. Case I
 - 2.2. General Prerequisites
 - 2.3. Palliative Care at Home
 - 2.4. Comprehensive Home Palliative Care Service
 - 2.5. Discussion of Case I
3. Symptom Control
 - 3.1. Case II
 - 3.2. Pain
 - 3.2.1. The Assessment of Pain
 - 3.3. Discussion of Case II
 - 3.4. Principles of Pain Management
 - 3.5. Opioid Analgesics
 - 3.6. Continued Discussion of Case II
 - 3.7. Barriers to the Use of Opioids
 - 3.8. Opioid Rotation
 - 3.9. Asthenia
 - 3.10. Nausea and Vomiting
 - 3.11. Case III
 - 3.12. Other Symptoms
4. Spiritual Suffering
5. Ethical Issues

6. Conclusion

Ethical Issues in Health

92

Bernard M. Dickens, *Professor, Faculty of Law and Joint Centre for Bioethics, University of Toronto, Canada*

1. Introduction
2. The Rise of Bioethics
3. The Role of (Bio)Ethics
4. Ethical Orientations
5. Duty-Based (or Deontological) Ethics
6. Consequentialist or Utilitarian Ethics
7. Other Bioethical Orientations
8. Feminist Ethics
9. (Bio)Ethical Principles
10. Respect for Persons
 - 10.1. Autonomy of Capable Persons
 - 10.2. Protection of Persons Incapable of Autonomy
11. Beneficence
12. Non-Maleficence
13. Justice
14. Levels of Ethical Analysis
 - 14.1. The Microethical Level
 - 14.2. The Macroethical Level
 - 14.3. The Mesoethical Level
 - 14.4. The Megaethical Level
15. Reproductive and Sexual Health Ethics
16. Research Ethics
17. Ethics and the Law
18. Ethics and Human Rights

Bioethics and Biotechnology

125

Abdallah S. Daar, *Sultan Qaboos University, Oman*
 Peter A Singer, *University of Toronto Joint Centre for Bioethics, Canada*

1. Introduction
2. Biotechnology will Play a Bigger Role in our Lives
 - 2.1. The Genetics Revolution and Human Health
 - 2.2. Developing Ethical Guidelines for Biotechnology: Important Modern Issues to Consider
 - 2.2.1. Involvement of Industry
 - 2.2.2. Public Trust of Biotechnology: Engaging the Public
 - 2.2.3. Increasing Complexity of Issues Necessitates a Global Dialogue
3. Agricultural Biotechnology
 - 3.1. Agriculture, Food, Economics and Public Health
 - 3.1.1. Why Some People Are Worried
 - 3.2. The Doubly Green Revolution: Ensuring Substantial Food Security for the Poor
 - 3.3. Transgenic Plants for the Manufacture and Delivery of Nutrients, Drugs and Vaccines
 - 3.4. Nuffield Council on Bioethics Guidelines
4. The Human Genome Project
 - 4.1. Aims of the Human Genome Project
 - 4.2. Concerns Regarding the Human Genome Project and Other Genetics Research
 - 4.3. Ethical, Legal and Social Implications (ELSI) of the Human Genome Project
 - 4.4. The Ethical, Legal and Social Implications (ELSI) Committee of the Human Genome Organization
 - 4.4.1. HUGO Statement on Benefit-Sharing
5. Cloning

- 5.1. Cloning by Embryo Splitting
 - 5.1.1. Embryo Splitting For Infertility Treatment: Statement by the American Society for Reproductive Medicine's Ethics Committee
- 5.2. Cloning by Nuclear Transfer
 - 5.2.1. Ethical Issues of Cloning by Nuclear Transfer from Adult Somatic Cells
- 6. Xenotransplantation
 - 6.1. Transgenic Animals
 - 6.2. Ethical Issues of Xenotransplantation
- 7. Human Embryonic Stem Cells
 - 7.1. The Great Potential of Human Embryonic Stem Cells
 - 7.2. Controversy and Differing Ethical Conclusions
 - 7.2.1. Nuffield Council on Bioethics Conclusions on Embryonic Stem Cells
 - 7.3. Adult Stem Cells
- 8. Developing Countries, Bioethics and Biotechnology
 - 8.1. The Genetics Revolution and Developing Countries
 - 8.1.1. "Expatriate" Research
- 9. A Vision for the Future

Codes of Conduct and Ethical Guidelines

160

Bernard M. Dickens, *Professor, Faculty of Law and Joint Centre for Bioethics, University of Toronto, Canada*

- 1. Introduction
- 2. Codification and Professionalism
- 3. Codes, Guidelines and Pre-Existing Practice
- 4. Medical and Related Codes of Conduct
- 5. The Scope of Codes and Guidelines
- 6. Law and Legal Enforcement
- 7. Ethical Interpretation and Application

Informed Consent in Clinical Practice and Biomedical Research

176

Mohammed Abdussalam, *Geneva CH-1209, Switzerland*

- 1. History
- 2. Essential Information for Patients and Research Subjects
 - 2.1. Extent of Disclosure
 - 2.2. Beneficent Deception
- 3. Exceptions to Consent
 - 3.1. Emergency Exception
 - 3.2. Waiver Exception
 - 3.3. The Therapeutic Privilege Exception
 - 3.4. Other Exceptions
- 4. Patient Competence to Consent
- 5. Informed Consent in the Clinical Setting
- 6. Informed Consent in Biomedical Research involving Human Subjects
- 7. Obtaining Informed Consent of Subjects
 - 7.1. Essential Information
 - 7.2. Inducements to Participate
 - 7.2.1. Deception and Lying
- 8. Research Involving Children and Other Incompetent Subjects
- 9. Consent to Epidemiological and Other Studies with Community Involvement
 - 9.1. Exceptions to Consent
- 10. Consent in Externally Sponsored Research
- 11. Factors Which Nullify Informed Consent
- 12. Future of Informed Consent

Health Ethics, Equity and Human Dignity**189**Mamdouh Gabr, *Professor of Pediatrics, Faculty of Medicine, Cairo University, Egypt*

1. Introduction
2. Definitions and Concepts
 - 2.1. Ethics
 - 2.2. Equity
 - 2.3. Human Rights and Human Dignity
3. Ethics and Major Determinants of Health
 - 3.1. Political system
 - 3.2. Economic factors
 - 3.3. Demographic Changes
 - 3.4. Cultural Diversity
 - 3.5. Global Ecosystem Sustainability
 - 3.6. Technological advances
 - 3.7. Changing pattern of disease
4. Future oriented approach

New Problems in Global Health**201**Arjuna P.R. Aluwihare, *University of Peradeniya, Kandy, Sri Lanka; Human Rights Commissioner, Sri Lanka*

1. Introduction
 - 1.1. A State of Health
 - 1.2. New Interactions
 - 1.3. A Context for This Article
2. The World Order
 - 2.1. Global Village
 - 2.2. Politicization and Corruption
 - 2.3. Demographic Transitions and Multiple Disease Burdens
 - 2.4. Climate and Environment
3. New Microbial Threats, the Environment in Which They Develop, and Related Matters
 - 3.1. Germs
 - 3.2. Mutations
 - 3.3. New Diseases, Lifestyle, Crime
 - 3.3.1. Human Immune-Deficiency Virus, Drugs
 - 3.4. Environments
 - 3.4.1. Hospital Ward Bacteria and Bacterial Resistance
 - 3.4.2. Antibiotic Promiscuity
 - 3.5. Nutrition
 - 3.6. Eradicated Diseases
 - 3.7. Low-Dose Exposure
 - 3.8. Zoonoses
 - 3.9. Travel Spread
 - 3.10. Lifestyle
 - 3.11. Vector Resistance
 - 3.12. Agrochemical Resistance
 - 3.13. Coordination
4. Food Chain Alterations
 - 4.1. New Field?
 - 4.2. Radiation
 - 4.3. Animal Feed
 - 4.4. Processing
 - 4.5. Agrochemical
 - 4.6. Packing Material
 - 4.7. Overall Effect
5. Environmental Toxins

- 5.1. Sub-Lethal Exposure
- 5.2. Agrochemicals and Suicide
- 5.3. Safety
- 5.4. Waste Disposal
 - 5.4.1. Dumping
- 5.5. Electromagnetic Radiation
- 5.6. Noise
- 6. Industrial Chemicals and Accidents; Occupational Hazards; Trauma
 - 6.1. Chemicals and Individuals
 - 6.2. Accidents
 - 6.3. Road Traffic Accidents
- 7. Human Gene Pool Changes
- 8. Armed Conflict and Violence
 - 8.1. New Conflicts
 - 8.1.1. Violence
 - 8.2. Gun Culture
 - 8.3. Psychology
 - 8.3.1. Development
 - 8.4. Border Areas and Internal Displacement
 - 8.5. Disasters
- 9. Family Systems and Values
 - 9.1. New Families
 - 9.2. Media
 - 9.3. Child Abuse
 - 9.4. Woman Abuse
 - 9.5. Suicide
- 10. Lifestyle
 - 10.1. Epidemic Lifestyles
 - 10.2. Stress
 - 10.3. Nutrition
 - 10.4. Social Habits
 - 10.5. Substance Abuse
 - 10.6. Local Applications
 - 10.7. Radiation
 - 10.8. Other Effects
 - 10.8.1. Mental Health
 - 10.9. Surveillance
- 11. New Methods of Spread of Disease
 - 11.1. New Vectors
 - 11.2. New Media
 - 11.3. Control
 - 11.4. Media for Health
- 12. Politicization
- 13. Human Rights
 - 13.1. Holistic
 - 13.2. Rights As a Tool
 - 13.3. Ethical Considerations
- 14. Poverty
 - 14.1. The Disease of Poverty
 - 14.2. Urbanization
 - 14.3. The Elderly
 - 14.4. Macro-Policy
 - 14.5. Refugees and the Internally Displaced
- 15. Monopolies
- 16. Macroeconomic Policy, Globalization, International Labor Regulation, International Patents, Etc.
 - 16.1. Health Effects
 - 16.2. Partiality
 - 16.3. Private Sector

- 16.4. Labor
- 16.5. Patents
- 17. Genetically Modified Foods
 - 17.1. Biotechnology is the Understanding and Use for Life, of the “I.T.” of Life Itself
 - 17.2. The Right to Food, Health, Housing, and Development
 - 17.3. The Right to a Return on Investment for Developers
 - 17.4. Basic Ethical Considerations in Health
 - 17.5. Biotechnology in War
 - 17.6. Food Safety
 - 17.7. Sustainability and the Environment
 - 17.8. Marketing and Labeling
 - 17.9. Technology Transfer, or Transfer of the Product?
 - 17.10. Urbanization—A New Threat in Itself
 - 17.11. Food Security
 - 17.12. Drugs, Hormones, and Vaccines
 - 17.13. Overview of Genetically Modified Foods
- 18. Conclusion

Global Aging

235

A. Michael Davies, *Professor of Public Health, Emeritus, Hebrew University of Jerusalem, Israel*

- 1. The Elderly
- 2. Aging Societies
- 3. Implications for Health
 - 3.1. Equity
 - 3.2. Social Support
 - 3.3. Healthy Environment
 - 3.4. Primary Health Care
 - 3.5. Acute Hospital Care
 - 3.6. Rehabilitation Services
 - 3.7. Long-Term Care
 - 3.8. Information Systems
 - 3.9. Organizational Reform
 - 3.10. Research
 - 3.11. Training
 - 3.12. Effectiveness and Costs
- 4. The Adaptation of Society

Urban Growth and Health

251

Yola L. G. Verhasselt, *Geografisch Instituut, Vrije Universiteit Brussel, Belgium*

- 1. Urban Development
 - 1.1. Increase of Urban Population
 - 1.2. Size of Cities
 - 1.3. Growth of Slums
- 2. Health Implications of Urban Growth
 - 2.1. Urban Characteristics of Health
 - 2.1.1. Urban Health Hazards
 - 2.1.2. The Health Transition
 - 2.2. Specific Health Situations in Slum Areas
- 3. Future Challenges
 - 3.1. Sustainability of Urban Systems
 - 3.2. Aging of Urban Populations

Implications of Atmospheric and Climatic Change for Human Health

262

John M. Last, *Emeritus of Epidemiology, University of Ottawa, Canada*

1. Introduction
2. The Context of Atmospheric and Climate Change
3. Stratospheric Ozone Depletion
4. Biological and Human Health Impact of Increased Ultraviolet Radiation Flux
5. Greenhouse Gases and Global Climate Change
6. Effects of Climate Change on Health
7. Public Health Action
8. Conclusion

Health in Border Areas

280

Wadie Wanies Kamel, *Tempe, Arizona 85283, USA*

1. Definitions
2. Current and Continuing Concerns of Health and Development in Border Areas
 - 2.1. The universal neglect and marginalization of border areas, border communities and border crossers impact communities beyond the borders.
 - 2.2. Borders are crucial entry points for communicable diseases which, if not properly managed, would affect the country's population significantly.
 - 2.3. Border communities frequently suffer from lack of health care, minimal or non-existent access to preventive health services, emergency medical services, and health promotion.
 - 2.4. Substance abuse, preventable injury, violence and behavioral health problems are prevalent at the borders.
 - 2.5. An abundance of refugees and migrant workers cross borders due to political and ethnic conflicts and economic and natural disasters.
 - 2.6. Borders are frequently threatened by environmental problems, and occupational hazards.
 - 2.7. Women, children, and the elderly are at more risk, with less food security and more malnutrition at the borders.
3. International Recognition of Health in Border Areas
4. Potential Promotion and Development
5. Conclusion

Disasters and Conflicts

298

S.W.A. Gunn, *International Association for Humanitarian Medicine, World Association for Disaster and Emergency Medicine, Switzerland*

1. Introduction
 - 1.1. Disasters
2. Disaster Medicine
 - 2.1. A Brief History
 - 2.2. The Scientific Base of Disaster Medicine
3. Disaster Epidemiology
 - 3.1. Natural Disasters, Human-Made Disasters, Complex Disasters, Human-Conceived Disasters
4. Action against Disasters
 - 4.1. International Aid
 - 4.1.1. The United Nations and Intergovernmental Organizations
 - 4.1.2. The International Red Cross
 - 4.1.3. Nongovernmental Organizations
 - 4.1.4. Bilateral Aid
 - 4.1.5. Non-Emergency International Cooperation in Disasters
5. Emergency Medical Supplies
 - 5.1. The Basic Unit
 - 5.2. The Supplementary Unit
6. Disaster Terminology

7. Conflicts
8. Humanitarian Medicine

Vaccination in Developing Countries: Problems, Challenges and Opportunities **317**
 Tikki Pang, *Department of Research Policy and Cooperation, World Health Organization, Geneva, Switzerland*

1. Introduction
2. Challenges to Improving Vaccination
3. Obstacles to Effective Vaccination
4. Solutions to Problems of Access and Coverage
5. Mechanisms: Cooperation Between Industrialized Nations and Developing Nations
6. Recent Initiatives—A Brighter Future?
 - 6.1. The International Vaccine Institute
 - 6.2. Global Alliance for Vaccines and Immunization
 - 6.3. Millennium Vaccine Initiative
 - 6.4. International AIDS Vaccine Initiative
 - 6.5. Malaria Vaccine Initiative
7. Role of the World Health Organization
8. The Future

Health **329**
 John M. Last, *University of Ottawa, Canada*

1. Introduction
2. Definitions and Concepts of Health
3. Health as Dynamic Equilibrium: Ecology of Human–Pathogen Interactions
4. Historical Perspectives
5. Theories about Health
6. Determinants of Health
 - 6.1 Physical Factors
 - 6.2 Biological Factors
 - 6.2.1 Ecology and Evolution of Infectious Diseases
 - 6.3 Behavioral Factors
 - 6.3.1 Personality
 - 6.3.2 Lifestyle
 - 6.3.3 Risk-taking Behavior
 - 6.3.4 Substance Use and Abuse
 - 6.4 Social Determinants of Health
 - 6.4.1 Socioeconomic Factors
 - 6.4.2 Occupation
 - 6.4.3 Social Connections and Interactions
 - 6.5 Cultural Factors
 - 6.5.1 Human Values as a Determinant of Health
7. Requirements for Good Health
 - 7.1 Safe Environment
 - 7.2 Enhanced Immunity
 - 7.3 Sensible Behavior
 - 7.4 Good Nutrition
 - 7.5 Well-born Children
 - 7.6 Prudent Health Care
8. Health Indicators
 - 8.1 Statistical Indicators
 - 8.2 Notifiable and Reportable Diseases
 - 8.3 Hospital and Other Medical Records
9. Health Services and Health-care Systems

9.1 Public Health Services	
9.2 Personal Health Services and Personal Care	
9.2.1 Primary Care	
9.2.2 Secondary Care	
9.2.3 Tertiary Care	
9.3 Economics of Health Care	
10. The Future of Human Health	
10.1 Global Change	
10.1.1 Atmospheric Change	
10.1.2 Emerging and Reemerging Pathogens	
10.1.3 Sociodemographic Changes	
10.1.4 War as a Public Health Problem	
10.2 Grounds for Optimism	
11. Conclusion	
Index	361
About EOLSS	373

VOLUME VIII

Interactions of Environmental Change and Human Health	1
Neil Pearce, <i>Massey University, Wellington, New Zealand</i>	
Anthony J. McMichael, <i>London School of Hygiene and Tropical Medicine, United Kingdom</i>	
1. Introduction	
2. The Agricultural Revolution	
2.1 Health Effects	
3. The Industrial Revolution	
3.1 Health Effects	
4. The Age of Development	
4.1 Health Effects	
5. The Information Technology Revolution	
5.1 Health Effects	
5.1.1 Population Health and the Physical Environment	
5.1.2 Population Health and the Biological Environment	
5.1.3 Population Health and the Socioeconomic Environment	
5.1.4 Ecosystem Health	
6. Discussion	
Molecular Epidemiology and the Prevention of Disease	19
Ellen K. Silbergeld, <i>Professor of Epidemiology and Toxicology, University of Maryland Medical School, Baltimore, MD, USA</i>	
1. Introduction	
2. Goals of Epidemiology	
3. Epidemiological Methods	
4. Molecular Epidemiology	
5. Limits of Molecular Epidemiology	
6. Future Directions in Molecular Epidemiology	
7. Conclusion	
Modern Medical Practices: A Commentary	31
Guy J. Lavoipierre, <i>Former Epidemiologist, World Health Organization, Geneva, Switzerland</i>	
1. Modern Medical Practices: A Commentary	

2. Medical Practices in Economically Developed Countries
 - 2.1. Changing Morbidity
 - 2.2. General Medical Practice
3. General Medical Practice and Training of Medical Students
4. Laboratory Investigations, Medical Malpractice and Cost of Health Care Delivery
5. Patients' Expectations, the 'Magic Pill Syndrome' and Lifestyle-Inflicted Illnesses
 - 5.1. Patients' expectations
 - 5.2. The 'Magic Pill' Syndrome and Lifestyle Illnesses
6. Prevention and the General Practitioner
7. Modern Medical Practice and Unconventional Therapies
8. Politicians and Medical Practice
9. Modern Medical Practice and the Pharmaceutical Industry
10. Medical Practices in Underprivileged and Developing Countries
11. Indoor Air Pollution Control as an Illustration
12. Health Care Delivery in Remote Zones
13. Conclusion

Reflections On The Scientific Method In Medicine

53

R.J. Stusser, *Former Consultant Researcher and Professor of National Research Centers of Havana University, Ministry of Public Health, and West Havana Scientific Productive Pole, Havana, Cuba.*

1. Background
 - 1.1. The Approach to a Scientific Method in Clinical Medicine
 - 1.2. How the Current Situation Developed
2. Essential Methodological Principles
3. Logical and Methodological Problems of Clinical Medicine Science
4. Suggestions to Improve Medical Scientific Methodology
 - 4.1. Creation of an Integrative Medical Scientific Methodology
 - 4.2. Use of a "Recombinant" Hypothesis-Discovery Support System
 - 4.3. Use of a Modeling and Simulation Research Design Optimizer
 - 4.4. Enhancement of Clinical Scientific Hypothesis Creativity
5. Underlying Theoretical and Philosophical Problems of Medical Science
6. Unified Methodological System for Investigation in Medicine
 - 6.1. A Trans-methodological Model of Clinical, Basic and Health Sciences
 - 6.2. Re-unification of Clinical Scientific Method for Practice and Research
7. Conclusions and Recommendations

Technology For Health And Medicine

78

Boutros-Pierre Mansourian Former Director (ret.), *Research Policy Coordination, WHO / HQ- Geneva, Switzerland*

1. Introduction
2. Science, Technology and Medicine
3. Science and Technology Disparities
4. Health Disparities
5. Global Costs of Health Technology
6. Avenues in Technological Development
 - 6.1. Major Advances
 - 6.2. Gene Technology and Medicines
 - 6.3. Engineering in Medicine
7. Conclusion

Public Health - An Evolving Concept

90

Lennart Köhler, *Nordic School of Public Health, SE-402 42 Göteborg, Sweden*

1. The Task of Public Health and its Development

2. The Concept of Health
3. Actual Problems of the Modern Health Care Systems
 - 3.1. Major Changes in the Disease Panorama
 - 3.2. Resource Constraints and the Infinity of Demand for Services
 - 3.3. Unequal Distribution of Resources and Utilization of Care
 - 3.4. Quality of Care and Sensitivity to Patients
4. The Response of the Modern Public Health
5. Shifting Focus of Public Health
 - 5.1. The Movement from Old to New Public Health
 - 5.2. Health Protection and Promotion
 - 5.3. Comprehensive Public Health
6. Principal Areas of Public Health
 - 6.1. Education
 - 6.2. Research
 - 6.3. Practice
7. Challenges
 - 7.1. The Artificial Separation of Medicine and Public Health
 - 7.2. The Need for a Broad View on the Citizen's Health
8. Forward
 - 8.1. Strategies to Strengthen the Role of Public Health
9. Concluding Remarks on the Health of Populations and the Role of Public Health

Public Health Surveillance

105

Laura R. Johnson, *Emory University School of Medicine, Atlanta, Georgia, USA*
 David L. Heymann, MD, MPH, *World Health Organization, Geneva, Switzerland*

1. Introduction
2. History of Surveillance
3. Background on the Modern Concept of Surveillance
 - 3.1 The Case Definition
 - 3.2 Data Collection
 - 3.3 Data Management and Analysis
 - 3.4 Data Dissemination
 - 3.5 Evaluation of Surveillance Systems
4. Source of Surveillance Information
 - 4.1 The Patient Treatment Record
 - 4.2 The Population Survey
 - 4.3 Networks for Outbreak Detection and Reporting
5. Conclusion

Environment And Public Health

123

P. Hartemann, *Nancy University School of Medicine, Nancy, France*

1. Introduction
2. Hazards and Risks Perception
3. Faring Classical Hazards
 - 3.1 Water
 - 3.1.1 Water Resources
 - 3.1.2 Drinking Water
 - 3.2 Air
 - 3.2.1 Air Pollution
 - 3.2.2 Indoor Air Pollution
 - 3.3 Toxic Chemicals and Hazardous Waste Disposal
 - 3.4 Noise
4. Emerging Risks and Global Environmental Change
5. Conclusion

Maternal And Child Health: A Basic Part Of Public Health **147**
 Mark A. Belsey, *Consultant in International Health and Development, New York, USA (World Health Organization -Retired)*

1. Introduction
2. The Historical Context
 - 2.1. In Ancient Times and Traditional Societies
 - 2.2. MCH in an Era of Scientific Discovery and Social Concerns
3. The Elements and Technologies of MCH
4. Indicators and Information Systems for Maternal and Child Health
5. The Organization and Management of MCH Services
6. Setting Policies for MCH and the Health of Women, Children and Families
7. Conclusion: The Challenges for the Future

Public Health Ethics For Today And Tomorrow **172**
 M. Manciaux, *School of Public Health, University of Nancy, France*
 G. Terrenoire, *Social scientist, National Center for Scientific Research (CNRS), France*

1. Introduction
2. Public Health
 - 2.1. From Mythology to Modernity
 - 2.2. Definitions and Charters
3. Ethics
 - 3.1. How should we act?
 - 3.2. Bioethics
 - 3.3. International Guidelines and Codes
4. From Bioethics to Public Health Ethics
 - 4.1. Convergences
 - 4.2. Turning Points
 - 4.3. Towards Codification
5. Current Challenges
 - 5.1. Equal Rights, Unequal Needs and Access
 - 5.2. Cultural Diversity
 - 5.3. The North-South Ethical Gap
 - 5.4. Efficiency vs. Ethics
 - 5.5. Information and Communication
 - 5.6. Precautionary Principle
 - 5.7. Ethical Issues in day-to-day Public Health Work
6. Ethics for Public Health Tomorrow

Geographic Medicine: An Introduction **191**
 Yola L.G. Verhasselt, *Free University of Brussels, Belgium*

1. Introduction
2. Topical Highlights
 - 2.1. Health Disparities, as a Reflection of Globalization and Fragmentation of the Contemporary World
 - 2.2. The Geography of Health Care Systems
 - 2.3. Environmental Change and Vector-Borne Diseases: The Contribution of Remote Sensing and Spatial Analyses.
 - 2.4. Bio-Environmental Correlates of Chagas' Disease.
3. Concept Evolution
4. Urbanization and Health
5. Ageing
6. Development and Health
7. Migration

8. Concluding remarks

The Geography Of Health Care Systems 199

D.R. Phillips, *Lingnan University, Tuen Mun, Hong Kong*
 M.W. Rosenberg, *Queen's University, Kingston, Ontario, Canada*
 K. Wilson, *University of Toronto at Mississauga, Mississauga, Ontario, Canada*

1. Introduction
2. Defining a Health Care System
3. Access to Health Care Services
4. Restructuring Health Care Systems
5. New Spaces of Health Care Delivery
6. Conclusions

Disparities In Health: A Reflection Of The World's Globalisation And Fragmentation 211

J.M. Amat-Roze, *Department of Geography, Paris 12 University, France*

1. Introduction
2. Undeniable convergence
 - 2.1. « Unheard-of » statistics in mankind's history.
 - 2.2. A worldwide struggle
3. Increased globalisation of health needs
 - 3.1. The threat of new infectious pandemics.
 - 3.2. Worldwide epidemic of non-infectious diseases.
4. But a powerful dynamic of divergence
 - 4.1. Gender-based disparities.
 - 4.2. Appearance of extreme disparities between nations.
5. The singular case of sub-Saharan Africa.
6. The rise of a global underprivileged class.
 - 6.1. A fall in extreme poverty but a rise in inequalities.
 - 6.2. Socio-territorial health disparities.
7. Conclusion

Environmental Change And Vector-Borne Diseases: The Contribution Of Remote Sensing And Spatial Analyses 231

Sophie O. Vanwambeke and Eric F. Lambin, *Department of Geography, Université catholique de Louvain, Belgium*

1. Vector-borne Disease in the 21st Century
2. Vector-borne Diseases and Environmental Change
3. People, Vectors and Landscape: A Conceptual Model
 - 3.1. People and Landscape
 - 3.2. People and Vectors
 - 3.3. Vectors and Landscape
4. Remote Sensing Systems: A Tool for Studying the Environment
 - 4.1. Land Surface Attributes Measured by Remote Sensing
 - 4.1.1. In the Spectral Domain
 - 4.1.2. In the Spatial Domain
 - 4.2. Processing and Analysis of Remotely Sensed Data
 - 4.2.1. Pre-processing
 - 4.2.2. Image Classification
 - 4.2.3. Change Detection
5. Remote Sensing and Vector-borne Diseases
 - 5.1. Examples of Use of Remotely-sensed Data for the Study of Vector-borne Diseases
 - 5.1.1. High-resolution Remotely-sensed Data Applications

- 5.1.2. Low-resolution Remotely-sensed Data Applications
- 6. Spatial Dimension of Disease Transmission and Geographical Information Systems
 - 6.1. Components of a Geographic Information System
 - 6.2. Examples of Spatial Analyses in Epidemiology
- 7. Conclusion

Bioenvironmental Correlates Of Chagas' Disease **248**
 S.I Curto, *National Council for Scientific and Technological Research, Institute of Epidemiological Research, National Academy of Medicine – Buenos Aires. Argentina.*

- 1. Introduction
- 2. Biological Members and Transmission Dynamics of Disease
- 3. Interconnection of Wild, Peridomestic and Domestic Cycles
- 4. Dynamics of domiciliation of the vectors: origin and diffusion of the disease
- 5. The Rural Housing as Environmental Problem
- 6. Bioclimatic Factors of Triatominae Species
- 7. Description of Disease
- 8. Rates of Human Infection
- 9. Conclusions

Adult Congenital Heart Disease: A Challenging Population **262**
 Khalid Aly Sorour, *Cairo University, Kasr el-Aini Hospital, Egypt*

- 1. Introduction
- 2. Epidemiology of Congenital Heart Disease
- 3. Types of Adult Patients with CHD
- 4. Congenital Heart Disease in Adults – Unoperated Survival
 - 4.1. Common Defects with Expected Adult Survival
 - 4.2. Common Defects with Exceptional Adult Survival
 - 4.3. Uncommon Defects with Expected Adult Survival
 - 4.4. Uncommon Defects with Exceptional Adult Survival
- 5. Why do we need Specialized Centers for the Care of Adults with CHD?
- 6. Transfer from Pediatric to Adult Services:
- 7. Organization of Services and Care
- 8. Conclusions

Advances And Prospects In Gastroenterology **270**
 Witold Bartnik, *Department of Gastroenterology and Hepatology, Medical Center for Postgraduate Education, Warsaw, Poland*

- 1. Introduction
- 2. Diagnostic Tests in Gastroenterology
- 3. Upper Gastrointestinal Diseases
 - 3.1. Gastro-esophageal Reflux Disease (GERD)
 - 3.1.1. Complications of GERD
 - 3.2. Gastric Cancer
 - 3.3. Peptic Ulcers and Their Complications
 - 3.4. Dyspepsia
- 4. Diseases of the Intestines
 - 4.1. Acute Infectious Diarrhea
 - 4.2. Celiac Disease
 - 4.3. Irritable Bowel Syndrome
 - 4.4. Lower Gastrointestinal Bleeding
 - 4.5. Inflammatory Bowel Disease (IBD)
 - 4.5.1. Treatment of IBD

- 4.6. Colorectal Cancer
 - 4.6.1. Screening for Colorectal Neoplasms
 - 4.6.2. Chemoprevention of Colorectal Cancer
- 5. Diseases of the pancreas
 - 5.1. Acute Pancreatitis
 - 5.2. Chronic Pancreatitis
 - 5.3. Pancreatic Cancer
- 6. Diseases of the Liver
 - 6.1. Hepatitis B
 - 6.2. Hepatitis C
 - 6.3. Non-alcoholic Fatty Liver Disease (NAFLD)
 - 6.4. Hepatocellular Carcinoma
- 7. Impact of Genomics in Gastroenterology and Hepatology

Obstetrics And Gynecology

292

A. Himaya, *Former Consultant Obstetrician and Gynaecologist, University of Ottawa, Ottawa, Canada.*

- 1. Definition of Obstetrics
- 2. History of Obstetrics
- 3. Infectious Diseases in the Pregnant Woman
- 4. Normal Pregnancy
- 5. Pregnancy Complications
 - 5.1 Maternal Complications
 - 5.2 Fetal Complications
- 6. Delivery
- 7. What is Gynecology
- 8. History of Gynecology
- 9. The Vulva
- 10. The Vagina
- 11. The Uterus

Index

353

About EOLSS

361

VOLUME IX

Probiotic A Novel Approach To Treating Childhood Atopy

1

Aziz Koleilat , *Department, Makassed University General Hospital. Riad El-Solh 110722 10. Beirut – Lebanon*

- 1. Introduction
- 2. Mechanisms of action of Probiotic
- 3. The aims of intervention
- 4. Clinical Context
- 5. How Probiotics Work?
- 6. Probiotics & Atopy
 - 6.1. Causes, Prevention and Treatment
 - 6.2. Who is at risk?
 - 6.3. The relationship between food allergy and atopic dermatitis
 - 6.4. Strategies for a primary prevention of atopy
 - 6.5. Use of Probiotics in Atopic Diseases
- 7. Conclusions

Overview Of Pathology And Its Related Disciplines**14**Soheir Mahmoud Mahfouz, *Cairo University, Kasr El Ainy Hospital, Egypt*

1. Introduction
 - 1.1 Pathology coverage
 - 1.1.1 Etiology and Pathogenesis of a Disease
 - 1.1.2 Manifestations of Disease (Lesions)
 - 1.1.3 Phases Of A Disease Process (Course)
 - 1.2 Physician's approach to patient
 - 1.3 Types of pathologists and affiliated specialties
 - 1.4 Role of pathologist
2. Pathology and its related disciplines
 - 2.1 Cytology
 - 2.1.1 Cytology Samples
 - 2.1.2 Technical Aspects
 - 2.1.3 Examination of Sample and Diagnosis
3. Pathology techniques and ancillary diagnostic methods
 - 3.1 Macroscopic pathology
 - 3.2 Light Microscopy
 - 3.3 Polarizing light microscopy
 - 3.4 Electron microscopy (EM)
 - 3.5 Confocal Microscopy
 - 3.6 Frozen section
 - 3.7 Cyto/histochemistry
 - 3.8 Immunocyto/histochemical methods
 - 3.9 Molecular and genetic methods of diagnosis
 - 3.10 Quantitative methods
4. Types of tests used in Pathology
 - 4.1 Diagnostic tests
 - 4.2 Quantitative tests
 - 4.3 Prognostic tests
5. The scope of Pathology and its main divisions
6. Conclusions

The Pathobiology Of Bilharzia-Associated Bladder Cancer**38**Nadia Mahmoud Mokhtar, *Department of Pathology National Cancer Institute(NCI). , Cairo University, Egypt*Nabil El Bolkainy, *National Cancer Institute NCI , Cairo University Egypt*Hussein Khaled, *National Cancer Institute NCI , Cairo University Egypt*Abdul Rahman Zekri, *Department of Cancer Biology at the National Cancer Institute NCI , Cairo University Egypt*

1. Introduction
2. Precursor Lesions
3. Classification
 - 3.1 Transitional Cell Carcinoma
 - 3.2 Papillary Transitional Neoplasm of Low Malignant Potential
 - 3.3 Papillary Transitional Carcinoma
 - 3.4 Invasive Transitional Carcinoma
 - 3.5 Squamous Cell Carcinoma
 - 3.6 Adenocarcinoma
 - 3.7 Undifferentiated Tumors
 - 3.8 Rare Variants
4. Early detection and chemoprevention
5. Biologic features
 - 5.1 Chromosomal Changes
 - 5.2 Cancer Genes

- 5.3 P53
- 5.4 Mdm2
- 5.5 Proliferation and cell cycle markers
- 5.6 Ras
- 5.7 Other Biologic Markers
- 5.8 Viruses
- 6. Conclusion

Bilharziasis: A Granulomatous Parasitic Disorder With Grave Implications

52

Maha Mahmoud Akl, *Professor of Pathology, Head of Pathology Department, Theodor Bilharz Research Institute (affiliated to Ministry of High Education and Scientific Research), Kornish El Nile. Warak El Hadar, Embaba, Cairo. Egypt P.O.Box 30. Postal Code: 12411.*

- 1. Introduction
 - 1.1 Discovery of schistosomes (Bilharzia worms) by Theodor Bilharz
- 2. Life cycle of the Bilharzial parasite
 - 2.1 Schistosomiasis species and their stages
 - 2.2. Asexual part of life cycle (intermediate host phase)
 - 2.3. Sexual part of the cycle
 - 2.4. Eggs
- 3. Pathogenesis of Schistosomiasis
 - 3.1. Eggs
 - 3.2. Egg granulomas
 - 3.3. Mechanisms underlying granuloma formation
 - 3.4. Pathological stages of schistosomiasis
- 4. Clinical features of Bilharziasis due to Schistosoma mansoni infection
 - 4.1. Skin Lesions
 - 4.2. Acute schistosomiasis
 - 4.2.1. Katayama fever
 - 4.2.2. Symptoms of the acute stage
 - 4.2.3. Treatment of Acute Phase
 - 4.3. Intestinal Schistosomiasis (Bilharziasis); chronic stage
 - 4.3.1. Mild and early intestinal lesions
 - 4.3.2. Severe and prolonged cases develop specific pathological lesions which include
 - 4.3.2.1 Bilharzial polyps
 - 4.3.2.2. Sandy patches
 - 4.3.2.3. Bilharzial ulcers
 - 4.3.2.4. Intestinal fibrosis
 - 4.4. Complications of Intestinal Bilharziasis: Includes the following
 - 4.5. Symptoms of Intestinal Bilharziasis
 - 4.6. Treatment of Intestinal Bilharziasis
- 5. Hepatosplenic Bilharziasis (Bilharzial hepatic portal fibrosis)
 - 5.1. Pathogenesis and Pathology of Bilharzial Hepatic Fibrosis
 - 5.1.1. The Portal Tracts show major changes
 - 5.1.2. The Hepatic Lobules
 - 5.1.3. Gross Features of the Affected Livers by Bilharziasis
 - 5.2. Classification of Bilharzial Portal Fibrosis
 - 5.2.1. Fine bilharzial periportal fibrosis
 - 5.2.2. Coarse bilharzial periportal fibrosis
 - 5.3. Effects of Bilharzial Portal Fibrosis and Its Complications
 - 5.4. Causes of Death in Hepatic Bilharziasis
 - 5.4.1. Pathogenesis of Splenic Enlargement
 - 5.4.2. Effects and Complications of Splenomegaly
- 6. Bilharziasis of the urogenital system
 - 6.1. Bilharzial Cystitis
 - 6.2. Pathogenesis of Bilharzial Cystitis
 - 6.3. Complications of Urinary Bilharziasis

- 6.4. Bilharziasis of Other Parts of the Uro-Genital System
 - 6.4.1. Bilharziasis of the Ureter
 - 6.4.2. Bilharziasis of the Male Genital Organs
 - 6.4.3. Bilharziasis of Female Genital Organs
 - 6.4.4. Impact of bilharziasis on bladder cancer pathology
- 7. Bilharziasis of the lungs
 - 7.1. Pathogenesis of Lung Bilharziasis
 - 7.1.1. Pathological Features of Lung (Pulmonary) Bilharziasis
 - 7.1.2. Effects and Complications of Pulmonary Bilharziasis
- 8. Bilharziasis of Other Organs
- 9. Schistosomal Antigens and Immune Complexes
- 10. Conclusion

The Pathology Of Breast Cancer

79

Ali Fouad El Hindawi, *Cairo University. Kasr El Ainy Hospital. Egypt.*

- 1. Introduction
- 2. Types of breast lumps
- 3. Breast carcinoma
 - 3.1 In Situ Carcinoma of the Mammary Gland
 - 3.1.1 Lobular Neoplasia (LN)
 - 3.1.2 Duct Carcinoma in Situ (DCIS)
 - 3.2 Invasive Carcinoma of the Mammary Gland
 - 3.2.1 Microinvasive Carcinoma of the Mammary Gland
 - 3.2.2 Invasive Lobular Carcinoma (ILC)
 - 3.2.3 Invasive Duct Carcinoma
 - 3.3 Paget's disease of the Nipple
 - 3.4 Bilateral Breast Carcinoma
- 4. Conclusions

Medical Informatics and Telematics at the Threshold of the 21st Century

101

K. C. Lun, *Past President, International Medical Informatics Association (IMIA) and Professor (Adjunct), School of Biological Sciences, Nanyang Technological University, Singapore*
 G. W. Brauer, *Associate Professor, School of Health Information Science, University of Victoria, Canada and Member of the International Commission on the development of EOLSS Theme on Medical Sciences*

- 1. Introduction
- 2. Brief History
- 3. Institution-centred Informatics
 - 3.1. Hospital Information Systems
 - 3.2. Picture Archiving and Communication Systems
- 4. Patient-centred Informatics
 - 4.1. Electronic Patient / Medical Record
 - 4.2. Knowledge Management / Decision Support
- 5. Community-centred Informatics
 - 5.1. Disease Surveillance
 - 5.2. Telehealth / Telemonitoring
- 6. Standards in Medical Informatics
- 7. Data Security, Confidentiality and Privacy in Medical Informatics
- 8. Medical and Health Informatics Education
 - 8.1. Curriculum Content
 - 8.2. Course Tracks Imbedded in non-MI Programs
 - 8.3. Dedicated MI Programs
 - 8.4. Modes of Delivery in MI Education
- 9. Promoting Medical Informatics
 - 9.1. Professional Organizations

- 9.2. Conferences
- 9.3. Yearbook and Journals
- 9.4. Web Resources
- 9.5. Textbooks

The Past And Future Impacts Of Health/Medical Informatics On Healthcare Delivery 132

Denis J. Protti, *School of Health Information Science, University of Victoria, B.C., Canada*

- 1. Introduction
- 2. The Use of Computers in Health Care Is Reducing Errors and Improving Patient Safety
- 3. The Benefits of a Unified Electronic Health Record
- 4. Computer Technology in Primary Care and Chronic Disease Management
- 5. Using Communications Technology to Traverse Space at the Speed of Care
 - 5.1. Tele-Semantics
 - 5.2. Tele-Informatics in Practice
- 6. Conclusion

Human Aspects of Health Care Information Systems 147

Andre Kushniruk, *School of Health Information Science, University of Victoria, Victoria, British Columbia, Canada*

Joseph Kannry, *Mt. Sinai Medical Center, New York, New York, U.S.A.*

- 1. Introduction
- 2. Background
 - 2.1. The Study of Human-Computer Interaction
 - 2.2. Cognitive Aspects of HCI in Health Care
 - 2.3. Human Information Processing and Distributed Cognition
 - 2.4. Skilled Performance, Expertise and Learning
 - 2.5. Perception and Attention
 - 2.6. User Interaction Style
 - 2.7. Principles for Displaying Information
 - 2.8. Data Entry
 - 2.9. General User Interface Principles in Health Care
- 3. Towards a Framework for Considering HCI in Health Care
- 4. Human-Computer Interaction and the System Development Life Cycle
- 5. Usability Engineering Methods for the Iterative Evaluation and Improvement of Health Information Systems
 - 5.1. Usability and Usability Testing in Health Care
 - 5.2. Usability Inspection in Health Care
 - 5.3. Modeling of Health Care Workflow
- 6. Examples of Emerging Technologies in Health Care User-Computer Interfaces
 - 6.1. Visualization of Health Care Data
 - 6.2. Web-based Systems
 - 6.3. Pervasive Computing in Healthcare
 - 6.4. Cooperative Work Environments
 - 6.5. Customizable and Adaptive User Interfaces
- 7. Conclusion -- Need for Cognitive Approaches to System Design in Health Care

Clinical Informatics 163

Andre Kushniruk, *School of Health Information Science, University of Victoria, Victoria, British Columbia, Canada*

Joseph Kannry, *Mt. Sinai Medical Center, New York, New York, U.S.A.*

- 1. Introduction
- 2. Background: The Origins of Clinical Informatics
- 3. The Emergence of Healthcare Information Technology and the Electronic Health Record (EHR)

- 3.1. Ideal Features Of Electronic Health Record Systems
- 3.2. Technical Requirements Of Electronic Health Record Systems
- 4. Issues with Electronic Health Record Systems
- 5. Emergence of Clinical Decision Support Systems (CDSSs) and On-line Clinical Guidelines
- 6. Monitoring Systems
- 7. Clinical Departmental Systems
- 8. Hospital-Wide Clinical Information Systems
- 9. Discussion
- 10. Conclusion

Tissue Engineering

173

Robert M. Nerem, *Georgia Tech/Emory Center for the Engineering of Living Tissues*
 Parker H. Petit, *Institute for Bioengineering and Bioscience, Georgia Institute of Technology, Atlanta, GA 30332-0363, USA*

- 1. Introduction
- 2. Clinical Applications
- 3. Cell Source: All Cells are not Created Equal
- 4. Other Critical Issues
- 5. From Benchtop Research to a Product and to the Patient
- 6. The Future

Biomaterials

188

Eileen Gentleman, *Department of Materials, Imperial College London, London SW7 2AZ, UK*
 Michael D. Ball, *Department of Materials, Imperial College London, London SW7 2AZ, UK*
 Molly M. Stevens, *Department of Materials, Imperial College London, London SW7 2AZ, UK*

- 1. Introduction
 - 1.1. History of Biomaterials
 - 1.2. Materials in Medicine
- 2. Types of Materials
 - 2.1. Metals
 - 2.1.1. 316L Stainless Steel
 - 2.1.2. Commercially Pure Titanium and Titanium Alloys
 - 2.1.3. Cobalt-Chromium Alloys
 - 2.2. Ceramics
 - 2.2.1. Bioinert Ceramics
 - 2.2.1.1. Pyrolytic Carbon
 - 2.2.1.2. Alumina
 - 2.2.1.3. Zirconia
 - 2.2.2. Bioactive Ceramics
 - 2.2.3. Biodegradable Ceramics
 - 2.3. Polymers
 - 2.3.1. Bioinert Polymers
 - 2.3.1.1. Polyethylene (PE)
 - 2.3.1.2. Polytetrafluorethylene (PTFE)
 - 2.3.1.3. Polyethylene terephthalate (PET)
 - 2.3.1.4. Polymethylmethacrylate (PMMA)
 - 2.3.1.5. Polysiloxanes
 - 2.3.1.6. Other
 - 2.3.2. Bioresorbable Polymers
 - 2.3.2.1. Hydrogels
 - 2.3.2.2. Polyglycolic acid (PGA)
 - 2.3.2.3. Polylactic acid (PLA)
 - 2.3.2.4. Other
 - 2.3.2.5. Natural Bioresorbable Polymers

3. Tissue/Biomaterials Interactions
 - 3.1. Protein Interactions
 - 3.2. Coagulation
 - 3.3. Acute Inflammation
 - 3.4. Wound Healing
 - 3.5. Immune Responses
 - 3.6. Foreign Body Reaction
 - 3.7. Non-Specific Cell Responses
4. Uses of Biomaterials
 - 4.1. Connective Tissues
 - 4.1.1. Bone
 - 4.1.2. Joints
 - 4.1.3. Ligament and Tendon
 - 4.1.4. Dental
 - 4.1.5. Soft Tissue Repair and Augmentation
 - 4.1.6. Sutures
 - 4.2. Sensory Tissues
 - 4.2.1. Nervous
 - 4.2.2. Ocular
 - 4.2.2.1. Contact Lenses
 - 4.2.2.2. Artificial Vitreous Humour
 - 4.2.2.3. Scleral Buckling Materials
 - 4.2.2.4. Intraocular Lenses
 - 4.2.3. Auditory
 - 4.3. Metabolic Tissues
 - 4.3.1. Kidney
 - 4.3.2. Liver
 - 4.3.3. Pancreas
 - 4.4. Cardiovascular Tissues
 - 4.4.1. Replacement Heart Valves
 - 4.4.2. Cardiac Assist Devices
 - 4.4.3. Artificial Blood Vessels
 - 4.4.4. Stents
 - 4.5 Drug Delivery
 - 4.6 Tissue Engineering
5. Challenges for Biomaterials
 - 5.1. Thrombus/Embolus
 - 5.2. Corrosion
 - 5.3. Wear
 - 5.4. Infection
 - 5.5. Calcification
 - 5.6. Tumourigenicity
 - 5.7. Hypersensitivity
 - 5.8. Systemic Toxicity
 - 5.9. Mechanical Failure
 - 5.10. Poor Biocompatibility
6. Next Generation Biomaterials
7. Conclusions

Robotics In Surgery – Past, Present And Future

231

Rajesh Aggarwal, *Department of Biosurgery and Surgical Technology, Imperial College London, UK*
Ara Darzi, *Department of Biosurgery and Surgical Technology, Imperial College London, UK*
Guang-Zhong Yang, *Royal Society/Wolfson Medical Image Computing Laboratory, UK*

1. Introduction
2. Limitations of Laparoscopic Surgery
3. The Development of Robotic Systems in Surgery

4. The Impact of Robotic Systems in Surgery
5. Robotics for Gastrointestinal Surgery
6. Robotics for Cardiac Surgery
7. Robotics for Urological Surgery
8. Training Programs for Robotic Surgery
9. Development of a Robotic Credentialing Program
10. Telerobotics, Telementoring and Telepresence
11. Conclusion

Physiological Measurement

255

Nigel H. Lovell, *Graduate School of Biomedical Engineering, University of New South Wales, Sydney, Australia*
National Information and Communications Technology Australia (NICTA), Australian Technology Park, Eveleigh, Australia
 Dean M. Karantonis, *Graduate School of Biomedical Engineering, University of New South Wales, Sydney, Australia*
 Shaun L. Cloherty, *Graduate School of Biomedical Engineering, University of New South Wales, Sydney, Australia*
 Branko G. Celler, *School of Electrical Engineering and Telecommunications, University of New South Wales, Sydney, Australia*

1. Introduction
2. Biomedical Signals and Measurement Systems
 - 2.1. Biomedical Signals
 - 2.2. Biomedical Instrumentation Overview
3. Physical Measurements
 - 3.1. Flow and Volume Measurement
 - 3.1.1. Blood Flow Measurement
 - 3.1.2. Volume Measurement
 - 3.2. Pressure and Force Measurement
 - 3.2.1. Sensing Elements
 - 3.2.2. Invasive Pressure Sensors
 - 3.2.3. Non-invasive Pressure Measurement
 - 3.2.4. Force Measurement
 - 3.3. Measurement of Motion (Displacement, Velocity and Acceleration)
 - 3.4. Chemical Measurement
 - 3.4.1. Optically-based Sensors
 - 3.4.2. Electrochemical Sensors
 - 3.5. Bioelectric Measurement
 - 3.5.1. Origin of Bioelectric Potentials
 - 3.5.2. Biopotentials and their Applications
 - 3.5.3. Biopotential Electrodes and Instrumentation
 - 3.6 Measurement of Thermal Radiation
4. Conclusion

Nanobiotechnology

304

C. Ruggiero, *Department of Communication Computer and System Sciences, University of Genoa, Italy*

1. Microtechnology and Nanotechnology
2. The Dawning of Nanotechnology
3. Nanoscale Structures: Technology and Applications
4. A Key Instrument For Nanotechnology: The Scanning Tunnelling Microscope
5. Nanotechnology And Government Policies
6. The Impact of Nanotechnology on Biology and Medicine: Nanobiotechnology
7. Assemblies of Organized Biomolecules and Nanoparticles: Ultra Thin Films
 - 7.1 Langmuir Blodgett Techniques

- 7.2 Processing from A Solution: Spin Coating and Solution Casting
- 7.3 Chemical Self-Assembly
- 7.4 Layer-By-Layer Self-Assembly
- 8. Carbon Nanotubes
 - 8.1 Properties of CNTs
 - 8.2 Biomedical Applications of Cnts
 - 8.2.1 Sensors
 - 8.2.2 Drug Delivery
 - 8.2.3 Implantable Nanorobot, Nanosensors and Devices
 - 8.2.4 Radiation oncology
- 9. High-Throughput Genomic and Proteomic Analysis: DNA Microarrays and Protein Antibody Microarrays
 - 9.1 DNA Microarrays
 - 9.2 Protein and Antibody Microarrays
- 10. Nanoparticles
 - 10.1 Preparation of Nanoparticles
 - 10.2. The Artificial Cell

House Dust Mites - What Might A Mite Do?

327

Nadia Aly El-Dib, *Faculty of Medicine, Cairo University, Egypt.*

- 1. Introduction
- 2. Taxonomy and Natural History of House Dust Mites
- 3. Morphology of Dust Mites
- 4. Life Stages of Dust Mites
- 5. Ecology and Habits
 - 5.1. Feeding Habits
 - 5.2. Excretion of Faecal Pellets
 - 5.3. Hosts
- 6. Effect on Health
 - 6.1. Environmental Factors associated with Increasing Sensitivity to Mite Allergens
- 7. The Common Sites for House Dust Mites
- 8. Exposure to House Dust Mite Allergens
- 9. The Familiar Signs and Symptoms of Airborne Allergies
 - 9.1. Allergic Rhinitis
 - 9.2. Conjunctivitis
 - 9.3. Dermatitis
 - 9.4. Bronchial Asthma
- 10. Diagnosis
- 11. Managing Dust Mite's Allergy
 - 11.1. Treatment of the Patient
 - 11.2. Modification of the Patient's Environment
 - 11.2.1. Furnishing
 - 11.2.2. Floors
 - 11.2.3. Beds
 - 11.2.4. Stuffed Furry Toys
 - 11.2.5. Indoor Humidity Control
 - 11.2.6. Vacuum Cleaning
 - 11.2.7. Air Purifiers
 - 11.2.8. Insecticide (Acricides)
- 12. Conclusion

Index

339

About EOLSS

347

VOLUME X

Tropical Health: A Global Challenge

1

Refaat Kamel, *Ain Shams University, Egypt.*

1. Introduction
2. Medical Conditions in the Tropics
 - 2.1. Infections
 - 2.2. Non-infectious Tropical Surgical Conditions
 - 2.3. Emergencies in the Tropics
 - 2.3.1. Surgical Emergencies in the Tropics
 - 2.3.2. Obstetric Emergencies in the Tropics
3. Anaemia in Tropical Areas
4. Global Warming: The Hidden Health Risk
5. Low Cost
6. Conclusion and Hope for the Future

Food Safety – Its Role In Health And Development: The Problems Related To Our Food Supply

14

Fritz Käferstein, *International Food Safety Consultant, Nyon, Switzerland*

Yasmine Motarjemi, *Food Safety Manager, Nestlé, S.A., Vevey, Switzerland*

Gerry Moy, *GEMS/Food Manager, World Health Organization, Geneva, Switzerland*

1. The Problems Related to our Food Supply
 - 1.1. Introduction
 - 1.2. Biological Hazards
 - 1.3. Chemical Hazards
 - 1.3.1. Introduction
 - 1.3.2. Food Additives
 - 1.3.3. Veterinary Drug Residues
 - 1.3.4. Pesticide Residues
 - 1.3.5. Environmental Chemicals
 - 1.3.6. Processing Contaminants
 - 1.3.7. Mycotoxins
 - 1.3.8. Marine Biotoxins
 - 1.3.9. Plant Toxicants
 - 1.3.10. Biogenic Amines
 - 1.4. Physical Hazards
 - 1.5. Hazards Caused by the Absence of Certain Substances in Food
 - 1.6. Emerging Biological Hazards
 - 1.7. Concern regarding emerging food technologies
 - 1.8. Food Allergy and Intolerance
 - 1.9. International Efforts Regarding Food Safety
 - 1.10. Factors of Significance for Food Safety
 - 1.10.1. Health and Demographics
 - 1.10.2. Food Supply Systems
 - 1.10.3. Health Systems and Infrastructure
 - 1.10.4. Social Situations, Behaviors, and Lifestyles
 - 1.10.5. Environmental Conditions
 - 1.10.6. Concluding Remarks on Food Safety Factors
 - 1.11. Developmental Aspects of Food Safety
 - 1.12. Concluding Remarks

Consumer Perceptions Of Food Safety**51**

Lynn Frewer, *Wageningen University, The Netherlands*
 Janneke de Jonge, *Wageningen University, The Netherlands*
 Ellen van Kleef, *Wageningen University, The Netherlands*

1. Introduction
2. Consumer Perceptions of Risk
3. Risk and Benefit
 - 3.1. Risk and Benefit Associated with New Food Technologies
 - 3.2. The Negative Correlation Between Perceived Risk and Benefit
 - 3.3. Habit
 - 3.4. Risk Uncertainty and Variability
4. Trust in Food and Actors in the Food Chain
5. Individual Differences
6. Conclusion

The Need For An International Approach – The Role Of FAO And WHO**72**

Jorgen Schlundt, *Director, Department for Food Safety, Zoonoses and Foodborne diseases, World Health Organization, Geneva, Switzerland*
 Kazuaki Miyagishima, *Secretary, Codex Alimentarius Commission, Joint FAO/WHO Food Standards Programme, Rome, Italy*

1. Introduction
2. Food Safety Risk Assessment at the International Level
 - 2.1. Joint FAO/WHO Expert Committee on Food Additives (JECFA)
 - 2.2. Joint FAO/WHO Meetings on Pesticide Residues (JMPR)
 - 2.3. Joint FAO/WHO Expert Meetings on Microbiological Risk Assessment (JEMRA)
3. Food Safety Risk Management at the International Level
 - 3.1. Codex Alimentarius Commission (CAC)
 - 3.1.1. Overview
 - 3.1.2. Legal Basis and Membership
 - 3.1.3. Organizational Structure and Strategic Planning
 - 3.1.4. Operation and Procedure
 - 3.1.5. International Standards and Related Texts
 - 3.1.6. Linkage with the World Trade Organization (WTO)
 - 3.1.7. Coordination with Other International Organizations
 - 3.1.8. Challenges
 - 3.2. International Food Safety Authorities Network (INFOSAN)

Home Food Safety And Consumer Responsibility**88**

Elizabeth C. Redmond, *Food Research and Consultancy Unit, University of Wales Institute Cardiff, Western Avenue, Cardiff, CF5 2YB, South Wales, UK.*
 Christopher J. Griffith, *Food Research and Consultancy Unit, University of Wales Institute Cardiff, Western Avenue, Cardiff, CF5 2YB, South Wales, UK.*

1. Introduction
2. Incidence and Cost of Foodborne Disease
3. Foodborne Disease Incidence Associated With the Home
4. Bacterial Contamination and the Domestic Kitchen
5. The Role of the Consumer
6. Consumer Food Preparation and Consumption Patterns
7. Mechanisms for Assessing Consumer Food Safety Behavior
8. Consumer Knowledge of Food Safety Issues
 - 8.1. Food Storage
 - 8.2. Cooking
 - 8.3. Cross Contamination During Food Preparation

- 8.4. Hand Decontamination
- 9. Consumer Attitudes to Food Safety in the Home
 - 9.1. General and Specific Attitudes towards Food Safety
 - 9.2. Consumer Perceptions of Risk, Control and Responsibility
 - 9.3. Perception of the Home as a Location for Foodborne Disease
 - 9.4. Perception of Preferred Sources and Types of Information
- 10. Consumer Food Preparation Behavior
 - 10.1. Behavioral Practices
 - 10.2. Self Report: Actual Behavior
- 11. Consumer Food Safety Education
 - 11.1. Social Marketing
 - 11.2. Food Hygiene Initiatives
- 12. Conclusions

Management Of Food Safety In The Industrial Setting

130

Yasmine Motarjemi, *Nestec, Vevey, Switzerland*

- 1. Introduction
- 2. Risks and Controls along the Food Supply Chain
 - 2.1. Environmental Contamination
 - 2.2. Raw Material (The focus of this section is on the hazards inherent to the raw material. Hazards contaminating the raw material are addressed in the next sections.)
 - 2.3. Primary Production
 - 2.4. Slaughter, Harvesting, Storage and Transport
 - 2.5. Processing and Manufacturing
 - 2.6. Retail and Distribution
 - 2.7. Food Preparation in Homes and in Food Service
- 3. Role of Food Technologies in Ensuring Food Safety
 - 3.1. Technologies Used For Rendering Food Safe
 - 3.1.1. Heat Treatment
 - 3.1.2. Non-thermal Technologies
 - 3.2. Technologies used to Control Contaminants
 - 3.3. Technologies to Prevent Re-Contamination during or after Processing
 - 3.4. Technologies to Support Food Analysis
 - 3.5. Technologies to Provide Support in Logistics and Supply Chain Management
 - 3.6. Emerging Technologies
- 4. Safety and Quality Assurance System
 - 4.1. Code of Good Practices
 - 4.2. HACCP
 - 4.3. Verification and Validation
 - 4.4. Traceability, Recall Procedure and Crisis Management
 - 4.5. Management Commitment, Human Resource Management and Training
- 5. Challenges and Outlook
 - 5.1. Changes Related to Internal Operations
 - 5.2. Changes in the Environment
- 6. Conclusions

Food Safety At The National Level - The Role Of Governments

190

Alan Reilly, *Food Safety Authority of Ireland, Lower Abbey Street, Dublin 1, Ireland*

Raymond Ellard, *Food Safety Authority of Ireland, Lower Abbey Street, Dublin 1, Ireland*

Judith O'Connor, *Food Safety Authority of Ireland, Lower Abbey Street, Dublin 1, Ireland*

- 1. Introduction
- 2. Threats to Food Safety
- 3. Food Safety – A Shared Responsibility
- 4. A Role for Government

5. Integrated Controls from Farm-to-Fork
6. Responsibilities for Food Control at Government Level
7. Food Laws and Regulations
8. Management of Official Food Controls
9. Inspection Services
10. Laboratories, Monitoring and Surveillance
11. Information, Education and Communication
12. Conclusion

The Current Status And Perspectives Of Vascular Surgery

201

Piotr Andziak, *Department of General and Vascular Surgery, Central Clinical Hospital of the Ministry of Internal Affairs, Warsaw, Poland; Department of General and Vascular Surgery Medical University of Warsaw, Poland*

1. Introduction
2. Arterial disease
 - 2.1. Surgery of carotid arteries
 - 2.2. Arteries of aortic arch
 - 2.3. Aneurysms in descending aorta.
 - 2.4. Thoracoabdominal aneurysms.
 - 2.5. Aneurysms of the abdominal aorta
 - 2.6. Aneurysms of the peripheral arteries.
 - 2.7. Surgical treatment of peripheral arterial occlusive disease (PAOD)
 - 2.8. Acute limb ischemia
 - 2.9. Arterial injuries
3. Venous diseases
 - 3.1. Varicose Veins in lower limbs
 - 3.2. Treatments of the deep vein thrombosis.

Progress in Pediatric Surgery – Selected Advances in Life Saving Procedures in Pediatric Surgery

219

Piotr J. Kaliciński, *Department of Pediatric Surgery and Organ Transplantation, Children's Memorial Health Institute, Warsaw, Poland*

1. Introduction
2. Scope of Pediatric Surgery
3. Progress in Pediatric Surgery as a Result of New Life Saving Procedures and Technologies
4. Neonatal Surgery
 - 4.1. Introduction
 - 4.2. Fetal Surgery
 - 4.2.1. Types of Fetal Surgery
 - 4.3. FIGS Procedures
 - 4.4. FETENDO Procedures
 - 4.5. Open Fetal Surgery
 - 4.6. Summary of Fetal Surgery.
 - 4.7. ECMO as a Life Supporting System in Neonates with Respiratory Failure
 - 4.8. Technical Aspects of ECMO
 - 4.9. Complications of ECMO
 - 4.10. Results of ECMO Therapy
5. Surgery in Children with Coagulopathy
6. Coagulation and Liver Diseases
 - 6.1. Coagulopathy
 - 6.2. Activated Recombinant Factor VII
 - 6.3. Summary of Coagulopathy in Liver Diseases
7. Other Advances in Bleeding Control and Hemostasis in Pediatric Surgery
8. Modern Liver Support or Substitution Possibilities in Children
9. Liver Transplantation as a Life Saving Procedure in Children with Liver Failure

- 9.1. Indications for Liver Transplantation in Children
- 9.2. Assessment of Liver Transplant Urgency in Children
- 9.3. Advances in Surgical Techniques of Liver Transplantation in Children
- 9.4. Results of Liver Transplantation in Children
10. Conclusions

Advances And Current Progress Of Liver Surgery

235

Marek Krawczyk, *Medical University of Warsaw, Poland*

1. Introduction
2. Terminology
3. Liver Resection
 - 3.1. Liver Resection Nomenclature
 - 3.2. New Diagnostic Possibilities
 - 3.3. Principles of Liver Resection
 - 3.3.1. Vascular Control
 - 3.3.2. New Surgical Devices
4. Operative Procedures
 - 4.1. Laparoscopic Technique
 - 4.2. Management of the Portal Hypertension
5. Treatment of the Most Common Liver Lesions
 - 5.1. Benign Tumors
 - 5.1.1. Cysts
 - 5.1.1.1. Solitary Liver Cysts
 - 5.1.1.2. Hydatoid Cysts
 - 5.1.2. Hemangioma
 - 5.1.3. Focal Nodular Hyperplasia
 - 5.1.4. Adenoma
 - 5.2. Malignant Tumors
 - 5.2.1. Hepatocellular Carcinoma
 - 5.2.2. Cholangiocarcinoma (Peripheral Type)
 - 5.2.3. Secondary Tumors

Gastrointestinal Fistulae: Lethal Implications Remain

271

Amin Makram Ebeid, *Dokki, Cairo Giza, Egypt*

1. Definition
2. Historical notes
3. Classification
 - 3.1. From an anatomical standpoint; GI fistulas are traditionally classified as internal or external.
 - 3.2. Classification based on the loss of fluid, electrolytes and proteins.
 - 3.3. Classification according to etiology.
4. Etiology
 - 4.1. Spontaneous fistulae clearly imply the presence of an underlying pathology.
 - 4.2. Acquired fistulae.
5. Evolution of the Management of Fistulae:- The MGH Experience.
 - 5.1. The first period
 - 5.2. The Second period
 - 5.3. The third period,
 - 5.4. Preliminary concluding remarks.
6. Management of gastrointestinal fistulae.
 - 6.1. Stabilization
 - 6.2. Investigations
 - 6.3. Decision
 - 6.4. Definitive therapy.
 - 6.5. Healing phase
7. Summary and Conclusions

Social Participation In R&D: The Citizens Consensus Conferences **289**
 Alberto Pellegrini Filho, *Oswaldo Cruz Foundation, Brazil*

1. Introduction
2. Citizen's Participation in Subjects of Science and Technology
3. The Modalities and Methodologies of Citizen Participation in R&D Issues
4. The Citizens Consensus Conference (CCC)

Financing Health Research: New Trends And Modalities **303**
 Andres de Francisco, *Global Forum for Health Research, Geneva, Switzerland.*

1. Introduction
2. Trends in health research financing
 - 2.1. Total funding and trends
 - 2.2. Public sector funding
 - 2.3. Private sector funding at the Global level
 - 2.4. Private not-for-profit
 - 2.5. Low- and middle-income countries
 - 2.6. Innovative developing countries
3. Financing for research on neglected diseases
 - 3.1. Investments in malaria research
 - 3.2. Investments in HIV-AIDS research
 - 3.2.1. HIV vaccine research
 - 3.2.2. HIV Microbicide research
 - 3.3. Comparisons of disease burden and research funding
4. Public-Private Interactions: new modalities for financing neglected disease research
 - 4.1. Progress and concerns
5. Scientific production and financing
6. Challenges ahead

Index **331**

About EOLSS **339**

VOLUME XI

An Introduction To Pharmacology **1**
 H. Majewski, *School of Medical Sciences, RMIT University, Australia*

1. History of Pharmacology
2. Pharmacodynamics and Receptors
3. Molecular Pharmacology
 - 3.1. Receptors: Ligand Gated Ion Channels
 - 3.2. Receptors: G-protein Coupled Receptors
 - 3.3. Enzyme Linked Membrane Receptors
 - 3.4. Nuclear Receptor Family
 - 3.5. Ion Channels
 - 3.6. Molecular Basis of Bacterial Chemotherapy
 - 3.7. Molecular Basis of Viral Chemotherapy
 - 3.8. Molecular Basis of Cancer Chemotherapy
4. Pharmacokinetics
5. Pharmacogenomics
6. Safety Pharmacology
7. Drug Discovery
8. Clinical Pharmacology

9. Pharmacology of the Nervous System
 - 9.1. Autonomic Pharmacology
 - 9.2. Neuropharmacology: Brain Neurotransmission
 - 9.3. Neuropsychopharmacology
 - 9.4. Pain and Analgesia
 - 9.5. Drugs used in Anesthesia
10. Muscle Relaxants
11. Gastrointestinal Pharmacology
12. Poisons, Venoms and Toxins
13. Reproductive Pharmacology
14. Drug Therapy of Inflammation
 - 14.1. Non Steroidal Anti-inflammatory Drugs
 - 14.2. Cromones
 - 14.3. Glucocorticoids
 - 14.4. Mediator Receptor Antagonists
 - 14.5. Disease Modifying Anti-rheumatoid Drugs
15. Immunopharmacology
16. Endocrine Pharmacology
17. Cardiovascular Pharmacology
 - 17.1. Heart Failure
 - 17.2. Angina
 - 17.3. Hypertension
 - 17.4. Disturbances to Cardiac Rhythm
 - 17.5. Disease Modifying Drug Strategies in Cardiovascular Disease
18. Pulmonary Pharmacology
 - 18.1. Allergies and Anaphylactic Shock

Neuropharmacology

42

Emilio Badoer, School of Medical Sciences, RMIT University, Melbourne, Victoria, Australia

1. Introduction
2. Excitatory Amino Acids
 - 2.1. Receptors for Glutamate
 - 2.1.1. NMDA Receptors
 - 2.1.1.1. Physiological Effects Of NMDA Receptors
 - 2.1.1.2. Role Of NMDA Receptors In Disease
 - 2.1.1.3. Agonists of NMDA Receptors
 - 2.1.1.4. Antagonists of NMDA Receptors
 - 2.1.2. AMPA Receptors
 - 2.1.2.1. Physiological Effects of AMPA Receptors
 - 2.1.2.2. Role Of AMPA Receptors In Disease
 - 2.1.2.3. Agonists of AMPA Receptors
 - 2.1.2.4. Antagonists of AMPA Receptors
 - 2.1.3. Kainate Receptors
 - 2.1.3.1. Physiological Effects of Kainate Receptors
 - 2.1.3.2. Role of Kainate Receptors in Disease
 - 2.1.3.3. Agonists Of Kainate Receptors
 - 2.1.3.4. Antagonists Of Kainate Receptors
 - 2.1.4. Metabotropic Glutamate Receptors
 - 2.1.4.1. Physiological Effects of mGluRs
 - 2.1.4.2. Role of mGluRs in Disease
 - 2.1.4.3. Agonists of mGluRs
 - 2.1.4.4. Antagonists of mGluRs
3. Gamma-aminobutyric Acid (GABA)
 - 3.1. Receptors for GABA
 - 3.1.1. Ligand-gated Ion Channel GABA Receptors
 - 3.1.1.1. GABA_A Receptors

- 3.1.1.2. Physiological effects of GABA_A receptors
- 3.1.1.3. Role of GABA_A Receptors in Disease
- 3.1.1.4. Agonists of GABA_A receptors
- 3.1.1.5. Antagonists of GABA_A Receptors
- 3.1.2. GABA_C Receptors
 - 3.1.2.1. Physiological Effects of GABA_C Receptors
 - 3.1.2.2. Role of GABA_C Receptors In Disease Receptors
 - 3.1.2.3. Agonists of GABA_C Receptors
 - 3.1.2.4. Antagonists of GABA_C Receptors
- 3.1.3. G-Protein coupled GABA Receptors
 - 3.1.3.1. GABA_B Receptors
 - 3.1.3.1.1. Physiological effects of GABA_B Receptors
 - 3.1.3.1.2. Role of GABA_B Receptors In Disease
 - 3.1.3.1.3. Agonists of GABA_B Receptors
 - 3.1.3.1.4. Antagonists of GABA_B Receptors
- 4. Conclusion

Cardiovascular And Renal Pharmacology

66

Sheila A Doggrell, *College of Science, Engineering and Health, RMIT University, Melbourne, VIC 3001, Australia*

Julianne J. Reid, *College of Science, Engineering and Health, RMIT University, Melbourne, VIC 3001, Australia*

- 1. Diuretics
 - 1.1. Introduction
 - 1.2. Endogenous Diuretics
 - 1.3 Diuretics
 - 1.3.1. Nephron Structure
 - 1.3.2. Osmotic Diuretics
 - 1.3.3. Carbonic Anhydrase Inhibitors
 - 1.3.4. Loop Diuretics
 - 1.3.5. Thiazide and Thiazide-like Diuretics
 - 1.3.6. K⁺-Sparing Diuretics
- 2. Antiplatelet, Anticoagulants and Fibrinolytic Agents
 - 2.1. Introduction
 - 2.2. Brief Overview of Thrombus Formation
 - 2.3. Antiplatelet Drugs
 - 2.3.1. Aspirin
 - 2.3.2. Purinergic P2Y₁₂ Receptor Antagonists
 - 2.3.3. GPIIb/IIIa Antagonists
 - 2.4. Anticoagulants Drugs
 - 2.4.1. Heparin and Heparin Fragments
 - 2.4.2. Warfarin
 - 2.4.3. Fondaparinux
 - 2.5. Fibrinolytic Agents
- 3. Drugs That Increase Blood Pressure
- 4. Drugs That Decrease Blood Pressure
 - 4.1. Systemic Hypertension
 - 4.1.1. Introduction
 - 4.1.2. Epidemiology
 - 4.1.3. Types of Systemic Hypertension
 - 4.2. Treatment of Systemic Hypertension
 - 4.2.1. Diuretics
 - 4.2.2. β-Adrenoceptor Antagonists (β-Blockers)
 - 4.2.3. Calcium Channel Blockers
 - 4.2.4. Inhibitors of the Renin-Angiotensin System
 - 4.2.5. α1-Adrenoceptor Antagonists

- 4.2.6. α 2-Adrenoceptor Agonists
- 4.2.7. K_{ATP} Channel Openers
- 4.2.8. Nitrovasodilators
- 4.2.9. Aldosterone Receptor Antagonist
- 4.3. Pulmonary Hypertension
- 5. Anti-Anginal Agents
 - 5.1. Introduction
 - 5.2. Types of Angina
 - 5.3. Approaches to the Treatment of Angina
 - 5.4. Treating Attacks of Angina
 - 5.5. Preventing Attacks of Angina
 - 5.6. Treatment of Variant Angina
- 6. Drugs Used in the Treatment of Heart Failure
 - 6.1. Introduction
 - 6.2. The Heart Failure Epidemic
 - 6.3. What is Heart Failure?
 - 6.4. Compensatory Changes in Heart Failure
 - 6.5. Drugs Used in the Treatment of Heart Failure
 - 6.5.1. Diuretics
 - 6.5.2. Cardiac Glycosides
 - 6.5.3. Vasodilation and ACE Inhibitors
 - 6.5.4. β -Adrenoceptor Agonists/Antagonists
 - 6.5.5. Aldosterone Receptor Antagonist
 - 6.5.6. AT_1 -Receptor Antagonists
 - 6.5.7. Amiodarone
 - 6.5.8. Nesiritide (BNP)
 - 6.5.9. Levosimendan
- 7. Cardiac Arrhythmias and Anti-Arrhythmic Drugs
 - 7.1. Introduction
 - 7.2. Mechanism of Arrhythmias
 - 7.3. Cardiac Action Potential
 - 7.4. The Original Classification
 - 7.5. Class I: Na^+ Channel Blockade
 - 7.6. Class II β -Adrenoceptor Antagonists
 - 7.7. Class I and II: Propranolol
 - 7.8. Class III Prolongation of the Action Potential: K^+ Channel Blockers
 - 7.9. Class I and III: Na^+ and K^+ Channel Blockers
 - 7.10. Class II and III: (\pm)-Sotalol
 - 7.11. Class IV: Ca^{2+} Channel Blockers
 - 7.12. Class I-IV Amiodarone
 - 7.13. Class V: Bradycardiac Agents
 - 7.14. Digoxin
- 8. Drugs Used in the Treatment of Dyslipidemia
 - 8.1. Introduction
 - 8.2. Physiological and Pathophysiological Role of Cholesterol
 - 8.3. Causes of Hyperlipidemia
 - 8.4. Drugs Used to Treat Hyperlipidemia
 - 8.4.1. Statins
 - 8.4.2. Fibric Acid Derivatives (Fibrates)
 - 8.4.3. Bile Acid-Binding Resins
 - 8.4.4. Nicotinic Acid
 - 8.4.5. Ezetimibe
 - 8.4.6. Orlistat
- 9. Drugs Used In the Treatment of Kidney Failure

Clinical Pharmacology**119**Winston Spencer Liauw, *Cancer Care Centre, St George Hospital, Gray Street, Kogarah NSW 2217, Australia*

1. Introduction
2. Clinical Pharmacokinetics
 - 2.1. Clearance
 - 2.2. Volume of Distribution
 - 2.3. Half-life
 - 2.4. Dose Determination
 - 2.5. ADME: Drug Absorption and Bioavailability
 - 2.6. ADME: Drug Distribution
 - 2.7. ADME: Drug Metabolism
 - 2.8. ADME: Elimination
 - 2.9. Drug Dosing in Pediatric and Geriatric Populations
3. Pharmacodynamics
4. Pharmacogenetics
5. Quality Use of Medicines
6. Therapeutic Drug Monitoring
7. Population Pharmacokinetics
8. Toxicology
9. Clinical Pharmacology and Drug Development
10. Conclusion

Pharmacokinetics: How Does The Body Handle Drugs?**148**Olavi Pelkonen, *Department of Pharmacology and Toxicology, University of Oulu, Finland*
Jorma Ahokas, *School of Medical Sciences, RMIT-University, Bundoora, Victoria, Australia*

1. Introduction
2. Movement of Drugs in the Body
 - 2.1. Mass Transport
 - 2.2. Passage through Biological Membranes
3. Absorption of Drugs
 - 3.1. Oral Administrations
 - 3.2. Parenteral Route of Entry
 - 3.2.1 Percutaneous
 - 3.2.2 Nose and Eyes
 - 3.3. Inhalation
 - 3.4. Bioavailability
 - 3.4.1. Physiological Factors
 - 3.4.2. Other Properties
 - 3.5. Therapeutic Delivery Systems (Prodrugs, Implants, etc.)
4. Distribution
 - 4.1. Blood Brain Barrier (BBB)
 - 4.2. Placental Distribution.
5. Elimination of Drugs
 - 5.1. Metabolism
 - 5.1.1. Phase I Enzymes
 - 5.1.2. Phase II Enzymes
 - 5.1.3. Tissue distribution of drug metabolizing enzymes
 - 5.1.4. Enzyme Inhibition
 - 5.1.5. Enzyme Induction
 - 5.1.6. Genetic and other factors
 - 5.2. Excretion
 - 5.2.1. Factors affecting urinary excretion of drugs
 - 5.2.2. Other routes of drug excretion
6. Mathematical parameters in pharmacokinetics
 - 6.1. Volume of distribution

- 6.2. Elimination kinetics
- 6.3. Half-life
- 6.4. Clearance
- 6.5. Two Compartment Model
- 6.6. Saturation Model
- 7. Studying pharmacokinetics during drug development
- 8. Conclusions

Pharmacogenomics And Pharmacogenetics

172

Andrew A Somogyi, *Discipline of Pharmacology, School of Medical Sciences, University of Adelaide, Adelaide, South Australia, Australia*

Janet K Coller, *Discipline of Pharmacology, School of Medical Sciences, University of Adelaide, Adelaide, South Australia, Australia*

- 1. Introduction
- 2. How Do We Determine a Person's Phenotype?
- 3. How Do We Determine a Person's Genotype?
- 4. Nomenclature Used For Genetic Variants
- 5. History of Pharmacogenetics and Genomics
- 6. Pharmacogenetics of Drug Metabolising Enzymes and Transporters: Pharmacokinetics
 - 6.1 Drug Metabolizing Enzymes
 - 6.1.1 Genetic Basis of the Polymorphisms
 - 6.1.1a. Phase I enzymes
 - 6.1.1b. Phase II Enzymes
 - 6.1.2. Impact of Pharmacogenetics on Drug Metabolism and Pharmacokinetics
 - 6.1.2a. Phase I Pathways
 - 6.1.2b. Phase II Pathways
 - 6.2. Drug Transporters
 - 6.2.1. Genetic Basis of the Polymorphisms
 - 6.2.1a. ABC Efflux Transporters – ABCB1 (P-Glycoprotein)
 - 6.2.1b. ABC Efflux Transporters – ABCC (Multidrug Resistance-Associated Proteins, MRP)
 - 6.2.1c. ABC Efflux Transporters – ABCG2 (Breast Cancer Resistance Protein)
 - 6.2.1d. Uptake Transporters
 - 6.2.2. Impact of Pharmacogenetics on Drug Distribution Pharmacokinetics
 - 6.2.2a. ABC Efflux Transporters – ABCB1 (P-glycoprotein)
 - 6.2.2b. ABC Efflux Transporters – ABCC (Multidrug Resistance-Associated Proteins)
 - 6.2.2c. ABC Efflux Transporters – ABCG2 (Breast Cancer Resistance Protein)
 - 6.2.2d. Uptake Transporters
- 7. Pharmacogenetics of Drug Targets: Pharmacodynamics
 - 7.1. G-Protein Coupled Receptors
 - 7.1.1. Beta Adrenoceptors
 - 7.1.2. Beta 1 Adrenoceptors
 - 7.2. Enzymes as Drug Targets
 - 7.3. Ion Channel Drug Targets
 - 7.4. Transporters as Drug Targets
- 8. Pharmacogenetics and Drug Safety
 - 8.1. TMPT and Thiopurine Dosing
 - 8.2. UGT1A1 Polymorphism and Irinotecan Toxicity
- 9. Future Directions

Neuropsychopharmacology

193

Mirjam A.F.M. Gerrits, *Rudolf Magnus Institute of Neuroscience, Department of Neuroscience and Pharmacology, Universiteitsweg 100, 3584 CG Utrecht, The Netherlands*

Jan M. van Ree, *Rudolf Magnus Institute of Neuroscience, Department of Neuroscience and Pharmacology, Universiteitsweg 100, 3584 CG Utrecht, The Netherlands*

- 1. Introduction

2. Chemical Synaptic Transmission in the Central Nervous System
3. Psychopharmacology and Psychotropic Drugs
4. Antipsychotics
 - 4.1. Schizophrenia
 - 4.2. Etiology and Pathogenesis of Schizophrenia
 - 4.3. Antipsychotic Drugs
 - 4.3.1. Mechanism of Action
 - 4.3.2. Side Effects of Antipsychotics
 - 4.3.3. Novel Targets for Antipsychotic Drug Action
5. Antidepressants and Mood Stabilizers
 - 5.1. Etiology and Pathogenesis of Affective Disorders
 - 5.2. Antidepressive Drugs and Mood-stabilizers
 - 5.2.1. Monoamine Oxidase Inhibitors
 - 5.2.2. Tricyclic Antidepressants
 - 5.2.3. Selective 5-HT Uptake Inhibitors
 - 5.2.4. Newer, 'Atypical' Antidepressant Drugs
 - 5.2.5. Mood-stabilizers
6. Anxiolytics
 - 6.1. Benzodiazepines
 - 6.1.1. Mechanism of Action
 - 6.1.2. Therapeutic and Side Effects
 - 6.1.3. Pharmacokinetic Aspects

Endocrine Pharmacology

221

Chen Chen, *School of Biomedical Sciences, The University of Queensland, Brisbane, QLD 4072, Australia*

1. Introduction
 - 1.1. Concept of Hormone Action
 - 1.1.1. Hormone Synthesis and Secretion
 - 1.1.2. Feedback Regulation
 - 1.1.3. Paracrine and Autocrine Regulation
 - 1.1.4. Hormone Rhythms and Pulsatility
 - 1.2. Endocrine Organs
 - 1.3. Control of Hormone Secretion
 - 1.3.1. Morphology of Endocrine Cells
 - 1.3.2. Composition of Mature Secretory Granules
 - 1.3.3. Regulation of Exocytosis by Calcium
 - 1.3.4. Modulation of Exocytosis by Protein Kinase C
2. Neuroendocrinology and Pituitary Diseases
 - 2.1. Pharmacologic Principles
 - 2.2. Diseases of the Pituitary
 - 2.2.1. Pituitary Hypofunction (Hypopituitarism)
 - 2.2.2. Pituitary Hyperfunction
 - 2.2.3. Growth Hormone Excess (Acromegaly)
 - 2.2.4. GH Deficiency
3. Thyroid Diseases and Disorders of Metabolic Rate
 - 3.1. Hypothyroidism
 - 3.2. Hyperthyroidism
4. Disorders of Carbohydrate Metabolism
 - 4.1. Insulin Receptor and Function
 - 4.2. Counter-Regulatory Hormones to Insulin
 - 4.3. Diabetes Mellitus
 - 4.4. Insulin in the Treatment of Diabetes Mellitus
 - 4.5. Oral Hypoglycemic Drugs for Diabetes
 - 4.6. Hypoglycemia

Overview On Gastrointestinal Pharmacology**240**Stefano Evangelista, *Menarini Ricerche spa, Firenze, Italy*

1. Introduction
2. Drugs that Control Gastric Acid Secretion and Treat Peptic Ulcers
 - 2.1. Antacids
 - 2.2. Histamine (H₂) Receptor Antagonists
 - 2.3. Proton Pump Inhibitors (PPIs)
 - 2.4. Helicobacter pylori (H. pylori) Therapy
3. Drugs Stimulating Gastrointestinal Motility
 - 3.1. Dopamine D₂-receptor Antagonists
 - 3.2. Serotonin 5-HT₄ Receptor Agonists
 - 3.3. Macrolides
4. Drugs to Treat Constipation
 - 4.1. Laxatives
5. Drugs to Treat Diarrhea
 - 5.1 Antidiarrheal Agents
6. Drugs to Treat Emesis
 - 6.1. Antiemetic Agents
7. Drugs to Treat Irritable Bowel Syndrome (IBS)
 - 7.1. Spasmolytics
 - 7.2. Serotonin Compounds: 5-HT₃ Receptor Antagonist and 5-HT₄ Receptor Agonists
8. Drugs to Treat Inflammatory Bowel Disease (IBD)
 - 8.1. Anti-IBD Therapies

Poisons, Venoms And Toxins**261**Koh Dawn Chin Ing, *Department of Biochemistry, Yong Loo Lin School of Medicine, National University of Singapore, Singapore*Tok Pei Loo, *Department of Biochemistry, Yong Loo Lin School of Medicine, National University of Singapore, Singapore*Chai Siaw Ching, *Department of Biochemistry, Yong Loo Lin School of Medicine, National University of Singapore, Singapore*Arunmozhiarasi Arumugam, *Department of Biochemistry, Yong Loo Lin School of Medicine, National University of Singapore, Singapore*Kandiah Jeyaseelan, *Department of Biochemistry, Yong Loo Lin School of Medicine, National University of Singapore, Singapore*Dannandan Jeyaseelan, *Box Hill Hospital, Nelson Road, Box Hill, Victoria 3128, Australia.*

1. Introduction
2. Categories of Poison
 - 2.1. Physical Agents
 - 2.2. Chemical Agents
 - 2.2.1. Metals as Poisons
 - 2.2.2. Alcohols - Delicious Poisons
 - 2.2.3. Glycosides and Cyanogenic Compounds-Plant Poisons
 - 2.2.4. Insecticides and Herbicides–Useful Poisons
 - 2.2.5. Over the Counter Analgesics
 - 2.2.6. Central Nervous System (CNS) Depressants
 - 2.2.7. Drugs of Abuse
 - 2.3. Biological Agents
 - 2.3.1. Plant and Microbial Toxins
 - 2.3.2. Animal Venoms and Toxins
 - 2.3.2.1. Amphibian Toxins
 - 2.3.2.2. Marine Toxins
 - 2.3.2.3. Reptile Toxins
 - 2.3.2.4. Arthropod Toxins
3. Toxins in Therapy
 - 3.1. Animal Toxins in Therapy

- 3.2. Plant Toxins in Therapy
- 4. Concluding Remarks

Safety Pharmacology Assessment And Associated Regulations **284**
Jega Iswaran, Biota Holdings Ltd, 10/585 Blackburn Road, Notting Hill, Vic 3168, Australia
Jorma Ahokas, School of Medical Sciences, RMIT-University, Bundoora, Victoria 3083, Australia

- 1. Introduction
- 2. Drug Screening Studies for Assessing Pharmacological Activity
- 3. Safety Pharmacology Studies in the Context of Regulatory Guidelines
- 4. Use of in vitro Systems and in vivo Models for Safety Pharmacology Testing
 - 4.1. Core Battery Studies
 - 4.1.1. Cardiovascular System
 - 4.1.2. Respiratory System
 - 4.1.3. Central Nervous System
 - 4.2. Supplemental Studies
 - 4.2.1. Renal/Urinary System
 - 4.2.2. Gastro-intestinal System
 - 4.2.3. Autonomic Nervous System
 - 4.2.4. Immune System
 - 4.2.5. Dependency Potential
 - 4.2.6. Effects on Skeletal Muscle
 - 4.2.7. Endocrine System
- 5. Concluding Remarks

Pharmacodynamics In Pharmacology **318**
Terry Kenakin, GlaxoSmithKline Research and Development, USA

- 1. Introduction
- 2. Pharmacological Receptors
- 3. What is Pharmacodynamics?
- 4. Definitions of Pharmacological Terms
- 5. Affinities
 - 5.1. Micro- and Macro-Affinity
- 6. Efficacy
- 7. The Operational Model for Agonism
- 8. Drug Antagonism
 - 8.1. Orthosteric Antagonism
 - 8.2. Allosteric Modulation
- 9. Partial Agonism
- 10. Inverse Agonism
- 11. Data-Driven Pharmacodynamics in Drug Discovery
 - 11.1. Agonists
 - 11.2. Antagonists
- 12. Conclusions

Index **355**

About EOLSS **365**

VOLUME XII

The Autonomic Nervous System**1**James Ziogas, *Department of Pharmacology, University of Melbourne, Parkville Victoria, 3010, Australia.*Fred Mitchelson, *Department of Pharmacology, University of Melbourne, Parkville Victoria, 3010, Australia.*

1. Introduction
2. Anatomical and Functional Organization of the Efferent Peripheral Nervous Systems
 - 2.1. Somatic and Autonomic Nerves
3. Sympathetic and Parasympathetic Divisions of the Autonomic Nervous System
 - 3.1. Anatomical considerations
 - 3.2. Physiological considerations
 - 3.3. Pharmacological and Biochemical considerations
4. Noradrenergic transmission
 - 4.1. Synthesis
 - 4.2. Storage
 - 4.3. Release
 - 4.4. Inactivation
 - 4.4.1. Neuronal Uptake
 - 4.4.2. Extra-neuronal Uptake
 - 4.4.3. Metabolism
 - 4.5. Receptors for Noradrenaline
 - 4.5.1. Adrenoceptor Structure and Signaling
 - 4.5.2. Targeting α -adrenoceptors
 - 4.5.3. Targeting β -adrenoceptors
5. Cholinergic Transmission
 - 5.1. Synthesis
 - 5.2. Storage
 - 5.3. Release
 - 5.4. Inactivation
 - 5.4.1. Cholinesterase inhibitors
 - 5.4.2. Targeting Acetylcholinesterase
 - 5.5. Receptors for Acetylcholine
 - 5.5.1. Nicotinic Cholinoceptors
 - 5.5.2. Muscarinic Cholinoceptors
 - 5.5.3. Targeting Nicotinic Cholinoceptors
 - 5.5.4. Targeting Muscarinic Cholinoceptors
 - 5.5.4.1 Agonists
 - 5.5.4.2 Naturally occurring muscarinic agonists
 - 5.5.4.3 Synthetic muscarinic agonists
 - 5.5.4.4 Muscarinic cholinoceptor antagonists
 - 5.5.4.5 Allosteric modulators and allosteric agonists
6. Conclusion

Drugs On Skeletal Muscle**31**Michael W. Nott, *RMIT University, Discipline of Pharmaceutical Sciences, Bundoora West campus, Bundoora, Victoria, Australia*

1. Introduction
2. Neuromuscular transmission and contraction in skeletal muscle
 - 2.1. Safety factor in transmission
 - 2.2. Train of four and tetanic stimulation
 - 2.3. Twitch, tetanic contraction and tremor
3. Neuromuscular blocking drugs
4. Non-depolarizing neuromuscular blocking drugs

- 4.1. Mechanism of action
- 4.2. Tubocurarine
- 4.3. Gallamine, benzoquinonium and alcuronium
- 4.4. Aminosteroid compounds
 - 4.4.1. Pancuronium
 - 4.4.2. Vecuronium
 - 4.4.3. Rocuronium
- 4.5. Bisbenzyl-isoquinolinium compounds
 - 4.5.1. Atracurium and cisatracurium
 - 4.5.2. Mivacurium
- 4.6. Reversal of non-depolarizing neuromuscular block by anticholinesterases
- 4.7. Other neuromuscular uses of anticholinesterases
- 4.8. Pharmacokinetics of non-depolarizing neuromuscular blocking drugs
 - 4.8.1 Clearance of non-depolarizing neuromuscular blocking drugs and duration of action
5. Depolarizing neuromuscular blocking drugs
 - 5.1. Mechanism of action
 - 5.2. Succinylcholine
 - 5.2.1 Prolonged block due to reduced butyrylcholinesterase activity
 - 5.2.2 Malignant hyperthermia
 - 5.2.3 Other adverse effects of succinylcholine
6. Other drugs that impair neuromuscular transmission
 - 6.1 Antibacterial drugs
 - 6.2 Quinine and other quinoline derivatives
 - 6.3. Hemicholinium
 - 6.4. Vesamicol
 - 6.5. Botulinum toxin
7. Drugs that directly affect muscle contractility
 - 7.1 Caffeine
 - 7.2. β_2 -Adrenoceptor agonists
 - 7.3. Anabolic steroids and peptides
 - 7.4. Dantrolene and azumolene
 - 7.5. Statins
8. Conclusion

The Pharmacotherapy Of Inflammation

59

Alastair G. Stewart, *Department of Pharmacology, The University of Melbourne, Parkville, Victoria, Australia.*

Graham A. Mackay, *Department of Pharmacology, The University of Melbourne, Parkville, Victoria, Australia.*

1. Introduction
2. The Major Mediators of Inflammation and their Origins
 - 2.1. Histamine and other Vasoactive Amines
 - 2.2. Kinins
 - 2.3. Complement
 - 2.4. Clotting Factor Cascade – Thrombin and Activated Protein C (APC)
 - 2.5. Arachidonic Acid (AA) Metabolites and Platelet Activating Factor
 - 2.5.1. Cyclo-oxygenases
 - 2.5.2. Production and Degradation of Prostanoids
 - 2.5.3. Prostaglandin E₂ (PGE₂)
 - 2.5.4. Prostaglandin D₂ (PGD₂)
 - 2.5.5. Prostaglandin F_{2 α} (PGF_{2 α})
 - 2.5.6. Prostacyclin (PGI₂)
 - 2.5.7. Thromboxane A₂
 - 2.5.8. Therapeutic exploitation of prostanoids and their receptors
 - 2.5.9.5-lipoxygenase (5LO)
 - 2.5.10. Cysteinyl Leukotrienes (Cys-LTs)

- 2.5.11. Leukotriene B₄ (LTB₄)
- 2.5.12. Platelet-activating Factor (PAF)
- 2.6. Free radicals
 - 2.6.1. Nitric oxide (NO)
 - 2.6.2. Reactive Oxygen Species
- 2.7. Cytokines and Chemokines
- 2.8. Neuropeptides
- 2.9. Redundancy and Synergy between Inflammatory Mediators
- 2.10. Endogenous Down-regulators of Inflammation
 - 2.10.1. Annexin
 - 2.10.2. Lipoxins, Resolvins and Protectins
- 2.11. Temporal Aspects of Bioactive Lipid Formation
- 3. Anti-inflammatory Drugs
 - 3.1. Non-steroidal Anti-inflammatory Drugs (NSAIDs)
 - 3.1.1. Traditional NSAIDs
 - 3.1.1.1. Aspirin
 - 3.1.1.2. Paracetamol
 - 3.1.2. COX-2 selective NSAIDs
 - 3.2. Cromones (or Chromones)
 - 3.3. Glucocorticoids (GCS)
 - 3.3.1. Mechanism of Action.
 - 3.3.2. Dose and Indication Limiting Adverse Effects of Glucocorticoids
 - 3.4. Mediator Receptor Antagonists
 - 3.4.1. Histamine Receptor Blockers
 - 3.4.2. Leukotriene Receptor Antagonists
 - 3.4.3. IL-1 receptor Antagonists
 - 3.4.4. Adhesion and Co-stimulatory Molecule Blockers
 - 3.4.5. Emerging receptor targets
 - 3.5. Cytokine-neutralizing Agents
 - 3.5.1. Anti-TNF agents
 - 3.6. Disease Modifying Anti-rheumatoid Drugs (DMARDs)
 - 3.6.1. Methotrexate
 - 3.6.2. Leflunomide
 - 3.6.3. Sulfasalazine
 - 3.6.4. Gold Compounds
 - 3.6.5. Penicillamine
 - 3.6.6. Hydroxychloroquine and Chloroquine
 - 3.6.7. Biological DMARDs
 - 3.6.8. Cyclosporine
 - 3.7. Immunosuppressant anti-inflammatory agents
 - 3.7.1. Glucocorticoids (GCS)
 - 3.7.2. Calcineurin Inhibitors and Related Compounds
 - 3.7.2.1. Cyclosporine and Tacrolimus
 - 3.7.2.2. Sirolimus (rapamycin)
 - 3.7.3. Cytotoxic Agents
 - 3.7.4. Antibody Therapies
 - 3.7.4.1. Intravenous immunoglobulin (IVIG) therapy
 - 3.8. Miscellaneous Anti-inflammatory Agents
 - 3.8.1. Gout
 - 3.8.1.1. Colchicine
 - 3.8.1.2. Allopurinol
 - 3.8.2. N-acetyl cysteine
 - 3.8.3. Fish oil
- 4. The Integrated Treatment of Inflammatory Disorders: Selected Examples
 - 4.1. Asthma
 - 4.1.1. Short-acting β_2 Adrenoceptor Agonists (SABA)
 - 4.2. Sepsis
- 5. Conclusions

Reproductive Pharmacology**109**

Jocelyn N. Pennefather, *Department of Pharmaceutical Biology, Victorian College of Pharmacy, Monash University, Parkville, Vic 3052, Australia*

Claire Garrett, *Department of Obstetrics and Gynaecology, The University of Melbourne, Parkville, Vic 3052, Australia*

Luba D. Tomaska, *Office of Chemical Safety, Department of Health and Ageing, Woden, ACT 2606, Australia*

Elizabeth H. Brown, *Department of Human Physiology and Anatomy, Faculty of Health Sciences, La Trobe University, Vic 3086, Australia*

1. Introduction
2. Reproductive Glands and Hormones and Their Regulation
 - 2.1. The Hypothalamic Factor
 - 2.2. The Pituitary Hormones
 - 2.3. The Gonadal Hormones
 - 2.3.1. Androgens
 - 2.3.2. The Female Sex Steroids
 - 2.3.3. Gonadal Peptides
 - 2.4. Prostanoids
 - 2.5. Steroid Hormone Receptors And Drugs Targeting Them
 - 2.5.1. The Androgen Receptor
 - 2.5.2. Estrogen Receptors
 - 2.5.3. Progesterone Receptors
3. Testicular Function and its Control
4. The Menstrual Cycle and Drugs used in Menstrual Disorders and the Menopause
 - 4.1. The Menstrual Cycle
 - 4.1.1. Ovarian Events
 - 4.1.2. Uterine Events
 - 4.1.3. Hormonal Control of the Menstrual Cycle
 - 4.1.4. The Menstrual Cycle During the Lifespan
 - 4.2. Menstrual Cycle Disorders and Their Treatment
 - 4.2.1. Amenorrhea
 - 4.2.2. Polycystic Ovarian Syndrome (PCOS)
 - 4.2.3. Menorrhagia
 - 4.2.4. Dysmenorrhea
 - 4.2.5. Endometriosis
 - 4.3. Management of the Menopause and Disorders Associated with the Menopause with Hormonal Products (HRT)
5. Fertility and Conception
 - 5.1. Hormonal Contraception
 - 5.1.1. The Combined Oral Contraceptive Pill
 - 5.1.2. Progestogen-only Methods of Contraception
 - 5.1.3. Hormonal Contraception for Men
 - 5.2. Drugs used in Erectile Dysfunction
 - 5.3. Management of Infertility
6. Pregnancy and Parturition, Lactation and Pharmacological Interventions
 - 6.1. Drug Treatments in Pregnancy
 - 6.2. Induction of Labor
 - 6.3. Pain Relief in Labor
 - 6.4. Management of Third Stage of Labor
 - 6.5. Drugs used in Premature Labor
 - 6.6. Drugs Modifying Lactation
7. Environmental and Other Non-therapeutic Agents Affecting Reproduction and Development
 - 7.1. Exposure to EDs
 - 7.2. Mechanism of Action
 - 7.3. Effects of EDs
 - 7.4. Do Xenoestrogens and Other EDs Pose a Risk to Human Health?
 - 7.5. Examples of Potential EDs

- 7.5.1. Phytoestrogens
- 7.5.2. Phthalates
- 7.5.3. Vinclozolin
- 8. Conclusion

Immunopharmacology: A Guide To Novel Therapeutic Tools

160

Francesco Roselli , *Department of Neurological and Psychiatric Sciences, University of Bari, Bari, Italy*
 Emilio Jirillo, *Department of Internal Medicine, Immunology and Infectious Disease, University of Bari, Italy*
National Institute for Digestive Disease, Castellana Grotte, Bari, Italy

- 1. Introduction
- 2. B cell targeted immunotherapy: Rituximab
- 3. Lymphocyte trafficking inhibitors: Natalizumab and Efalizumab
 - 3.1. Natalizumab
 - 3.2. Efalizumab
- 4. Costimulatory molecules antagonists (Abatacept, Betalcept, Alefacept)
 - 4.1 Abatacept
 - 4.2 Betalcept
 - 4.3 Alefacept
- 5. Interleukin-2 receptor antagonists: Basiliximab, Daclizumab
 - 5.1 Basiliximab
 - 5.2 Daclizumab
- 6. Antagonists of soluble mediators of inflammation
 - 6.1 TNF- α antagonists: Infliximab, Etanercept, Adalimumab
 - 6.1.1 Infliximab
 - 6.1.2 Etanercept
 - 6.1.3 Adalimumab
 - 6.2 Interleukin-1 Receptor Antagonist (Anakinra)
 - 6.3 Interleukin-6 receptor antagonist (tocilizumab)
- 7. Antagonist of Immunoglobulin E (Omalizumab)
- 8. Interleukin therapy in oncology
 - 8.1 Interleukin-2
 - 8.2 Interleukin-2/diphtheria toxin conjugate (Ontak)
 - 8.3 Interferon- γ and Interleukin-12
- 9. Perspectives and future developments

Pain Pharmacology And Analgesia

193

Maree T. Smith, *Centre for Integrated Preclinical Drug Development and School of Pharmacy, The University of Queensland, St Lucia Campus, Brisbane, Queensland, Australia.*
 Samantha M. South, *Centre for Integrated Preclinical Drug Development and School of Pharmacy, The University of Queensland, St Lucia Campus, Brisbane, Queensland, Australia.*

- 1. Pain Definitions
 - 1.1 Pain – According to Duration
 - 1.1.1 Acute Pain
 - 1.1.2 Chronic Pain
 - 1.2 Pain – According to Type
 - 1.2.1 Nociceptive Pain
 - 1.2.2 Inflammatory Pain
 - 1.2.3 Neuropathic Pain
 - 1.3 Emotional Response to Pain
- 2. Pain Signaling System
 - 2.1 Pain Detection
 - 2.2 Functional Characteristics of the Pain Signaling Apparatus
 - 2.2.1 Nociceptors
 - 2.2.2 Primary Sensory Neurones
 - 2.2.3 Primary Sensory Neurons and the Spinal Cord

- 2.2.4 Spinal Cord Neurons
 - 2.2.4.1 Projection Neurons and the Spinal Cord
 - 2.2.4.2 Spinal Interneurons
- 2.3 Pain Characteristics
- 2.4 Animal Models of Nociception/Pain
- 2.5 Neurochemical Characteristics of the Nociceptive Signaling System
 - 2.5.1 Transmission of Nociceptive Information from the Periphery to the Spinal Cord
- 2.6 Nociceptive Neurotransmitters and their Target Receptors
 - 2.6.1 Excitatory Amino Acids and their Receptors
 - 2.6.1.1 Glutamate Receptors
 - 2.6.1.2 NMDA receptors
 - 2.6.1.3 AMPA receptors
 - 2.6.1.4 Kainate receptors
 - 2.6.1.5 Metabotropic glutamate receptors (mGluRs)
 - 2.6.1.6 Excitatory amino acid transporters (EEATs)
 - 2.6.1.7 Glycine transporters (GlyTs)
 - 2.6.2 Co-containment of Neurotransmitters in Nerve Terminals
- 2.7 Descending Modulation of Nociception
- 3. Neural Plasticity and Pain
 - 3.1 Inflammation
 - 3.1.1 Inflammation and Peripheral Sensitization
 - 3.1.2 Inflammation and Post-translational Changes
 - 3.1.3 Inflammation-Induced Transcriptional Changes: Effects on Peripheral Sensitization
 - 3.1.4 Inflammation and Central Sensitization
 - 3.2 Peripheral Nerve Injury and Neuropathic Pain
 - 3.3 Central Sensitization and Neuropathic Pain
 - 3.3.1 Dysfunction of Central Inhibition
 - 3.4 Non-Neuronal Cells in the DRG and the CNS
 - 3.4.1 Satellite Glia Cells in the DRG
 - 3.4.2 Activated Microglia and Astrocytes in the CNS
- 4. Endogenous Pain Relief System
 - 4.1 Processing of low-intensity stimuli
 - 4.2 Processing of high-intensity stimuli
 - 4.3 Opioids
 - 4.3.1 Heterodimeric Opioid Receptors
 - 4.4 Tolerance to Opioids
 - 4.4.1 Innate Tolerance
 - 4.4.2 Acquired Tolerance
 - 4.4.2.1 Pharmacodynamic Tolerance
 - 4.4.2.2 Pharmacokinetic Tolerance
 - 4.4.3 Tolerance to Opioid-Related Side-Effects
 - 4.4.4 Prevention of the Development of Analgesic Tolerance
- 5. Strategies for Producing Pain Therapeutics
 - 5.1 Modulation of the NMDA Receptor-NOS Cascade
 - 5.1.1 NMDA receptor antagonists
 - 5.1.2 Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)
 - 5.1.3 NOS inhibitors
 - 5.1.4 SP antagonists
 - 5.2 Inhibition of Pro-nociceptive Neurotransmitter Release
 - 5.2.1 N-type Calcium Channel Blockers
 - 5.2.2 Gabapentinoids
 - 5.3 Voltage-Gated Sodium Channels as Potential Drug Targets in Persistent Pain States
 - 5.3.1 Nav1.8
 - 5.3.2 Nav1.9
 - 5.3.3 Sodium Channels in Inflammatory Pain
 - 5.3.4 Sodium Channels in Neuropathic Pain
 - 5.4 Transient Receptor Potential Vanilloid Receptor-1 (TRPV1) as a Potential Drug Target
 - 5.5 Purinergic (P2X) Receptors

- 5.6 Nerve Growth Factor (NGF) and trkA Receptors
- 5.7 Brain-Derived Neurotropic Factor (BDNF) and trkB Receptors
- 5.8 Nicotinic Cholinergic Agonists
- 5.9 Neuronal Nicotinic Cholinergic Antagonists
- 5.10 Anti-opioid Peptides
 - 5.10.1 CCK-8
 - 5.10.2 Dynorphin A
- 5.11 Adenosine
- 5.12 Cannabinoids
- 6. Pain assessment and pain assessment tools
- 7. Pharmacological treatment of pain: analgesics and adjuvants
 - 7.1 Treatment of Pain in the Clinical Setting
 - 7.2 Major Aims of the Treatment of Clinical Pain
 - 7.3 Pharmacological management of pain: current treatment guidelines
 - 7.4 Controlled or Sustained Release Oral Formulations
- 8. Analgesic Agents
 - 8.1 Non-opioid Analgesics
 - 8.1.1 Paracetamol
 - 8.1.2 Non-steroidal anti-inflammatory drugs, (NSAIDs)
 - 8.2 Opioid Analgesics
 - 8.3 Commonly Prescribed Opioid Analgesics
 - 8.3.1 Strong Opioid Analgesics
 - 8.3.1.1 Morphine
 - 8.3.1.2 Oxycodone
 - 8.3.1.3 Methadone
 - 8.3.1.4 Hydromorphone
 - 8.3.1.5 Fentanyl
 - 8.3.2 Weak Opioid Analgesics
 - 8.3.2.1 Codeine
 - 8.3.2.2 Pethidine (Meperidine)
 - 8.3.2.3 Tramadol
 - 8.3.3 Partial Opioid Agonists/Antagonists: Buprenorphine
 - 8.4 Opioid-Related Adverse effects
 - 8.5 Adjuvant analgesics
 - 8.5.1 Tricyclic Antidepressants
 - 8.5.2 Anticonvulsants
 - 8.5.3 Anti-arrhythmics
 - 8.6 Topical Agents
 - 8.6.1 Lignocaine (lidocaine)
 - 8.6.2 Capsaicin
 - 8.7 NMDA receptor antagonists
 - 8.7.1 Ketamine
 - 8.7.2 Dextromethorphan
 - 8.8 Alpha(2)-Adrenergic Receptor Agonists
 - 8.9 Invasive Procedures
 - 8.9.1 Neurolytic Celiac Plexus Blockade
 - 8.9.2 Implantable Intrathecal Drug Delivery
 - 8.9.3 Spinal Cord Stimulation
- 9. Conclusion

Anesthetics

269

Amanda Baric, *Department of Anesthesia and Perioperative medicine, The Northern Hospital, Melbourne, Australia.*

David Pescod, *Department of Anesthesia and Perioperative medicine, The Northern Hospital, Melbourne, Australia.*

- 1. Inhalation Agents
 - 1.1. Introduction

- 1.2. Pharmacokinetics and Pharmacodynamics
- 1.3. Specific Agents
 - 1.3.1. Diethyl Ether (Ether)
 - 1.3.2. Chloroform
 - 1.3.3. Cyclopropane
 - 1.3.4. Trichloroethylene
 - 1.3.5. Halogenated Alkanes and Ethers
 - 1.3.6. Nitrous Oxide.
 - 1.3.7. Xenon
2. Neuromuscular Blocking Agents (Muscle Relaxants)
 - 2.1. Introduction
 - 2.2. Non-Depolarizing Muscle Relaxants
 - 2.2.1. Tubocurarine (1935)
 - 2.2.2. Metocurine (dimethyl tubocurarine chloride/bromide)
 - 2.2.3. Alcuronium (1961)
 - 2.2.4. Gallamine (1948)
 - 2.2.5. Pancuronium (1968)
 - 2.2.6. Vecuronium (1983)
 - 2.2.7. Atracurium (1980s)
 - 2.2.8. Cis-atracurium (1995)
 - 2.2.9. Mivacurium (1993)
 - 2.2.10. Rocuronium (1994)
 - 2.2.11. Sugammadex (2003)
 - 2.2.12. Rapacuronium
 - 2.3. Reversal Drugs (Anticholinesterase)
 - 2.4. Depolarizing Muscle Relaxants (Suxamethonium or Succinylcholine)
3. Local Anesthetics
 - 3.1. Introduction
 - 3.2. Pharmacokinetics and Pharmacodynamics
 - 3.3. Toxicity
 - 3.4. Specific Agents
 - 3.4.1. Cocaine
 - 3.4.2. Procaine
 - 3.4.3. Chlorprocaine
 - 3.4.4. Tetracaine (Amethocaine)
 - 3.4.5. Lidocaine
 - 3.4.6. Prilocaine
 - 3.4.7. Mepivacaine
 - 3.4.8. Bupivacaine
 - 3.4.9. Ropivacaine
 - 3.4.10. Eutectic Mixture of Local Anesthetics (EMLA)
4. Intravenous Induction Agents
 - 4.1. Introduction
 - 4.2. Actions and Mechanisms of General Anesthetics
 - 4.3. Specific Agents
 - 4.3.1. Barbiturates
 - 4.3.2. Propofol
 - 4.3.3. Ketamine
 - 4.3.4. Etomidate
 - 4.3.5. Benzodiazepines

Drug Discovery

311

Robert R. Ruffolo, Jr., *Wyeth Pharmaceuticals, 500 Arcola Road, Collegeville, Pennsylvania 19426, USA*

Frank S. Walsh, *Wyeth Pharmaceuticals, 500 Arcola Road, Collegeville, Pennsylvania 19426, USA*

Giora Z. Feuerstein, *Wyeth Pharmaceuticals, 500 Arcola Road, Collegeville, Pennsylvania 19426, USA*

1. Introduction

2. The Modern Drug Discovery Process
 - 2.1. Target Selection
 - 2.2. Compound/Biological Identification
 - 2.3. Compound/Biological Optimization for Efficacy
 - 2.4. Pharmacokinetic Profiling
 - 2.5. Safety Assessment
3. Clinical Development
 - 3.1. Phase I Clinical Studies – Investigational New Drug (IND) Application
 - 3.2. Phase II Clinical Studies
 - 3.3. Phase III Clinical Studies - New Drug Application (NDA)
 - 3.4. Phase IV and Life Cycle Management
4. Translational Medicine
 - 4.1. The Role of Translational Medicine in Drug Discovery
 - 4.1.1. Disease Biomarkers
 - 4.1.2. Compound-Target Interaction Biomarkers
 - 4.1.3. Pharmacodynamic Biomarker
 - 4.1.4. Surrogate Endpoints (Biomarkers)
5. The Role of Experimental Animal Models in Drug Discovery and Development
6. The Use of Imaging Technology in Drug Discovery and Development
7. Personalized Medicine and Drug Discovery and Development
8. Conclusion

Gene Therapy

331

K. K. Jain, *Jain PharmaBiotech, Basel, Switzerland*

1. Introduction
2. Relation of Gene Therapy to Other Biotechnologies
3. Gene Therapy Technologies
 - 3.1. Classification of Gene Therapy Techniques
 - 3.2. Physical Methods of Gene Transfer
 - 3.2.1. Electroporation
 - 3.2.2. Particle Bombardment
 - 3.2.3. Ultrasound-mediated Transfection
 - 3.2.4. Molecular Vibration
 - 3.2.5. Gene Transfection using Laser Irradiation
 - 3.2.6. Photochemical Transfection
 - 3.2.7. Chemical Methods of Gene Transfer
 - 3.3. *Ex vivo* and *In vivo* Gene Therapy
 - 3.3.1. *Ex vivo* Gene Therapy
 - 3.3.2. *In vivo* Gene Therapy
 - 3.4. Gene Repair and Replacement
 - 3.4.1. Gene Repair by Single-stranded Oligonucleotides
 - 3.5. Spliceosome-mediated RNA Trans-splicing
 - 3.6. Vectors for Gene Therapy
 - 3.6.1. Use of Genes as Pharmaceuticals
 - 3.6.2. The Ideal Vector for Gene Therapy
 - 3.6.3. Viral Vectors
 - 3.6.4. Non-viral Vectors for Gene Therapy
 - 3.7. Concluding Remarks about Vectors
 - 3.8. Cell-mediated Gene Therapy
 - 3.8.1. Stem Cell Gene Therapy
 - 3.9. Routes of Administration for Gene Therapy
 - 3.10. Targeted Gene Therapy
 - 3.10.1. Controlled Induction of Gene Expression
 - 3.10.2. Controlled Gene Therapy
 - 3.10.3. Technologies for Gene Suppression
 - 3.10.4. Locked Nucleic Acid

- 3.11. Clinical Applications
 - 3.11.1. Strategies for Cancer Gene Therapy
 - 3.11.2. Gene Therapy of Neurological Disorders
 - 3.11.3. Gene Therapy of Cardiovascular Disorders
- 4. Concluding Remarks

Index **359**

About EOLSS **371**

VOLUME XIII

Ethnopharmacology: An Overview **1**

Elaine Elisabetsky, *Laboratory of Ethnopharmacology, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil.*

Nina L. Etkin, *Departments of Anthropology and Ecology & Health, University of Hawai'i, USA.*

- 1. Introduction
 - 1.1. Defining Ethnopharmacology
- 2. Methods
- 3. Contexts of Medicinal Plant Use
 - 3.1. The Social Relations of Healing
 - 3.2. Criteria Used in the Selection of Plant Medicines
 - 3.3. Preparation of Plant Medicines
 - 3.4. Interactions among Plants and between Plants and Pharmaceuticals
 - 3.5. Outcome and Efficacy
 - 3.5.1 Do Medicines Work?
 - 3.5.2 How do Medicines Work?
 - 3.5.3 Efficacy versus effectiveness
- 4. Multicontextual Plant Use

Historical Foundations Of Botanical Medicine **13**

Daniel E. Moerman, *University of Michigan-Dearborn, Michigan, USA.*

- 1. Introduction
- 2. Primates, Birds, and Butterflies
- 3. Shanidar
- 4. Ötzi
- 5. Herbals
- 6. Native American Medicinal Plants
 - 6.1. St. John's Wort, *Hypericum hypericoides* Crantz (Clusiaceae)
 - 6.2. Yarrow, *Achillea millefolium* L. (Asteraceae)
 - 6.3. Crane's-bill or Wild Geranium, *Geranium maculatum*.L. (Geraniaceae)
- 7. Conclusions

Insights Into Evolutionary Systems Via Chemobiological Data **25**

Otto R. Gottlieb, *Programa de Pós-Graduação em Química Orgânica, Instituto de Química, Universidade Federal Fluminense, Campus do Valonguinho, Rio de Janeiro, Brazil*

Maria Renata de M. B. Borin, *Programa de Pós-Graduação em Química Orgânica, Instituto de Química, Universidade Federal Fluminense, Campus do Valonguinho, Rio de Janeiro, Brazil*

- 1. The Phytochemical Discovery of Brazil
- 2. Chemical Variability: Puzzles of the Lauraceae

- 2.1. The Puzzle of Cinnamon (The Discovery of Amazonia)
- 2.2. The Puzzle of Sassafras
3. A Plant is no Factory
4. How does Nature Work?
5. What is Quantitative Chemo-Biology?
6. What are Natural Products?
7. Chemobiological Language: What are its Grammatical Rules?
 - 7.1. Evolutionary Canalization
 - 7.2. Redox Potential
8. Medicinal Plants
 - 8.1. Traditional Knowledge
 - 8.2. Scientific Knowledge
 - 8.3. Shamanism x Science
9. Ethnobotany: Evolutionary Patterns for Useful Plants
 - 9.1. Regional Ethnobotanical Inventories:
 - 9.2. Extensive Ethnobotanical Inventory:
 - 9.3. Worldwide Ethnobotanical Inventories:
10. Phytochemistry: Regulatory Mechanisms of Plant Bioactivity
11. Antagonism: A Unifying Concept?
12. Perspectives

Contemporary Methodological Approaches In The Search For New Lead Compounds From Higher Plants **69**

Emerson F. Queiroz, *Laboratoire de Pharmacognosie et Phytochimie, Section de Sciences Pharmaceutiques, University of Geneva, 1211 Geneva, Switzerland*

Andrew Marston, *Laboratoire de Pharmacognosie et Phytochimie, Section de Sciences Pharmaceutiques, University of Geneva, 1211 Geneva, Switzerland*

Kurt Hostettmann, *Laboratoire de Pharmacognosie et Phytochimie, Section de Sciences Pharmaceutiques, University of Geneva, 1211 Geneva, Switzerland*

1. Introduction
2. Approaches for the discovery of new drugs from higher plants
3. Selection of plant material
4. Biological and pharmacological targets
5. Chemical screening
 - 5.1. Metabolite profiling: a LC-multi-hyphenated strategy
 - 5.2. Problems encountered in metabolite profiling
 - 5.3. Application of LC/UV/MS and LC/NMR in phytochemical analysis
 - 5.3.1. Dereplication of flavanones and isoflavones in crude plant extracts
 - 5.3.1.1. Dereplication of the antifungal constituents of *Erythrina vogelii* by LC/UV/MS and on-flow LC/1H-NMR.
 - 5.3.1.1.1 High resolution LC/UV/APCI-Q-TOF/MS/MS analyses
 - 5.3.1.1.2. Low-flow LC/1H-NMR with microfractionation
 - 5.3.1.1.3. LC/UV-DAD with post-column derivatisation
 - 5.3.1.1.4. De novo structure determination based on on-line data
 - 5.3.2. Stop-flow LC/1H-NMR with 2D correlation experiments for the structure elucidation of a flavanone of *Monotes englerii*
 - 5.4. Combination of LC/NMR and LC/MS with in-mixture NMR experiments for the investigation of labile constituents
 - 5.4.1. On-line characterisation of unstable cinnamic ester derivatives in *Jamesbrittenia fodina*
 - 5.4.2. Study of epimerisation reactions
 - 5.5. On-line absolute configuration determination
6. Isolation of active principles and their structure determination
7. Conclusion

Integrating Ethnographic And Ecological Perspectives For Ethnopharmacology Field Research

97

Nina L. Etkin, *Departments of Anthropology and Ecology & Health, University of Hawai'i, USA*

Tamara Ticktin, *Department of Botany, University of Hawai'i, USA*

1. Introduction
2. Anthropological (Ethnographic) Field Methods
 - 2.1. Informed Consent and Research Ethics
 - 2.2. Identifying/Inviting Study Participants
 - 2.3. Key Respondents/Informants
 - 2.4. Participant Observation
 - 2.5. Semi- and Unstructured Interviews and Questionnaires
 - 2.5.1. Unstructured Interviews
 - 2.5.2. Semi-Structured Interviews
 - 2.5.3. Frame Elicitation
 - 2.5.4. Cultural Domain Analysis
 - 2.5.5. Free-Listing
 - 2.5.6. Pile Sorts
 - 2.5.7. Triad Exercise
 - 2.5.8. Questionnaires
 - 2.6. Discourse, Narrative, and Text Analysis
 - 2.7. Group Interview Methods
 - 2.7.1. Community Interviews
 - 2.7.2. Natural Group
 - 2.7.3. Consensus Panel
 - 2.7.4. Focus Group
 - 2.8. Quantitative Data
 - 2.9. Prioritizing (Ethnographic) Methods
3. Integrating Ethnographic and Ecological Field Methods
 - 3.1. Ecocultural Research Questions in Ethnopharmacology
 - 3.2. Examining Ecological Factors that Influence the Collection of Medicinal Plants
 - 3.3. Distinguishing Environmental Versus Genetic Variation
 - 3.4. Assessing Relationships between Anthropogenic Landscape Changes and Medicinal Plants
 - 3.5. Ecocultural Research on Medicinal Plant Conservation
 - 3.6. Variation in Plant Collection and Management Methods
 - 3.7. Assessing the Ecological Impacts of Variation in Plant Collection
 - 3.8. Participatory Ecological Research Methods Applied to Medicinal Ethnobotany
 - 3.9. Assessing the Ecological Consequences of Medicinal Plant Harvest on Other Organisms
4. Conclusion

Managing Ethnopharmacological Data: Herbaria, Relational Databases, Literature

116

J. R. Stepp, *Department of Anthropology, University of Florida, USA*

M. B. Thomas, *Department of Botany, University of Hawai'i, USA*

1. Introduction
2. Historical Trends
3. Present Trends
 - 3.1. Ethnopharmacological Databases
 - 3.2. New Models for Ethnopharmacological Databases
 - 3.3. Managing Field Data and Workflow
 - 3.4. Voucher Specimens and Ethnopharmacological data
4. Conclusions and Future Challenges

Professional Ethics And Ethnopharmacology**131**

Kelly P. Bannister, *POLIS Project on Ecological Governance, Faculty of Law and School of Environmental Studies, University of Victoria, Canada.*

1. Introduction
2. What are Professional Ethics?
 - 2.1. Ethnopharmacology as a Profession
 - 2.2. Unearthing a Professional Ethic for Ethnopharmacology
3. External Standards for Ethnopharmacology
 - 3.1. Approvals
 - 3.2. Permissions and Permits
 - 3.2.1 Documentation of Cultural Knowledge
 - 3.2.2 Genetic Resources
 - 3.3. Compensation and Benefit-sharing
 - 3.4. Credit and Rights Issues
 - 3.5. Community Protocols
4. Remaining Challenges for Ethnopharmacology as a Profession
5. Conclusions

Medicinal Plants In The Evolution Of Therapeutics—A Case Of Applied Ethnopharmacology**158**

Fernando Ortega, *Universidad San Francisco de Quito, Cumbayá-Ecuador.*

1. Introduction
2. Medicinal plants in the evolution of biomedicine
 - 2.1. Medicinal plants as landmarks in medical history
 - 2.1.1. Ancient times
 - 2.1.2. Arabic and Greek legacies
 - 2.1.3. Last century of the second millennium legacy
 - 2.2. Medicinal plants as sources of prototypic agents
3. Disease Control in a cross-cultural context: a case of applied ethnopharmacology to common intestinal parasitism.
 - 3.1. Knowledge accumulated by American peoples in the treatment of worms
 - 3.2. Ethnopharmacology applied to intestinal worms. A Cost-effectiveness study for community control of ascariasis comparing herbal and pharmaceutical treatments in Ecuador
4. Material and Methods
 - 4.1. Study design
 - 4.2. Study Subjects
 - 4.3. Effectiveness assessment
5. Results and analysis
 - 5.1. Population's living conditions
 - 5.2. Prevalence of parasitism
 - 5.3. Risk factors of Ascariasis: association between ascariasis and selected explanatory variables.
 - 5.4. Regression Analysis
 - 5.5. Analysis of risk factors
 - 5.6. Treatment groups
 - 5.7. Evaluation of effectiveness of treatments
 - 5.8. Cost/effectiveness analysis
6. Discussion: Health, sustainable development and socio-economic aspects of treating the most common parasitic disease in the world
 - 6.1. Multidisciplinary approach
 - 6.2. Importance of ecological preservation and human security
 - 6.3. Limitations of this study
7. Recommendations for further research:
8. Policy implications

Plants As A Source Of Anti-Cancer Agents**181**

G. M. Cragg, *Natural Products Branch, Developmental Therapeutics Program, Division of Cancer Treatment and Diagnosis, National Cancer Institute, , Maryland, U S A.*

D. J. Newman, *Natural Products Branch, Developmental Therapeutics Program, Division of Cancer Treatment and Diagnosis, National Cancer Institute, , Maryland, U S A.*

1. Introduction
2. Plant-Derived Anti-Cancer Agents in Clinical Use
3. Plant-Derived Anticancer Agents in Clinical Development (Figure 2)
4. Targeting Natural Products
5. Plant-Derived Antitumor Agents in Preclinical Development (see Figure 3)
6. Cell Cycle Target Inhibition and Anticancer Drug Discovery
7. Conclusions

Traditional Medicinal Plants For The Treatment And Prevention Of Human Parasitic Diseases**196**

Merlin L Willcox, *Research Initiative on Traditional Antimalarial Methods, Buckingham, UK*

Benjamin Gilbert, *FarManguinhos-FIOCRUZ, Rua Sizenando Nabuco, Rio de Janeiro, Brazil.*

1. Introduction
2. Protozoa
 - 2.1. Blood protozoa
 - 2.1.1 Malaria
 - 2.1.1.1 Importance of traditional medicine in treatment of malaria
 - 2.1.1.2 Important plant species and their active ingredients
 - 2.1.1.2.1 Ethnobotanical studies
 - 2.1.1.2.2 Pharmacological studies
 - 2.1.1.2.3 Clinical safety and efficacy
 - 2.1.1.3 Vector control
 - 2.1.1.3.1 Mosquito Repellents
 - 2.1.1.3.2 Larvicides
 - 2.1.1.4 Future Directions for Research
 - 2.1.2 Trypanosomiasis
 - 2.1.2.1 Human African Trypanosomiasis (sleeping sickness)
 - 2.1.2.1.1 The importance of traditional medicine for African trypanosomiasis
 - 2.1.2.1.2 Important plant species and their active ingredients
 - 2.1.2.1.3 Clinical safety and efficacy
 - 2.1.2.2 American Trypanosomiasis (Chagas' disease)
 - 2.1.2.2.1 Important plant species and their active ingredients
 - 2.1.2.2.2 Vector control
 - 2.2. Tissue protozoa
 - 2.2.1 Leishmaniasis
 - 2.2.1.1 The importance of traditional medicine for cutaneous leishmaniasis
 - 2.2.1.2 The importance of traditional medicine for visceral leishmaniasis
 - 2.2.1.3 Important plant species and their active ingredients
 - 2.2.1.4 Clinical safety and efficacy
 - 2.2.1.5 Vector control
 - 2.3. Intestinal protozoa
 - 2.3.1. Importance of Traditional Medicine
 - 2.3.2. Important plant species and active ingredients
3. Helminths (worms)
 - 3.1. Nematodes (roundworms)
 - 3.1.1. Intestinal nematodes
 - 3.1.1.1 Importance of traditional medicine
 - 3.1.1.2 Important plant species and active ingredients
 - 3.1.1.3 Clinical safety and efficacy
 - 3.1.2 Blood nematodes

- 3.2 Cestodes (tapeworms)
- 3.3 Trematodes (flat worms)
 - 3.3.1. Schistosomiasis
 - 3.3.1.1 Importance of traditional medicine
 - 3.3.1.2 Important plant species and active ingredients
 - 3.3.1.3 Clinical safety and efficacy
 - 3.3.2. Flukes
 - 3.3.3. Control of intermediate hosts
- 4. Conclusions

Index **225**

About EOLSS **229**

VOLUME XIV

Plants And Plant Substances Against AIDS And Other Viral Diseases	1
P. Cos, L. Maes, <i>Laboratory for Microbiology, Parasitology and Hygiene, Faculty of Pharmaceutical, Biomedical and Veterinary Sciences, University of Antwerp, Belgium</i>	
D. Vanden Berghe, <i>Laboratory for Microbiology, Parasitology and Hygiene, Faculty of Pharmaceutical, Biomedical and Veterinary Sciences, University of Antwerp, Belgium</i>	
N. Hermans, <i>Laboratory of Pharmacognosy and Phytochemistry, Faculty of Pharmaceutical, Biomedical and Veterinary Sciences, University of Antwerp, Belgium</i>	
S. Apers, <i>Laboratory of Pharmacognosy and Phytochemistry, Faculty of Pharmaceutical, Biomedical and Veterinary Sciences, University of Antwerp, Belgium</i>	
A.J. Vlietinck, <i>Laboratory of Pharmacognosy and Phytochemistry, Faculty of Pharmaceutical, Biomedical and Veterinary Sciences, University of Antwerp, Belgium</i>	

1. Introduction
2. The plant kingdom as source of new antiviral agents
 - 2.1. Opportunities and challenges
 - 2.2. Selection of plants
 - 2.3. Preparation of plant extracts
3. Antiviral test methodology
4. Plant-derived anti-Human Immunodeficiency Virus (anti-HIV) agents
 - 4.1. AIDS and anti-HIV drugs
 - 4.2. AIDS and traditional medicine
 - 4.3. Plant-derived anti-HIV agents
 - 4.3.1. Alkaloids
 - 4.3.2. Carbohydrates
 - 4.3.3. Coumarins
 - 4.3.4. Flavonoids
 - 4.3.5. Lignans
 - 4.3.6. Naphthodiantrones
 - 4.3.7. Phenolics
 - 4.3.8. Phorbol esters
 - 4.3.9. Proteins
 - 4.3.10. Tannins
 - 4.3.11. Terpenes
5. Plant-derived anti-Herpes Simplex Virus (anti-HSV) and anti-cytomegalovirus (anti-CMV) agents
 - 5.1. The human herpes virus (HHV) family and anti-HHV drugs
 - 5.2. Plant-derived anti-HSV and anti-CMV agents
 - 5.2.1. Alkaloids
 - 5.2.2. Carbohydrates
 - 5.2.3. Flavonoids
 - 5.2.4. Lignans

- 5.2.5. Phenolics
- 5.2.6. Proteins
- 5.2.7. Tannins
- 5.2.8. Terpenes
- 5.2.9. n-Docosanol
- 6. Plant-derived anti-influenza virus agents
 - 6.1. Influenza and anti-influenza drugs
 - 6.2. Plant-derived anti-influenza virus agents
- 7. Conclusions

Botanical Analgesic And Anti-Inflammatory Drugs

37

João B. Calixto, *Department of Pharmacology, CCB, Universidade Federal de Santa Catarina (UFSC), Florianópolis, SC, Brazil.*

Maria Martha Campos, *Department of Pharmacology, CCB, Universidade Federal de Santa Catarina (UFSC), Florianópolis, SC, Brazil.*

Adair R.S. Santos, *Department of Physiologic Sciences, CCB, Universidade Federal de Santa Catarina (UFSC), Florianópolis, SC, Brazil.*

- 1. Introduction
- 2. Principal plants that have contributed to the development of modern analgesic and anti-inflammatory drugs
 - 2.1. Papaver somniferum
 - 2.2. Salix species
 - 2.3. Cannabis sativa
 - 2.4. Capsicum sp.
 - 2.5. Panax ginseng
 - 2.6. Tanacetum parthenium
 - 2.7. Aconitum sp.
- 3. New plant-derived substances with potential antinociceptive or anti-inflammatory properties
 - 3.1 Siphocampylus verticillatus
 - 3.2 Drymis winteri
 - 3.3 Hedyosmum brasiliense
 - 3.4. Phyllanthus sp.
 - 3.5. Protium sp.
- 4. Possible biological targets for botanical-derived substances with potential anti-inflammatory and antinociceptive properties
- 5. Conclusion

The Search For Plants to Manage Diabetes

61

Steven R. King, *Napo Pharmaceuticals Inc, South San Francisco, California, USA*

Charles Limbach, *Big Sur Health Center, California, USA.*

- 1. Introduction
 - 1.1. Diabetes Type 1
 - 1.2. Diabetes Type 2
- 2. Need for Medicinal Plant Discovery for Type 2 Diabetes
- 3. Methods for Searching for Type 2 Diabetes Active Plants
 - 3.1. Ethnomedical search for plants to treat Type 2 diabetes
 - 3.2. Field research methods for identifying plant to manage type 2 diabetes
 - 3.3. Field studies on efficacy of plants utilized to treat type 2 diabetes
 - 3.4. In vivo animal models for screening, testing and developing plants, extracts and compounds to treat type 2 diabetes
 - 3.5. Masoprocil: an example of an investigational drug candidate for type 2 diabetes derived from traditional knowledge.
 - 3.5.1. Pre clinical studies
 - 3.5.2. Safety studies

4. Selected examples of medicinal plants under investigation for antidiabetic activity
 - 4.1. *Momordica charantia*
 - 4.2. *Trigonella foenum-graecum*
 - 4.3. *Opuntia ficus-indica*
 - 4.4. *Phyllanthus niruri*
5. Compounds often associated with hypoglycemic activity in medicinal plant research
6. Conclusion

Medicinal Plants For The Prevention And Treatment Of Coronary Heart Disease

75

Gail B. Mahady, *Department of Pharmacy Practice, Program for Collaborative Research in the Pharmaceutical Sciences, UIC/NIH Center for Botanical Dietary Supplements Research, University of Illinois at Chicago, USA.*

1. Introduction
 - 1.1. Coronary Heart Disease and treatment
2. Artichoke (*Cynara scolymus*).
 - 2.1. Clinical studies
 - 2.2. In vitro and in vivo studies
3. Garlic (*Allium sativum*)
 - 3.1. Clinical studies
 - 3.1.1. Antihypercholesterolemic activity
 - 3.1.2. Antihypertensive activity
 - 3.1.3. Effects on platelet aggregation and myocardial infarction
4. Guggul (*Commiphora mukul*)
 - 4.1. Clinical studies
 - 4.1.1. Antihyperlipidemic effects
5. Ginkgo (*Ginkgo biloba*)
 - 5.1. Clinical studies
 - 5.1.1. Antioxidant activity
 - 5.1.2. Inhibition of Platelet Aggregation
 - 5.1.3. Hematological effects
 - 5.2. In vitro and in vivo studies
 - 5.2.1. Antioxidant and antiplatelet activities
 - 5.2.2. Enhancement in coronary blood flow
 - 5.2.3. Vasodilatation
 - 5.2.4. Inhibition of Platelet Aggregation and Thrombus Formation
 - 5.2.5. Blood Pressure Regulation
6. Hawthorn (*Crataegus species*)
 - 6.1. Clinical studies
 - 6.1.1. Cardiac insufficiency
 - 6.2. In vitro and in vivo studies
 - 6.2.1. Inotropic effects
 - 6.2.2. Antiarrhythmic effects
 - 6.2.3. Ischemic-reperfusion injury
 - 6.2.4. Vasodilation and coronary blood flow
 - 6.2.5. Antihypertensive effects
 - 6.2.6. Antioxidant effects
7. Red wine (*Vitis vinifera*) and resveratrol
 - 7.1. In vitro studies
 - 7.1.1. Effects on nitric oxide
 - 7.1.2. Effects on infectious components
8. Saffron (*Crocus sativus*)
 - 8.1. Clinical studies
 - 8.1.1. Antioxidant effects
 - 8.2. In vitro and in vivo studies
 - 8.2.1. Antiatherosclerotic effects.
 - 8.2.2. Antihypertensive activity.

9. Tea (*Camellia sinensis*)

9.1. Clinical studies

10. Conclusion

The Search For Plants To Manage Neurodegenerative Diseases

100

P.J.Houghton, *Department of Pharmacy, King's College London, UK*

M-J.R.Howes, *Jodrell Laboratory, Royal Botanic Gardens Kew, UK*

1. Introduction

1.1 Neurodegenerative disease in perspective

1.2. Searching for symptoms in traditional medicine

1.3. Approaches to scientific investigation

1.4. Plants as a source of useful therapeutic agents in neurodegenerative diseases

2. Plants and their constituents from Ayurvedic medicine

2.1 *Withania somnifera*

2.2. *Bacopa monniera*

2.3. *Centella asiatica*

2.4. *Mucuna pruriens*

3. Plants and their constituents from Chinese traditional medicine (TCM)

3.1. *Huperzia serrata*

3.2 *Ginkgo biloba*

3.3 *Salvia miltiorrhiza*

3.4. Soya

4. Plants and their constituents from European herbal medicine

4.1. Galantamine

4.2. *Salvia* spp.

4.3. Ergot and its alkaloids

5. Plants and constituents from African and South American traditional medicine

5.1. *Physostigma venenosum*

5.2. *Ptychopetalum olacoides*

5.3. *Banisteriopsis caapi*

6. Conclusions

Psychoactive Botanicals In Ritual, Religion, And Shamanism

128

G.H. Shepard Jr., *Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil*

1. Introduction

1.1. Definitions and Scope

1.2. Cross-Disciplinary Perspectives

2. Shamanism, Psychoactive Plants, and the Origins of Religion

2.1. Trance and Altered States of Consciousness

2.2. Evidence from Ancient Art

3. Psychoactive Botanicals: A World Overview

3.1. Africa

3.1.1. *Coffea arabica*: The Wine of Islam

3.1.2. *Tabernanthe iboga*: Way to the Ancestors

3.2. Europe and Asia

3.2.1. *Amanita muscaria*: Divine Mushroom of Immortality?

3.2.2. *Claviceps paspali*: Key to the Eleusinian Mysteries?

3.2.3. *Atropa belladonna*, *Datura metel*, *Hyoscyamus niger*: Nightshades for Oracles, Witches, and Beautiful Ladies.

3.2.4. *Cannabis sativa*: Hemp for Fiber, Medicine, and Delight

3.3. Oceania

3.3.1. *Piper methysticum*: Kava-kava

3.3.2. *Boletus manicus*: Kuma Mushroom Madness

3.4. The Americas

- 3.4.1. *Nicotiana tabacum*: Magical Breath of Shamans
- 3.4.2. *Datura*, *Brugmansia*, *Brunfelsia*: Nightshades for Visions, Healing, and Divination
- 3.4.3. *Psilocybe mexicana*: Flesh of the Gods
- 3.4.4. *Lophophora williamsii*, *Trichocereus pachanoi*: hallucinogenic cacti of Mexico and Peru
- 3.4.5. *Virola theiodora*, *Anadenanthera peregrina*: hallucinogenic snuffs of the Northwest Amazon
- 3.4.6. *Banisteriopsis caapi*: Vine of the Soul
- 3.4.7. *Cyperus*: Ergot-Infested Sedges
- 3.4.8. *Erythroxylum coca*: From Sun King to Drug Lord
- 4. Contemporary Issues
- 5. Conclusion

Primates, Plants, And Parasites: The Evolution Of Animal Self-Medication And Ethnomedicine **183**

Michael A. Huffman, *Section of Ecology, Primate Research Institute, Kyoto University, JAPAN*
 Sylvia K. Vitazkova, *EPSCoR, University of Virgin Islands, 2 Brewer's Bay, St. Thomas, USVI, USA.*

- 1. Introduction
- 2. Animal self-medication and ethnomedicine
- 3. The impact of parasites on the evolution of self-meditative behavior
- 4. Food as medicine in animals and humans
- 5. Use of plants as medicine by chimpanzees in the wild
 - 5.1. Whole leaf swallowing and the physical expulsion of parasite
 - 5.2. *Vernonia amygdalina* and bitter pith chewing behavior
 - 5.3. The ethnomedicine and phytochemistry of bitter pith chewing
- 6. A link between animal self-medication and ethnomedicine
- 7. Tongwe ethnozoology and health care
- 8. Future studies and directions of research

Ethnopharmacology And Health Care In The Developing World **203**

R. Kutalek, *Unit Ethnomedicine and International Health, Center for Public Health, Medical University of Vienna, Austria*
 A. Prinz, *Unit Ethnomedicine and International Health, Center for Public Health, Medical University of Vienna, Austria*

- 1. Introduction
- 2. Indigenous Plants in Western Medicine
 - 2.1. Plants from Indigenous African Medical Systems
 - 2.2. Plants from other Medical Traditions
 - 2.3. The Case of *Artemisia annua* L.
- 3. Biodiversity and Sustainability
 - 3.1. *Taxus brevifolia* and Biodiversity
 - 3.2. The Case of *Rauvolfia* spp.
 - 3.3. *Prunus africana*
 - 3.4. Indigenous Strategies
- 4. Safety and Efficacy of Medicines
- 5. Pharmaceutical Anthropology
 - 5.1. Indigenous Interpretations of Medicines
 - 5.2. Injections: Skepticism towards Biomedicine
 - 5.3. Accessibility and Distribution of Medicines
- 6. Conclusion

Safety Of Traditional Remedies **226**
 Michael Heinrich, *Centre for Pharmacognosy and Phytotherapy, The School of Pharmacy, University of London, UK.*

1. Introduction—safety of phytotherapeutic preparations
2. Examples of safety issue with traditional remedies
 - 2.1. Acute toxicity
 - 2.2. Chronic Toxicity
 - 2.3. Drug interactions
 - 2.4. Adulterations
 - 2.5. Quality of botanical products used
3. How frequent are toxic effects of traditional remedies
4. Quality control measures
5. Toxicity of traditional medicines—a public health perspective
6. Conclusion

Medicinal Plants In International Trade: Conservation And Equity Issues **244**
 Sarah A. Laird, *Department of Anthropology, University College London, UK*

1. Introduction
2. Conservation and Sustainable Use of Medicinal Plants
3. Equity Issues in the Medicinal Plant Trade
4. The Botanical Medicine Industry
 - 4.1. Overview of the Market
 - 4.2. The Use of Traditional Knowledge in Product Development, Formulation and Marketing
 - 4.3. Raw Material Sourcing
 - 4.4. Certification of Raw Materials
5. The Pharmaceutical Industry
 - 5.1. Overview of Markets and the Role of Natural Products
 - 5.2. The Use of Traditional Knowledge in R&D
 - 5.3. Raw Material Sourcing
6. Conclusion

The Future Of Ethnopharmacology: Seeking A Transdisciplinary And Culturally Germane Science **262**
 Nina L. Etkin, *Departments of Anthropology and Ecology & Health, University of Hawai’I, USA*
 Elaine Elisabetsky, *Laboratory of Ethnopharmacology, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil*

1. Introduction: Defining Ethnopharmacology
 - 1.1. The International Society for Ethnopharmacology and the Journal of Ethnopharmacology
2. Objectives of Ethnopharmacology Research
 - 2.1. Critical Reviews and Challenges for an Integrated Ethnopharmacology
3. Future Trends

Index **271**

About EOLSS **277**

VOLUME XV

Biological Science Foundations

1

Ralph Kirby, *Department of Biochemistry and Microbiology, Rhodes University, Grahamstown, South Africa.*

1. Introduction
2. The Beginning of Modern Biological Science
 - 2.1. What Is Biological Life?
 - 2.2. Microscopic Life
 - 2.3. The Origin of Life
 - 2.4. Evolution and the Origin of Species
3. Genetics and Evolution
 - 3.1. Genetics in the Modern World
 - 3.2. The Mechanisms Involved in Evolution
 - 3.3. Humanity, the Environment, and Evolution
 - 3.4. Artificial Evolution
4. The Molecular Basis of Life
 - 4.1. The Cell
 - 4.2. The Gene
 - 4.3. The Biochemical Processes of Life
 - 4.4. Genetic Manipulation
5. The Molecular Tree of Life
 - 5.1. Morphological Methods of Classifying Species
 - 5.2. Biochemical Methods of Classifying Species
 - 5.3. Gene-Based Classification
 - 5.4. Life on Earth Over the Last 4 Billion Years
6. The Limits of Life on Earth
 - a. Water as a Limiting Factor
 - b. Ionic Concentration as a Limiting Factor
 - c. Temperature as a Limiting Factor
 - d. Acidity/Alkalinity as a Limiting Factor
 - e. Gaseous Atmosphere as a Limiting Factor
 - f. Energy as a Limiting Factor
 - g. The Edges of the Envelope
7. Life Elsewhere in the Universe
 - 7.1. Is Carbon-Based Life Alone?
 - 7.2. Carbon-Based Life on the Planets
 - 7.3. Carbon-Based Life in Other Star Systems
 - 7.4. Panspermia
8. Conclusion

Organic Chemicals Involved In Life Processes

30

Brett Pletschke, *Department of Biochemistry, Microbiology and Biotechnology, Rhodes University, Grahamstown, South Africa*

1. Proteins
 - 1.1. Amino acids
 - 1.2. Polypeptide chains
 - 1.3. Primary structure
 - 1.4. Secondary structure
 - 1.5. Tertiary structure
 - 1.6. Quaternary structure
 - 1.7. Enzymes
2. Carbohydrates
 - 2.1. Monosaccharides

- 2.1.1. Stereo-isomerization
- 2.1.2. Cyclic Structures
- 2.2. Disaccharides
- 3. Polysaccharides
- 4. Lipids
 - 4.1. Fatty acids
 - 4.2. Fatty acids in humans
 - 4.3. Triacylglycerols
 - 4.4. Phospholipids
 - 4.5. Steroids
- 5. Nucleic Acids
 - 5.1. Nucleotides
 - 5.2. The nucleic acids
 - 5.2.1. DNA
 - 5.2.2. DNA can have different structural features
 - 5.2.3. RNA

Carbon Fixation

51

Joanna E Burgess, *Department of Biochemistry, Microbiology and Biotechnology, Rhodes University, Grahamstown, South Africa.*

Brett I Pletschke, *Department of Biochemistry, Microbiology and Biotechnology, Rhodes University, Grahamstown, South Africa.*

- 1. Introduction
- 2. Carbon fixation in higher plants
 - 2.1. The Light Dependent Reactions of Plant Photosynthesis
 - 2.2. The Light Independent Reactions of Photosynthesis: Synthesis of Carbohydrates
 - 2.3. C₃, C₄ and CAM metabolism
- 3. Algae
- 4. Bacteria
 - 4.1. Purple Bacteria
 - 4.2. Green Sulfur Bacteria
 - 4.3. Green Gliding Bacteria
 - 4.4. Heliobacteria
- 5. Global photosynthesis and the atmosphere

Anaerobic And Aerobic Respiration

78

Joanna E Burgess, *Department of Biochemistry, Microbiology and Biotechnology, Rhodes University, Grahamstown, South Africa.*

Brett I Pletschke, *Department of Biochemistry, Microbiology and Biotechnology, Rhodes University, Grahamstown, South Africa.*

- 1. Introduction
- 2. Cellular Anaerobic Respiration
 - 2.1. Glycolysis
 - 2.2. Formation of Acetyl Coenzyme A through the Transition Reaction
 - 2.3. The Citric Acid Cycle
- 3. The Electron Transport Chain and Chemiosmosis
- 4. Fermentation
 - 4.1. Glycolysis During Fermentation
 - 4.2. Fermentation End Products
 - 4.3. Precursor Metabolites: Linking Catabolic and Anabolic Pathways
 - 4.4. Anaerobic Respiration in Animals
- 5. Anaerobic Metabolism and Humankind.
 - 5.1. Waste Treatment
 - 5.2. The Role of Anaerobic Digestion

- 5.3. Feedstocks
- 5.4. Products
- 6. Future Direction
 - 6.1. Food Production and Manufacture of Goods
 - 6.2. Lactic Acid Fermentation
 - 6.3. Alcohol Fermentation
 - 6.4. Fermentation in Industry
 - 6.5. Fermentation in Biotechnology
 - 6.6. Synthetic Rubber

Biochemistry

113

Thomas Traut, *Department of Biochemistry & Biophysics, University of North Carolina at Chapel Hill, USA*

- 1. Introduction
 - 1.1 Basic Concepts and Definitions
- 2. Central Metabolism
 - 2.1. Sugars and Carbohydrates
 - 2.1.1. Problems of Hyperglycemia
 - 2.2. Amino Acids and Proteins
 - 2.3. Fats and Lipids
 - 2.4. Nucleotides
 - 2.5. Ribonucleic Acids (RNAs)
 - 2.6. Modeling Networks in Central Metabolism
 - 2.6.1 Networks in Hepatocytes
 - 2.6.2 Yeast Metabolic Networks
 - 2.6.3 Networks for Drug Metabolism
 - 2.7. Future Research in Metabolism
- 3. Deoxyribonucleic Acid (DNA)
 - 3.1. General Features of DNA
 - 3.2. Transcription of DNA
 - 3.3. Regulation of Transcription
 - 3.4. Regulatory RNAs
 - 3.5. Duplicated Genes Provide Isozymes
 - 3.6. Gene Regulation
 - 3.6.1. Variable Splicing of the hnRNA
 - 3.6.2. Natural Time Clocks
 - 3.7. Identifying Genes
 - 3.7.1. Probing Blots from Electrophoresis
 - 3.7.2. DNA Fingerprinting
 - 3.7.3. Microarrays
 - 3.8. Future Research in DNA
 - 3.8.1. The Emergence of Introns
 - 3.8.2. Mutations and Cancer
 - 3.8.3. Epigenetic Regulation or Inheritance
- 4. Proteins and Enzymes
 - 4.1. Post-translational Processing
 - 4.2. The General Limits for Enzymes
 - 4.2.1. Metabolites are Metastable
 - 4.2.2. Enzymes are Specific
 - 4.3. Types of Enzymatic Reactions
 - 4.4. Types of Cofactors for Catalysis
 - 4.5. Regulation of Enzyme Catalysis
 - 4.6. Future Research for Proteins and Enzymes
 - 4.6.1. An Algorithm to Predict the Structure of a Protein From Its Sequence
 - 4.6.2. Completely Define Post-translational Processing
 - 4.6.3. An Algorithm to Predict the Function of a Protein From Its Sequence

- 4.6.4. Amyloid Formation
- 4.7. Novel Catalysts
- 5. The Origins of Life
 - 5.1. Metabolism First
 - 5.2. The RNA World
 - 5.3. The Protein/Enzyme World

Inorganic Biochemistry

161

Ivano Bertini, *University of Florence, Italy*
 Marco Salomone-Stagni, *University of Florence, Italy*
 Paola Turano, *University of Florence, Italy*

- 1. Introduction
- 2. Historical background
- 3. The philosophy of model chemistry
- 4. The role of metal cofactors
 - 4.1. The Metals of Biology
 - 4.1.1. Iron
 - 4.1.2. Zinc
 - 4.1.3. Copper
 - 4.1.4. Molybdenum and Tungsten
 - 4.1.5. Nickel
 - 4.1.6. Vanadium
 - 4.1.7. Alkali and Alkaline Earth Cations
- 5. The role of special metal cofactors
 - 5.1. Tetrapyrroles
 - 5.1.1. Hemes
 - 5.1.2. Chlorophylls
 - 5.1.3. Corrins
 - 5.1.4. Coenzyme F430
 - 5.2. Metalloclusters
 - 5.2.1. Iron-sulfur Clusters
 - 5.2.2. Complex Metalloclusters
 - 5.2.2.1. Metalloclusters in Nitrogenases
 - 5.2.2.2. Metalloclusters in Hydrogenases
 - 5.2.2.3. Metalloclusters in Nitrous Oxide Reductase
 - 5.2.2.4. The Metallocluster of the Oxygen-evolving Center of Photosystem II
 - 5.2.2.5. Metalloclusters in Carbon Monoxide Dehydrogenase/Acetyl Coenzyme A Synthase

Organic Chemistry And Biological Systems -Biochemistry

201

M. Lotti, *Department of Biotechnology and Biosciences, University of Milano-Bicocca, Italy*

- 1. From molecules to living systems: complexity is obtained from simple building blocks
- 2. Amino acids and proteins
 - 2.1. Proteogenic Amino Acids
 - 2.2. Non Proteinogenic Amino Acids
 - 2.3. Amino Acid Polymers: Proteins. Their Structure and Function
 - 2.3.1. Proteins Folding and Structure
 - 2.3.2. Proteins Function and Regulation
- 3. Nucleotides and nucleic acids: information, energy transport, catalysis
 - 3.1. Chemical Structures of Nucleotides
 - 3.2. Nucleotide Polymers: RNA and DNA
 - 3.2.1. The Flow of Genetic Information
 - 3.2.2. DNA: Storage and Transmission of Information
 - 3.2.3. RNA: Expression of Information and Catalysis

- 3.3. Nucleotides Derivatives and Coenzymes
- 4. Sugars: energy, structures, modulation of proteins properties
 - 4.1. Monosaccharides and Polysaccharides
 - 4.2. Structural Support and Intracellular Storage of Fuel for Cell Metabolism
 - 4.3. Effects of Glycans on Glycoproteins Properties
 - 4.4. Sugars as Sources of Energy and Metabolic Intermediates
- 5. Lipids: energy, membranes, protein targeting and signal transduction
 - 5.1. Structures of Lipids Common in Biochemistry
 - 5.2. Lipids in Cell Metabolism
 - 5.3. Lipids as the Constituents of Cell Membranes
 - 5.4. Lipid Tails Target Proteins to Membranes

Eukaryote Cell Biology

233

Michelle Gehringer, *Department of Biochemistry and Microbiology, University of Port Elizabeth, South Africa*

- 1. Introduction
 - 1.1. The first cell
- 2. Origin of Eukaryotes
- 3. Cellular differentiation in multicellular organisms
 - 3.1. Plants
 - 3.2. Animals
- 4. Eukaryotic cell structure
- 5. Organization of eukaryotic cells
 - 5.1. Plasma membrane
 - 5.2. Extracellular matrices
 - 5.3. Protein synthesis and transport
 - 5.4. Cytoskeleton and movement
 - 5.5. Nucleus
 - 5.5.1 Genomes
 - 5.5.2 Gene expression
 - 5.5.3 Maintaining the genome
 - 5.6. Organelles
- 6. The cell cycle
 - 6.1. Mitosis
 - 6.2. Meiosis
- 7. Regulation of cell growth
 - 7.1. Signal transduction
 - 7.2. Programmed cell death
 - 7.3. Cancer
- 8. Experimental models
 - 8.1. Yeast
 - 8.2. Arabidopsis
 - 8.3. Drosophila
 - 8.4. The mouse
 - 8.5. Cell culture
 - 8.6. Separation of cellular contents
 - 8.7. Tracing biochemical pathways
- 9. Future investigations

Cell Theory, Properties Of Cells And Their Diversity

258

Michelle Gehringer, *Department of Biochemistry and Microbiology, University of Port Elizabeth, South Africa*

- 1. The Composition of Life
 - 1.1. Origin of organic molecules

- 1.2. RNA and the origin of life
- 2. Cell as the unit of life
 - 2.1. Cell theory
 - 2.2. The theory of organisms
 - 2.3. Cell size
- 3. The diversity of life
 - 3.1. Origin of the first cell
 - 3.2. The endosymbiont hypothesis
- 4. Cellular diversity
 - 4.1. Plant tissue diversity
 - 4.1.1. Dermal tissue
 - 4.1.2. Vascular tissue
 - 4.1.3. Ground tissue
 - 4.2. Animal tissue diversity
 - 4.2.1. Epithelial tissue
 - 4.2.2. Muscle tissue
 - 4.2.3. Connective tissue
 - 4.2.4. Nervous tissue
 - 4.2.5. Blood
 - 4.2.6. Sensory cells
 - 4.2.7. Germ cells
- 5. Tissue maintenance and renewal
 - 5.1. Tissue renewal rates
 - 5.2. Stem cells
- 6. Discussion

Index **281**

About EOLSS **287**

VOLUME XVI

Cell Morphology And Organization	1
<i>Michelle Gehringer, Department of Biochemistry and Microbiology, University of Port Elizabeth, South Africa</i>	

- 1. Introduction
 - 1.1. The cytoplasm
 - 1.2. Membranes
 - 1.2.1 Structure
 - 1.2.2 The cell cortex
 - 1.2.3 Transmembrane proteins
 - 1.2.4 Endoplasmic reticulum
 - 1.2.5 Golgi apparatus
 - 1.2.6 Lysosomes
 - 1.3. Extracellular matrices
 - 1.3.1 Glycocalyx
 - 1.3.2 Cell walls
 - 1.4. Cytoskeleton
 - 1.4.1 Microfilaments or Actin filaments
 - 1.4.2 Intermediate filaments
 - 1.4.3 Microtubules
 - 1.5. Cilia and Flagella
 - 1.6. Connections between cells
 - 1.6.1 Plasmodesmata
 - 1.6.2 Desmosomes

- 1.6.3 Tight junctions
- 1.6.4 Gap junctions
- 1.7. Vacuoles
 - 1.7.1 Central vacuoles
 - 1.7.2 Contractile vacuoles
- 2. Cell organization
 - 2.1 Membrane transport systems
 - 2.1.1 Passive transport
 - 2.1.2 Active transport
 - 2.1.3 Endocytosis
 - 2.2. Protein synthesis
 - 2.2.1. Initiation
 - 2.2.2 Elongation
 - 2.2.3 Termination
 - 2.3 Protein targeting
 - 2.3.1 Proteins made in the cytoplasm
 - 2.3.2 Chaperones
 - 2.3.3 Proteins made on the rough endoplasmic reticulum
 - 2.3.4 The Golgi apparatus
 - 2.3.5 Vesicles
 - 2.4. Protein breakdown
 - 2.4.1 Proteosomes
 - 2.4.2 Lysosomes
 - 2.5. Cell movement
 - 2.5.1 Microfilaments and cell movement
 - 2.5.2 Myosin
 - 2.5.3 Microtubules
 - 2.5.4 Cilia and flagella movement

Cell Nucleus And Chromatin Structure

24

Michelle Gehringer, *Department of Biochemistry and Microbiology, University of Port Elizabeth, South Africa*

- 1. The nucleus
 - 1.1 The nuclear membrane
 - 1.2 The nuclear pore
 - 1.2.1 Structure of the nuclear pore
 - 1.2.2 Function of the nuclear pore
 - 1.3 The lamina
- 2. The genome
- 3. Chromosomes
 - 3.1. The nucleosome
 - 3.1.1. Histones
 - 3.1.2. DNA condensation
 - 3.2. Functional domains
 - 3.2.1. Centromere
 - 3.2.2. Telomere
- 4. DNA replication
 - 4.1. Origin of replication
 - 4.2. DNA polymerases
 - 4.3. Nucleosome replication
- 5. Nucleolus
 - 5.1. rRNA genes and expression
 - 5.2. Ribosome assembly and export
- 6. Transcription
 - 6.1. RNA polymerases
 - 6.2. Eukaryote promoters

- 6.3. Initiation of transcription
- 6.4. RNA elongation
- 6.5. Termination of transcription
- 6.6. Regulation of transcription
- 6.7. Chromatin structure and transcription
- 7. mRNA processing and turnover
 - 7.1. Capping
 - 7.2. Polyadenylation
 - 7.3. Splicing
 - 7.4. RNA editing
- 8. tRNA processing and turnover
- 9. Conclusion

Organelles And Other Structures In Cell Biology

43

Ralph Kirby, *Department of Life Science, National Yang Ming University, Peitou, Taipei, Taiwan*

- 1. Introduction
- 2. The distribution and function of the mitochondrion
 - 2.1 The structure of the mitochondrion
 - 2.2 The mitochondrial genome
 - 2.3 The mitochondrial genetic code and translation mechanism
 - 2.4 Maternal inheritance of the mitochondrion
- 3. Distribution and structure of the chloroplast
 - 3.1 The chloroplast genome
 - 3.2 The chloroplast genetic code
 - 3.3 Maternal inheritance of the chloroplast
- 4. An endosymbiotic origin for the mitochondrion and chloroplast
 - 4.1 Evolution of the mitochondrion
 - 4.2 Evolution of the Chloroplast
 - 4.3 Other possibly endosymbiotic organelles
- 5. Conclusions

Mitosis, Cytokinesis, Meiosis And Apoptosis

65

Michelle Gehringer, *Department of Biochemistry and Microbiology, University of Port Elizabeth, South Africa*

- 1. The eukaryote cell cycle
 - 1.1. Phases
- 2. Mitosis
 - 2.1 Prophase
 - 2.2 Metaphase
 - 2.3 Anaphase
 - 2.4 Telophase
 - 2.5 Cytokinesis
- 3. Meiosis
 - 3.1. Stages of meiosis
- 4. Fertilization and development
- 5. Regulators of the cell cycle
 - 5.1. Checkpoints
 - 5.1.1 G1/S checkpoint
 - 5.1.2 G2/M checkpoint
 - 5.1.3 Mitosis checkpoint
 - 5.2 Maturation promoting factor
 - 5.3 Cyclin dependent protein kinases
 - 5.3.1 Diversity and action
 - 5.3.2 Regulation

- 5.3.3 Cyclin regulation of mitosis
- 5.4 Growth factors
- 5.5 Inhibitors of cell cycle progression
- 6. Programmed cell death
 - 6.1. Triggers of apoptosis
 - 6.2. Pathways leading to apoptosis
- 7. Conclusion

Cell Growth Regulation, Transformation And Metastases

82

Michelle Gehringer ,*Department of Biochemistry and Microbiology, University of Port Elizabeth, South Africa.*

- 1. Introduction
- 2. Signal molecules
 - 2.1 Transmembrane signals for large signal molecules
 - 2.2 Small signal molecules
- 3. Switches of intracellular molecules
 - 3.1 Regulation of signal molecules
- 4. Cell surface receptors
 - 4.1 Ion-channel-linked receptors
 - 4.2 G-protein-linked receptors
 - 4.2.1 General structure and function of G-protein-receptors.
 - 4.2.2 G-proteins and ion-channels
 - 4.2.3 G-proteins and enzymes.
 - 4.3 Enzyme-linked receptors
 - 4.3.1 Protein tyrosine kinases
 - 4.3.2 Signaling domains SH2 and SH3.
 - 4.3.3 Ras/MAPK pathway.
 - 4.4 The JAK/STAT pathway
- 5. Cancer
 - 5.1. Ras proto-oncogenesis
 - 5.2. Signal transduction
 - 5.3 Kinases
 - 5.4 Insertions, deletions and translocations
 - 5.5 Viral oncogenesis
 - 5.5.1 DNA viruses
 - 5.5.2 RNA viruses
 - 5.6 Tumor suppressor genes
- 6. Conclusion

Networks In Cell Biology

100

R. Albert, *Departments of Physics and Biology, Pennsylvania State University, USA*

- 1. Introduction
- 2. Inference of interaction networks from expression information
- 3. Network analysis
- 4. Dynamic modeling
- 5. Conclusions

Microbiology

115

Ralph Kirby , *Department of Life Science, National Yang Ming University, Peitou, Taipei, Taiwan*

- 1. Introduction
- 2. Taxonomy
 - 2.1 Morphology
 - 2.1.1 Eucaryote Microorganisms - Protozoa
 - 2.1.2 Eucaryote Microorganisms - Algae

- 2.1.3 Eucaryotic Microorganisms - Fungi
- 2.1.4 Procaryotic Microorganisms – Bacteria and Archaea
- 2.1.5 Viruses
- 2.2 Chemical Taxonomy
- 2.3 Molecular Taxonomy
 - 2.3.1 Protein based taxonomy
 - 2.3.2 DNA based taxonomy
 - 2.3.3 Ribosomal DNA based taxonomy
 - 2.3.4 Limitation of single gene based taxonomy
- 2.4 Genome based phylogeny and taxonomy
 - 2.4.1 Genome sequencing
 - 2.4.2 Genomics and phylogeny
 - 2.4.3 The future for genome phylogenies
- 2.5 Horizontal genetic exchange
 - 2.5.1 Transformation
 - 2.5.2 Transduction
 - 2.5.3 Conjugation
- 3. Procaryote and Eucaryote Microbial Cell Structure
 - 3.1 Procaryote Cell Structure
 - 3.2 Bacterial Spores and Cysts
 - 3.3 The subcellular structure of eucaryotic Microorganisms
 - 3.4 Morphology of Fungi
 - 3.5 Morphology of Protists
- 4. Cultivation of Microorganisms
- 5. Control of Microorganisms
- 6. Major Groups of Procaryotes
- 7. Viruses
- 8. Pathogenesis and Microorganisms
- 9. Antibiotics and Microorganisms
- 10. Microbial Biotechnology

Prokaryotic Cell Structure And Function

136

T. G. Downing, *Department of Biochemistry & Microbiology, University of Port Elizabeth, South Africa*

- 1. Introduction
- 2. Nucleoid
- 3. Cytoplasmic Matrix
 - 3.1. Ribosomes
 - 3.2. Plasmids, episomes and bacteriophage
 - 3.3. Inclusion bodies and storage granules
 - 3.4. Endospores
 - 3.5. Intracytoplasmic membranes
- 4. The Cell Envelope
 - 4.1. Cytoplasmic Membrane
 - 4.2. The Periplasmic Space
 - 4.3. The Cell Wall
 - 4.4. The Outer Membrane
- 5. Components Exterior to the Cell Wall
 - 5.1 EPS
 - 5.2 Flagella
 - 5.3 Pili
 - 5.4 Fimbriae
- 6. Differentiation and multicellularity
 - 6.1. Differentiation in Actinomycetes
 - 6.2. Multicellularity and differentiation in cyanobacteria
 - 6.3. Differentiation in Myxobacteria

Prokaryotic Diversity**160**T. G. Downing, *Department of Biochemistry & Microbiology, University of Port Elizabeth, South Africa*

1. Introduction
2. The Archae, Cyanobacteria, Green phototrophs, and Deeply Branching Genera
 - 2.1. Thermoprotei, Sulfolobi and Barophiles
 - 2.2. The Methanogens
 - 2.3. The Halobacteria
 - 2.4. The Thermoplasms
 - 2.5. The Thermococci
 - 2.6. Aquifex and relatives
 - 2.7. Thermotogas and Geotogas
 - 2.8. The Deinococci
 - 2.9. Thermi
 - 2.10. Chrysiogenes
 - 2.11. The Chlorflexi and Herpetosiphons
 - 2.12. Thermomicrobia
 - 2.13. Prochloron and the Cyanobacteria
 - 2.14. Chlorobia
3. Proteobacteria
 - 3.1. The α -Proteobacteria
 - 3.2. The β Proteobacteria
 - 3.3. The γ Proteobacteria
 - 3.4. The δ Proteobacteria
 - 3.5. The ϵ Proteobacteria
4. The low G+C gram-positives
5. The high G+C gram-positives
6. The Planctomycetes, Spirochetes, Fibrobacter, Bacteroides and Fusobacteria
 - 6.1. The Planctomycetes
 - 6.2. The Spirochetes
 - 6.3. The Fibrobacters
 - 6.4. The Bacteroides
 - 6.5. The Flavobacteria
 - 6.6. The Sphingobacteria, Flexibacteria and Cytophaga
 - 6.7. The Fusobacteria

Prokaryote Genetics**185**Ralph Kirby, *Department of Life Science, National Yang Ming University, Peitou, Taipei, Taiwan.*

1. Mechanism of DNA Mutation, Transfer and Recombination in Bacteria
2. Mutation
 - 2.1. Types of mutations
 - 2.2. DNA damage
 - 2.3. DNA Repair
3. Transformation
 - 3.1. Gram -ve Bacteria
 - 3.2. Low G+C% Gram +ve Bacteria
 - 3.3. High G+C% Gram +ve Bacteria
 - 3.4. Archaea
4. Transduction
 - 4.1. Generalized Transduction
 - 4.2. Specialized Transduction
 - 4.3. Importance of Generalized and Specialized Transduction.
5. Conjugation
 - 5.1. Plasmids
 - 5.1.1 Plasmids in Gram -ve Bacteria
 - 5.1.2 Plasmids in Low G+C% Gram +ve Bacteria
 - 5.1.3 Linear Plasmids

- 5.1.4 Plasmids in the Archaea
- 5.2. Conjugation
 - 5.2.1 Gram -ve Bacteria
 - 5.2.2 Low G+C% Gram +ve Bacteria
 - 5.2.3 Linear Chromosomes
- 6. Recombination in viruses
- 7. Prokaryote Genetics and Evolution
 - 7.1. Multiple Drug Resistant Plasmids
 - 7.2. Transposition
 - 7.3. Gene Scavenging
 - 7.4 Bacterial Species, do they really exist?
- 8. Conclusions

Prokaryotic Growth, Nutrition And Physiology

208

T. G. Downing, *Department of Biochemistry & Microbiology, University of Port Elizabeth, South Africa*

- 1. Introduction
- 2. Bacterial Cell Growth and Division
- 3. The bacterial cell cycle and its regulation
- 4. Bacterial Population Growth
- 5. Bacterial Nutrition
 - 5.1. Carbon sources and assimilation
 - 5.2. Nitrogen sources and assimilation
 - 5.3. Phosphate sources and assimilation
 - 5.4. Sulfur sources and assimilation
 - 5.5 Nutrient reserves
- 6. Energy generation
 - 6.1 Aerobic respiration
 - 6.2. Anaerobic respiration
 - 6.3. Fermentation
 - 6.4. Photosynthesis
- 7. Bacterial Nutrient Stress Responses

Microbial Pathogenesis and Antibiotics

229

Ralph Kirby, *Department of Biochemistry & Microbiology, Rhodes University, Grahamstown, South Africa*

- 1. Microbial Disease and Pathogenesis in History
 - 1.1. The Germ Theory
 - 1.1.2. Microorganisms are pathogens
 - 1.1.3. Host response to pathogens
 - 1.2. Chemotherapy
 - 1.3. Types of Antibiotics and Their Sources
 - 1.3.1. Modes of Action of Antibiotics
 - 1.3.2. Commonly used Antibiotics
 - 1.3.3. Anti-viral Drugs
 - 1.3.4. The future for anti-microbial and anti-viral agents
- 2. Food and Water Borne Diseases
 - 2.1. Bacterial Diseases
 - 2.2. Viral Diseases
 - 2.3. Protozoal and Helminth Diseases
 - 2.4. Control of Food and Water Borne Disease
- 3. Air Borne Diseases
 - 3.1. Bacterial Diseases
 - 3.2. Viral Diseases
 - 3.3. Fungal Diseases
 - 3.4. Control of Airborne Disease

4. Sexually Transmitted Diseases
 - 4.1. Bacterial Diseases
 - 4.2. Viral Diseases
 - 4.3. Fungal Diseases
 - 4.4. Control of Sexually Transmitted Diseases
5. Infections Acquired in Hospital
 - 5.1. Epidemiology of Nosocomial Infections
 - 5.2. Antibiotics and Nosocomial Infections
6. Prion Diseases

Index **251**

About EOLSS **257**

VOLUME XVII

An Introductory Treatise on Biophysics **1**

M.I.El Gohary, *Faculty of Science, Al Azhar University, Cairo, Egypt*

1. Introduction
 - 1.1 Definition of Biophysics
 - 1.1.1 Classification of Biophysics
 - 1.1.1.1 Physical Biophysics (“True” Biophysics)
 - 1.1.1.2 Physico-Chemical Biophysics (Biophysical Chemistry)
 - 1.1.1.3 Physiological Biophysics (Physical Physiology)
 - 1.1.1.4 Mathematical Biophysics
 - 1.2 Characteristics of Life
 - 1.2.1 Reproduction
 - 1.2.2 Growth
 - 1.2.3 Metabolism
 - 1.2.4 Movement
 - 1.2.5 Responsiveness
 - 1.3 A Few Biological Generalizations
 - 1.3.1 Cellular Organization
 - 1.3.2 Cellular Division
 - 1.3.3 What Causes Cells to Divide?
 - 1.3.4 Cell Differentiation
 - 1.3.5 Organ Regeneration
 - 1.3.6 Biological Classification
2. Chemistry Of Living Systems
 - 2.1 Chemical Bonds
 - 2.1.1 Types of Bonds
 - 2.1.2 Bond Strengths
 - 2.1.2.1 Making and Breaking Bonds
 - 2.1.3 Free Energy
 - 2.1.4 Bonds and Molecular Shapes
 - 2.2 Subunits of Macromolecules
 - 2.3 Biological Macromolecules
 - 2.3.1 Proteins
 - 2.3.1.1 Structure
 - 2.3.2 Prediction, Interaction, and Design of Macromolecules
 - 2.3.3 Protein folding
 - 2.3.4 Enzymes
 - 2.3.5 Nucleic acids (DNA and RNA Chains)
 - 2.3.5.1 DNA
 - 2.3.5.2 Ribonucleic acid (RNA)
3. Biological Energy

- 3.1 Cellular Energy Conversion
- 3.2 ATP-Biological Energy Reservoir
- 3.3 Photosynthesis Process
- 3.4 Dioxygen Formation
- 3.5 Respiration
 - 3.5.1 Anaerobic Respiration
 - 3.5.2 Aerobic Respiration
- 4. Transport Processes
 - 4.1 Diffusion
 - 4.2 Random Motion
 - 4.3 The Diffusion Equation
 - 4.3.1 Movement of biomolecules
 - 4.4 Osmosis
- 5. Membrane Biophysics
 - 5.1 Models of Membrane Architecture
 - 5.1.1 Cellular Membranes Contain a Lipid Bilayer
 - 5.1.2 The Davson-Danielli Model Was the First Detailed Representation of Membrane Organization
 - 5.1.3 Membranes exhibit a Trilaminar Appearance in Electron Micrographs
 - 5.1.4 The Davson-Danielli Model failed to explain many aspects of Membrane Behavior
 - 5.1.5 The Fluid Mosaic Model is a more accurate Representation of Membrane Architecture
 - 5.2 Membrane Protein Insertion
 - 5.3 Ions Moving Through Membrane Channels
 - 5.3.1 The Electrochemical Gradient
 - 5.3.2 Ionic gradients in cells
 - 5.4 Permeability and selectivity
 - 5.4.1 Permeability: theoretical approaches
 - 5.4.2 The independent electrodiffusion model
 - 5.4.3 Describing selectivity with the GHK equations
- 6. Innovative Biophysical Methods
 - 6.1 X-Ray Diffraction and Molecular structure
 - 6.2 X-Ray Diffraction reveals the Three- Dimensional Structures of Macromolecules
 - 6.3 Nuclear Magnetic Resonance (NMR)
 - 6.3.1 The Resonance Condition
 - 6.3.2 The Chemical Shift
 - 6.3.3 The Indirect Couplings
 - 6.4 Atomic Magnetometer
 - 6.5 Patch Clamping Technique
- 7. Bioenergetics
 - 7.1 Food Webs and Energy Flow
 - 7.2 Oxidation Process by Heterotrophic Cells
 - 7.3 Biological Work
 - 7.4 The Cycling of Matter in the Biological World
 - 7.5 Energy from Biomass
- 8. Bioelectric Phenomena
 - 8.1 The Nervous System and the Neuron
 - 8.2 Electric Potentials of Nerves
 - 8.3 Impulse Conduction
 - 8.4 Synaptic Conduction
 - 8.5 Electrical Signals from the Heart – Electrocardiogram (ECG)
 - 8.6 Electrical Signals from Muscles - Electromyogram (EMG)
 - 8.7 Electrical signals From the Brain - Electroencephalogram (EEG)
 - 8.7.1 Evoked Response Potentials
 - 8.7.2 Auditory Evoked Response Potentials
 - 8.7.3 Sumato Sensory Evoked Response Potentials
 - 8.7.4 Excitation of Nerves or Muscles
 - 8.7.5 Understanding Intentions
- 9. Radiation Biophysics

- 9.1 Radiation Measurements
 - 9.1.1 Definitions
 - 9.1.1.1 Directly Ionizing Particles
 - 9.1.1.2 Indirectly Ionizing Particles
 - 9.1.1.3 Gamma Rays and X-Rays
 - 9.1.2 Quantities and Units
 - 9.1.2.1 Exposure
 - 9.1.2.2 Energy Imparted
 - 9.1.2.3 Relative Biological Effectiveness
 - 9.1.2.4 Particle Fluence
 - 9.1.2.5 Particle Flux Density
 - 9.1.2.6 Energy Fluence
 - 9.1.2.7 Energy Flux Density
 - 9.1.2.8 Kerma
 - 9.1.2.9 Linear Energy Transfer
- 9.2 Radioactivity Measurements
 - 9.2.1 Decay Constant
 - 9.2.2 Activity
- 9.3 Electromagnetic Radiation: Its Nature and Properties
 - 9.3.1 Quantum Theory of Electromagnetic Radiation
- 9.4. Interaction of EMR with Matter
 - 9.4.1 Linear Attenuation Coefficient
 - 9.4.2 Annihilation Reaction
- 9.5 Biological Effects Of Radiation
 - 9.5.1 Dose-Response Characteristics
 - 9.5.2 Direct Action
 - 9.5.3 Indirect Action
 - 9.5.4 Acute Effects
 - 9.5.4.1 Hemopoietic Syndrome
 - 9.5.4.2 Gastrointestinal (Gi) Syndrome
 - 9.5.4.3 Central Nervous System Syndrome
 - 9.5.5 Other Acute Effects
 - 9.5.6 Treatment Of Acute Overexposure
- 9.6 Radioactive Ghost Town
- 10. Environmental Biophysics
 - 10.1 Exposure to Natural Background Radiation
 - 10.1.1 Background and Source Terms
 - 10.1.2 Naturally Occurring Radionuclides
 - 10.1.2.1 Cosmogenic Radionuclides
 - 10.1.3 Dose from External Sources
 - 10.1.3.1 Outdoor Exposure
 - 10.1.3.2 Air Pollution
 - 10.1.3.3 Carbonaceous Aerosol Emissions
 - 10.1.3.4 Indoor Exposure from External Sources
 - 10.2 Dose from Inhaled Radionuclides
 - 10.2.1 ²²²Radon as a Source of Internal Exposure
 - 10.2.2 Thorium Series and Its Decay Products
 - 10.2.3 Non Series Radionuclides
 - 10.3 Exposure From Cosmic Rays And Cosmogenic Radionuclides
 - 10.3.1 Cosmic Rays
 - 10.3.2 Cosmogenic Radionuclides
 - 10.4 Exposure from Medical Applications
 - 10.4.1 Diagnostic X-Ray Examinations
 - 10.4.2 Therapeutic Radiology
 - 10.4.3 Nuclear Medicine Procedures
 - 10.5 Population Exposure from Civilian Nuclear Power Operations
 - 10.5.1 Nuclear Fuel Cycle

- 10.5.2 Estimated Population Exposures
- 10.6 Radiation Exposure from Consumer Products
 - 10.6.1 Natural Radioactive Products
 - 10.6.1.1 Tobacco Products
 - 10.6.1.2 Other Contributors
 - 10.6.1.3 Television Receivers, Video Display Terminals, and Airport X-Ray Machines
 - 10.6.1.4 Other Consumer Products
 - 10.7. Radiation Protection
 - 10.7.1 Basic precautions
 - 10.7.2 Legal requirements
 - 10.7.3 Ultrasound safety
- 11. Laser In Medicine
 - 11.1 Laser generation - Laser medium
 - 11.1.1 Laser Operation
 - 11.1.2 Lasing Action
 - 11.1.3 Manner of Operation
 - 11.2 Tissue Interaction
 - 11.3 Properties of individual lasers
 - 11.3.1 The carbon dioxide (CO₂) laser
 - 11.3.1.1 Cutting
 - 11.3.1.2 Vaporization
 - 11.3.1.3 Coagulation
 - 11.3.2 The Dye Laser
 - 11.3.3 The Excimer Laser
 - 11.4 Laser Beam Delivery Systems
 - 11.4.1 CO₂ Lasers
 - 11.4.2 Argon and dye lasers
 - 11.4.3 Nd:YAG lasers
 - 11.4.4 Excimer lasers
 - 11.4.5 Aiming beams
 - 11.5 Clinical applications
 - 11.5.1 Surgery
 - 11.5.2 Dermatology and Plastic Surgery
 - 11.5.3 Photoradiation Therapy
 - 11.5.4 Treatment of Glaucoma by Femto Second Laser
 - 11.6 Laser safety
 - 11.6.1 General points
- 12. Biomedical Engineering
 - 12.1 Transducers
 - 12.1.1 Types of Transducers
 - 12.1.2 Desired Attributes of a Measurement System
 - 12.1.3 Biopotentials
 - 12.1.4 Biopotential Recording Systems
 - 12.2 Pacemakers
 - 12.3 Blood Pressure Measurements
 - 12.3.1 Medical Aspects of Blood Pressure Measurement
 - 12.3.2 Sphygmomanometer Blood Pressure Measurement
 - 12.3.3 Harmonic motion in blood vessel walls
 - 12.3.4 Heart Valve Model
 - 12.4 Invasive Measurement of Blood Pressure
 - 12.4.1 Catheter Measurement
 - 12.4.2 Catheter Tip Transducer
 - 12.4.3 Design of Blood Pressure Transducers
 - 12.4.4 Strain Gauge Pressure Transducers
 - 12.5 Safety of Blood Pressure Transducers
 - 12.6 Measurement of Blood Pressure within the Heart (the Swan Ganz Catheter)
 - 12.6.1 Heart Catheterization
- 13. Molecular Genetics

- 13.1 Synthesis of RNA
 - 13.1.1 RNA Structure
- 13.2 The Role of RNA in Protein Synthesis
 - 13.2.1 Messenger RNA
 - 13.2.2 Transfer RNA
 - 13.2.3 Ribosomal RNA
 - 13.2.4 Noncoding RNA
- 13.3 The Protein Synthesis Mechanism
- 13.4 The Genetic Code
- 14. Modeling Of Biological Systems
 - 14.1 Systems, Models, and Modeling
 - 14.2 Uses of Scientific Models
 - 14.3 Classifications of Models
 - 14.3.1 Forms of Models
 - 14.3.2 Mathematical Classification
 - 14.3.3 System Concept Classification
 - 14.4 Constraints on Model Structure
 - 14.5 Signaling Systems Model
- 15. Bio-Communication
 - 15.1 Introduction
 - 15.2 What is communication?
 - 15.3 Lines of Communication
 - 15.4 Functions of Communication
 - 15.4.1 Group Spacing and Coordination
 - 15.4.2 Recognition
 - 15.4.2.1 Species Recognition
 - 15.4.2.2 Deme Recognition
 - 15.4.2.3 Class Recognition
 - 15.4.2.4 Neighbor Recognition
 - 15.4.2.5 Kin Recognition
 - 15.4.2.6 Individual Recognition
 - 15.4.3 Reproduction
 - 15.4.4 Agonism and Social Status
 - 15.4.5 Alarm
 - 15.4.5.1 Size Up Predators by Alarm
 - 15.4.6 Finding Food
 - 15.4.7 Giving and Soliciting Care
 - 15.4.7.1 Soliciting Play
 - 15.4.8 Synchronization of Hatching
 - 15.5 Channels of Communication
 - 15.5.1 Odor-Olfactory
 - 15.5.2 Sound-Auditory
 - 15.5.2.1 Low-Frequency Sound and Seismic Vibrations
 - 15.5.3 Touch-Tactile
 - 15.5.3.1 Electric Field
 - 15.5.4 Vision
- 16. Bio-Nanotechnology
 - 16.1 DNA Computing
 - 16.2 Improved imaging
 - 16.2.1 A Grand Plan for Medicine
- 17. Molecular Biophysics
 - 17.1 Molecules
 - 17.1.1 Biomolecules in Crystallography
 - 17.1.2 The Flow of Energy in Biomolecules
 - 17.2 Intermolecular Forces
 - 17.2.1 The Hydrogen Bond
- 18. Biophysics In Proteomics

- 18.1 Proteomics
- 18.2 Genes were easy
- 18.3 Proteo-factories
- 18.4 New Protein Atlas
- 19. Regulation Mechanisms
 - 19.1 The Control Systems of the Body
 - 19.2 Examples of Control Mechanisms
 - 19.2.1 Regulation of Oxygen and Carbon Dioxide Concentrations in the Extracellular Fluid
 - 19.2.2 Regulation of Sodium Ion Concentration
 - 19.2.3 Regulation of Arterial Pressure
 - 19.2.4 Regulation of Calcium/Calmodulin Dependent Signaling
 - 19.3 Characteristics of Control Systems
 - 19.3.1 Negative Feedback Nature of Control Systems
 - 19.3.2 Amplification or Gain of a Control System
 - 19.3.3 Positive Feedback as a Cause of Death—Vicious Cycle
 - 19.3.4 Fast and Slow Positive Feedback Loops

Mathematical Models In Biophysics

245

Riznichenko Galina Yur'evna, *Biological faculty of the Lomonosov Moscow State University, Leninskie gori, Moscow, 119992, Russia*

- 1. Introduction
- 2. Specificity of mathematical modeling of living systems
- 3. Basic models in mathematical biophysics
 - 3.1. Unlimited growth. Exponential growth: Auto-catalysis
 - 3.2. Limited growth: The Verhulst equation
 - 3.3. Constraints with respect to a substrate. The models of Monod and Michaelis–Menten
 - 3.4. Competition. Selection
 - 3.5. The Jacob and Monod trigger system
 - 3.6. Classic Lotka–Volterra models
 - 3.7. Models of species interaction
 - 3.8. Models of enzyme catalysis
 - 3.9. Model of a continuous microorganism culture
 - 3.10. Age structure of populations
 - 3.10.1. Continuous models of the age structure
- 4. Oscillations and rhythms in biological systems
 - 4.1. Oscillations in Glycolysis
 - 4.2. Intracellular calcium oscillations
 - 4.3. Cellular cycles
- 5. Spatio-temporal self-organization of biological systems
 - 5.1. Waves of life
 - 5.2. Autowaves and dissipative structures
 - 5.3. The basic ‘Brusselator’ model
 - 5.4. Models of morphogenesis
 - 5.5. The Belousov–Zhabotinskii (BZ) reaction
 - 5.6. Theory of nerve conductivity
- 6. Physical and mathematical models of biomacromolecules
 - 6.1. Molecular dynamics
 - 6.2. Models of DNA Dynamics
- 7. Modeling of complex biological systems
 - 7.1. Metabolic control analysis
 - 7.2. Mathematical models of primary photosynthetic processes
- 8. Conclusions

Index

301

About EOLSS

309