Essential Question: What different types of technology? What's the history? How is it used and on what or who? How advanced is it, who is still working on it? Who made it and when did they make it? What are the pros and cons/ impacts it could have?

| **Question/Key Term** | **Notes** |
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| Notes 1 Source: <https://www.britannica.com/science/gene-editing>  Don't get to specific within the science when this is more about history and morals  **What technology is used? And who made this technology**  Is there a way to know how long ago people have considered gene editing even if they do not have the sufficient technology  **What can this technology do and what SHOULD it do?**  What such diseases are being cured/ worked on being cured  **Earlier history, where did the idea come from?** | **Definition /what is it?**  Gene editing is the ability to make specific changes in the DNA sequence of a living organism, essentially customizing its genetic makeup. This technology works because it uses enzymes, particularly nucleases that have been engineered to target a specific DNA sequence, where they introduce cuts into the DNA strands. This removes existing DNA and the insertion of replacement DNA.    There have been many prototypes and different technology used over the years but the most used and successful is called CRISPR-Cas9, a powerful technology created in 2012 by American scientist Jennifer Doudna, French scientist Emmanuelle Charpentier, and later worked on by American scientist Feng Zhang and colleagues. CRISPR-Cas9 allows researchers to remove and insert DNA into desired locations, with the most accuracy of these technologies. Keep in mind that this is still a very new technology and there could be other places in the world with more advanced technology then us without it being publicised. Or secret projects/inventions that we don't know exist.  Over history it has been a debate what the morals or gene editing should revolve around and what we should be allowed to use it for? And now that this technology is actually available the debate has only amplified. And many different questions have been brought up such as “whether genetic engineering should be used to treat human disease or to alter traits such as beauty or intelligence”  The idea of creating a gene editing tool/ machine to treat disease and/or alter traits goes back around the 1950s( but people probably have the idea way before) and the discovery of the double-helix structure of DNA made this idea seem more possible. In the mid-20th-century era there was a base idea of how we could make gene editing possible because scientists discovered DNA is passed (mostly) faithfully from parent to offspring and that small changes in the sequence can mean the difference between health and disease. And they started creating new technologies of how to edit and replace these genes.  Summary: There are many different types of gene editing technology and they all hold much complexity in science and unlike many things there are not just one person who was to first create the complex technology there was most likely contribution form dozens if not hundreds of scientists and we can not know of |

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| Notes 2 Source: <https://news.harvard.edu/gazette/story/2019/01/perspectives-on-gene-editing/>  **Different technologies**  I believed this source to have sufficient information but It was incorrect so I will include another  Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6751566/>  **Morals and concerns:**  I agree that if this technology is going to be used eventually then we should use is continuously | EQ: more base information on the subject and different types of technologies. What are the pros and cons and what are the laws/morals  Another very important tool used is called CRISPR and it is an able tool in biological research. Once known as the bacterial immune system against invading viruses, the programmable capacity of the Cas9 enzyme is now revolutionizing fields of medical research  The history of gene editing is much more recent and even considered incomplete and is unreliable with new inventions and technologies being created each day. But with the discovery of restriction enzymes that normally protect bacteria against phages in the late 1970s was a turning point that fueled the era of recombinant DNA technology. For the first time ever, scientists gained the ability to manipulate DNA in test tubes. And this led to fourth development with animal DNA and other human strands.  There are many other type of gene editing technology such as followed by ZFNs and TALENs and especially after a few were found successful and they all serve a different purpose in the editing whether it be killing viruses and genetic diseases or to alter some feature or appearance  Since the advent of recombinant DNA technology, expectations (and trepidations) about the potential for altering genes and controlling our biology at the fundamental level have been sky high. These expectations, however, have gone largely unfulfilled. The ability to eliminate all inherited diseases, choose traits, and make ourselves stronger, faster, and smarter does not appear to be in our foreseeable future. But though the dream (or nightmare) of being able to control our biology is still a ways off  .  at the same time, a gene therapy for beta thalassemia has also been developed, a medical goal which is actively being pursued today, so we much aggolage that  “We should continue to talk about biomedical enhancement, and what it means for our notions of dignity, autonomy, and human nature. But, given the possibility that we may end up in a situation in which gene editing is done regardless, we also need to talk about how, in such a world, it could be done right.”  Summary: more specifics of the different types of technology and now I know that since the technology is so complex different ones for killing disease and different ones for editing people/ features. There is also many different moral issues that much be addressed such as when should it end and to what point will we stop being considered people. |