生醫工程概論

上課時間: 週一 6, 7, 8 節

上課地點: 電機二館102

授課老師: 莊曜宇等四位 (電機二館249室, chuangey@cc.ee.ntu.edu.tw)

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　%

生醫工程概論95上				
Month	Date	Module	Instructor	Textbook Chapter
September	18	Overview	莊曜宇	1
	25	Physiology	陳文翔	3
October	2	Physiology	陳文翔	5 & 12
	9	Imaging	鍾孝文	15
	16	Imaging	鍾孝文	16
	23	Imaging	鍾孝文	supplement
	30	Sensor/Device/Instrumentation, Signal processing, Optics	宋孔彬	supplement
November	6	Sensor/Device/Instrumentation, Signal processing, Optics	宋孔彬	11
	13	Midterm	莊曜宇	
	20	Biology	莊曜宇	7 & 13
	27	Biochip/Bioinformatics	莊曜宇	supplement
December	4	Sensor/Device/Instrumentation, Signal processing, Optics	宋孔彬	9
	11	Sensor/Device/Instrumentation, Signal processing, Optics	宋孔彬	8
	18	Sensor/Device/Instrumentation, Signal processing, Optics	宋孔彬	10
	25	Sensor/Device/Instrumentation, Signal processing, Optics	宋孔彬	supplement
January	1	Holiday		
	8	Sensor/Device/Instrumentation, Signal processing, Optics	宋孔彬	17
	15	Final	莊曜宇	

Textbook: **Introduction to Biomedical Engineering (2nd edition)**

Author: John Enderle,Susan M. Blanchard,Joseph Bronzino

Academic Press 2005

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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

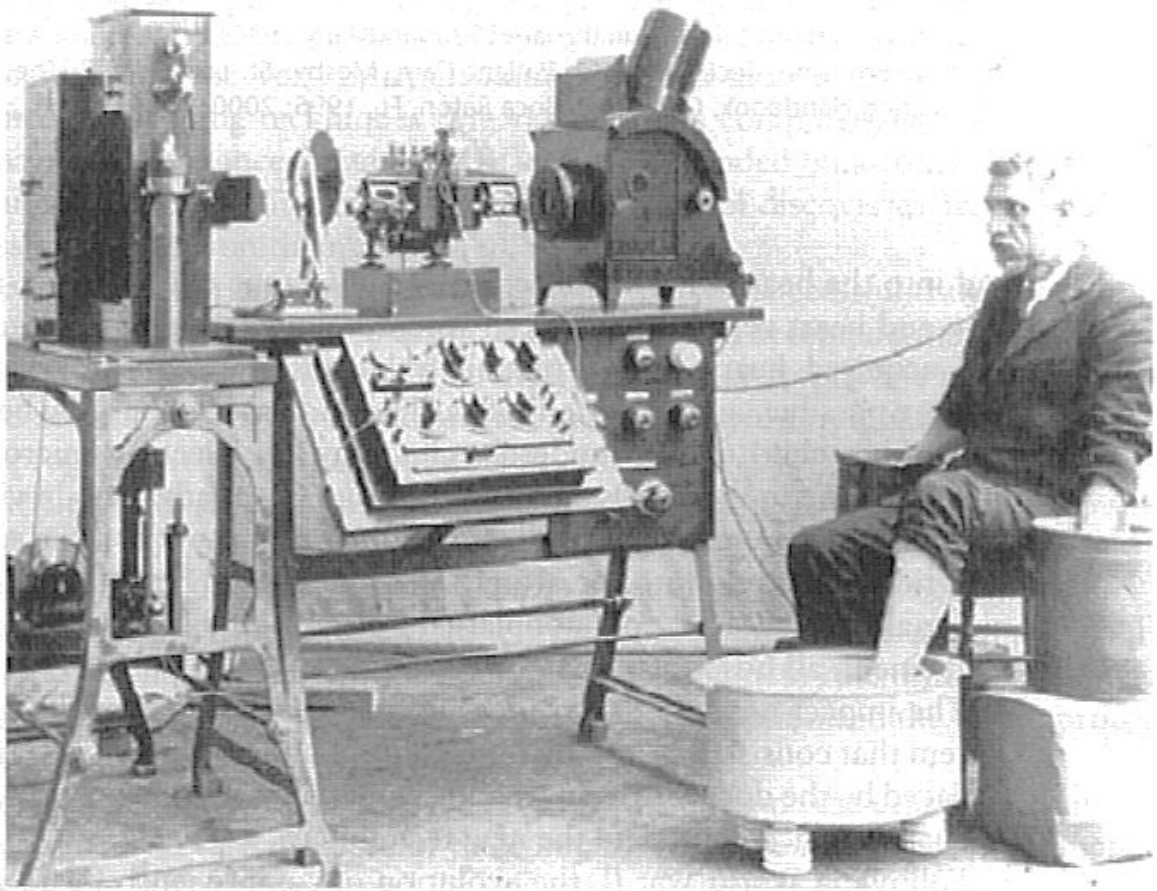


Figure 1.3 Photograph depicting an early electrocardiograph machine.

Changes in the Operating Room

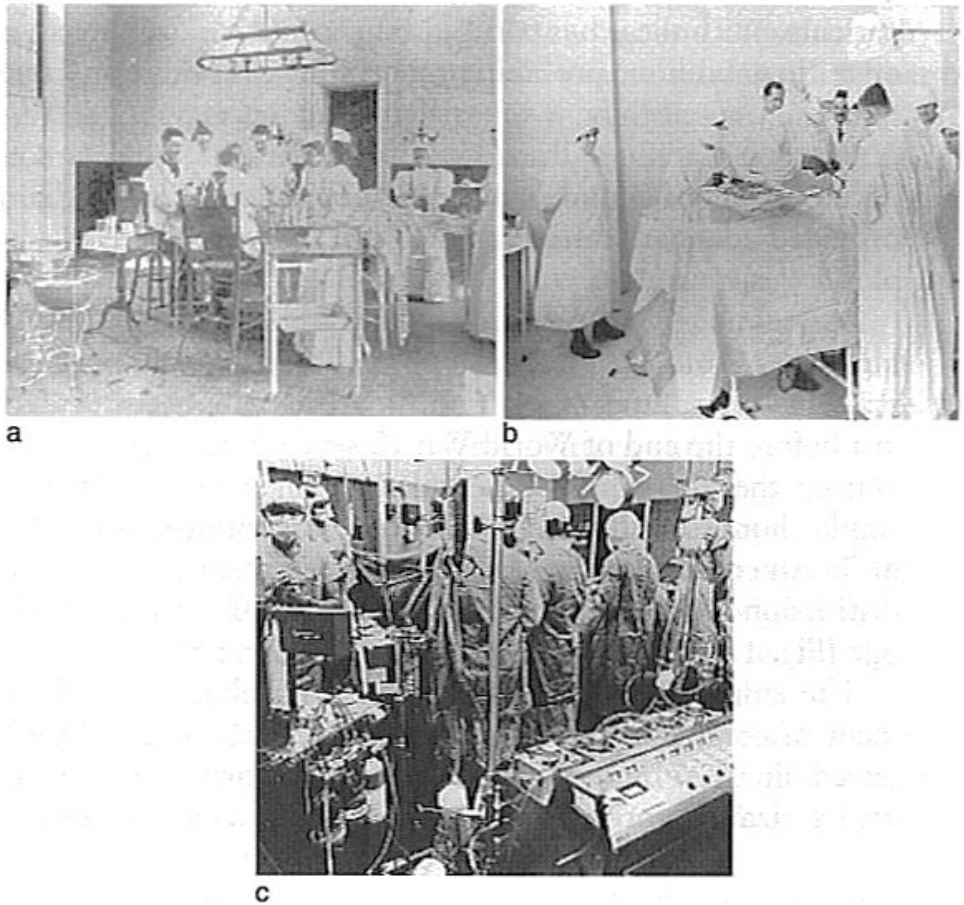


Figure 1.4 Changes in the operating room: (a) the surgical scene at the turn of the century, (b) the surgical scene in the late 1920s and early 1930s, (c) the surgical scene today (from JD Bronzino, Technology for Patient Care, Mosby: St. Louis, 1977; The Biomedical Engineering Handbook, CRC Press: Boca Raton, FL, 1995; 2000; 2005).

Medical Imaging

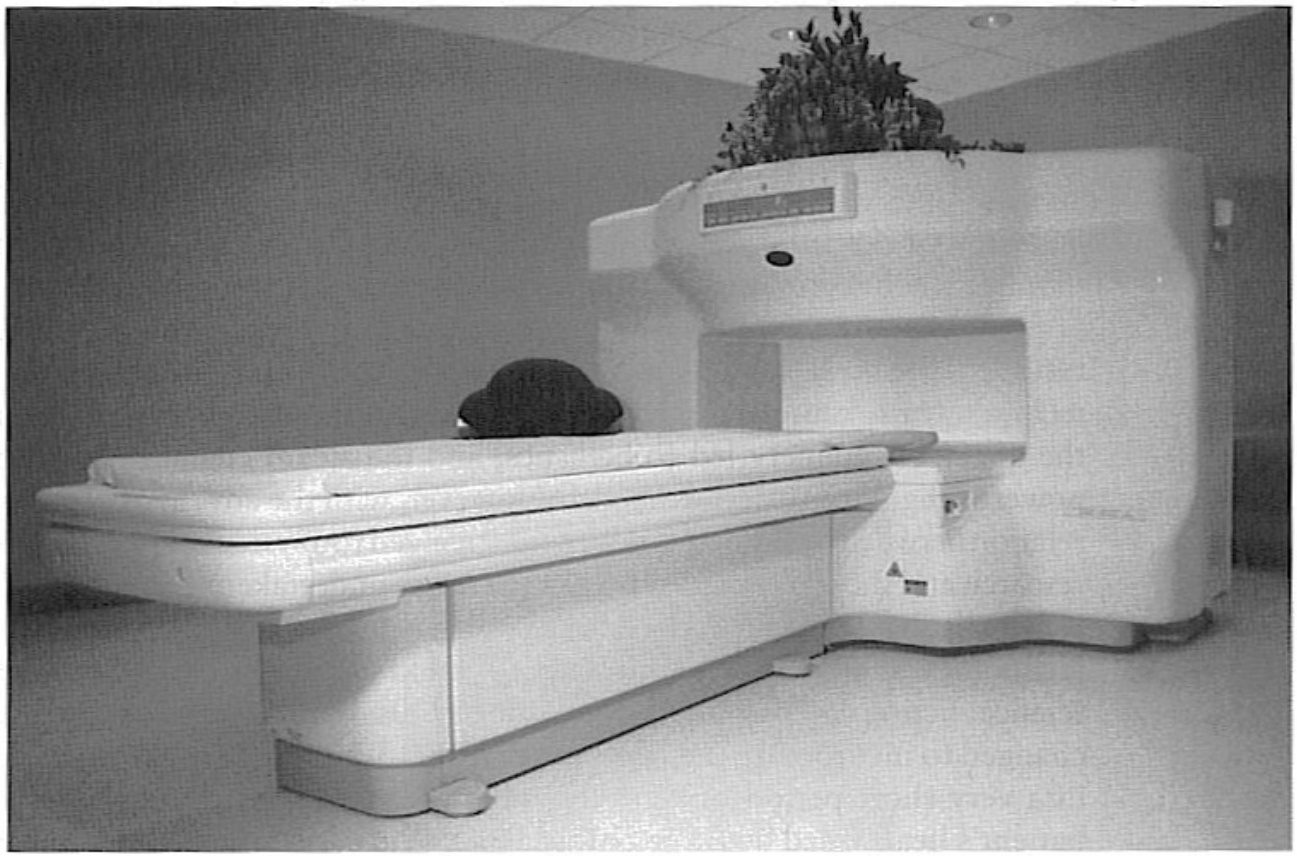


Figure 1.5 Photograph of a modern medical imaging facility (http://137.229.52.100/~physics/p113/hasan/).

Various Transplantation Possibilities

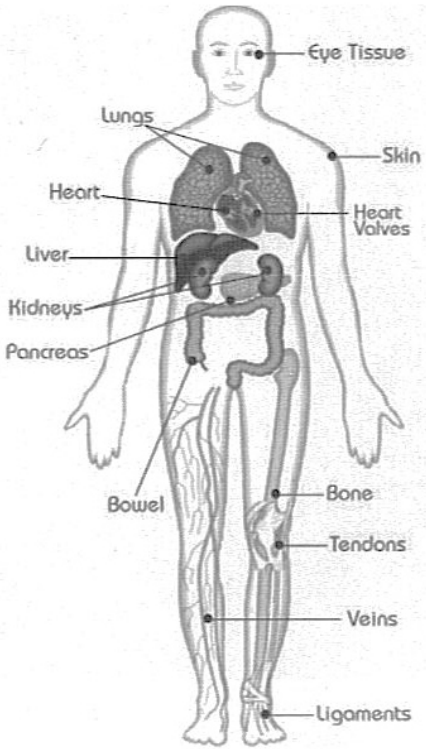


Figure 1.6 Illustration of various transplantation possibilities (http://www.transplant.bc.ca/images/what_organs.GIF).

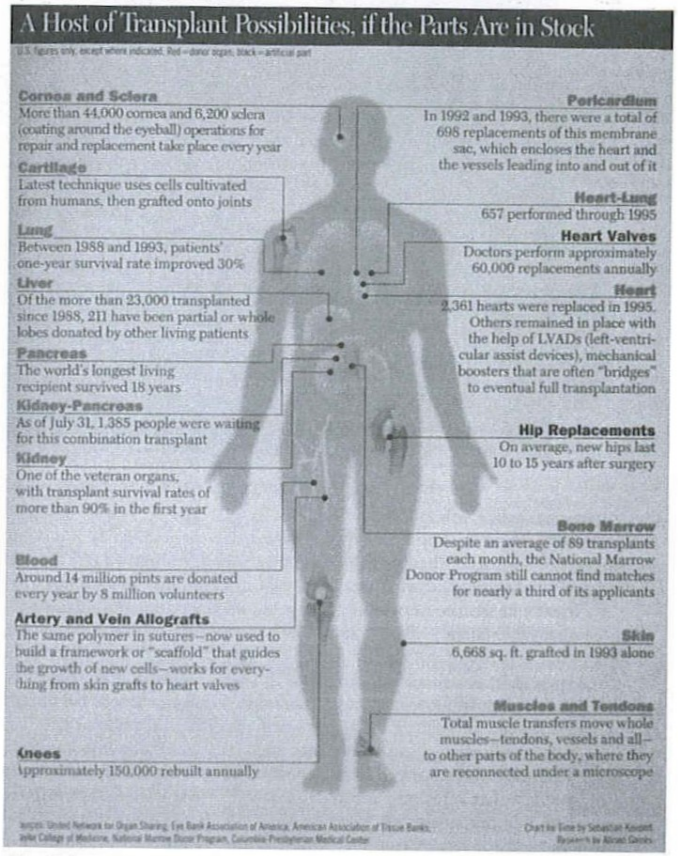


Fig. 1.4 Identification of various transplantation procedures (Chart by Sebastian Kaupert).

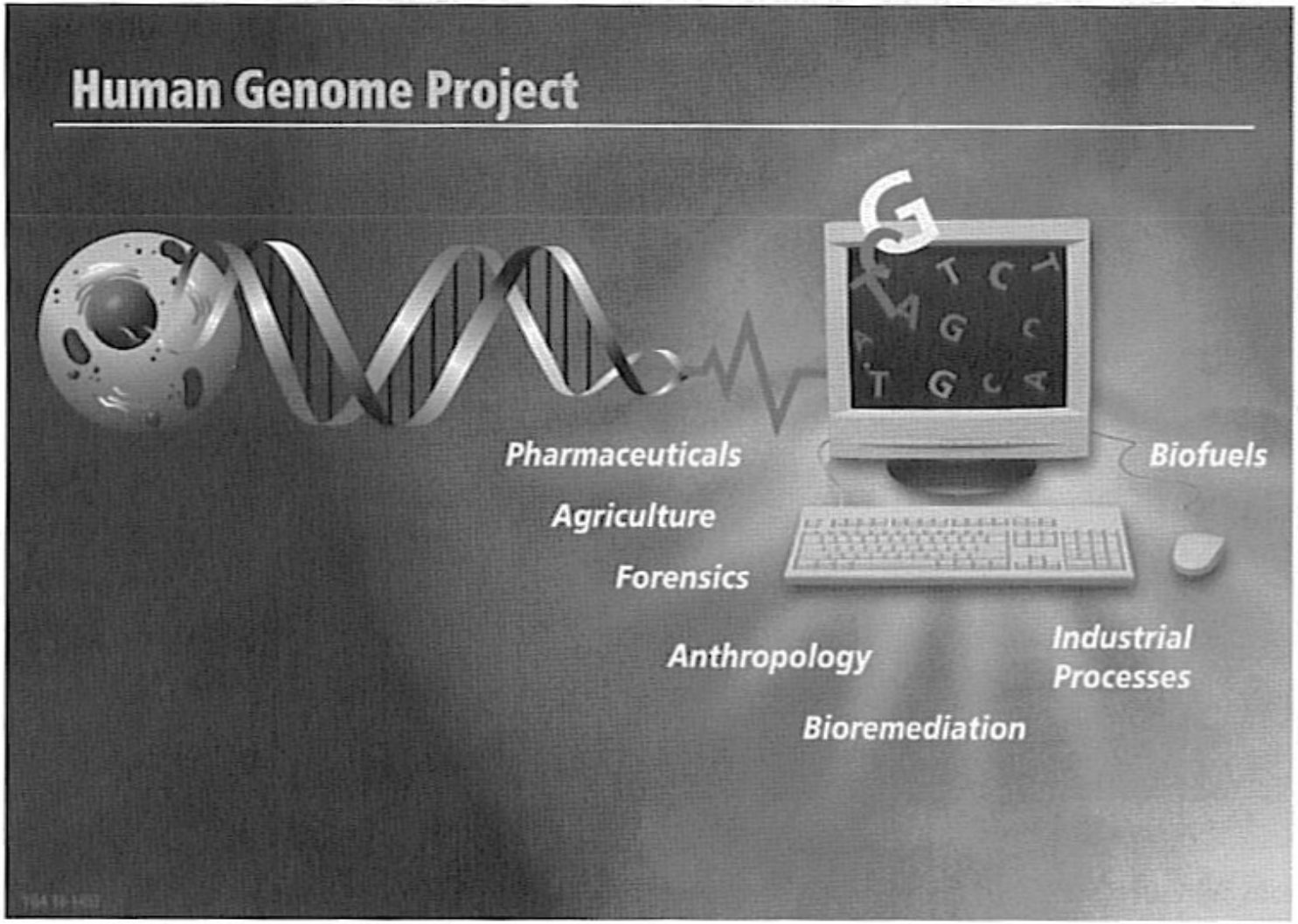


Figure 1.7 The Human Genome Project's potential applications (http://labmed.hallym.ac.kr/genome/genome-photo/98-1453.jpg).

LASIK- Laser-Assisted *In Situ* Keratomileusis

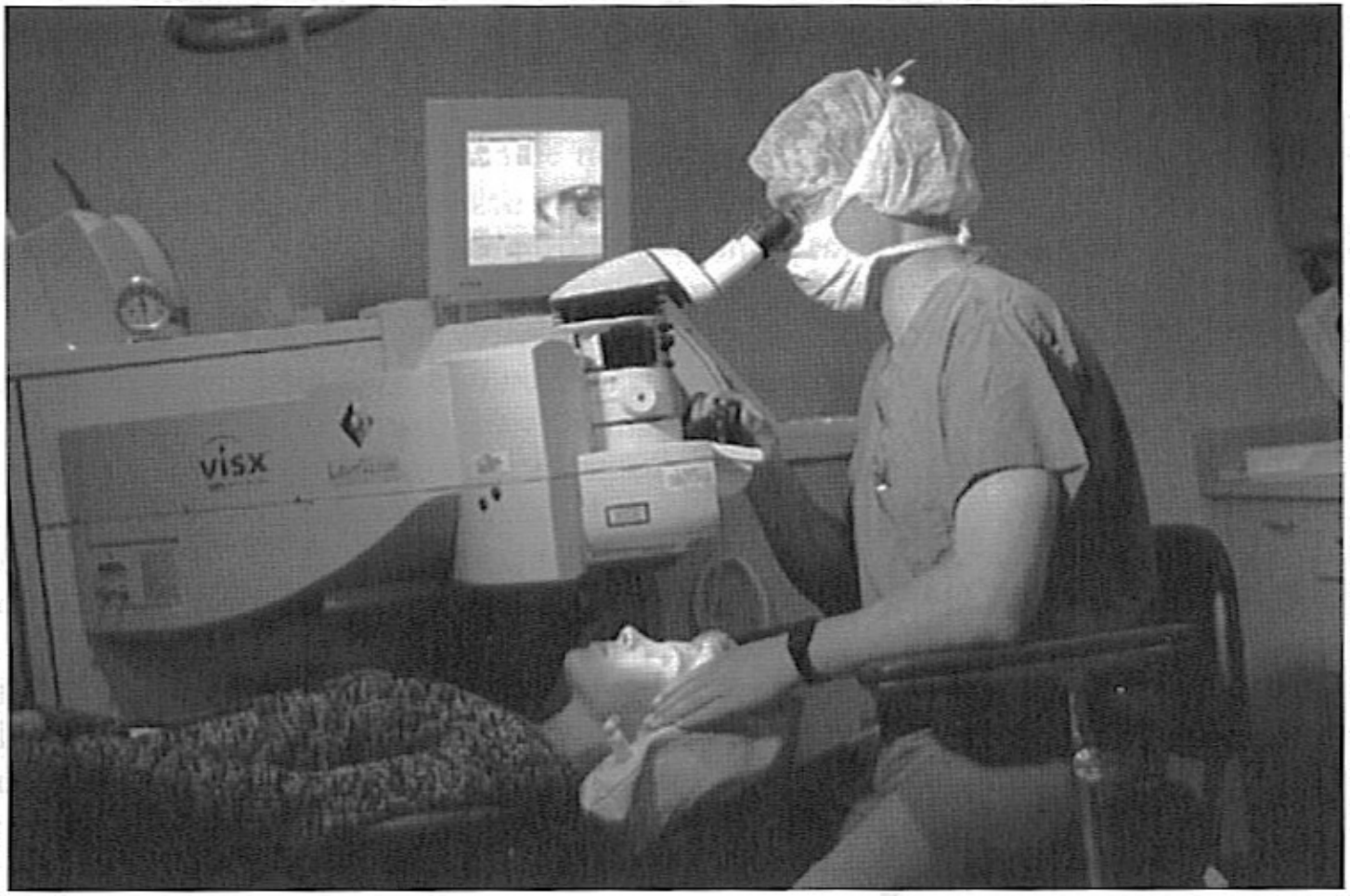


Figure 1.8 Laser surgery, a new tool in the physician's arsenal (http://riggottphoto.com/corporate/lgimg6.html).

Remote Surgery Techniques

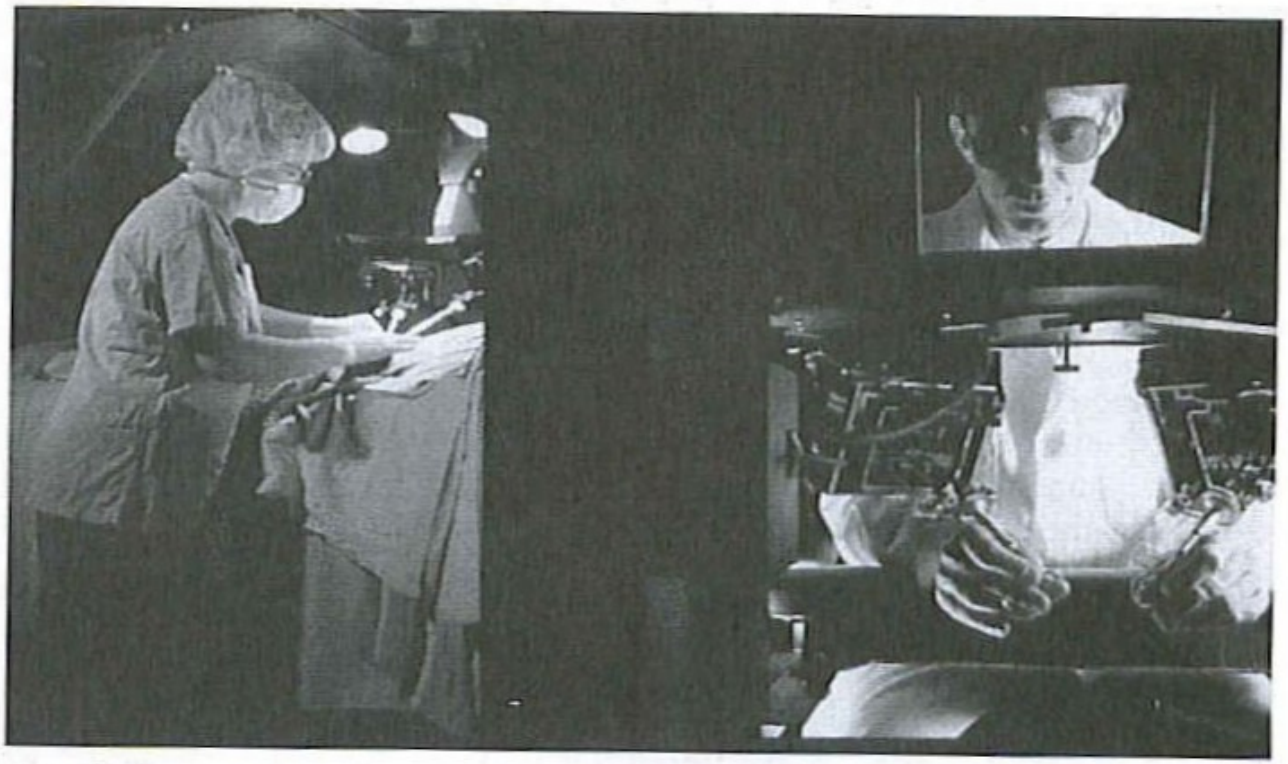


Fig. 1.5 The reach of technology — remote surgery techniques permit medical experts to assist others in the field (courtesy of Robert Holmgren/Zuma Syndication).

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

Biomedical Engineers

- Apply electrical, chemical, optical, mechanical, and other engineering principles to understand, modify, or control biological systems

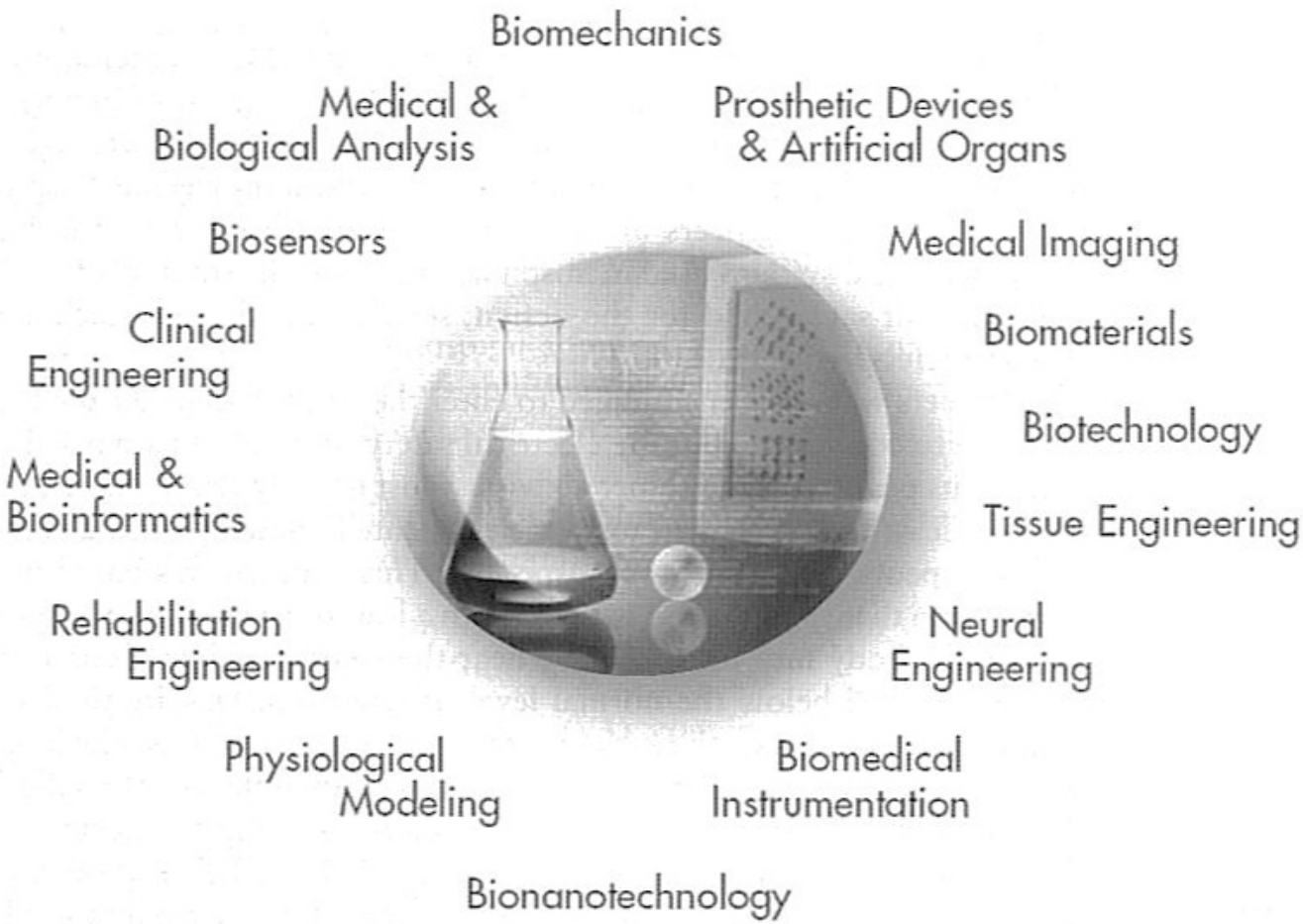


Figure 1.9 The world of biomedical engineering.

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 Engineers

- 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

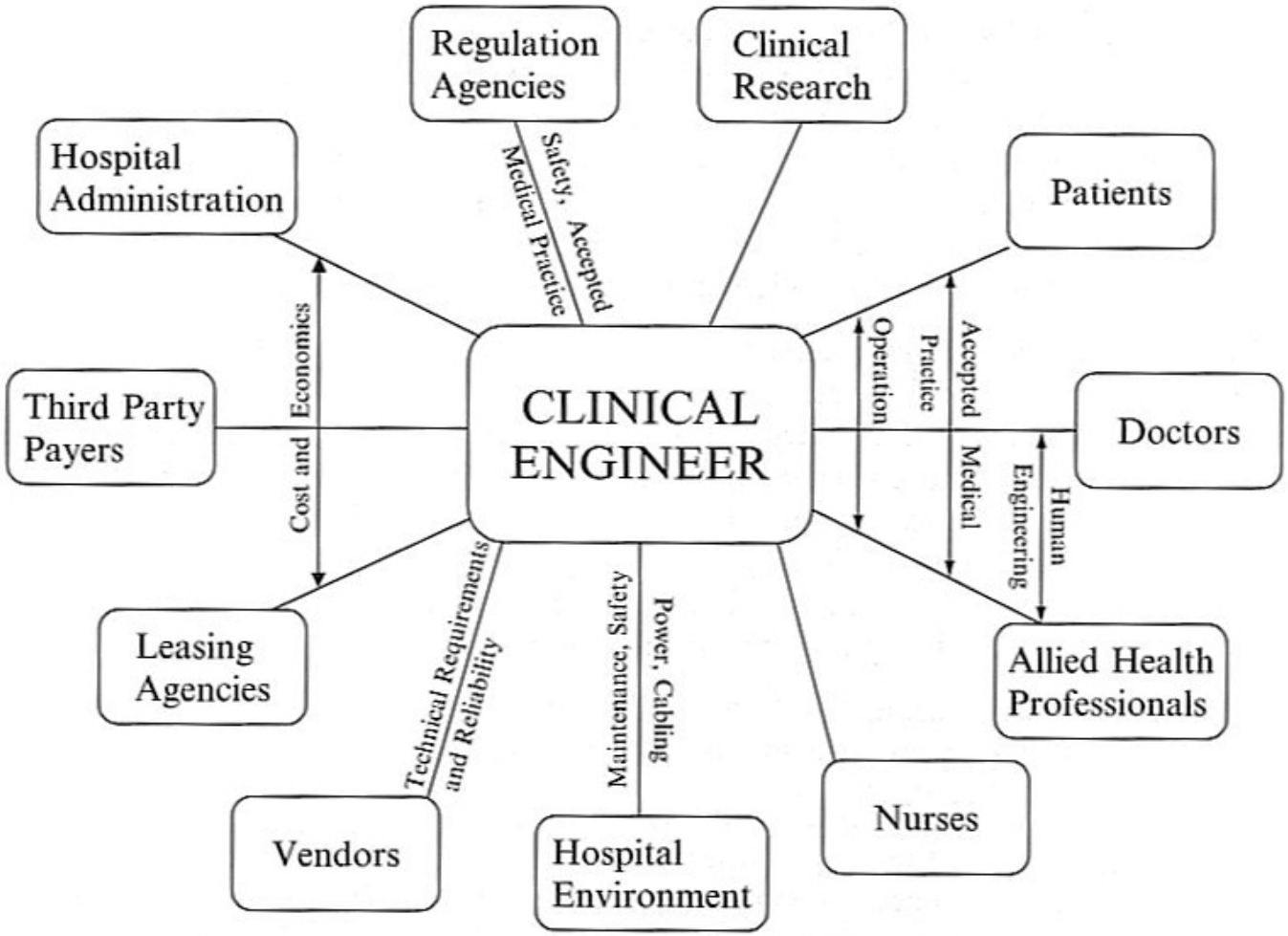


Figure 1.10 The range of interactions with clinical engineers in a hospital setting.

Gene Therapy

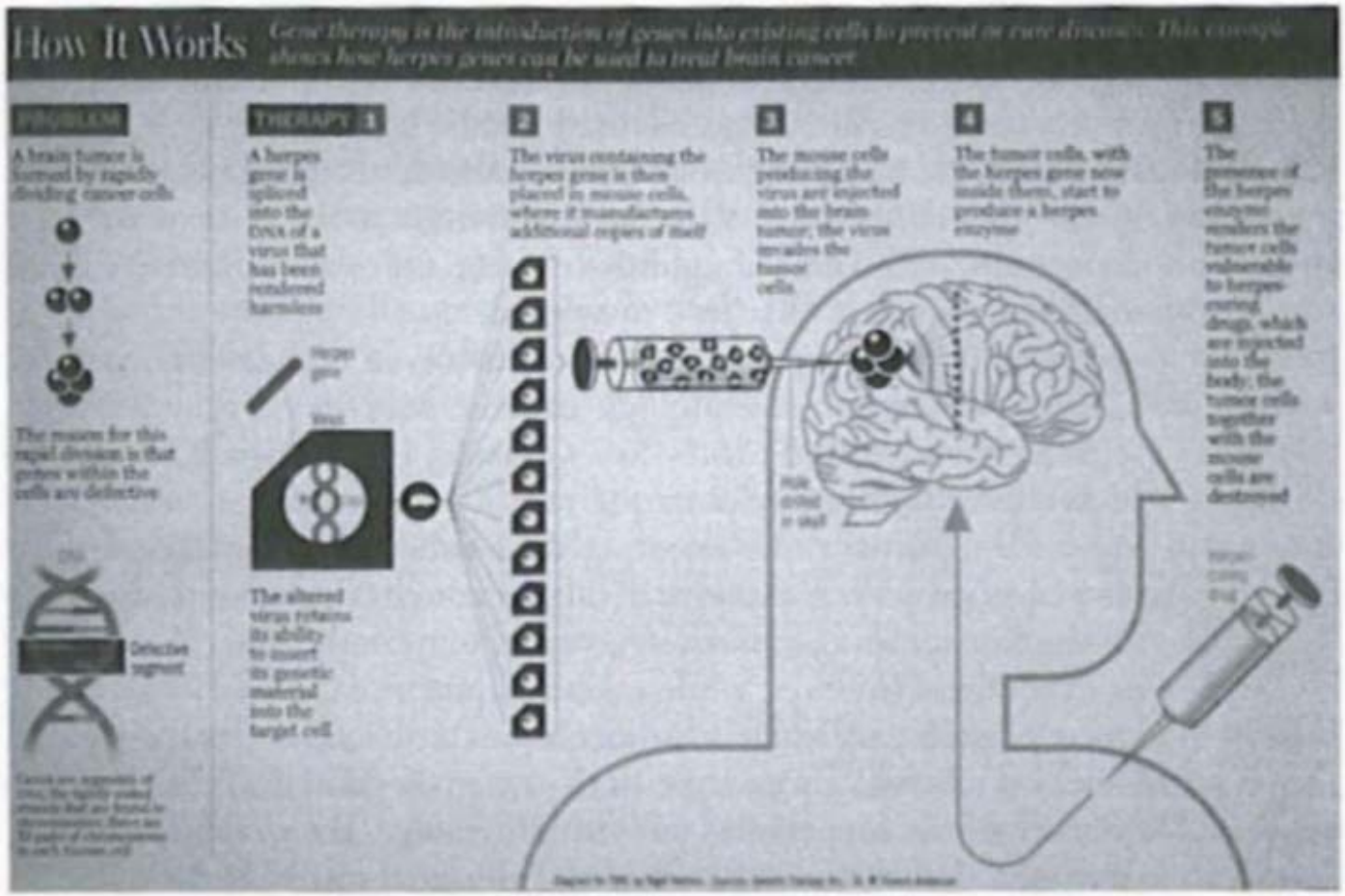
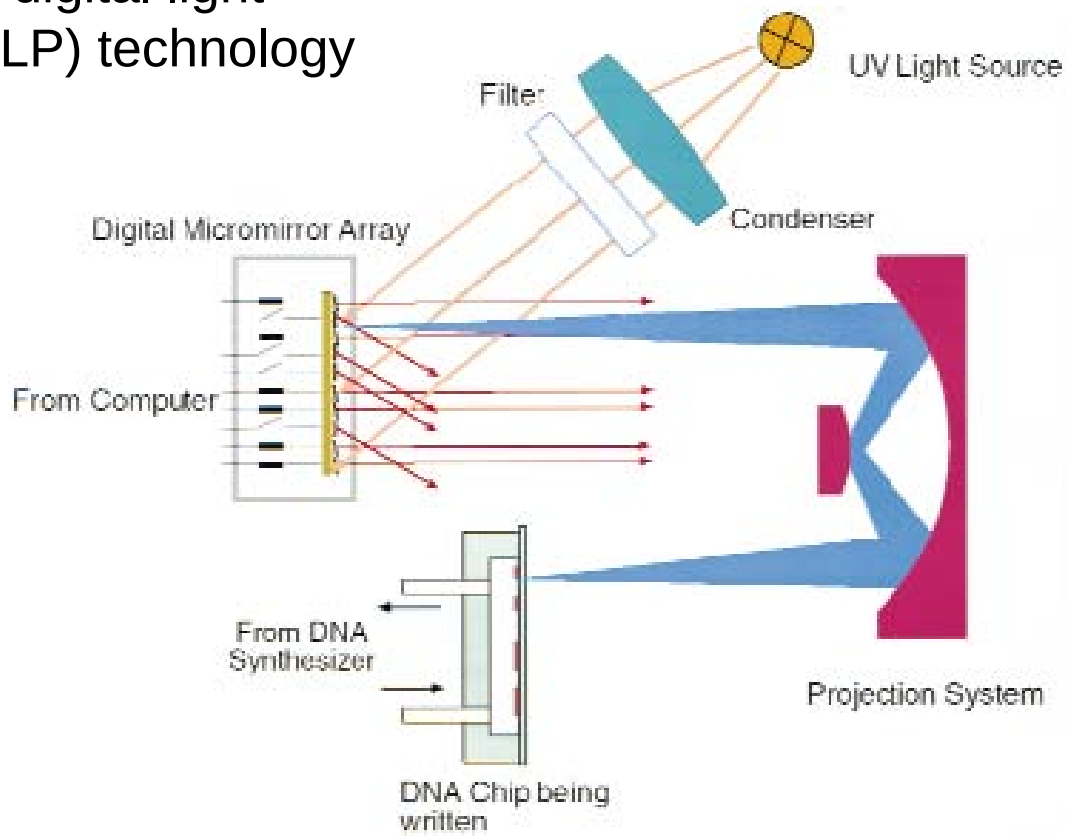


Fig. 1.10 Gene therapy — how it works (diagram by Nigel Holmes).

Biochip Production-Micromirrors

•Adaptation of digital light Processing (DLP) technology



The TELESYNERGY® System Developed at the NIH

TELESYNERGY® is a fully HIPAA-compliant video conferencing system that provides medical professionals with all of the components necessary to collaborate with one another on cancer research and treatment, regardless of geographical location. The system's multi-imaging capabilities integrate peripheral images into one system to be used together during a video conference where they can be viewed in near-diagnostic quality.

Collagen Matrix Engineering

Professional Societies

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

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
- Provide modern examples (i.e., names of individuals and their activities) of the three major roles played by biomedical engineers.