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The Future of the Human Race

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What is Biotechnology?

Scientists discover and explore bio-tech's vast range of possibilities, which arose from ancient times and Mendel's revolutionary work

Co-founder and former CEO of Apple Inc. once said, "I think the biggest innovations of the 21st century will be at the intersection of biology and technology." The dream of past scientists, conservationists, entrepreneurs, inventors, and healthcare has become our reality. Biotechnology uses scientific and engineering principles and is essentially the manipulation of biological systems or organisms in order to create new products or processes. It is considered as the most prominent approach to genetic engineering and it allows scientists to modify the DNA of an organism at will. To really understand what this means, we have to dive deeper into the origins of biotechnology.

Early Origins of Bio-tech

Modern biotechnology has pretty much changed our industry, but its origins are nearly as old as humanity itself. Our distant ancestors kick-started the agricultural revolution by using artificial selection for crops, livestock, and other living organisms. This is how we have some of the various species of animals and plants living on our planet. Our ancestors have used ancient

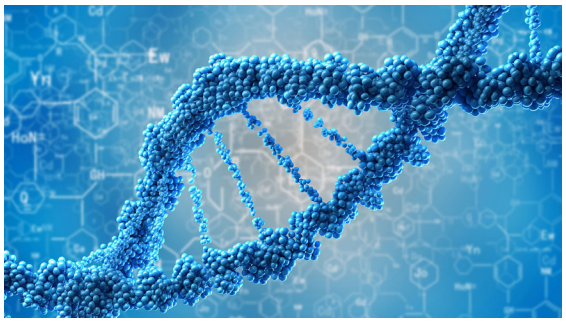
methods involving biotechnology to survive and sustain their human population. Mendel's work on genetics, institutes for investigating fermentation, and other microbial processes that have been founded by famous scientists Koch, Pasteur, and Lister have all been the beginnings of the development of biotech. Biotechnology has also risen from the field of zymotechnology (study of yeast fermentation) to find a better understanding of industrial fermentation to produce national commodities like beer and wine. Modern biotechnology came into the industry around this point in time, at the end of the 19th century. When antibiotics were discovered by famed microbiologist Alexander Fleming, he harnessed the power of biotechnology in order to develop them. The same was done by famous physician Edward Jenner who had discovered vaccines. In 1919, agriculturalist Karl Erkey described biotechnology as "all lines of work by

which products are produced from raw materials with the aid of living things." Erkey describes the face of modern biotechnology, which would soon come into the industry. Modern Biotechnology:

Biotechnology then advances into a new and more modern era, which would help find extraordinary ways to sustain human life just like our ancient ancestors did centuries ago. Researchers are now able to modify DNA and proteins to shape the potential of many plants, animals, and even living cells into something practical for humans. This is done by sequencing DNA found in nature. Modern biotechnology involves a scientific and engineering process that complies with the nature of genetic and hereditarial engineering. As a matter of fact, biotechnology advancements are occurring at the microscopic level within the membranes of cells. After numerous decades of research into unraveling the chemical and genetic makeup of cells, biologists launched a new era of research and breakthroughs. In the coming years, scientists will use biotechnology to manipulate cells with more control, from editing DNA with precision to synthesizing entire genomes. These powerful supercells could go on to be the cure for cancer or even the end of Covid-19.

What are the various methods/tools used in biotechnology?

1. DNA Sequencing
2. Recombinant DNA
3. DNA Synthesis



4. Genome Editing

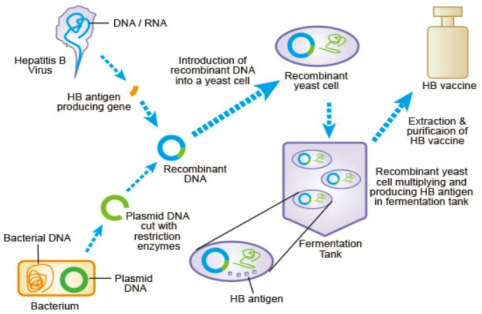
DNA Sequencing:

This refers to the general laboratory technique for determining the sequence of nucleotides, or bases, in a DNA molecule. Any method or technology can be used to determine the order of the four bases: adenine, guanine, cytosine, and thymine. DNA sequencing has been widely used on the medical side through the diagnosis and treatment of disease/illness, as well as epidemiology studies. Sequencing allows healthcare professionals to determine if a particular gene or region contains variants or mutations that are linked to a disorder. Genomics/DNA sequencing can detect a disease long before its symptoms present themselves. Genome sequencing is also used in preventing adverse drug outcomes in certain areas. According to "hsph.harvard.edu," genetic information from sequencing has "'opened our eyes' to the diverse characteristics of cancers and helped inform advances in drug development." Early cancer detection might increase a patient's chances of survival—possibly by a factor of 5–10 compared to a late-stage diagnosis. Adding on, this method is not only effective in the science field, as it saves trillions of dollars in economic activity every year. DNA sequencing has impacted the lives of millions and scientists continue to explore its world of possibilities.

Recombinant DNA

This procedure involves using various enzymes and laboratory techniques to isolate

DNA segments of interest. DNA can be combined or split from different species (to form a "hybrid") or to create genes with new functions. Recombinant DNA is mainly involved with the production of vaccines (e.g. hepatitis B vaccine) and protein-based therapies such as insulin, interferon, and human growth hormone. Recombinant vaccines are manufactured with the assistance of expression systems (genetic constructs encoded by DNA) such as bacteria, insects, mammalians, and plants. Recombinant vaccines are also known as subunit vaccines as they contain only a fraction of the pathogenic organism. Protein therapy is a form of treatment that involves sending well-structured proteins to a precise location to repair or replace damaged or irregular ones. Such therapies are extensively used in the treatment of cancer, HIV, and other diseases. The therapeutic proteins will replace damaged proteins, interfering with an organism or molecule, and deliver different proteins or compounds to help fight the disease.



Recombinant *Hepatitis* B vaccine production

Recombinant DNA has also been exploited in crop agriculture and bioremediation. R-DNA has improved plant growth and quality by increasing nitrogen fixation efficiencies, cloning bacterial genes, and inserting them into plant cells. Access to fixed nitrogen allows plants to produce leaves fortified with nitrogen that can essentially be recycled throughout the plant. And this allows the plant to increase its capacity of photosynthesis, which then yields nitrogen-rich seed. Nitrogen supports rapid growth of the plant and it encourages the healthy development of foliage and the produce (fruits/vegetables) made by the plant. Nitrogen deficiencies in plants lead to poor fruit/vegetable quality and can even cause them to spoil, which can impact the human population's health. Without R-DNA playing an agricultural role in the industry, how would all of us be able to consume our vegetables and fruits knowing that they have problems within or are spoiled? Bioremediation is a process that uses mostly microorganisms, plants, and other microbial or plant enzymes to detoxify contaminants, pollutants, and toxins in our environments. This process helps us clean up water sources, improve air quality, remove oil spills, and create healthier soil. Typically, bioremediation is economically stable and sustainable in comparison to other techniques out there. This biological technique is able to facilitate the remediation of environments without damaging delicate ecosystems. Recombinant DNA has many applicable uses and plays a major role in the well-being of people and our planet on a whole as its branches will stretch out to many more innovative ideas in the future.

DNA Synthesis

This process is essentially the natural or artificial creation of DNA or deoxyribonucleic acid by linking the four bases: adenine, guanine, cytosine, and thymine. DNA synthesis is an essential technique in molecular biology that plays a vital role in clinical diagnosis/treatment and genetic engineering. This technique plays a significant role as a therapeutic strategy in treating hyperproliferative diseases such as viral infections, autoimmune disorders, and even cancer. When medical professionals spot an incorrect sequence in the DNA, they are able to diagnose the disease by locating the base pair with the mutation and by finding out which base or bases have been moved or switched. By making sure the four bases of DNA are linked in the correct order, medical professionals are able to avoid mutations in the DNA as these mutations are what lead to diseases. And if there is a disease present, the

order of the incorrect DNA sequence can be altered to cure the illness. DNA synthesis allows us to synthetically create a gene of interest and then incorporate it into an organism's genome, which is basically genetic engineering. The gene of interest can have many functions that are specific to the medical professional, researcher, or scientist. Genetic engineering has been used over the years to increase crop yields, reduce costs of food or drug production, enhance nutrient composition and food quality, have greater food security, reduce the need for pesticides, and provide medical benefits to the growing population. Genetic engineering has also been used for cancer therapies, brewing yeasts, human insulin, hepatitis B vaccine, and even the development of disease-resistant plants.

Genome editing

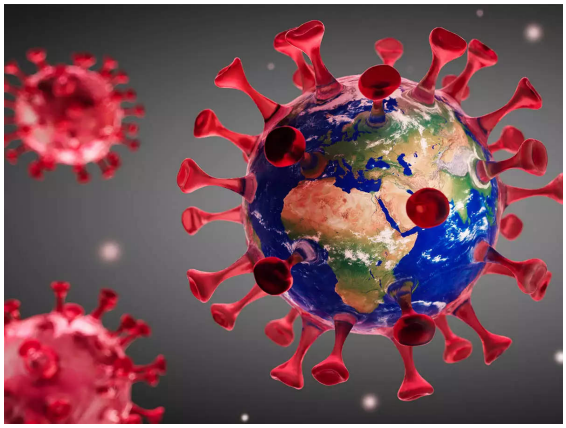
This is a group of enzyme-based technologies that give scientists the ability to alter or change an organism's DNA. By using this method, DNA can be either inserted, deleted, modified or replaced in the genome of a living organism. Genes contain our DNA, which is essentially the code that controls our body's form and functions, from regulating blood pressure to regulating our bodily systems. Genes that are misplaced or those that don't work properly can cause disease. Many doctors and medical professionals have had very few tools to address the root causes of many of the deadly diseases our population faced. Around a decade ago, a rise in genome editing technology known as CRISPR changed our situation. This new technology operated like a DNA scissor as it was able to open slots in an organism's genome, where scientists were able to insert their own sequence. According to the National Library of Medicine, in 2018, the media reported that two twin girls had been born with modified genes to make them immune to the HIV virus. Using CRISPR technology, scientist He Jiankui managed to disable the CCR5 gene that enabled HIV infection. His so-called 'experiment' did not provide any legal basis and went against the law, but his discovery revolutionized science and showed us that gene editing and immunity to illness are not impossible. Currently, genome editing is being used to generate a more efficient and accurate diagnosis of diseases, as well as finding more targeted treatments and prevention methods for genetic disorders. Using this technique, a faulty gene is replaced or a new gene is added in an attempt to cure disease or improve the body's ability to fight disease. Faster and more accurate diagnosis leads to fewer deaths and better treatment methods to cure disease faster and more safely. Even though genome editing may be known to reduce human diversity and increase social inequality, its impact on our modern world's knowledge and

ideas is unforgettable.

Benefits of Biotechnology

Biotechnology has benefited the human race for hundreds of years. Most of the food we eat comes from Genetically Modified Organisms or GMOs. Nowadays, these plants can grow with fewer nutrients, in extreme climates, and without pesticides through the use of biotechnology. Biological tech even follows us through childhood with all of the antibiotics and immunizations we were given to fight off illness as they are biologically engineered to fight off diseases and make us immune to them. Biotechnology has been set up to find a cure for Alzheimer's disease and even reverse aging for future generations. The scientists and researchers behind the technology called CRISPR believe it may be the key to safely

editing DNA for curing heredeterial or genetic



diseases. Biotech has many benefits, but it may also potentially be the end of us humans.

Risks of Biotechnology

Even though biotechnology can lead our current world into a new era of possibilities, it has its own risks. The same technology that we can use to expand our lives can be used to end them. Researchers and scientists may view a supercharged SARS-CoV-2 virus as a perfect way to fight the disease, but the public may see the drawbacks as being just as worse. The virus could escape or even someone could weaponize it. Modified cells can divide and spread out in the wild, which can lead to consequences. For example, sugar cane farmers in the 1930s had a major issue with Cane beetles destroying their crops. So, they introduced a natural predator known as the Cane toad to demolish the beetle population. In fact, these toads became a major nuisance over the Australian continent by consuming the local plants/animals. This is a scenario that went wrong in an ecosystem by adding a predator, and a similar problem can occur with biotechnology. People can take advantage of these cells and modify them, which can harm or even kill millions or billions of organisms if exposed to nature. In 2011, a professor in the Netherlands had genetically engineered a deadly, airborne version of the flu virus and got fired. If this issue hadn't been contained a public health emergency would have occurred. Biotechnology can be weaponized and if in the wrong hands, can bring an end to the human race itself.

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