



CHAPTER 4

What is BIOMEDICAL ENGINEERING

When thinking about health care delivery team, we usually think about physicians, nurses and surgeons. However, technological innovations have progressed at such an accelerated pace that they have permeated almost every facet of our lives, especially the area of medicine and the delivery of health care services. The development of technologically based health care systems capable of providing a wide range of diagnostic and therapeutic treatments cannot be done without the presence of those who are specialized in engineering. Thus, biomedical engineers serve as relatively new members of the health care delivery team and their field emerges as an integrating medium for two dynamic professions, medicine and engineering.

PRE-READING

Improve Your Reading Skills

Restatement / Paraphrasing: Putting it in Other Words

One of the important reading skills is to be able to identify “synonymous sentences”. These sentences are different in form but similar in meaning. In these cases, the focus must be on meaning to find out similarities in meaning in spite of the use of different sentence formations.

Example 1:

“Although no one knew for sure who discovered penicillin, Fleming has won the honor among a few others.” How can this sentence be restated?

- a) Many people have claimed the honor of discovering penicillin among whom Fleming is the most famous one.
- b) It is not clear who discovered penicillin for the first time but many people consider Fleming as its discoverer.
- c) The fact that penicillin was first discovered by Fleming is not known by many people.
- d) Many people know that penicillin was discovered by several scientists among whom Fleming is the most famous one.

Pay attention that restatement is different from making inferences. Restatement means stating the same idea using different words, but inferencing means what can be understood from a sentence which is not directly stated.

Look at the example and decide which of the two choices is a restatement and which one is inferencing.

Example 2:

“The United States set the goal of landing the first man on moon in 1961 and accomplished it in 1969. “

- a) It took 8 years for the U.S. to land its first astronauts on moon during 1960’s.
- b) Before 1969, no man had been able to step on moon.

READING

Engineering and Technology at the Service of Life Sciences

Biomedical engineering (also called medical engineering or bioengineering) is the practice of solving problems in the life sciences including biology and medicine using an engineering approach. Biomedical engineers apply engineering principles to research and development of medical applications, including diagnostic, treatment and recovery technologies related to acute or chronic medical conditions. Biomedical engineers may specialize in medical devices, sports medicine, stem cell research, biomarkers, genomics, nanotechnology, etc. Biomedical engineers differ from other engineering disciplines that have an influence on human health in that they use and apply an intimate knowledge of modern biological principles in their engineering design practices. Aspects of mechanical engineering,

electrical engineering, chemical engineering, materials science, chemistry, mathematics, and computer sciences and engineering are all integrated with human biology in biomedical engineering to improve human health.

Background

Although biomedical engineering, as a field, did not exist 50 years ago, it can be traced back to centuries ago. This included prosthetic devices, designed to replace missing body parts. Mummies with wooden digits have been found in Egyptian tombs.

The new developments started in the late 1700s, when Galvani's experiments led to the exploration of the link between electricity and animal physiology and the use of electrical impulses of the body as diagnostic indications of health, such as in electrocardiology. Galvani's student Volta invented the first battery early 18th century, which almost immediately led to the application of electricity to therapeutic purposes. The discovery by Roentgen of x-rays in the 19th century led to the use of electromagnetic radiation for diagnostic purposes and how the rays could be used, with the eventual result being the common X-ray, one of the most frequently used tools for diagnosing medical problems.

The time after the World Wars was also an incredible era for medical innovations and breakthroughs, with many universities beginning to offer specialized programs for biomedical engineering and find ways to treat conditions that limit a patient's quality of life. This led to many discoveries, especially regarding the convergence of mechanical, electrical, and chemical engineering processes into complex medical systems. Such systems included dialysis, the pacemaker and ultimately the artificial heart, prosthetic devices that could respond, and the DNA testing that underlies a range of genetic technologies.

Advances and Innovations

Today, medical engineering projects include a wide range of innovations including artificial organs and prosthetic limbs, computer-assisted procedures and treatments, informatics and medical imaging, biosensors, biomaterials, image processing, artificial intelligence, nano cameras, nanobots, neuromodulation devices, genetic sequencing, and cellular scanning devices. Tissue and stem cell engineers are working towards artificial recreation of human organs, aiding in transplants and helping millions around the world live better lives. Clinical engineers work to ensure that medical equipment is safe and reliable for use in clinical settings.

The discipline is also concerned with the development of new medications, establishing a better base of knowledge about how the human body works, and simply creating elegant solutions for medical problems through the proliferation of a wide range of technologies from implantable medical devices, such as coronary stents, orthopedic implants, dental

products, and ambulatory devices to more futuristic technologies such as stem cell engineering, the 3-D printing of biological organs, and nanobots.

A Dream About Future

If you live until 2050, maybe you are able to live for a thousand years or even forever.” This idea may at first seem unrealistic, ambitious, and even foolish, but with the development of nanobots (nano robots), it may come true one day.

Nanobots or nanomachines are very tiny robots –50,000 of them would fit across the diameter of a human hair– that can act as microscopic medical weapons which identify and obliterate especially cancerous cells, but the technology can also be used to repair damaged or diseased tissues at a molecular level. They identify and penetrate malfunctioning cells and blast them. They will patrol the circulatory system of the human body, detect specific chemicals, symptoms or toxins and give early warnings of organ failure or tissue rejection. As well as these diagnostic and treatment functions, another potential function of them may be preventive, taking biometric measurements to monitor a person’s general health.

POST-READING

Recalling Information. *Decide if the following sentences are True (T), False (F), or Not Given (NG).*

- 1. A mummy is an ancient example of prosthetic limbs used for human body.
- 2. The modern bioengineering began in 18th century.
- 3. At the first half of the 20th century, bioengineering was taught at some universities.
- 4. Stem cell engineers have recreated heart, kidney and other organs.
- 5. Studying the genes has no relationship with the area of bioengineering.
- 6. Nanobots may be able to keep man alive forever.
- 7. Nanobots can only be used for diagnostic and therapeutic purposes.
- 8. The problems of transplanted organs have made bioengineers to recreate them artificially

Text Comprehension. *Provide the following questions with appropriate answers from the text.*

1. According to the text
 - a. The first cases of using technology in medicine happened after the World Wars.
 - b. The invention of Galvani paved the way for electrocardiology.
 - c. It took a long time for the electricity to be applied for curing purposes.
 - d. The technology of nanobots has cured many patients in the 21th century.

2. It can be inferred from this passage that
 - a. Egyptians were probably the first nation to make artificial limbs.
 - b. The use of electromagnetic radiation became common after Roentgen's discovery of x-rays in the 19th
 - c. Biomedical engineer use knowledge of many other engineering disciplines.
 - d. Nanotechnology helps bioengineering in designing tiny sensors and cameras.

3. What is the difference between biomedical engineers and other groups of engineering?
 - a. They need knowledge of biomaterial and chemistry.
 - b. Bioengineering uses technology for health purposes.
 - c. Bioengineers need and use a comprehensive knowledge of biology.
 - d. Bioengineers need to know nanotechnology in order to make extremely small devices.

4. "Another potential function of them may be prevention, taking biometric measurements to monitor a person's general health ". This sentence can be restated as
 - a. The invention and development of nanobots can prevent the measurement of general health conditions
 - b. Nanobots can possibly prevent diseases by measuring the features of a person's general health.
 - c. The prevention of diseases can control the general health conditions of a person.
 - d. With the development and applications of nanobots, there will possibly be no diseases in future.

5. What is the main idea of the fourth paragraph?
 - a. The first applications of technology in medicine during history
 - b. The first inventions in physics used for medical purposes
 - c. The importance of Galvani's experiments regarding the link between electricity and animal physiology
 - d. Pioneers of applying modern technology for medical purposes

Vocabulary Practice

Synonyms: Go through the text and find a word or phrase which is synonymous to the underlined words.

1. After the accident he left the city to remove painful memories.
2. He received a new kidney from another person, but his body rejected it.
3. The whole town is kept under surveillance by police because of the possibility of robbery.
4. The specialist recognized his disease as some type of blooddisorder.

5. Shortly before the crash, the pilot had reported a fault of the airplane's navigationsystem.
6. Tiredness, loss of appetite and sleeping problems are all classic signs of depression
7. He was so lucky that the bullet did not enter his brain.
8. An old bridge was to be exploded across the river.
9. There is much debate on the issue of "advertisements" placing falseideas in the heads of the audience.
10. After the earthquake, they made two moveable health care facilities to reach remote villages.