Human genetic engineering

Amish Dudeja Professor Montgomery Research Paper English 1000 12/18/09 Genetic Engineering: The Rise of Science??™s Pride and Joy Science is a creature that continues to evolve at a much higher rate than the beings that gave it birth.

The transformation time from tree shrew, to ape, to human far exceeds the time from analytical engine, to calculator, to computer. But science in the past has always remained distant. It has allowed for advances in production, transportation, and even entertainment, but never in history will science be able to so deeply affect our lives as genetic engineering will undoubtedly do. With the birth of this new technology, scientific extremists and anti-technologists have risen together to halt the rise of this impeccable form of science.

Spreading fear by misinterpretation of facts, they promote their views in the halls of the United States congress. However, genetic engineering is a safe and powerful tool that will yield unprecedented results, specifically in the field of medicine. It will usher in a world where gene defects, bacterial disease, and even aging are a thing of the past. By understanding genetic engineering and its history, discovering its possibilities, and answering the ethical and safety questions it brings forth, the blanket of fear covering this remarkable technical miracle can be lifted. The first step to understanding genetic engineering, and embracing its possibilities for society, is to obtain a rough knowledge base of its history and method. The basis for altering the evolutionary process is dependant on the understanding of how individuals pass on characteristics to their offspring. Genetics achieved its first foothold on the secrets of natures evolutionary process when an Austrian monk named Gregor Mendel developed the first " laws of heredity.

" Using these laws, scientists studied the characteristics of organisms for most of the next one hundred years following Mendels discovery. These early studies concluded that each organism has two sets of character determinants, or genes (Stableford 16). For instance, in regards to eye color, a child could receive one set of genes from his father that were encoded one blue, and the other brown. The same child could also receive two brown genes from his mother. The conclusion for this inheritance would be the child has a three in four chance of having brown eyes, and a one in three chance of having blue eyes (Stableford 16). Genes are transmitted through chromosomes that reside in the nucleus of every living organisms cells.

Each chromosome is made up of fine strands of deoxyribonucleic acids, or DNA. The information carried on the DNA determines the cells function within the organism. Sex cells are the only cells that contain a complete DNA map of the organism; therefore, " the structure of a DNA molecule or combination of DNA molecules determines the shape, form, and function of the organisms offspring " (Lewin 1). DNA discovery is attributed to the research of three scientists, Francis Crick, Maurice Wilkins, and James Dewey Watson in 1951.

They were all later accredited with the Nobel Price in physiology and medicine in 1962 (Lewin 1). " The new science of genetic engineering aims to take a dramatic short cut in the slow process of evolution" (Stableford 25). In essence, scientists aim to remove one gene from an organisms DNA, and place it into the DNA of another organism. This would create a new DNA strand, full of new encoded instructions; a strand that would have taken Mother Nature millions of years of natural selection to develop. Isolating and removing a desired gene from a DNA strand involves many different tools. Exposing it to ultra-high-frequency sound waves can break up DNA, but this is an extremely inaccurate way of isolating a desirable DNA section (Stableford 26). A more accurate way of DNA splicing is the use of " restriction enzymes, which are produced by various species of bacteria" (Clarke 1).

The restriction enzymes cut the DNA strand at a particular location called a nucleotide base, which makes up a DNA molecule. Now that the desired portion of the DNA is cut out, it can be joined to another strand of DNA by using enzymes called ligases. The final important step in the creation of a new DNA strand is giving it the ability to self-replicate. Using special pieces of DNA, called vectors, that permit the generation of multiple copies of a total DNA strand and fusing it to the newly created DNA structure can accomplish this. Another newly developed method, called polymerase chain reaction, allows for faster replication of DNA strands and does not require the use of vectors (Clarke 1). The possibilities of genetic engineering are endless. Once the power to control the instructions given to a single cell is mastered anything can be accomplished.

Furthermore, every new idea is faced with both criticism and applause and genetic engineering proves no different. This revolutionary concept will alter every aspect of life as we seem to know it, and as in most cases the benefits are accompanied by predicaments. However, when weighed, the advantages seem too great to be ignored. Genetic engineering can lead us into a new era of scientific history. For example, certain human proteins, such as insulin, are sometimes needed on demand.

Unfortunately, our bodies cannot produce them on the spot. This can be very dangerous for some people, like those with diabetes. Diabetics do not produce enough insulin, and therefore they need a way to obtain new insulin. Through genetic engineering, insulin can be created to be ready when needed. Genes can be transplanted from one organism to another through the use of genetic engineering. The genes can then be combined with genes of the second organism.

This is used to move human genes {draw: frame} into mammals such as goats and sheep so that the animals can then produce great quantities of human proteins, such as insulin. (Clarke 10) Additionally, microorganisms are used to help produce human proteins. The procedure of transplanting genes is shown to the right using a bacterium. Essentially, this process insures that a supply of insulin will always be available for the diabetic patients that require it to fight their disease.

In addition, the major problem of organ scarcity in the United States can be alleviated by the implementation of genetically engineered organs. Every day thousands of people of all ages are admitted to hospitals because of the malfunction of some vital organ. Because of a scarcity of transplantable organs, many of these people will die. In perhaps the most dramatic example, the American Heart Association reports only 2, 300 of the 40, 000 Americans who needed a new heart in 1997 got one (Simmons 35). Lifesaving livers and kidneys likewise are scarce, as is skin for burn victims and others with wounds that fail to heal. An exciting new strategy, however, is believed to revolutionize the treatment of patients who need new vital structures: the creation of man-made tissues or organs, known as neo-organs.

In one scenario, a tissue engineer injects or places a given molecule, such as a growth factor, into a wound or an organ that requires regeneration. These molecules cause the patients own cells to migrate into the wound site, turn into the right type of cell and regenerate the tissue (Davis 15). In the second, and more ambitious, procedure, the patient receives cells – either his or her own or those of a donor – that have been harvested previously and incorporated into three-dimensional scaffolds of biodegradable polymers, such as those used to make dissolvable sutures (Davis 18). The entire structure of cells and scaffolding is transplanted into the wound site, where the cells replicate, reorganize and form new tissue.

At the same time, the artificial polymers break down, leaving only a completely natural final product in the body – a neo-organ (Davis 20) In addition, for the first time researchers at the UCLA Henry Samueli School of Engineering and Applied Science have successfully pushed nature beyond its limits by genetically modifying Escherichia coli, a bacterium often associated with food poisoning, to produce unusually long-chain alcohols essential in the creation of biofuels. “ Previously, we were able to synthesize long-chain alcohols containing five carbon atoms,” stated James Liao, professor of chemical and biomolecular engineering at UCLA. “ We stopped at five carbons at the time because that was what could be naturally achieved. Alcohols were never synthesized beyond five carbons. Now, weve figured out a way to engineer proteins for a whole new pathway in E. coli to produce longer-chain alcohols with up to eight carbon atoms.

” (Humans Scientific Playground 1) Longer-chain alcohols, with five or more carbon atoms, pack more energy into a smaller space and are easier to separate from water, making them less volatile and corrosive than the commercially available biofuel ethanol. The greater the number of carbon atoms, the higher the density of the biofuel. Ethanol, most commonly made from corn or sugarcane, contains only two carbon atoms. Organisms typically produce a large number of amino acids, which are the building blocks of proteins.

In their research, Liaos team examined the metabolism of amino acids in E. coli and changed the metabolic pathway of the bacterium by inserting two specially coded genes. One gene, from a cheese-making bacterium, and another, from a type of yeast often used in baking and brewing, were altered to enable E.

colis amino acid precursor, keto acid, to continue the chain-elongation process that ultimately resulted in longer-chain alcohols (Humans Scientific Playground 2). Liao, the study??™s main author, said that the discoveries were important for two reasons. “ From a scientific standpoint, we wanted to show that we can expand natures capability in making alcohol molecules. We showed we are not limited by what nature creates. From an energy standpoint, we wanted to create larger, longer-chain molecules because they contain more energy. This is significant in the production of gasoline and even jet fuel.

??? Though this new frontier of biofuels production from organisms has the potential to address significant issues in global warming, the scientific significance of successful genetic modification could also mean great benefits beyond the environment. (Humans Scientific Playground 2) “ We used E. coli because the genetic system is well known, it grows quickly and we can engineer it very easily,” addressed co-author Kechun Zhang, a UCLA postdoctoral researcher. “ But this technique can actually be used on many different organisms, opening the door to vast possibilities in the realm of polymer as well as drug manufacturing.” (Humans Scientific Playground 3) While genetic engineering can open a realm of biotechnology that the world has never seen, this field has its own share of dangers.

For example, Australian researchers who were trying to genetically engineer a contraceptive vaccine for mice produced a deadly virus. They spliced a gene for the protein interleukin-4 (IL-4) into the relatively harmless mousepox virus in the hope that IL-4 would boost the immune system to make more antibodies. When the researchers injected this vaccine into mice, all the mice died. In fact, this synthetic virus was so lethal that it also killed half of all the mice that had been vaccinated against mousepox. The virally-encoded IL-4 not only suppressed primary antiviral immune responses but also inhibited the immune memory responses. (New Scientist 28) Furthermore, these findings raise the possibility of biological warfare.

But the far greater danger lies in the unintentional creation of deadly pathogens in the course of apparently innocent genetic engineering experiments. Additionally, the technique used to create the first synthetic polio virus could be also used to recreate Ebola or the 1918 flu strain that killed up to 40 million people (New Scientist 30) What is even more worrying is that there are easier ways of recreating microbes. You can simply add key genes to a close relative. The key in all cases is knowing the genetic sequence (New Scientist 31). That raises fundamental questions about the wisdom of publishing the genomes of deadly pathogens on the Internet. Although particular instances of genetic engineering of plants, animals, and bacteria have caused some controversy, mostly because of environmental or health concerns, genetic engineering is a generally accepted practice. The major moral controversy concerns whether to allow directly altering the genetic structure of human beings. Genetic engineering done by altering the somatic cells of an individual in order to cure genetic and non-genetic diseases has not been controversial.

In fact, what is known as somatic cell gene therapy is becoming a standard method for treating both kinds of diseases. Unlike the genetic engineering used in plants and animals, somatic cell gene therapy alters only the genetic structure of the individual who receives it; the altered genetic structure is not passed on to that individuals offspring. (Shanks 21) Somatic gene therapy has been used to treat genetic diseases and disorders. Scientists first used gene therapy on single-gene defects, like cystic fibrosis, hemophilia, muscular dystrophy, sickle cell anemia and ADA deficiency. Theoretically, these various types of gene therapy could be used to treat any disease that is caused from gene disorders. Some of the diseases that have been mentioned as possible candidates for somatic gene therapy include cancer, AIDS, Alzheimers diseases, Lou Gehrigs disease, cardiovascular disease and arthritis.

(Shanks 53) As for safety measures regarding genetic engineering, genetically modified organisms (GMO??™s) are put under strict laboratory regulations and are constantly put under small and large scale field tests to determine if they pose a danger to the society. As a rule, competent researchers or a research team, taking into consideration the laboratory practices and the acceptable safety of releasing the GMOs into the environment, undertake investigations on GMOs to maintain a necessary level of safety. (Thompson 44) Thus, many of the concerns regarding genetic engineering??™s safety are carefully taken into consideration and are handled with much care by experienced scientists. In essence, fear of the unknown has slowed the progress of many scientific discoveries in the past. The thought of man flying or stepping on the moon did not come easy to the average citizens of the world.

But the fact remains; they were accepted and are now an everyday occurrence in our lives. Understanding the mechanisms that allow genetic engineering to function, realizing the capabilities and products of genetic engineering, and becoming aware of the moral and safety issues regarding the science will optimistically alter one??™s view on the life-changing science. Genetic engineering too is in its period of fear and misunderstanding, but like every great discovery in history, it will enjoy its time of realization and come into full use in society. Works Cited Clarke, Bryan C. Genetic Engineering. Microsoft (R) Encarta. Microsoft Corporation, Funk & Wagnalls Corporation, 2005. Davis, Bernard, and Lissa Roche.

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