生醫工程概論

上課時間: 週一 2, 3, 4 節

上課地點: 電機二館104

教科書: Introduction to Biomedical Engineering;

John Enderle, Susan Blanchard, and Joseph Bronzio;

Academic Press

評分方式:

1.作業	30	%
2.期中考	30	%
3.期末考	40	%

Month	Date	Module	Instructor	Textbook Chapter
February	21	Overview	莊曜宇	1
	28	Holiday		
March	7	Imaging	鍾孝文	14
	14	Imaging	鍾孝文	supplement
	21	Imaging	陳志宏	16
	28	Physiology	陳文翔	2
April	4	Holiday		
	11	Physiology	陳文翔	7
	18	Physiology	曹建和	8
	25	Midterm	莊曜宇	
May	2	Device/instrumentation	鍾孝文	3
	9	Device/instrumentation	李百祺	5
	16	Device/instrumentation	李百祺	supplement
	23	Optics	林啓萬	17
	30	Biology	莊曜宇	12 & 13
June	6	Biosensor/biosignal processing	莊曜宇	supplement
	13	Biosensor/biosignal processing	曹建和	6
	20	Biosensor/biosignal processing	林啓萬	4
	27	Final	莊曜宇	

Biomedical Engineering: A Historical Perspective

1.1 Evolution of the Modern Health Care System

1.2 The Modern Health Care System

1.3 What is Biomedical Engineering?

1.4 Roles played by biomedical engineers

1.5 Professional Status of Biomedical Engineering

1.6 Professional societies

The Modern Health Care System

- Electrocardiogram machine
- X-rays
- Antibiotics
- Full development of blood bank
- Development of complex surgical procedures
- Electron microscope

The First Electrocardiograph in 1903

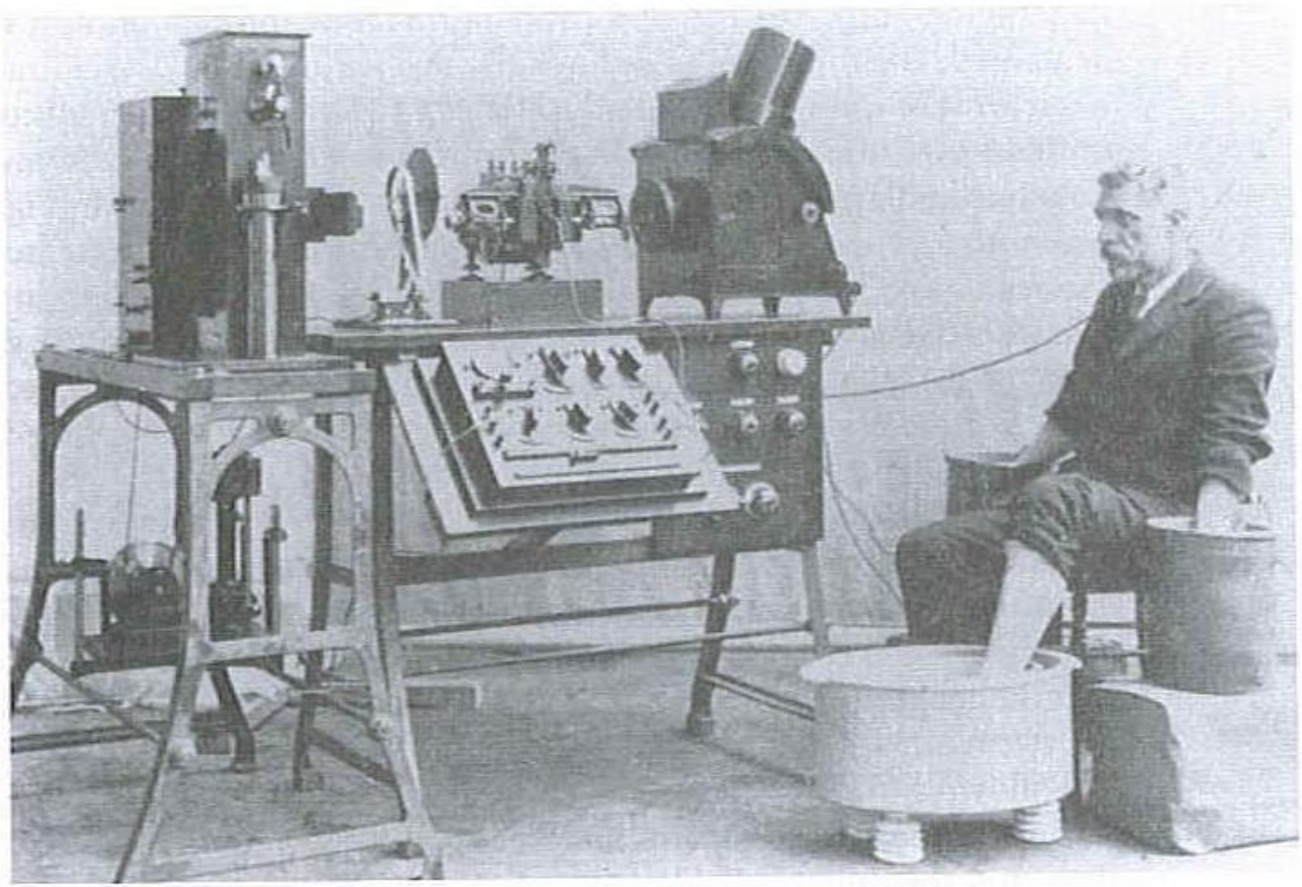

Fig. 1.1 Photograph depicting an early electrocardiogram machine.

Changes in the Operating Room

a

b

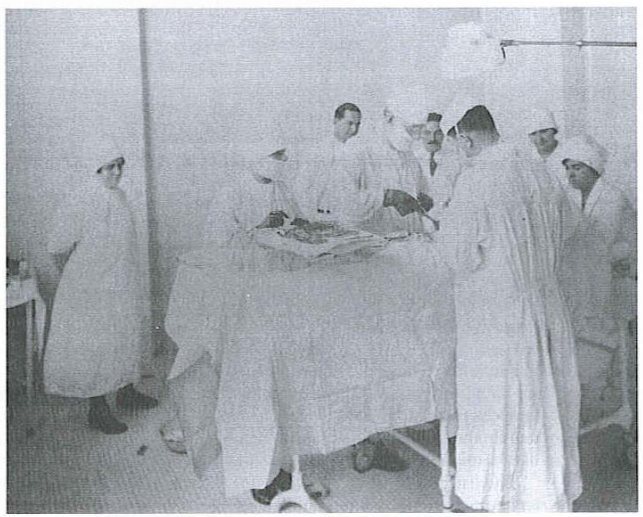

Fig. 1.2 Changes in the operating room: (a) the surgical scene at the turn of the century, (b) the surgical scene in the late 1920s and early 1930s, and (c) the surgical scene today (from Bronzino, 1977).

C

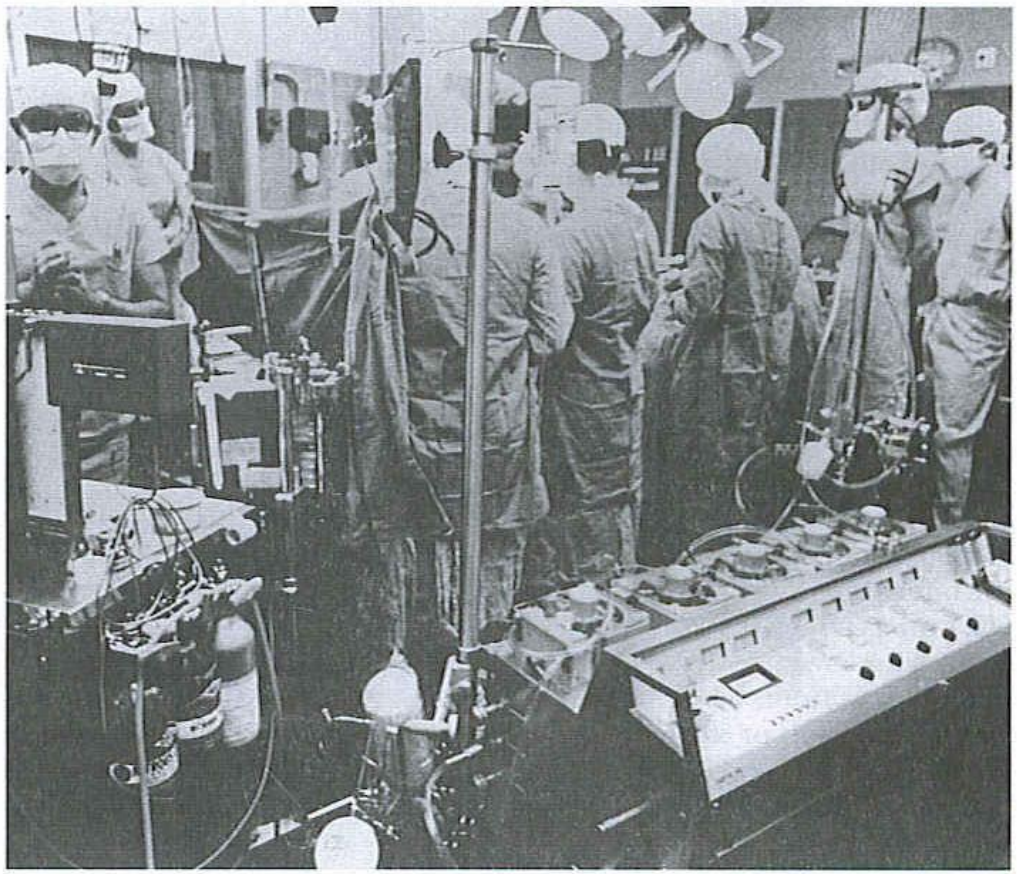

Fig. 1.2 *Continued*

CT Scan

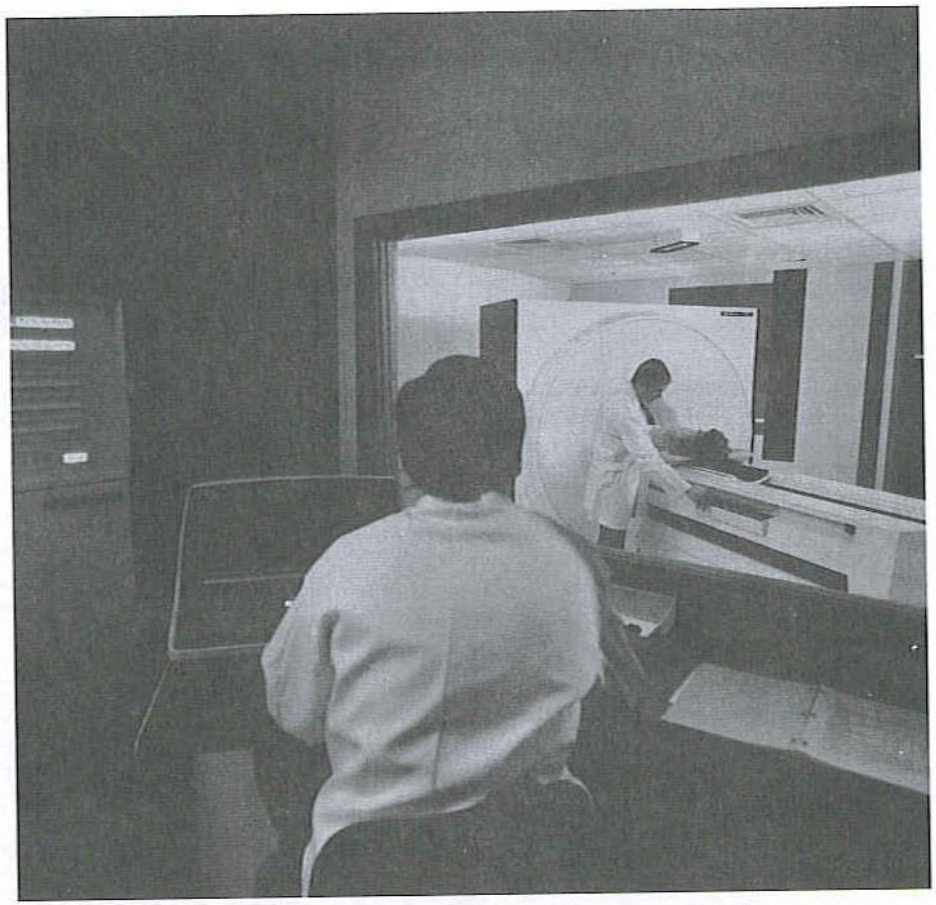

Fig. 1.3 Photograph of modern medical imaging facility.

Various Transplantation Procedures

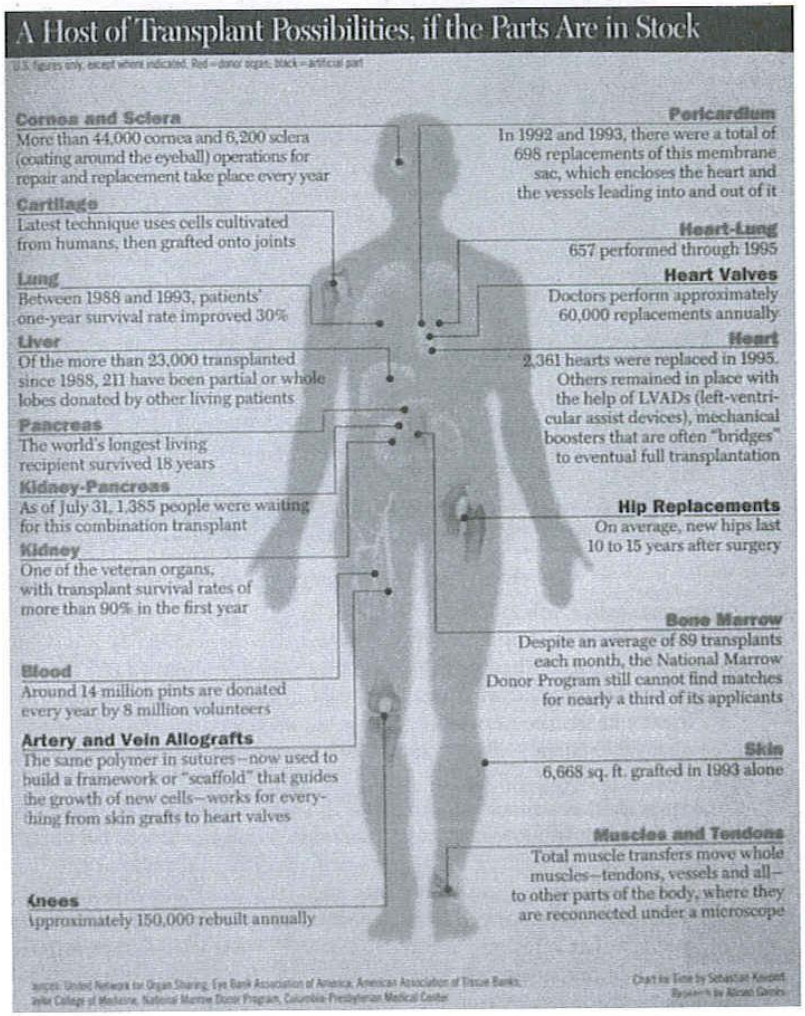

Fig. 1.4 Identification of various transplantation procedures (Chart by Sebastian Kaupert).

Remote Surgery Techniques

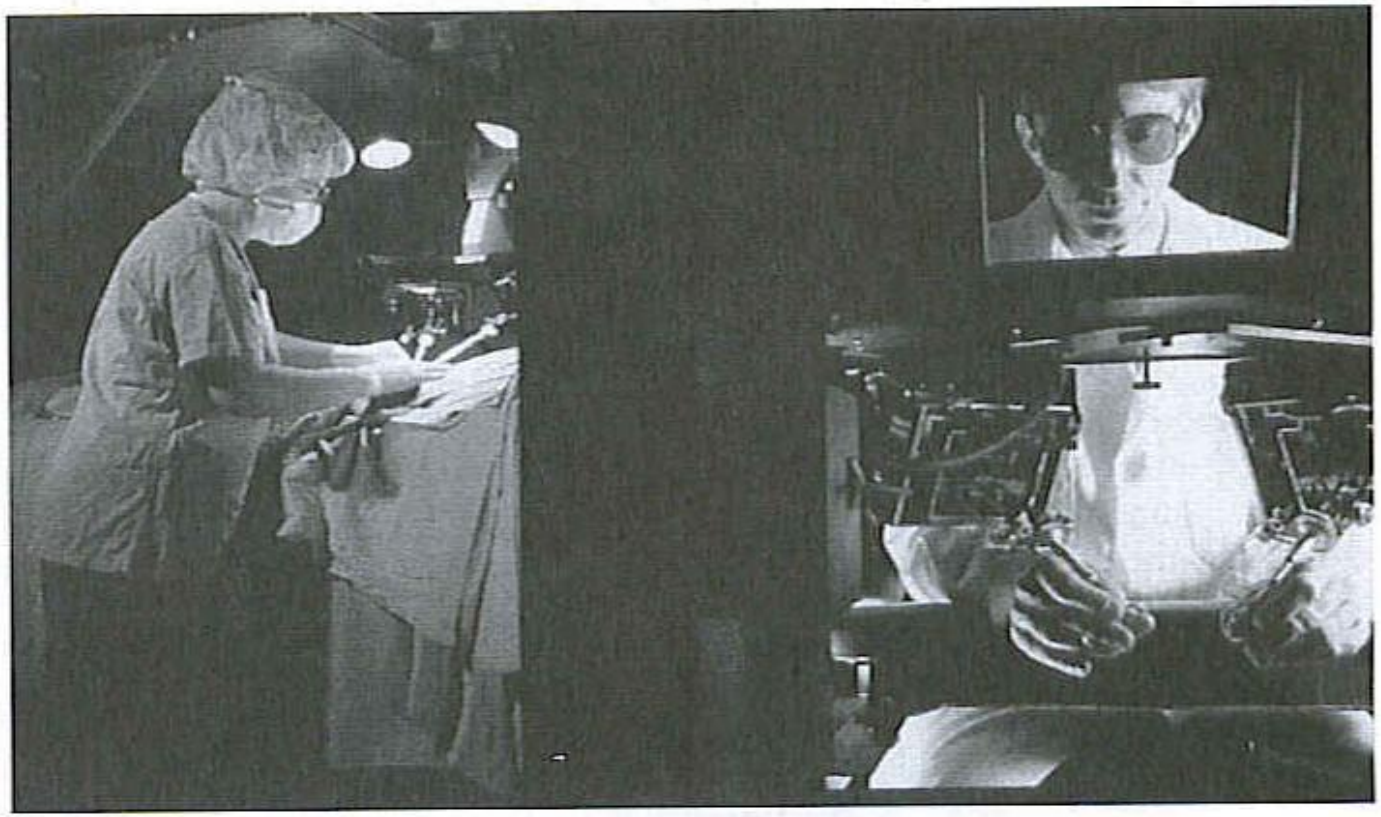

Fig. 1.5 The reach of technology — remote surgery techniques permit medical experts to assist others in the field (courtesy of Robert Holmgren/Zuma Syndication).

Laser Surgery

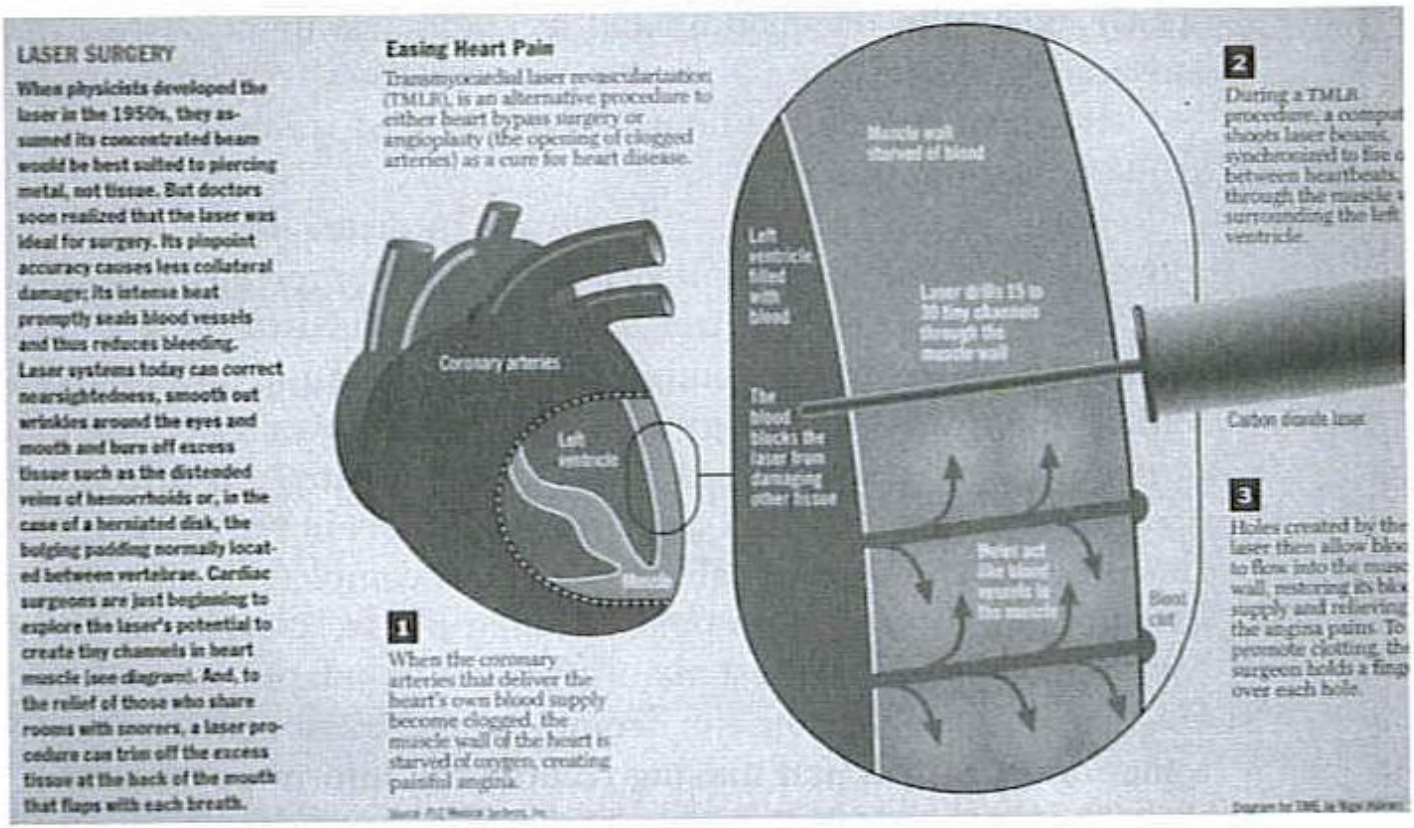

Fig. 1.6 Laser surgery — how it works (diagram by Nigel Holmes).

Typical Pursuits of Bioengineering

- Development of improved species of plants and animals for food production
- Invention of new medical diagnostic tests for diseases
- Production of synthetic vaccines from clone cells
- Bioenvironmental engineering to protect human, animal, and plant life from toxicant and pollutants
- Study of protein-surface interactions
- Modeling of the growth kinetics of yeast and hybridoma cells
- Research in immobilized enzyme technology
- Development of therapeutic proteins and monoclonal antibodies

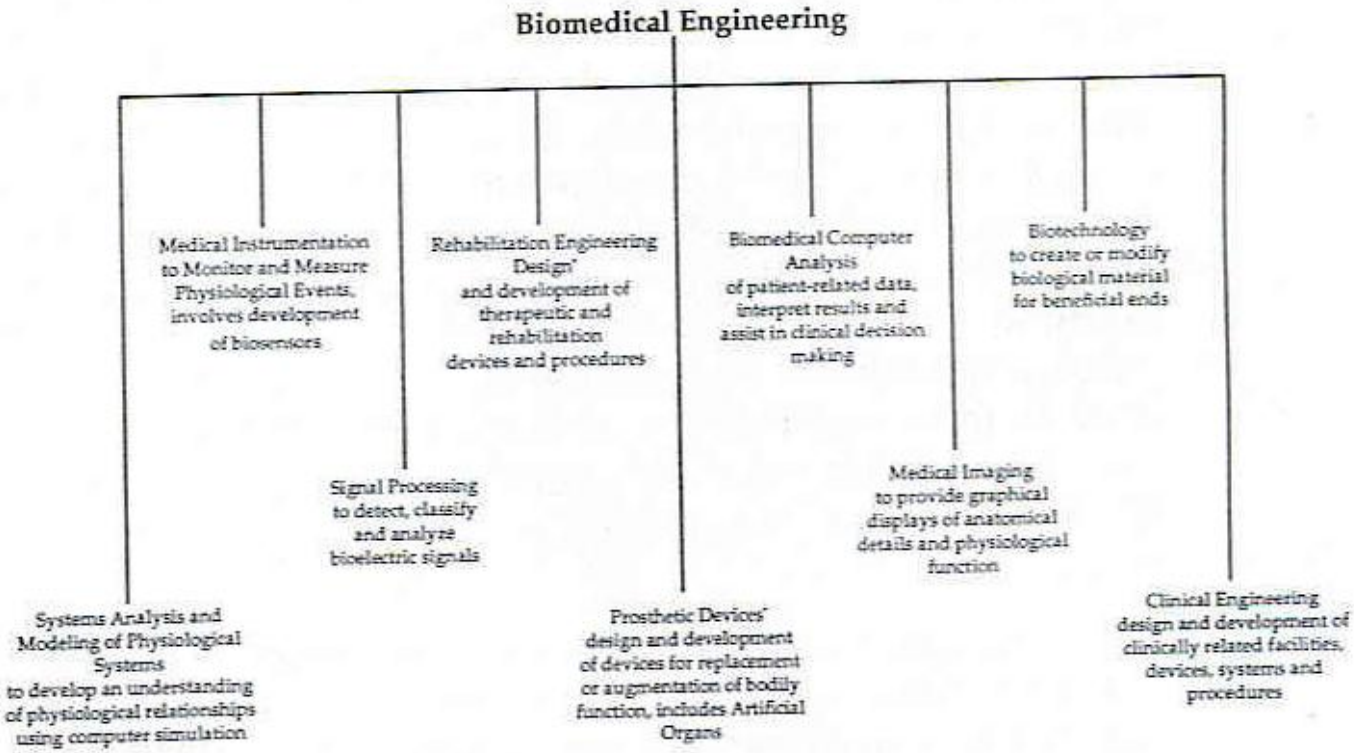

Fig. 1.7 Schematic diagram illustrating the various fields of activity within the discipline of biomedical engineering.

New Career Areas of Biomedical Engineering

- Application of engineering system analysis (physiologic modeling, simulation, and control to biological problems)
- Detection, measurement, and monitoring of physiologic signals (i.e., biosensors and biomedical instrumentation)
- Diagnostic interpretation via signal-processing techniques of bioelectric data
- Therapeutic and rehabilitation procedures and devices (rehabilitation engineering)
- Devices for replacement or augmentation of bodily functions (artificial organs)
- Computer analysis of patient-related data and clinical decision making (i.e., medical informatics and artificial intelligence)
- Medical imaging, that is, the graphical display of anatomic details or physiologic function
- The creation of new biologic products (i.e., biotechnology and tissue engineering)

Typical Pursuits of Biomedical Engineering

- Research in new material for implants artificial organs
- Development of new diagnostics instruments for blood analysis
- Computer modeling of the function of the human heart
- Writing software for analysis of medical research data
- Analysis of medical device hazards for safety and efficacy
- Development of new diagnostic imaging systems
- Design of telemetry systems for patient monitoring
- Design of biomedical sensors for measurement of human physiologic system variables
- Development of expert system for diagnosis of diseases
- Design of closed-loop control systems for drug administration
- Modeling of the physiologic systems of the human body
- Design of instrumentation for sports medicine
- Development of new dental materials
- Design of communication aids for the disabled
- Study of pulmonary fluid dynamics
- Study of biomechanics of the human body
- Development of material to be used as replacement for human skin

Roles Played by Biomedical Engineers

- The clinical engineer in health care
- The biomedical design engineer for industry
- The research scientist

Gene Therapy

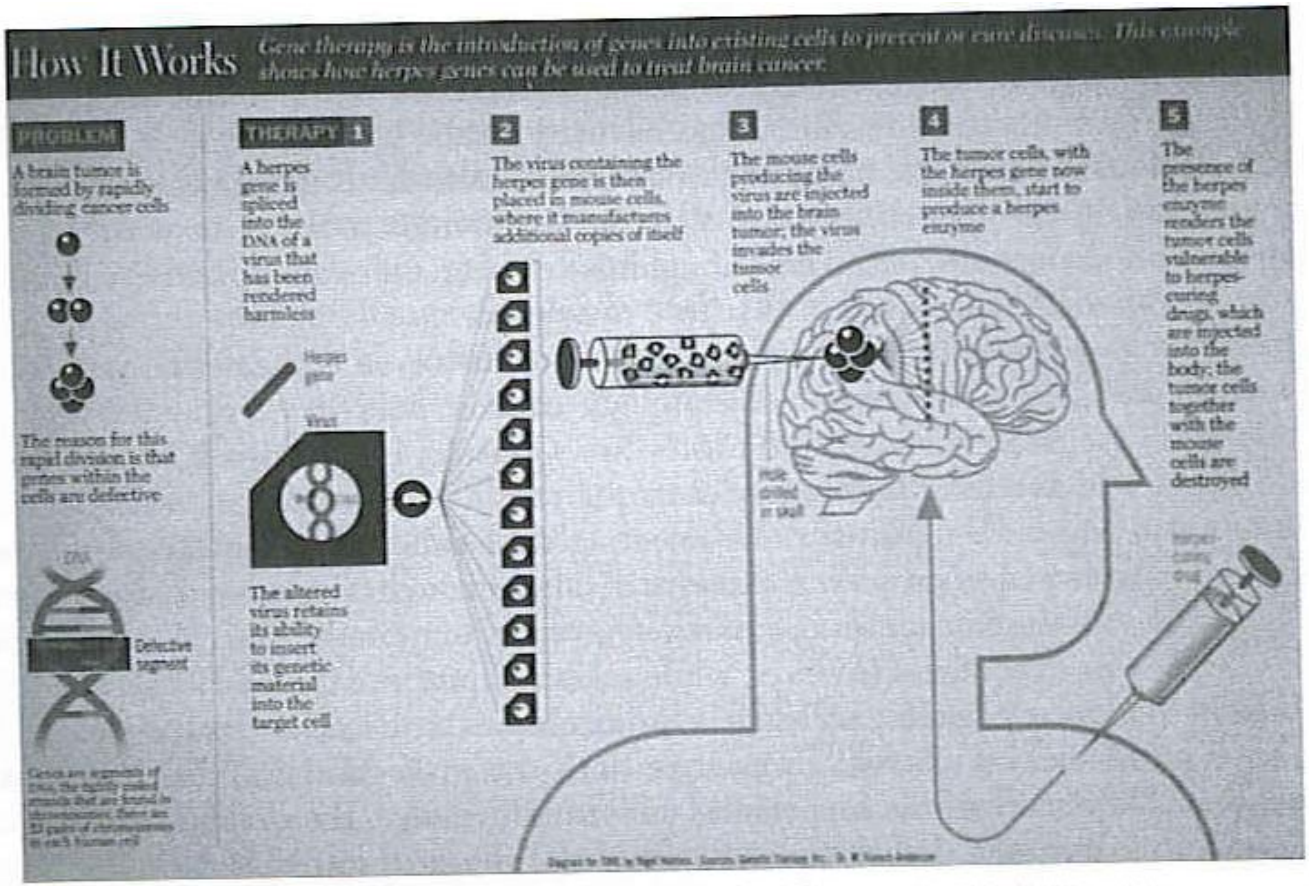

Fig. 1.10 Gene therapy — how it works (diagram by Nigel Holmes).

Professional Societies

- American Institute for Medical and Biological Engineering
- IEEE Engineering in Medicine and Biology Society
- International Federation for Medical and Biological Engineering

Exercises

- Select a specific medical technology from the historical periods indicated. Describe the fundamental principles of operation and discuss their impact on health care delivery
- The term “genetic engineering” implies an engineering function. Is there one? Should this field be included in the field of biomedical engineering?
- Provide modern examples (i.e., names of individuals and their activities) of the three major roles played by biomedical engineers.