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Bioengineering: a short note

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ABSTRACT

The application of engineering principles, practices, and technologies to the fields of biology and healthcare can be regarded as bioengineering. This newly emerging field is characterized by its multidisciplinary nature, cutting across science, engineering, and medicine. Bioengineers are expected to have a solid education in engineering and sound knowledge of biology, physiology, and medicine. This short note discusses the basics of bioengineering.

KEYWORDS

bioengineering; biomedical engineering; biology; healthcare

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INTRODUCTION

In recent years, engineering has been subdivided into separate branches including bioengineering. Bioengineering or biomedical engineering is the application of engineering principles or methods to the fields of medicine and biology. Engineering itself is the discipline where physical and mathematical sciences are applied in creating and designing systems and tools to make human living more comfortable. The bioengineer must be well-grounded in the fundamentals of both biology and engineering knowledge. Bioengineering emerged from specific needs such as the desire of surgeons to bypass the heart, the need for replacement organs, and the requirement for life support in space.

Bioengineering tackles and solves complex problems in biomedicine using several tools in the fields of science and engineering in all their facets. Biomedical engineers have developed a variety of life-saving technologies including prosthetics, such as dentures and artificial limb replacements; surgical devices and systems, such as robotic and laser surgery; systems to monitor vital signs and blood chemistry; implanted devices, such as insulin pumps, pacemakers, and artificial organs; imaging methods, such as ultrasound, X-rays, particle beams, and magnetic resonance; diagnostics, such as lab-on-a-chip and expert systems; therapeutic equipment and devices, such as kidney dialysis and transcutaneous electrical nerve stimulation; radiation therapy using particle beams and X-rays; physical therapy devices, such as exercise equipment and wearable tech; and assisted living technologies such as telecare and home-based devices [1].

BIOENGINEERING BRANCHES

- Medical Engineering: This concerns the application of engineering principles to medical problems, including the replacement of damaged organs, instrumentation, and the systems of health care.
- Agricultural Engineering: This includes the application of engineering principles to the problems of biological production and to the external operations and environment that influence this production.
- Tissue Engineering: Tissue engineering aims at repairing or replacing damaged tissue. In tissue engineering, a large variety of synthetic and biological materials can be used to produce scaffolds.
- Food and biological process engineering: This includes microbiological engineering, food processing, and bioenergy.

- Bionics: This is the study of living systems so that the knowledge gained can be applied to the design of physical systems.

- Biochemical engineering: Biochemical engineering includes fermentation engineering, application of engineering principles to microscopic biological systems that are used to create new products.

- Human-factors Engineering: This concerns the application of engineering, physiology, and psychology to the optimization of the human–machine relationship.

- Environmental health engineering: Also known as bioenvironmental engineering, this field concerns the application of engineering principles to the control of the environment for the health, comfort, and safety of human beings.

- Genetic engineering: Genetic engineering is concerned with the artificial manipulation, modification, and recombination of deoxyribonucleic acid (DNA) or other nucleic acid molecules in order to modify an organism [2].

BENFITS AND CHALLENGES

Research in bioengineering presents exciting possibilities for biomedical and pharmaceutical applications. Bioengineering has the potential to improve the existing healthcare systems. There is a growing need for well-trained bioengineers due to economic growth and medical advances. Bioengineering applications in the assessment of current treatment modalities can lead to the development of new therapeutic devices. The diversity of bioengineering may be considered both a blessing and a curse. The translation of ideas from basic bioengineering research to commercial operation or development of new products is usually an expensive, high-risk, and time-consuming process. The issue concerning who should fund translation is not as clear-cut. The pharmaceutical sector can provide funding to enable translation [3]. There is an ongoing debate on the social and ethical implications of bioengineering. Some scientists and engineers have been concerned with the ethical implications of bioengineering. Bioengineering raises challenges that transcend the ethics of complex healthcare [4].

CONCLUSIONS

Bioengineering includes several areas of scientific interest, each of which is governed by many different factors. It integrates physical sciences and engineering principles for the study of biology, medicine, and health. Advancement in bioengineering is an ever-evolving process. The employment opportunities for bioengineering graduates are increasing. Such students are needed by emerging cell and tissue engineering companies [5].

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