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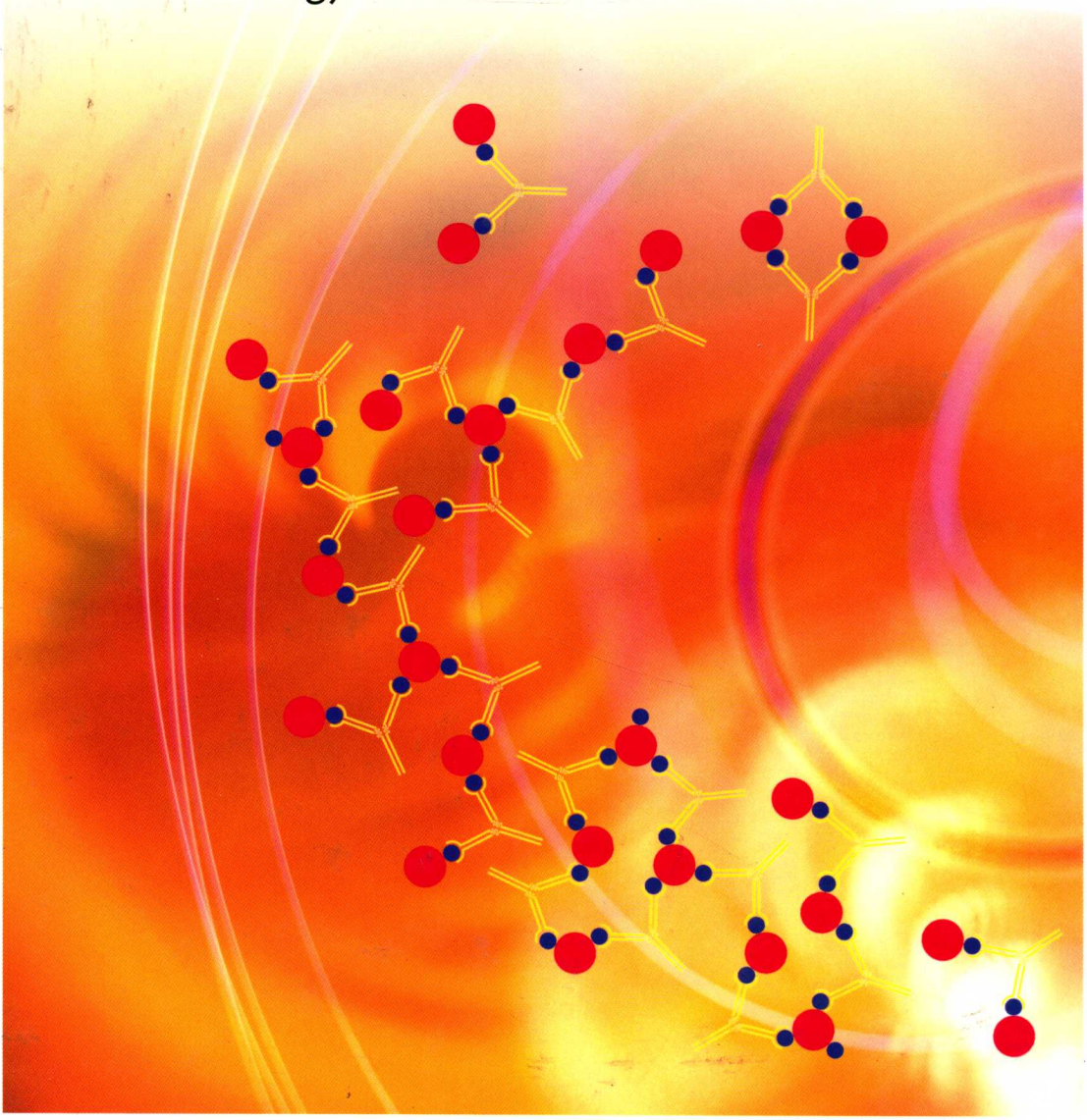
Immunology

From Cell Biology to Disease



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From Cell Biology to Disease

Edited by

Robert A. Meyers

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Each generation has its unique needs and aspirations. When Charles Wiley first opened his small printing shop in lower Manhattan in 1807, it was a generation of boundless potential searching for an identity. And we were there, helping to define a new American literary tradition. Over half a century later, in the midst of the Second Industrial Revolution, it was a generation focused on building the future. Once again, we were there, supplying the critical scientific, technical, and engineering knowledge that helped frame the world. Throughout the 20th Century, and into the new millennium, nations began to reach out beyond their own borders and a new international community was born. Wiley was there, expanding its operations around the world to enable a global exchange of ideas, opinions, and know-how.

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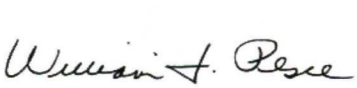

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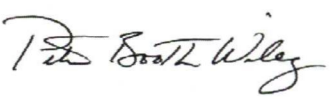

Peter Booth Wiley
Chairman of the Board

Preface

This treatise on molecular immunology and molecular medicine approaches to understanding and treatment of immune diseases was compiled from a selection of key articles from the recently published 16 volume *Encyclopedia of Molecular Cell Biology and Molecular Medicine* (ISBN 978-3-527-30542-1, http://www.meyers-emcbmm.de/). This volume is comprised of 15 detailed articles arranged in four sections covering innate and adaptive immunity, signaling in the immune system, techniques and immunological disorders. The articles were prepared by eminent researchers from many of the major global molecular cell immunology research institutions including The Scripps Research Institute; University of Oxford; University of Cambridge; Institut Pasteur; University of Zürich; National University of Ireland; Roche Center for Medical Genomics; Sloan-Kettering Institute; Cornell University; National Institute for Biological Standards and Control, UK; Columbia University; and University of California, Los Angeles.

Each article begins with a concise definition of the subject and its importance, followed by the body of the article and extensive references for further reading. The references are divided into secondary references (books and review articles) and primary research papers. Each subject is presented on a first-principle basis, including detailed figures, tables and drawings. Because of the self-contained nature of each article, some overlap among articles on related topics occurs. Extensive cross-referencing is provided to help the reader expand his or her range of inquiry.

The master publication, which is the basis of the Proteins set, is the *Encyclopedia of Molecular Cell Biology and Molecular Medicine*, which is the successor and second edition of the *VCH Encyclopedia of Molecular Biology and Molecular Medicine*, covering the molecular and cellular basis of life at a university and professional researcher level. The First Edition, published in 1996–97 was utilized in libraries around the world. This second edition is double the first edition in length and comprises the most detailed treatment of both molecular and cell biology available today. The Board with eleven Nobel laureates and I believe that there is a serious need for this publication, even in view of the vast amount of information available on the World Wide Web and in text books and monographs. We feel that there is no substitute for our tightly organized and integrated approach to selection of articles and authors and implementation of

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peer review standards for providing an authoritative single-source reference for undergraduate and graduate students, faculty, librarians and researchers in industry and government.

Our purpose is to provide a comprehensive foundation for the expanding number of molecular biologists, cell biologists, pharmacologists, biophysicists, biotechnologists, biochemists and physicians as well as for those entering molecular cell biology and molecular medicine from majors or careers in physics, chemistry, mathematics, computer science and engineering. For example there is an unprecedented demand for physicists, chemists and computer scientists who will work with biologists to define the genome, proteome and interactome through experimental and computational biology.

The Board and I first divided all of molecular cell biology and molecular medicine into primary topical categories and each of these was further defined into subtopics. The following is a summary of the topics and subtopics:

- Nucleic Acids: amplification, disease genetics overview, DNA structure, evolution, general genetics, nucleic acid processes, oligonucleotides, RNA structure, RNA replication and transcription.
- Structure Determination Technologies Applicable to Biomolecules: chromatography, labeling, large structures, mapping, mass spectrometry, microscopy, magnetic resonance, sequencing, spectroscopy, x-ray diffraction.
- Proteins, Peptides and Amino Acids: analysis, enzymes, folding, mechanisms, modeling, peptides, structural genomics (proteomics), structure, types.
- Biomolecular Interactions: cell properties, charge transfer, immunology, recognition, senses.
- Molecular Cell Biology of Specific Organisms: algae, amoeba, birds, fish, insects, mammals, microbes, nematodes, parasites, plants, viruses, yeasts.
- Molecular Cell Biology of Specific Organs or Systems: excretory, lymphatic, muscular, neurobiology, reproductive, skin.
- Molecular Cell Biology of Specific Diseases: cancer, circulatory, endocrine, environmental stress, immune, infectious diseases, neurological, radiation.
- Biotechnology: applications, diagnostics, gene altered animals, bacteria and fungi, laboratory techniques, legal, materials, process engineering, nanotechnology, production of classes or specific molecules, sensors, vaccine production.
- Biochemistry: carbohydrates, chirality, energetics, enzymes, biochemical genetics, inorganics, lipids, mechanisms, metabolism, neurology, vitamins.
- Pharmacology: chemistry, disease therapy, gene therapy, general molecular medicine, synthesis, toxicology.
- Cellular Biology: developmental cell biology, diseases, dynamics, fertilization, immunology, organelles and structures, senses, structural biology, techniques.

We then selected some 340 article titles and author or author teams to cover the above topics. Each article is designed as a self-contained treatise. Each article begins with a key word section, including definitions, to assist the scientist or student who is

unfamiliar with the specific subject area. The Encyclopedia includes more than 3000 key words, each defined within the context of the particular scientific field covered by the article. In addition to these definitions, the glossary of basic terms found at the back of each volume, defines the most commonly used terms in molecular and cell biology. These definitions should allow most readers to understand articles in the Encyclopedia without referring to a dictionary, textbook or other reference work.

Larkspur, May 2007

Robert A. Meyers
Editor-in-Chief

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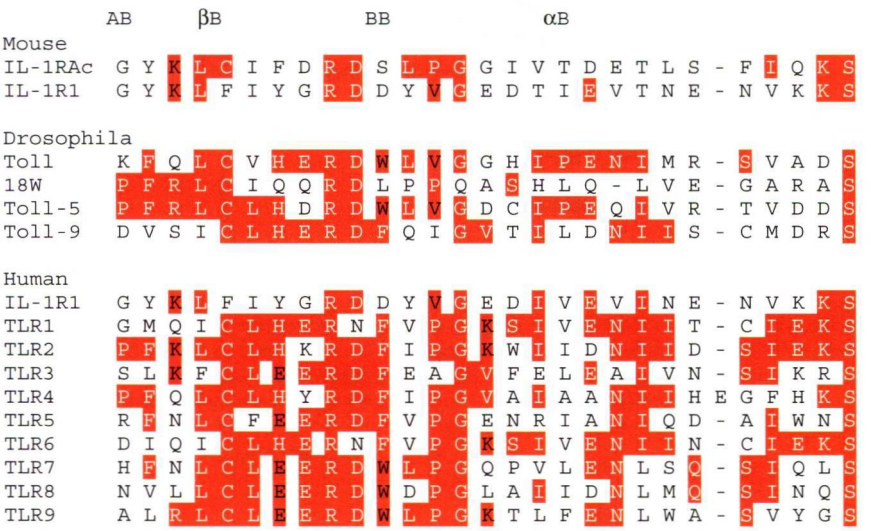

Fig. 2 (p. 13) Sequence alignment of the TLR domain-signaling region of mouse and human IL-1R proteins, *Drosophila* Toll proteins, and human TLRs. Residues conserved in at least four sequences are shaded. The greatest homology between *Drosophila* and human proteins occurs between the cytoplasmic domains of Toll-9 and TLRs 1, 2, 4, and 6.

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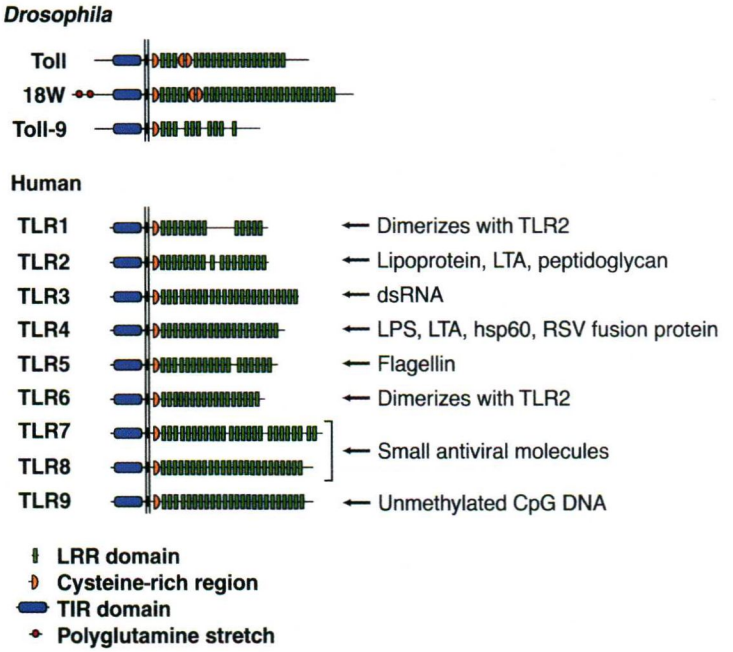


Fig. 3 (p. 15) Schematic representation of human TLR domains and their stimuli. Adapted from Imler, J.-L., Hoffmann, J.A. (2001) Toll receptors in innate immunity, *Trends Cell Biol.* **11**, 304–311.

Fig. 1 (p. 30) Ribbon diagram of staphylococcal enterotoxin A (SEA), representative of the common structural features of the staphylococcal and streptococcal SAg family. Blue spheres represent the positions of the two zinc sites. The cysteine residues that form the disulfide loop are shown in stick representation (yellow), the surfaces defining the TCR binding region (green), and MHC class II binding region (red) are shown.

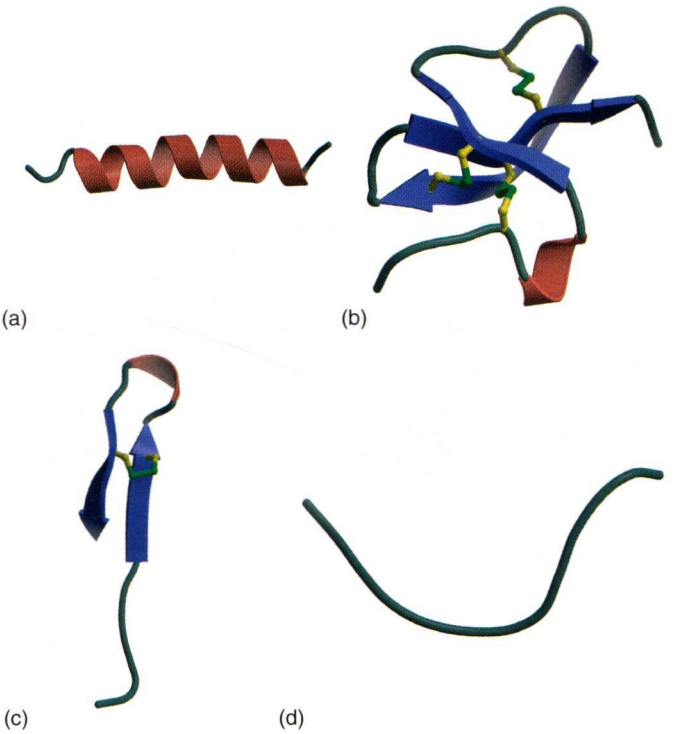
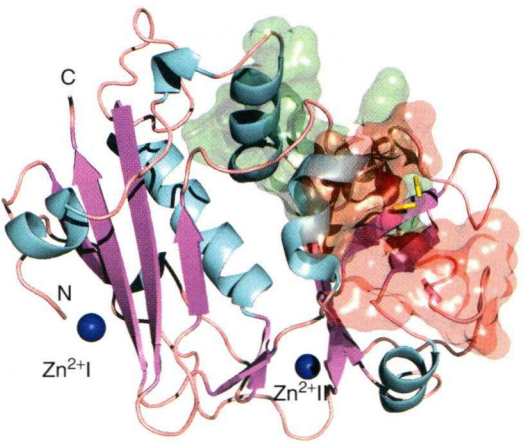


Fig. 7 (p. 23) Antimicrobial peptides. Representative member of each structural class: (a) magainin 2, alpha-helix; (b) β-defensin, beta-sheet; (c) thanatin, loop; (d) indolicidin, extended. Pictures generated by Matt Kelker, using bobscript and raster3D. Coordinates obtained from the RCSB Protein Data Bank under the accession codes 1BNB (defensin), 1G89 (indolicidin), 2MAG (magainin), and 8TFV (thanatin). Raster3D: Merritt & Bacon (1997) *Meth. Enzymol.* **277**, 505–524. bobscript: Esnouf, RM (1997) *J. Mol. Graph. Model.* **132–134**, 112–113.



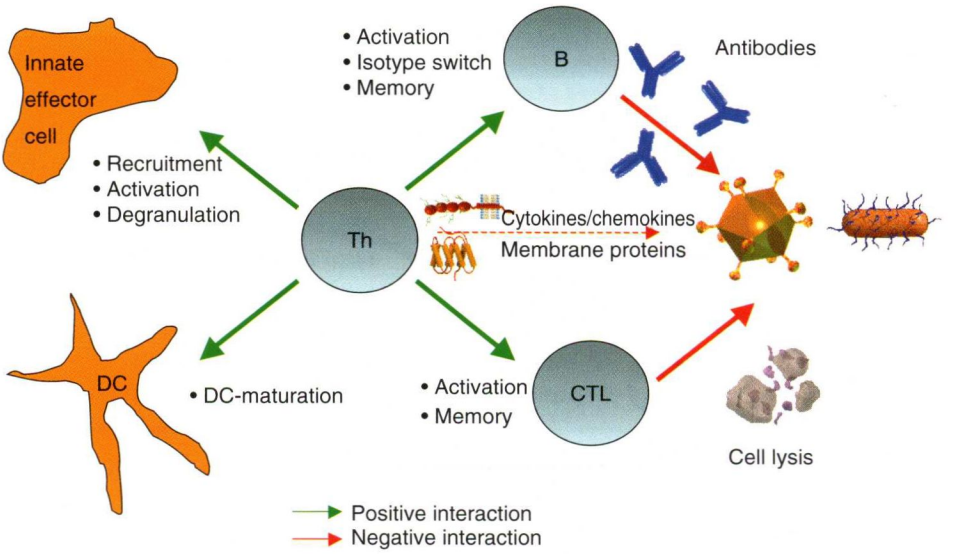


Fig. 3 (p. 107) Cross-talk between the innate and adaptive immune system and the critical role of Th cells in orchestrating the immune response.

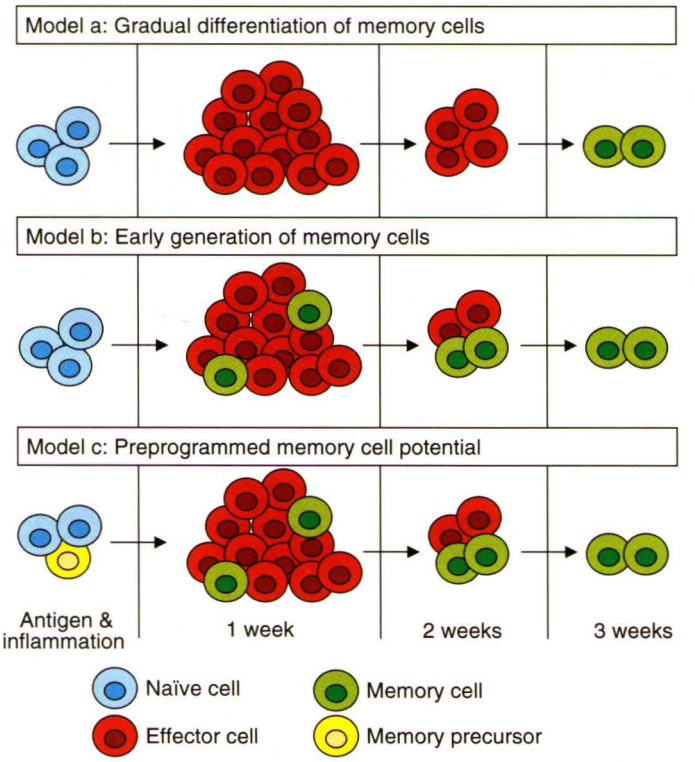


Fig. 1 (p. 124) Models of programmed memory T-cell generation.

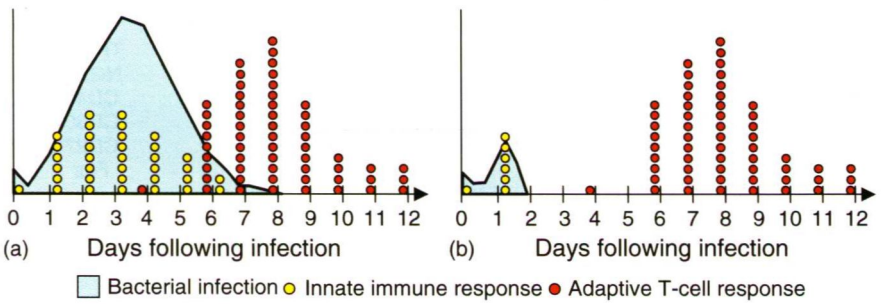


Fig. 2 (p. 125) Antigen-independent proliferation and memory generation.

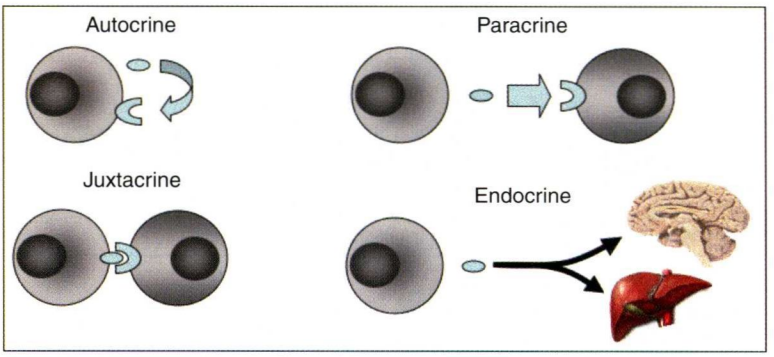


Fig. 1 (p. 142) Mode of action of cytokines.

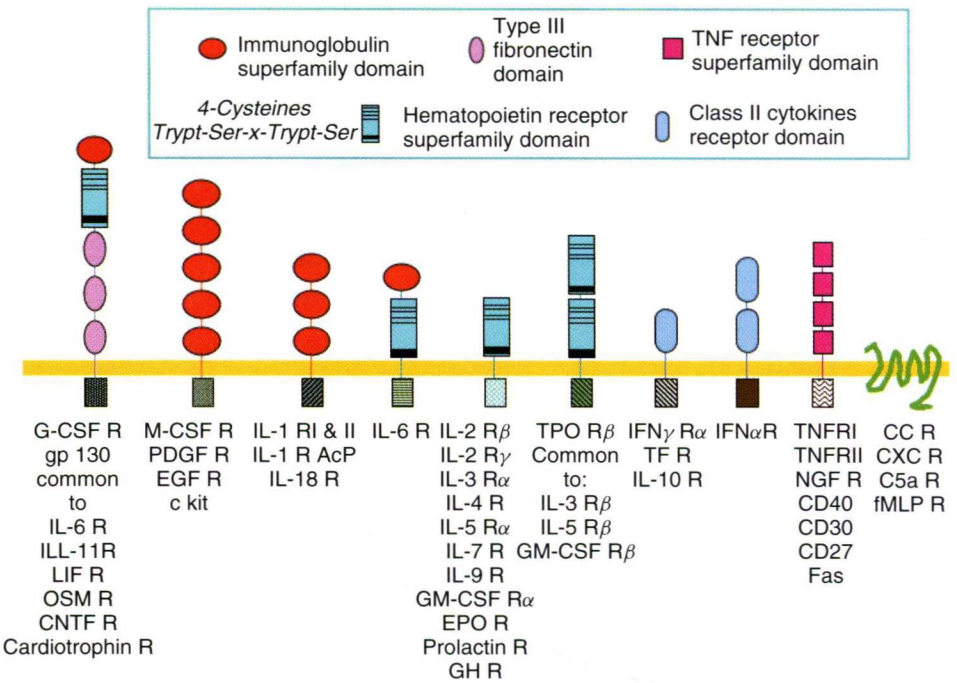


Fig. 2 (p. 145) Families of cytokine receptors.

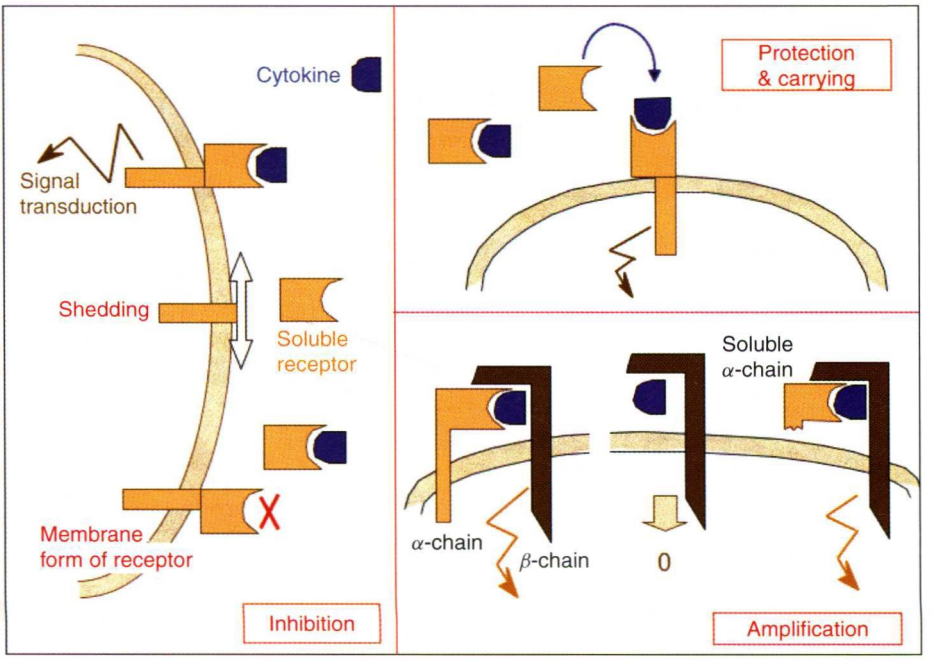


Fig. 3 (p. 146) Different properties of soluble receptors.