

Epilogue

Although we hope that you have learned a great deal about bioprocess engineering, you should realize that the material in this book is only the beginning. None of the topics has been covered in real depth. Most chapters would require a whole book to provide that depth. However, you should now have the vocabulary and perspective to benefit from more specialized books.

Some topics of increasing importance to biotechnology are functional genomics, cell surface receptor-mediated phenomena, high-throughput drug screening, protein engineering, metabolic engineering, and tissue engineering. A clear understanding of how cells perceive external signals through cell surface receptors promises to be a key to developing new therapies, as well as to understanding how shear effects in a bioreactor may alter cellular physiology. Insights into the interrelationship of protein structure with function promise the possibility of large-scale design of custom catalysts and drugs. Here the engineering approach to computational molecular dynamics may yield important dividends. Genetic engineering to produce proteins is beginning to mature; the development of cells with altered metabolic pathways is at a much earlier stage of development. The engineer's sense of optimization and the ability to quantitatively model intracellular interactions will be critical to the economically attractive development of this technique and its extension to gene therapy. Engineers will be needed to develop new and effective ways to culture organized tissues and artificial organs. Questions on the relationship of protein posttranslational processing to the microenvironment about cultured cells will be a key