Drug Development

Today most drugs are synthesized by chemists in the laboratory. Synthetic drugs are better controlled than those occurring naturally, which ensures that each dose imparts the same effect. Some new synthetic drugs are developed by modifying the structure of existing substances. These new drugs are called analogues. For example, prednisone is an analogue of the hormone cortisone (Hydrocortisone). Because scientists can selectively alter the drug's structure, analogues may be more effective and cause fewer side effects than the drugs from which they were derived.
One of the newer methods for developing drugs involves the use of gene splicing, or recombinant DNA (Genetic Engineering). In drug research, this technique joins the DNA of a specific type of human cell to the DNA of a second organism, usually a harmless bacterium, to produce a recombinant (or "recombined") DNA. The altered organism then begins to produce the substance produced by the human cell. This substance is extracted from the bacteria and purified for use as a drug.
The first drug produced in this manner was the hormone insulin in 1982, which was created in large quantities by inserting the human insulin gene in Escherichia coli (E. coli) bacteria. Since 1982 other genetically engineered drugs for humans have been developed, including tissue plasminogen activator (tPA), an enzyme used to dissolve blood clots in people who have suffered heart attacks, and erythropoetin, a hormone used to stimulate the production of red blood cells in people with severe anemia.
Because of the great expense and time involved, most new drugs are created by large, well-funded pharmaceutical companies. From idea to production, the development of a new drug can take up to ten years and cost about $200 million. The process usually starts with the idea that an existing chemical substance has therapeutic value or that the structure of an existing drug can be modified for new clinical uses. Out of 10,000 chemicals tested in a laboratory, only one may eventually become a drug.
Once drug researchers have determined that a new substance may have medical value, an elaborate testing program begins. The drug is tested first on small animals such as rats and mice, and then on larger animals such as monkeys and dogs. If these tests indicate that the new drug is effective against its intended target-such as a particular disease-and shows an acceptably low level of toxicity, the drug company requests permission from the Food and Drug Administration (FDA), an agency of the U.S. Department of Health and Human Services, to test the drug in humans.
If the agency approves the request, clinical trials on humans can begin. These experiments are usually divided into three phases, each of which can last from several months to several years. In the first phase, the drug is tested on a small number of healthy individuals to determine its effect on the body. The second phase tests the drug on a small number of people who have the disease or disorder the drug manufacturer hopes the drug will treat. These individuals are divided into two groups: those who receive the drug and those who receive a placebo, or inactive compound. Neither the investigating physicians nor the members of the test group know who is receiving the drug or who is receiving the placebo. This technique, called a double-blind study, ensures that no one consciously or unconsciously

influence the drug's effect. The third phase tests the drug on a much larger group of people and determines specific doses, possible interactions with other drugs, responses related to gender, and other information used for drug labeling. At the end of the third phase, a drug manufacturer compiles the results of the clinical trials and submits them to the FDA in a new product application. If the drug has been proven effective and safe, and its benefits outweigh any risks, the agency approves the drug for marketing. FDA approval of a new drug may take up to 18 months; however, the agency is working to reduce the time to 12 months for most drugs and 6 months for highly effective drugs that treat previously incurable conditions.