

Human Genome CRISPR Stem Cells and Cancer Technologies

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We have ended the course on several 21st century technologies involving covering a wide range of subjects

- Human genome and its applications (25pts)
- Epigenomics and CRISPR (25pts)
- Stem cells and cloning (25pts)
- Cancer and personalized diagnostics and treatments (25pts)

For each of these four general topics, pick a couple of things you find interesting and expand upon them. Each of these expansions should be about 3 paragraphs. You should use at least two references for each topic

Human Genome and Its Applications

The Human Genome Project is an international scientific research project that maps and sequences the human genome from 1990 to 2003. The human genome is the complete set of DNA that contains the instructions for making every cell and tissue in the human body. The human genome is an important DNA set consisting of about 3.3 billion base pairs for understanding human biology, disease, and health. These base pairs are the building blocks of DNA that are arranged into 23 pairs of chromosomes which synthesize the chemical makeup of the entire human genetic code (Watson, 1990).

The human genome is a topic of great scientific and ethical interest in the contemporary world but is also a controversial debate. One of the ongoing controversies is human heritable genome editing (HHGE) which is a genome editing technique to modify the DNA of human embryos, eggs, or sperms. These modifications can be inherited by future generations but also raise questions about social justice, safety, human dignity, efficacy, and the future of humanity (Yadav & Thelma, 2021). The international scientific community tries to oversight HHGE but many countries have restricted or banned the research on this technique because there is no global consensus on its ethical acceptability.

Genetic testing and gene therapy are the current potential applications the human genome offers in the field of biology. By comparing an individual's genome to a reference genome, variations can be identified that may be associated with certain diseases or traits which through the application of genetic testing helps in the diagnosis, prevention, or treatment of genetic disorders. Moreover, through the application of gene therapy, a modified gene can be introduced into a person's cell which could enhance a desired function or correct a genetic defect.

In a nutshell, the human genome project is a landmark achievement for the world of biotechnology as this project provides a valuable and effective resource for future biomedical research. Moreover, this project leads to the development of new areas in the field of biotechnology that study the structure, function, and interaction of biological molecules but also raises social, legal, and ethical issues that need to be addressed by policymakers, researchers, and scientists. In terms of the HHGE approach, there is a dire need for ethical and legal frameworks to balance the rights of individuals and the interests of researchers as well as society as there is a growing demand for future genomic research.

Epigenomics and CRISPR

Epigenomics and CRISPR are two related fields of biology and biotechnology that deal with the modification and regulation of gene expression in the human body. By definition, Epigenomics studies epigenomes which are small molecules of proteins that latch onto DNA or DNA sequences. These epigenomes while latched onto DNA control and affect how genes are turned off or on in the DNA sequence. In addition, the technique of CRISPR edits the genome by introducing target changes in the sequence of the DNA. This technique of CRISPR fuses Cas proteins into epigenetic modifiers that can be used to manipulate the epigenome. This manipulation of epigenomes allows scientists to research and investigate the causal and functional relationships between epigenetic modifiers and gene expressions in organisms (Nakamura et al., 2021).

Furthermore, CRISPR and Epigenomics have garnered a lot of interest in both the fields of biology and biotechnology yet these techniques have been a topic of controversy in recent years because of the ethical implications of using CRISPR to edit epigenomes. This gene-editing tool modifies human embryos, animal embryos, and plant embryos and poses serious unforeseen consequences for human dignity, biodiversity, and the environment. Despite the discoveries and advances made in the related fields, many countries in different parts of the world have distinctive policies and laws regarding the licensing and ownership of inventions and interventions related to the technique of CRISPR. Moreover, there is also an ongoing dispute between two groups of scientists in the field of biotechnology who claim that they have invented or discovered CRISPR and Epigenomics. The controversial phenomenon is that this dispute could possibly affect the future of biotechnology and its commercialization in the global market.

The proponents of the CRISPR approach support its use for therapeutic purposes especially enhancing human traits and curing genetic diseases. This support is due to the fact that some of the current implications of Epigenomics and CRISPR are in cancer diagnosis, cancer treatment, inheritance, and gene therapy. Additionally, this approach can be used to detect and correct epigenetic changes such as histone modifications. These modifications are often associated with cancer development and progression in the body. However, the epigenetic alterations in this regard can further be used to target and kill cancer cells in the affected body. CRISPR and Epigenomics can also be used to create gene drives to transmit epigenetic information across generations such as affecting stress response, behavior, or metabolism of the individuals in the invasive species. Moreover, it can also be used to

regulate gene expression in order to introduce beneficial genes and correct genetic defects such as sickle cell anemia without altering the DNA sequence.

In conclusion, both fields of biotechnology namely CRISPR and Epigenomics offer potential applications in the fields of medicine, biotechnology, and agriculture. On one hand, CRISPR precisely alters the DNA of living cells and Epigenomics, on the other hand, studies how environmental factors can affect the expression of genes without changing the sequence of DNA. Both fields explore many aspects and perspectives of biotechnology but there are also some controversies that surround CRISPR and Epigenomics as their scientific challenges and limitations question how reliable and safe these technologies are in different contexts and applications.

Stem Cells and Cloning

In the field of biology, stem cells and cloning are two related topics that have both scientific and ethical implications as both involve manipulating the differentiation and development of cells in the species. The term “Cloning” refers to the ability to make a genetic replica of a cell or a whole organism whereas the term “Stem Cells” refers to the cells that can replicate into some other variety of cells. The somatic cell nuclear transfer (SCNT) is the technique that connects cloning and stem cells through a nuclei of somatic cells which can be transferred to an egg cell whose own nucleus is removed. An embryo is created in the process that is genetically identical to the donor of the somatic cell nucleus which can be used for reproductive cloning. The embryo is then implanted into a surrogate mother to produce a cloned species. This cloned animal is further disaggregated to culture embryonic stem cells that have the potential to treat various diseases by replacing missing or damaged cells in the body (Prentice & Palladino, 2003).

Stem cells and cloning also raise ethical implications such as the risks of cloning species, the moral status of embryos, the possible abuse of the technology, and the oversight or regulation of the research in the field of biotechnology. The moral status of the embryos produced during the process of cloning is one of the controversies that raise ethical, social, and moral issues. Embryonic stem cells are derived from embryos of human that are usually left over during fertilization procedures (Prentice & Palladino, 2003). Critics argue that these leftover human embryos have the potential to become a whole living organism or a human being that should not be destroyed in the laboratory or used for research. However, proponents contend and believe that these leftover human embryos are not actual persons or living organisms so using them in the laboratory or for research can lead to several lifesaving treatments for many serious or life-threatening diseases.

Furthermore, stem cells and cloning have the potential to treat many serious conditions and life-threatening diseases such as heart disease, Alzheimer’s, diabetes, Parkinson’s, and cancer. These conditions can be treated by generating healthy cells through the procedure of cloning and replacing diseased or damaged cells with them. The stem cells also provide a gateway to drug testing research for ensuring the safety and effectiveness of drugs newly introduced in the field of medicine. The stem

cells in this regard are programmed to become specific types of body cells to test the drugs such as liver or cardiac cells. Moreover, the current implication of cloning is that it can be used to produce desired animals or species with desired traits such as animals with high disease resistance for medicinal purposes.

In conclusion, despite the ethical, moral, and psychological implications of developing human cloned bodies, the techniques of stem cells and cloning are used in the field of biotechnology to treat many diseases, achieve animals with desirable traits, and test new drugs for effectiveness. However, the embryos of humans that are developed through the process of cloning are still controversial and a topic of debate in the field of biology as people are still confused about whether the cloned humans should be considered dignified human beings or not.

Cancer and Personalized Diagnostics and Treatments

In the field of personalized medicine, cancer and personalized diagnostics and treatments are the related topics that provide a new gateway to fighting cancer as cancer is the leading cause of death around the globe. Personalized medicine or precision medicine is, therefore, a new way to fight cancer or its symptoms that uses information about the individual or their tumor to figure out what drives the disease in a human (Khondakar et al., 2019). This approach creates a plan for the affected individual and helps in the process of diagnosis, prevention, and treatment by using risk assessment tools such as genetic tests and targeted therapies. For instance, people with lung cancer, colorectal cancer, or breast cancer can have their personalized cancer treatment options based on their genetic makeup.

The topic of personalized cancer diagnosis and treatment is a topic of debate in the medical field from which many people are already benefitting and researchers are working on diverse areas of it. This approach to diagnosis, treatment, and medicine options tailors treatments and prevention strategies to the unique characteristics of each individual and their tumor. However, there are controversies associated with the approach of personalized cancer diagnostic and treatment options which include the availability and accessibility of molecular testing and the social and ethical implications of personalized treatment options (Duffy & Crown, 2008). The molecular testing varies depending on the type, stage, and severity of cancer because it affects the health system of the affected individual. It also poses [ethical and social](#) implications such as the security of genomic data, the potential for discrimination based on information about genes, the privacy of genomic data, and the informed consent of patients which makes it difficult to identify the drivers and best targets for cancer therapy.

The ongoing implications in this area of personalized medicine include certain limitations and challenges that not all types of cancer have personalized options available for their treatments. Also, the availability and cost of personalized treatment options may vary depending on the type or stage of cancer. So, the personalized diagnostics and cancer treatment approach may also face limitations as the response or resistance to personalized therapies depends on several crucial factors. These

crucial factors include the immune system, the microenvironment for the cancerous tumor in which it grows, or the interactions between different drugs in the treatment procedure. Scientists are working to mitigate these limitations by discovering and testing new targeted drugs for cancer, developing new methods for monitoring tumors, and exploring the role of personalized medicine in the early detection of cancerous tumors.

In a nutshell, personalized options for diagnostics and treatments of cancer or tumors are promising approaches to cancer care. The personalized cancer care approach tailors treatment options or therapies to the specific genetic and molecular characteristics of each person and their tumor for the early detection or prevention of cancer. This approach can potentially improve the effectiveness of treatment options and reduce the potential side effects of treatment that an individual might face during cancer therapies.

References

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