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Drug Discovery Trends

There'll always be serendipity involved in discovery.

Jeff Bezos

1.1 Introduction

If the number of drugs approved by the U.S. Food and Drug Administration (FDA) can be taken as a measure of success, then there is a steady approval pace; over the past 4 years, 2015–2018, the FDA has already approved approximately 150 novel drugs and about 500 since the year 2000, bringing the total novel drugs approved to about 1500 since the year 1930. The new drugs under development are into thousands; for example, at least 500 new drugs are currently developed for neurological disorders that affect 100 million Americans.

Much has changed in the discovery of drugs over the past 50 years; the pace of change has accelerated exponentially since the first edition of this book was published. Microprocessor-driven instrumentation has revolutionized data-handling systems, robotic systems have eased large sample processing, and the integration of various physical and chemical sciences has resulted in the emergence of newer techniques. For example, high-throughput screening (HTS) is now an integral component of the drug discovery process that has evolved over the past decade from crude automation to the use of sophisticated computer-driven array systems using robotic devices. Improved physicochemical data on prospective new active entities (NAEs) provide a great stimulus to new drug development, as well as offer insights for the preformulation scientists to project the characteristics of the NAEs that would prove useful in their downstream processing. The downstream processes include hit-to-lead (HTL); lead optimization (LO); and in vitro absorption, distribution, metabolism, elimination, and toxicology (ADMET) studies, all driven by the peculiar characteristics of the NAE.

Figure 1.1 shows the most common types of drug discovery modalities, their costs, and the time it takes for the discovery.

1.1.1 Genome Editing

Targeted genome editing technology, based on the clustered regularly interspaced short palindromic repeats (CRISPR)-Cas9 system, offers a great promise for the future of medicine. Clustered regularly interspaced short palindromic repeats or CRISPR refers to the system consisting of two key molecules: an enzyme Cas9—"molecular scissors," able to cut the two strands of DNA at a specific location in the genome, and a piece of