

Chapter 21

INTRODUCTION TO METABOLIC PATHWAYS

0000 The metabolic activities of cells are dictated by two major concerns:

- 00010 1. *The cell has to synthesize its macromolecules.* Proteins have to be synthesized from amino acids, complex carbohydrates from monosaccharides, membrane lipids from fatty acids and other building blocks, and nucleic acids from nucleotides (pathway ① in Fig. 21.1). These biosynthetic processes are called **anabolic**. They require metabolic energy in the form of adenosine triphosphate (ATP).
- 00015 2. *The cell has to generate metabolic energy.* Nutrients must be oxidized to supply ATP for biosynthesis, active membrane transport, cell motility, and muscle contraction. Degradative processes are called **catabolic**. Most ATP is produced during the **oxid-oxidation** of metabolic intermediates to CO_2 and H_2O in the mitochondria (pathway ② in Fig. 21.1).

Therefore an unsuspecting nutrient molecule entering a cell has two alternative fates: either it becomes incorporated into a cellular macromolecule, or it is oxidized for the generation of ATP.

00020 The biosynthesis of cellular macromolecules has to be balanced by their degradation (pathway ③ in Fig. 21.1). Under steady-state conditions, the rates of synthesis and degradation are balanced and the amount of the macromolecule remains constant. Different nutrients can also be interconverted through metabolic intermediates. For example, most amino acids can be converted to glucose, and glucose can be converted to amino acids and fatty acids.

ALTERNATIVE SUBSTRATES CAN BE OXIDIZED IN THE BODY

00025 The complete oxidation of carbohydrates and protein yields about 17 kJ/g (4 kcal/g), fat 37 kJ/g (9 kcal/g), and alcohol 29 kJ/g (7 kcal/g). Molecular oxygen is consumed during fuel oxidation, and carbon dioxide is produced:



Glucose



Tripalmitate, a triglyceride

The stoichiometry of O_2 consumption and CO_2 production is described by the respiratory quotient (RQ):

$$\text{RQ} = \frac{\text{CO}_2 \text{ (produced)}}{\text{O}_2 \text{ (consumed)}}$$

The RQ for the oxidation of carbohydrates is 1.0; for fat, about 0.7; and for protein, about 0.8.

Most cells have a choice among alternative substrates including glucose, fatty acids, and amino acids. Others are more specialized. A few cell types, such as neurons and red blood cells, depend mainly or exclusively on glucose for their energy needs.

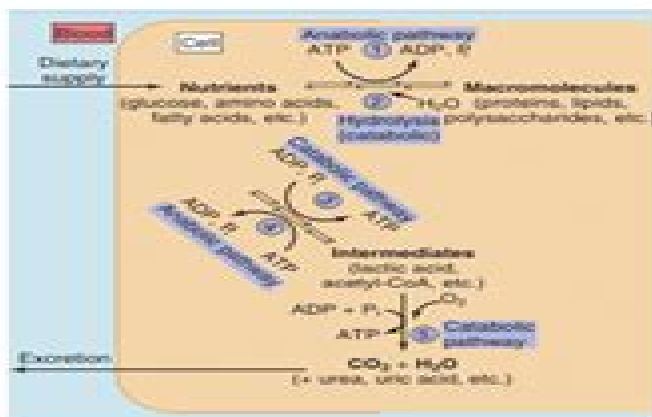


Fig. 21.1 Major types of metabolic activity in the cell. ADP, Adenosine diphosphate; ATP, adenosine triphosphate; CoA, coenzyme A; P_i, inorganic phosphate.

An Introduction To Metabolic Pathways

Giuseppe Liotta



An Introduction To Metabolic Pathways:

An Introduction to Metabolic Pathways Stanley Dagley, Donald Elliot Nicholson, 1970-01-01 **An Introduction To Metabolic Pathways** S. Dagley, Donald E. Nicholson, 1972 **An Introduction to Metabolic Pathways [by] S. Dagley [and] Donald E. Nicholson** S. Dagley, 1970 *Introduction to Metabolic Pathways* Dagley, 1970-01-01 **Bioreaction Engineering** K. Schügerl, K.-H. Bellgardt, 2012-12-06 The book is intended to present various examples for reactor and process modeling and control as well as for metabolic flux analysis and metabolic design at an advanced level In Part A General principles and techniques with regard to reactor and process models process control and metabolic flux analysis are presented In addition the accuracy precision and reliability of the measured data are discussed which are extremely important for process modeling and control A virtual bioreactor system is presented as well which can be used for the training of students and operators of industrial plants and for the development of advanced automation tools In Part B the General principles are applied for particular bioreactor models It covers the application of the computational fluiddynamic CFD technique to stirred tank and bubble column bioreactors Different solution methods are presented the Reynolds averaging of the turbulent Navier Stokes equations and modeling of the Reynolds stresses with an appropriate turbulence k- ϵ model and the Euler two fluid model as well as the Euler-Lagrange approaches **Lahita's Systemic Lupus Erythematosus** Robert G. Lahita, 2021-07-23 Systemic lupus erythematosus SLE commonly called lupus is a chronic autoimmune disorder that can affect virtually any organ of the body In lupus the body's immune system which normally functions to protect against foreign invaders becomes hyperactive forming antibodies that attack normal tissues and organs including the skin joints kidneys brain heart lungs and blood Lupus is characterized by periods of illness called flares and periods of wellness or remission Because its symptoms come and go and mimic those of other diseases lupus is difficult to diagnose There is no single laboratory test that can definitively prove that a person has the complex illness To date lupus has no known cause or cure Early detection and treatment are the key to a better health outcome and can usually lessen the progression and severity of the disease Anti-inflammatory drugs antimalarials and steroids such as cortisone and others are often used to treat lupus Cytotoxic chemotherapies like those used in the treatment of cancer are also used to suppress the immune system in lupus patients A new edition of this established and well regarded reference combines basic science with clinical science to provide a translational medicine model Systemic Lupus Erythematosus Sixth Edition is a useful reference for specialists in the diagnosis and management of patients with SLE a tool for measurement of clinical activity for pharmaceutical development and basic research of the disease and a reference work for hospital libraries Completely updated revised and expanded with the most comprehensive and accessible reference on SLE for clinicians and scientists Full color presentation throughout the book Provides the latest information available on diagnosis and treatment Incorporates an international panel of authors who are experts in their fields with an emphasis on young cutting edge

scientists and physicians Computational Methods in Systems Biology Vincent Danos, Vincent Schachter, 2005-03-24 The Computational Methods in Systems Biology CMSB workshop series was established in 2003 by Corrado Priami The purpose of the workshop series is to help catalyze the convergence between computer scientists interested in language design concurrency theory software engineering or program verification and physicists mathematicians and biologists interested in the systems level understanding of cellular processes Systems biology was perceived as being increasingly in search of sophisticated modeling frameworks whether for representing and processing syst level dynamics or for model analysis comparison and refinement One has here a clear cut case of a must explore field of application for the formal methods developed in computer science in the last decade This proceedings consists of papers from the CMSB 2003 workshop A good third of the 24 papers published here have a distinct formal methods origin we take this as a confirmation that a synergy is building that will help solidify CMSB as a forum for cross community exchange thereby opening new theoretical avenues and making the field less of a potential application and more of a real one Publication in Springer s new Lecture Notes in Bioinformatics LNBI offers particular visibility and impact which we gratefully acknowledge Our keynote speakers Alfonso Valencia and Trey Ideker gave challenging and somewhat humbling lectures they made it clear that strong applications to systems biology are still some way ahead We thank them all the more for accepting the invitation to speak and for the clarity and excitement they brought to the conference

Graph Drawing Guiseppe Liotta, 2004-01-13 The 11th International Symposium on Graph Drawing GD 2003 was held on September 21 24 2003 at the Universit a degli Studi di Perugia Perugia Italy GD 2003 attracted 93 participants from academic and industrial institutions in 17 countries In response to the call for papers the program committee received 88 re larsubmissionsdescribingoriginalresearchand orsystemdemonstrations Each submission was reviewed by at least 4 program committee members and c ments were returned to the authors Following extensive e mail discussions the program committee accepted 34 long papers 12 pages each in the proceedings and 11 short papers 6 pages each in the proceedings Also 6 posters 2 pages each in the proceedings were displayed in the conference poster gallery In addition to the 88 submissions the program committee also received a submission of special type one that was not competing with the others for a time slot in the conference program and that collects selected open problems in graph drawing The aim of this paper which was refereed with particular care andUNCHANGEDtworoundsoffrevisions istostimulatefutureresearchinthe graph drawing community The paper presents 42 challenging open problems in di erentareasofgraphdrawingandcontainsmorethan120references Although the length of the paper makes it closer to a journal version than to a conference extended abstract we decided to include it in the conference proceedings so that it could easily reach in a short time the vast majority of the graph drawing community

Impact of Incomplete Metabolism on Health Rajesh Kumar, 2025-11-21 Impact of Incomplete Metabolism on Health uncovers how the buildup of toxic intermediates enzyme deficiencies and pathway impairments destabilize metabolic homeostasis These disruptions contribute to chronic

diseases oxidative stress mitochondrial dysfunction and a wide range of cellular abnormalities The book begins with the fundamental principles of metabolism and then systematically explains the biochemical origins of incomplete reactions and their physiological consequences Subsequent chapters explore metabolic syndrome inborn errors of metabolism and other clinically significant disorders arising from flawed metabolic pathways The later sections delve into diagnostic strategies therapeutic innovations and emerging fields such as nutrigenomics enzyme replacement therapy and personalized metabolic medicine Supported by contemporary research detailed pathway illustrations and case based clinical insights this book serves as both an academic foundation and a practical guide for understanding the biochemical roots of human disease

Key Features

- Clarifies the biochemical basis and clinical implications of incomplete metabolic processes
- Illustrates metabolic pathways through detailed accurate and easy to understand diagrams
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- Integrates updated research across biochemistry molecular biology and clinical medicine
- Explores diagnostic tools therapeutic approaches and emerging personalized interventions

[Advances in Visual Computing](#) George Bebis, Richard Boyle, Bahram Parvin, Darko Koracin, Ronald Chung, Hammoud, Muhammad Hussain, Kar-Han Tan, Roger Crawfis, Daniel Thalmann, David Kao, Lisa Avila, 2010-11-05 The three volume set LNCS 6453 LNCS 6454 and LNCS 6455 constitutes the refereed proceedings of the 6th International Symposium on Visual Computing ISVC 2010 held in Las Vegas NV USA in November December 2010 The 93 revised full papers and 73 poster papers presented together with 44 full and 6 poster papers of 7 special tracks were carefully reviewed and selected from more than 300 submissions The papers of part I LNCS 6453 are organized in computational bioimaging computer graphics behavior detection and modeling low level color image processing feature extraction and matching visualization motion and tracking unconstrained biometrics advances and trends 3D mapping modeling and surface reconstruction and virtual reality Part II LNCS 6454 comprises topics such as calibration pose estimation and reconstruction segmentation stereo registration medical imaging low cost virtual reality expanding horizons best practices in teaching visual computing applications and video analysis and event recognition Part III LNCS 6455 mainly contains papers of the poster session and concludes with contributions addressing visualization as well as motion and tracking

[Encyclopedia of Cell Biology](#), 2015-08-07 The Encyclopedia of Cell Biology Four Volume Set offers a broad overview of cell biology offering reputable foundational content for researchers and students across the biological and medical sciences This important work includes 285 articles from domain experts covering every aspect of cell biology with fully annotated figures abundant illustrations videos and references for further reading Each entry is built with a layered approach to the content providing basic information for those new to the area and more detailed material for the more experienced researcher With authored contributions by experts in the field the Encyclopedia of Cell Biology provides a fully cross referenced one stop resource for students researchers and teaching faculty across the biological and medical sciences Fully annotated color images and videos for full comprehension of concepts

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Science Books ,1970 *Color Atlas of Biochemistry* Jan Koolman,K H Rhm,2005 Totally revised and expanded Color Atlas of Biochemistry presents the fundamentals of human and mammalian biochemistry on 215 stunning color plates Alongside a short introduction to chemistry and the classical topics of biochemistry the second edition covers new approaches and aspects in biochemistry such as links between chemical structure and biological function or pathways for information transfer as well as recent developments and discoveries such as the structures of many new important molecules Key features include The unique combination of highly effective color graphics and comprehensive figure legends Unified color coding of atoms coenzymes chemical classes and cell organelles that allows quick recognition of all involved systems Computer graphics provide simulated 3D representation of many important molecules This Flexibook is ideal for students of medicine and biochemistry and a valuable source of reference for practitioners

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