Dear Editor,

Please find enclosed a modified version of my Microreview [or high school textbook chapter for the next assignment] manuscript “Biotechnology” To address the concerns and comments raised by the 3 reviewers, I made the following changes to improve and clarify the manuscript. It is my hope that these changes make the manuscript acceptable for publication in Microreviews in Cell and Molecular Biology.

* Added a section over “Karoly Ereky” as suggested
* Simplified manuscript so it would be easier to understand

Sincerely,

Alexandra Lopez

**Reviewer 1:**

 1. Briefly state if you found the comments of Reviewer 1 helpful or not.

I understand the points raised by Reviewer 1 and definitely took their thoughts into account while making revisions. I agreed with most everything they said.

 2. What changes did you make to your manuscript as a result of the comments of Reviewer 1?

Reviewer 1 made a valid point that the article would be hard to understand by a high school audience. I went ahead and simplified the article. He also pointed out that I didn’t write about Karoly Ereky and added a section about him.

**Reviewer 2:**

1. Briefly state if you found the comments of Reviewer 2 helpful or not.

I did not find the comments helpful. Reviewer 2’s comments were not necessarily constructive or nice. Although I agree it might not flow the way he intends, but I think as a textbook chapter, the sections should be able to be read by themselves and you should be able to start in any section in case you need to find information quickly. They also made comments over personal opinions that were unnecessary.

1. What changes did you make to your manuscript as a result of the comments of Reviewer 2?

I made minor changes in the flow, but as I did not agree with Reviewer 2, I made no major changes.

**Reviewer 3:**

1. Briefly state if you found the comments of Reviewer 3 helpful or not.

Reviewer 3 was helpful in telling me what things I shouldn’t change and what I did a good job on.

1. What changes did you make to your manuscript as a result of the comments of Reviewer 3?

Although Reviewer 3 stated that the two column format was not helpful, I do think most textbooks are in columns so I decided to stay with that format.

**Chapter 1: Biotechnology**

**I. What is Biotechnology?**

Biotechnology is the exploitation of biological processes for industrial and research purposes. It is a broad area of biology involving living systems and organisms that are manipulated to create processes and products. To simplify, biotechnology is technology based on biology. Biotechnology has been used for over 6,000 years in agriculture, environment, medicine, and food production. Biotechnology is used in research and development in the laboratory using bioinformatics for exploration, extraction, exploitation, and production from any living organism.

The domestication of plants and animals is the earliest example of biotechnology. Rice, barley, and wheat were all examples of some of the first domesticated plants, wild animals were tamed to provide milk, meat, or help with the farm, and dog, sheep, and goats are thought to be the first animals to be domesticated. Back in the day, ancestors used microorganisms to make cheese, yogurt, bread, beers, and wine.

Theophrastus, an ancient Greek who lived 2,300 years ago, swore that broad beans left magic in the soil. A French chemist years later suggested that some organisms would be able to fix atmospheric nitrogen into plant fertilizer. Some of the first forms of agritech include using cattle as power for cultivation and finding that seeds can be used to grow plants. These examples show how biotechnology has been used for years.

One of the main industries in biotechnology is agriculture. Agriculture in biotechnology is also called agritech. Crop modification, improved nutritional contents, genes and traits of crops, and genetically modified crops, are all part of agritech. Crops have been engineered to decrease pesticide and herbicide usage, protect against stressors, enhance yields, and extend shelf life. People have crossbred plants or animal species to develop new varieties or hybrids with advantageous traits for centuries. Modern techniques include genetic engineering which has the opportunity to select the characteristics that are needed. Genomics information is used to determine the nutritional needs of animals which consist of higher quality meat, eggs, or milk. Another way biotechnology is used is in cloning animals. This results in a way to make the healthiest and most productive livestock. Even when not cloning, genetic engineering can be used as a tool for breeding. Biotechnology is also used in the food industry in processes like fermentation and in areas like safety.

Perhaps the biggest industry in biotechnology is medicine. Biotechnology is used in medicine for diagnosing and treating diseases. Microorganisms are used to develop drugs in biopharmaceuticals. The source of biopharmaceuticals are proteins that target mechanisms of diseases. Gene therapy is used to treat diseases as well as diagnose them. Gene therapy can destroy damaged cells and replace them or even make corrections to genetic information. Another way to genetically modify a cell is through pharmacogenomics. This technique is used to study the genetic information of an individual and analyzes the body’s response to such drugs. It combines pharmaceuticals and genomics. Lastly, genetic testing is a technique in genetics used to determine genetic diseases. This is done by using DNA probes which have the sequences similar to the mutated sequences. This is also used for identifying criminals and testing the paternity of the child.

Another area of biotechnology is environmental biotechnology, which is used to solve environmental and ecosystem problems. Environmental biotechnology helps keep our environment safe and clean. It is used in biomarkers, bioenergy, bioremediation, and biotransformation. Biomarkers help measure the level of damage caused or the exposure to a toxic or pollution effect. Bioenergy includes biogas, biomass, and fuels. Clean energy is needed for the recent climate change crisis. Bioremediation is the process of cleaning up toxic and hazardous substances, and biotransformation is used in the manufacturing sector where toxic substances are converted to biproducts. Other uses of biotechnology in the environment include drought, salt, and heat tolerance, flood tolerance, cold adaptation, and frost resistance.

**II. Influential People**

**i. Louis Pasteur**

Louis Pasteur was a French biologist, microbiologist, and chemist who is known for his breakthroughs in vaccination, microbial fermentation, and pasteurization. Pasteur obtained his master of science degree and in 1847 he earned his doctorate of science in 1847. He was appointed as a professor of Physics in 1848 and later he accepted a position as a professor in chemistry.

Pasteur discovered the existence of molecular asymmetry and the foundation of stereochemistry, as it was revealed by optical activity. He studied the relationship that existed between crystal structure and molecular configuration. His studies led to the conclusion that asymmetry was one of the fundamental characteristics of living matter.

In 1854, Pasteur was appointed professor of chemistry and dean of the science faculty at the University of Lille. There he was asked to solve issues at a local distillery. This led to his research in alcoholic fermentation. He presented evidence for the participation of living organisms in all fermentative processes. He also presented that a specific organism was associated with each particular fermentation. Pasteur also studied the fermentation process of butyric acid. This led to the discovery that the fermentation process could be stopped by oxygen through the fermenting fluid. This led to the introduction of aerobic and anaerobic organisms. This was called the Pasteur effect. He also proposed that the phenomena occurring during putrefaction were due to specific germs that function under anaerobic conditions.

After the beer and wine industries were on the brink of collapse, Pasteur applied his new knowledge on fermentation to help with production problems. He heated the wine to prevent contamination. This is also known as “pasteurization”. Today, this process is used in many foods and beverages, including milk. Pasteur also helped save the silkworm crisis. After a disease had attacked the silkworm nurseries in France, Pasteur decided to try to save yet another dying industry. He decided to study infectious disease and eventually succeeded in saving the silk industry. After the silkworms, Pasteur kept studying infectious diseases and he developed certain practices of epidemiology, which he later applied to animal and human diseases.

After working with infectious diseases, he developed the principle of vaccination and immunology. He began by working on a disease called chicken cholera. He inoculated chickens with an attenuated form of the disease and displayed the chicken’s resistance to the original strand. He then applied this to many other diseases. After an anthrax epidemic, Pasteur confirmed that the anthrax bacillus was responsible for the infection. This established the germ theory of diseases, which is the fundamental concept of medical microbiology. He then developed a vaccine for the anthrax bacillus that confirmed his work was valid. He eventually studied pathogenic microbes and microbial mechanisms which made him a pioneer in the field of pathology. He went on to develop a vaccine for rabies which would be his last piece of work. His research led to the beginning of the era of preventable medicine.

**ii. Gregor Mendel**

Gregor Mendel is known as the founder of modern science of genetics. He was not very successful in his early life due to mental health issues, but his first science experiment, an experimental program in hybridization, started in 1854. His goal was to trace the transmission of hereditary characters in successive generations of the hybrid progeny. He conducted his famous study with a pea which led to the Law of Segregation and the Law of Independent Assortment, also known as Mendel’s Law of Inheritance. He deduced that genes come in pairs and are inherited as distinct units, one from each parent. His work would not be immediately publicly celebrated like Pasteur’s, but in 1900 a Dutch botanist and geneticist reported their results in hybridization experiments which included Mendel in the results.

1. **Karoly Ereky**

Karoly Ereky was a Hungarian agricultural engineer in the 1900’s. He obtained his engineering degree from Technical University of Budapest and designed machines for paper and food industries. He later became an Assistant Professor at Jozsef Technical University and published over a hundred publications. His publication became recognized all over the world and his publication of *Biotechnologies* became his crowning achievement. Ereky was sentenced to jail during World War II and died later after. He was known as the father of biotechnology.

**III. Fields**

Many fields use biotechnology every day. This will give you a deeper understanding on how biotechnology is used in everyday life, as well as how you can use it to determine your future. Most of these industries overlap with each other and/or work together. Jobs in these fields include engineers, biologists, lab technicians, technicians, manufacturers, scientists, plant scientists, doctors, and more. A big part of these jobs includes research. Research is how new advancements are made and how we have grown as a society.

**i. Nanobiotechnology**

Biotechnology combined with nanotechnology produces nanobiotechnology. This is defined by the application of nanotechnologies in biological fields. Usually, nanobiotechnology deals with metabolic and other physiological processes of biological subjects. This process has led to the development of diagnostic devices, contrast agents, analytical tools, therapy, and more. Nanobiotechnology is primarily used in the medical field for diagnosis, drugs, and molecular imaging. Another industry that uses nanobiotechnology is the agriculture industry. This includes dealing with pesticide delivery systems, biosensors, food composition, and edible films for food preservation.

**ii. Molecular Biotechnology**

Molecular biotechnology is the study and modification of nucleic acids and proteins in humans, animals, agriculture, and the environment. This area includes biology, microbiology, biochemistry, immunology, genetics, and cell biology. It mostly focuses on the ability to transfer genetic information between organisms with the goal of understanding important biological processes. Molecular biotechnology can be used to develop and improve drugs, vaccines, therapies, and diagnostic tests that will improve human and animal health.

**iii. Bioengineering**

Bioengineering applies engineering principles and design concepts to medicine and biology. It has developed materials, processes, devices, and more. Bioengineering is used in the medical field, the agricultural field, and includes subjects like mass and heat transfer, kinetics, biomechanics, biocatalysts, bioenergy, and more. Biological engineers use biological systems to create products or modify and control biological systems so they can replace, augment, sustain, or predict chemical and mechanical processes.

**iv. Biomedical Engineering**

Biomedical engineering is the application of engineering principles and design concepts to medical and biological purposes. Examples include prosthetics, surgical devices, systems, implanted devices, imaging methods, diagnostics, therapeutic equipment, and more. Bioengineering has evolved to be one of the most effective areas in the medical field. Using nanotechnology in the medical field will also include many other engineers and scientists. For example, to construct an artificial heart, an electrical, mechanical, and bioengineer is needed. Biomedical engineering can also be bioengineering.

**v. Biomanufacturing**

Biomanufacturing utilizes biological systems to produce commercially important biomaterials and biomolecules for use in medicines, food and beverage processing, and industrial applications. Biomanufacturing includes biopharmaceutical, industrial enzymes, biofuels, “green” chemicals and products, and more. Biomanufactured products are found in natural sources like microbes, blood, and plant and animal cells. Biomanufacturing methods include blood plasma fractionation, cell culture, column chromatography, fermentation, homogenization, and more.

**vi. Genetics**

Genetics is the study of genes, genetic variation, and heredity in organisms. Many of the processes and fields are fueled by genetic engineering. Genetic engineering is used to manipulate cell’s genetic information using laboratory techniques in order to change the traits of living organisms. With genetic engineering, scientists are able to change the way an organism looks, behaves, functions, or interacts. From bacteria, to plants and animals, genetic engineering is possible in all living cells. It is the backbone of the biotechnology industry, and it has been used for centuries.

**vii. Molecular/Biomolecular Engineering**

Biomolecular engineering applies biological processes, chemical engineering, and engineering principles and practices to solve problems. Molecular and biomolecular engineers work in agriculture, energy, environment, food production, and biotechnology. Carbohydrates, proteins, nucleic acids, and lipids are purposefully manipulated to apply to areas like livestock production, biofuel cells, and more. Molecular engineering is very similar to bioengineering.

**IV. Conclusion**

Biotechnology covers many different disciplines and spans across many careers. Biotechnology has been used since civilization started. Revenues of U.S. and European biotechnology industries doubled from 1996 to 2000, and rapid growth has continued into the 21st century. New products have changed healthcare, agriculture, the environment, and food production.

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