designer baby

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CRISPR:
Though the discovery of repeated sequences in DNA initially happened in three places across the globe, each independently of each each other, the discovery of CRISPR (**Clustered Regularly Interspaced Short Palindromic Repeat**) sequences can be tied back to a single source; that would be **Osaka University**, where in **1987**, researchers, namely **Yoshizumi Ishino** and a few of his colleagues, had noticed an unusual repetition in the DNA sequence of the E. coli they were examining; where repeated sequences in DNA typically occurred consecutively, CRISPR sequences, as the name says, was regularly interspaced between other sequences. It should be noted that Yoshizumi and his colleagues did *not* give CRISPR its name or anything--they just discovered what was essentially the base upon which further research would expand.
Their paper: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC213968/
Other sources:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5847661/#:~:text=The%20first%20hint%20of%20their,genes%20involved%20in%20phosphate%20metabolism.
The function of the CRISPR sequences was unknown until **Francisco Mojica,** now a professor at the University of Alicante, had done his own research and garnered results that became the core of CRISPR as we know it today. In **1992**, as he was working on his thesis, he and a group of various others had been studying microorganisms in the archaea group known to live in environments of high salinity and trying to examine how they'd adapted. To do this, he began sequencing their DNA, and upon doing so, noticed that there were regularly spaced patterns of repetition, which he had initially called TREPs, or Tandem Repeats (name would later be revised multiple times and changed to CRISPR in the end). After making this

discovery, Mojica searched for works by other scientists perhaps indicated the same results. What he had found in the end was Yoshizumi et al., and seeing that they had not figured out the function of the repetitions, he became curious and began to conduct further research to see if he could do just that, since he figured they must have a purpose of they appeared in both archaea and bacteria, prokaryotes that do not have much space in their structure to be wasting on insignificant things. The appearance of CRISPR sequences in both archaea and bacteria also implied ancestral origins. In **2001**, he discovered that CRISPR genes could be found in many **different organisms** quite far apart from each other evolutionary. **At the same time, another group** had discovered genes that were consistently found next to the CRISPR genes, later to be called cas genes, or CRISPR-associated genes. Mojica would then come to form his own research group at the University of Alicante, where in **2003**, they would discover that the CRISPR and cas genes worked essentially like an **immune system** for the archaea and bacteria; they would save the DNA sequences of parasites/viruses/etc., and the cas genes would recognize foreign entities with the same DNA sequences and protect the bacteria from them.
Mojica and his team knew that their research would revolutionize biotechnology, but they thought more-so that it would be used for pharmaceutical purposes or food fermentation, rather than in living organisms. It was truly shocking to them when **Emmanuelle Charpentier** and **Jennifer Doudna** published a paper in **2012** revealing that they'd discovered a way to cut DNA sequences to allow for genome editing in eukaryotes with the research Mojica had done. They had demonstrated the technology in vitro as well. Then, just a few months later, **Feng Zhang and George Church** published their own journal demonstrating the first use of it in mice and humans (human cells). This technology is CRISPR-cas9, or just CRISPR for short--and it's what makes designer babies possible.
Interview with Mojica: https://www.labiotech.eu/interview/francis-mojica-crispr-interview/

GMO:
GMO's, in humans and animals, has been around since the 1800's, when Robert Bakewell established selective breeding as a science. Crops and animals have both been bred to the whims of humans, whether to increase crop output or for aesthetic purposes. Since then, GMO's have evolved to the point where we can take pieces of genetic material and insert them into other pieces of genetic material. The type of GMO we're speaking about is more complex than selective breeding, as it utilizes CRISPR to modify the genes of a child before it's even born.
While GMO's have been getting progressively more in-depth, development slowed until the 1950's, when researchers started seeking additional means to introduce desired genes into the gene pool. Keep in mind that the process of understanding genetically modified organisms also follows the progression of what we understand of biology, which is why there's such a massive gap between the 1800's and the next breakthrough in the 1950's.
In the 1970's, researchers came up with the first genetically modified organism, which sparked controversy and ethical concerns. To address them, a conference was held to set the standard for genetic engineering in the future; the Asilomar Conference. Only

five years later, the Supreme court ruled in favor of patenting genetically modified organisms.
The 1980's marked the first significant sign of modern genetic engineering, as we started to breed for insect/repellent resistant crops. Following that, in the 1990's, the EPA approved the genetically modified crops, and they were introduced to the market. Since then, GMO's have only been on the rise.
https://www.fda.gov/food/agricultural-biotechnology/science-and-history-gmos-and-other-food-modification-processes
https://sitn.hms.harvard.edu/flash/2015/from-corgis-to-corn-a-brief-look-at-the-long-history-of-gmo-technology/#:~:text=An%20enormous%20breakthrough%20in%20GMO,and%20paste%20it%20into%20another.

CRISPR Timeline

1987	Yoshizumi discovers CRISPR genes
1992	Mojica sees the same pattern, begins further research
2001	Mojica discovers CRISPR in different organisms, another group discovers cas genes
2003	CRISPR and cas purpose discovered
2012	First utilization of CRISPR-cas tech for genome editing

I lied about CRISPR babies being what makes designer babies possible-- but it is a big part of designer babies as I am describing them!

Definition
In "Ethics of Designer Babies," a page written by Sarah Ly, now a postdoctoral fellow who, at the time, was a student at Arizona State University, in The Embryo Project Encyclopedia (published by the university), a designer baby is defined as "a baby genetically engineered in vitro for specifically selected traits, which can vary from lowered disease-risk to gender selection. Alterations made would affect every cell in the baby's body, and traits would be heritable by every generation after the baby. You could edit the DNA of a baby to have a specific eye colour, hair colour, etc. Theoretically, you could have it physically be whatever you wanted it to.

History
Though differing sources may have differing opinions as to who exactly would've been the first designer baby, the very first case of what I (Sandra) would consider a "designer baby" would have to be in the Collins family, in 1996, when in vitro fertilization was used for a pregnancy without any specific medical condition making it necessary. Monique and Scott Collins had always wanted a girl for their family, but having only been able to have two sons, the couple decided to see doctors for in vitro fertilization; it was through this process that they were finally able to have their daughter, Jessica, as doctors could identify the chromosomes in an embryo through PGD testing. Other debated "firsts" include Adam Nash, born in 2000 using in vitro fertilization with PGD, similarly to Jessica, who was conceived so that the stem cells

in his umbilical bord could be used to save his sister's life (she had a rare blood condition and they used PGD testing to make sure he wouldn't have it either), and Nana and Lulu, twins created by He Jiankui and the first designer babies on whom specifically CRISPR was used.

Designer babies are a pretty clear-cut concept, and the discussion around them really is mostly around the ethics of such a practice.

By Sarah Ly, who is (as far as I know) now a postdoctoral fellow:
https://embryo.asu.edu/pages/ethics-designer-babies
Tides Foundation:
https://www.tides.org/accelerating-social-change/policy/designer-babies-dna-in-the-headlines/
The Conversation:
https://theconversation.com/those-designer-babies-everyone-is-freaking-out-about-its-not-likely-to-happen-103079#:~:text=The%20inevitable%20rise%20of%20designer,the%20limits%20of%20nature%20by
Get Animated+:
https://getanimated.uk.com/meet-lulu-and-nana-the-worlds-first-crispr-genome-edited-babies/

IVF Timeline

1923	Estrogen discovered
1929	Progesterone discovered
1943	Hormone supplements for fertility
1950s	IVF testing (mice and rabbits)
1969	First human egg cell retrieved and fertilized
1970s	IVF testing (humans)
1973	First human IVF preganncy, though pregnancy was lost shortly
1978	First baby born through IVF
1986	Over 1k babies born through IVF
1996	First "designer baby" born through IVF- Jessica Collins
2000	Adam Nash born through similar methods
2018	Nana and Lulu, first babies modified by CRISPR

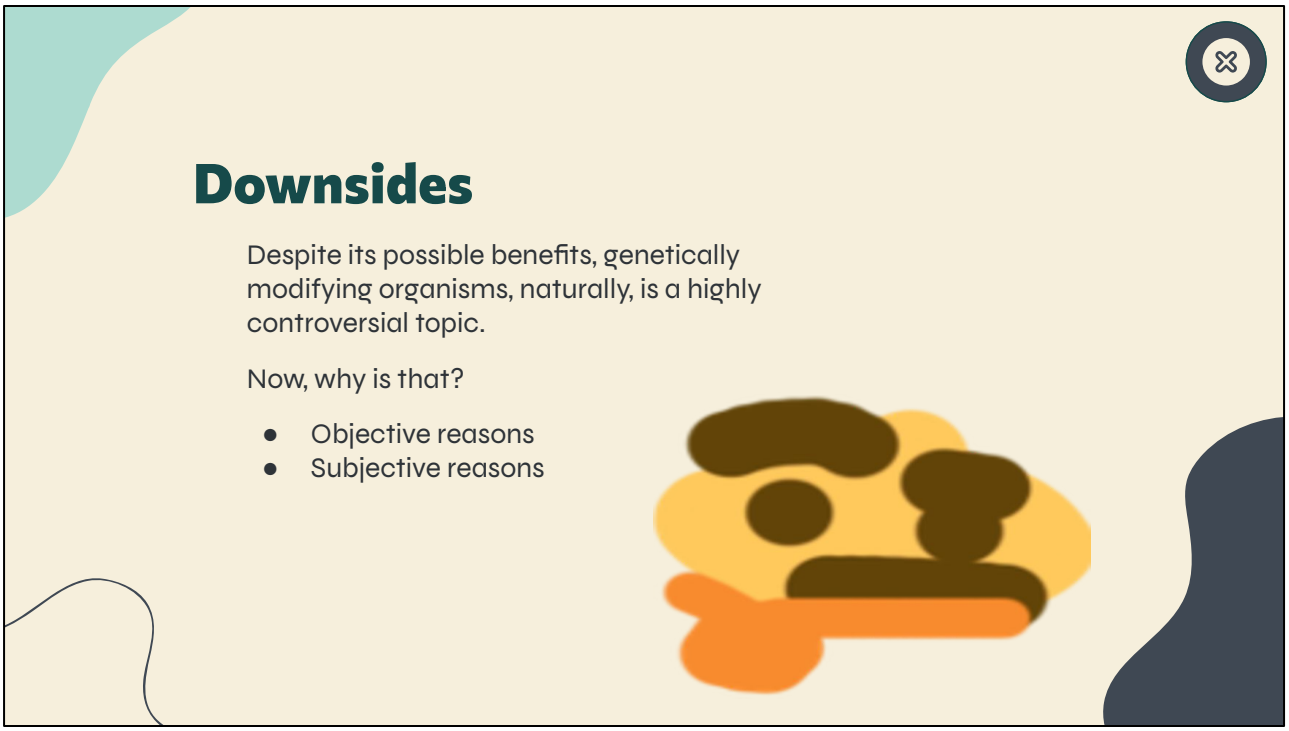
Sources for events:
https://www.pfcla.com/blog/history-of-ivf
https://embryo.asu.edu/pages/ethics-designer-babies
https://www.nature.com/articles/d41586-018-07545-0

In theory, designer babies are going to be created for the better. It's possible that genetically modified babies could be genetically modified to have a resistance towards genetic diseases, to increase their lifespans, or to gain more favorable genes. For example, He Jiankui, a Chinese biophysicist, has created what might be considered the first genetically modified baby, or the first "designer baby". Of course, the process hasn't been approved yet, so He was sentenced to three years in prison, but he stated that his original intention in creating the designer babies was to give them a resistance against HIV. Beyond that, designer babies would provide the opportunity to understand genetics at a deeper level. Parents would also be able to choose their child's appearance, their intelligence, and select whatever genes that they desire.

If designer babies were to come to fruition, genetic disease could possibly be eliminated from the general population. (genuinely have no other ideas than this omg.)

Another possible upside of designer babies!: consider the preference for male children in places like Asia!! (China, India, etc etc.) Lots of female infanticide (restriction on # of kids you can have, whether by law or by the resources available to you [e.g. kids are expensive so you can't have too many, etc.]). If we make designer babies not so designer and we perhaps make it a more widespread and common practice, people can have their male babies without the sacrifice of females! The thing is though, this is more of a social issue than a real issue with genetics-- the best thing you could do to fix that is to reshape your society to that of one less focused on patriarchal ideals and more focused on equity and etc. etc. But you know. Easy way out, I guess! Although if everyone gets their boy baby there will be less girls and then

the population in those areas will plummet….. Actually I'm pretty sure that's even happened/happening in China following the One Child Policy
https://www.nature.com/articles/d41586-018-07545-0



While the upsides to designer babies tend to be pretty objective, the downsides largely rely on one's own perception of ethics. Everyone has a different idea of what is ethical and what isn't; thus, there are few **objective** downsides to designer babies. One of which would be:

- Class divide
    - Designer babies will naturally be very expensive, so when the rich will be able to afford designer babies while the poor can't, it will further separate the two social classes down to their very gene pools.

Subjective:

- Homogeneity
    - People will make their babies appeal most to beauty standards in their respective regions, and everyone will look the same. May lead to standards getting higher and higher over time, and more and more genetic editing having to be done to reach them, to the point where they are nearly unfathomable.
    - While homogeniety may lead to less discrimination, that would only be the case if everyone were to be able to get designer babies. They are bound to be incredibly expensive if made a commodity, so naturally, not everyone will be able to get them! Only the rich will. Adds to class divide issue.
- "Goes against God," other beliefs
    - Many people view human lives as sacred, so to be tampering with the base building blocks that create it may be viewed as a violation of humanity/human rights

    - **Refute:** human life is not necessarily sacred, so why do we feel we can conduct experiments on animals like rodents, chimps, and etc. but not our own, even if that experimentation could serve to be beneficial to us in the end? Look at the upsides of genetic modification-- you could be saving thousands if not millions of lives that would otherwise succumb to untimely deaths.
- Over controlling of children by parents
    - Parents do not necessarily have the right to control their children's physical nature, even despite that they are able to control the personality of the child though how they are raised. Ties into the above point-- there are certain boundaries that shouldn't be crossed.
    - **Refute**: you could make the argument that parents would designer babies wouldn't be crossing any boundaries like that at all; babies literally have no say in how they turn out anyway. Besides, parents will have less reason to discriminate against their children or shame them for their appearance if they could decide how they looked.
- Babies will be "soulless"
    - There is an argument in circles that disagree with the development of designer babies that these infants cannot be considered fully human, as they've been manufactured to fit a mould of the parents' desire.
    - **Refute:** If genetically modified babies are seen, in some capacity, as subhuman, then why were the lab-grown human/pig embryos seen as something sacreligious? Why were people so upset about that? Even if the baby has traits of the parents' desire, they are still a human being, and they are still autonomous. Designer babies will be more than just puppets. Think of the genetic modifications like how people shave their kids' hair off when they're babies so it'll grow back thicker.
- People could use designer babies to get away with infidelity
    - Parents who choose to be unfaithful to their partners, should they be well-off enough to afford it, will be able to get away with infidelity by altering the traits of the baby they may produce to resemble themself and their significant other as opposed to their paramour.
    - **Refute:** if people should do this, it wouldn't be the fault of the technology. Rather, it would be those who make that choice who should be blamed, as they are using it for a purpose that it was not inherently created for.

Sandra's Summary

While I do find designer babies and the technology behind them absolutely fascinating, I don't quite agree with using it for a variety of reasons. I don't think of designer babies as some product of sacrilege or anything, but it could be quite bad if it got into the wrong hands or things were taken too far with it-- say, if parents wanted to change something that would affect the brain chemistry of the child so they would act as desired or something. I feel that would truly be a violation of human rights. The thing I find most disagreeable, though, is that it could erase part of one's identity. Let me explain--

Beauty standards all over the globalized world tend to be quite Eurocentric, as the perception of Europe and the United States, ever since the Industrial Revolution, has always been that they are above others-- therefore, there is somewhat of a "cool factor" associated with everything European/American, including European features. Should people want to have designer babies, they will probably want them to have everything seen as "beautiful," and in many places, that means traits like fair skin, large eyes, tallness, thinness, a small nose, a tall nose bridge, and etc. I don't believe this to be too much of an issue in European/American societies, as.. well, everyone pretty much looks like that already, but in places like Asia, that would mean the permanent erasure of many ethnic features, which is a bit heartbreaking to me. Phenotypes are what define one's race and serve as identifiers to let others recognize them as.. them. Their identity. Let me give you an example of why this is bad.
Say you are Chinese, and you were genetically modified by your parents to fit the beauty standard because they wanted for you to have the best life they could offer you. You look around, and nobody in your community quite looks like you. While

nobody tries to alienate you from their social circles because of that-- you're beautiful and quite popular because of it, in fact-- you feel less Chinese because you look like what a Chinese person is "supposed" to look like; you do not look how everyone else looks, and you do not look like your parents, so you don't feel like you belong with them either. You are beautiful, yes, but it's almost an otherworldly kind of beauty. You feel it takes away from your identity as a Chinese person, and you almost wish you looked like everyone else. Worst of all, you never would have had to wish like this if your parents hadn't had you genetically modified. It was a choice you had no say in, and though they had good intentions, you now suffer because of a decision made for you before you even had the consciousness to say "no."

Of course, genetically modified or not, children are never able to choose how they look before they're born, and the average Chinese person probably wishes they fit the beauty standard just as you did in that example, but do you not see my point? Designer babies are not great. Really cool! But really, I don't think this kind of technology should have a price tag and be available for just anyone who can pay it. It'd be best if usage of it it was kept strictly for medical purposes, such as prevention of cancer, HIV, etc, because it really can do a lot of good, but if it ever leaves that environment, I would not be able to support it.

Ivy's Summary

designer baby bad

Designer babies are atrocious. The idea of playing God and genetically modifying children seemed so far away, but to consider them in real time now? This is terrifying. Having to considering condemning someone to a possibly hellish existence isn't something that I'm willing to risk. We don't know what consciousness is, we don't know what it constitutes, so the possibility of altering it in a negative way is real. Beyond that, physical harm is bound to happen, too. Maybe we'll select for traits that deform the child so badly that they have to rely on a slew of drugs to prevent themselves from feeling their own bodies. There are so many possible downsides of designer babies that it isn't even funny, so to risk trapping an innocent person in a prison of their own flesh isn't something to be considered. Frankly, I hate the idea of genetically modifying something with a consciousness, so I'm kind of against the idea of cloning something sentient, too. Even sheep, even lamb like Mary. Designer babies touches upon a facet of humanity so ugly that I don't entertain even the idea of 'designing babies'. I cannot stress how much I would rally against it. Who are we if we martyr a consciousness for personal gain?

References

www.fda.gov/food/agricultural-biotechnology/science-and-history-gmos-and-other-food-modification-processes.

https://sitn.hms.harvard.edu/flash/2015/from-corgis-to-corn-a-brief-look-at-the-long-history-of-gmo-technology/#:~:text=An%20enormous%20breakthrough%20in%20GMO,and%20paste%20it%20into%20another.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC213968/

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5847661/#:~:text=The%20first%20hint%20of%20their,genes%20involved%20in%20phosphate%20metabolism.

https://www.labiotech.eu/interview/francis-mojica-crispr-interview/

https://embryo.asu.edu/pages/ethics-designer-babies

https://www.tides.org/accelerating-social-change/policy/designer-babies-dna-in-the-headlines/

ttps://theconversation.com/those-designer-babies-everyone-is-freaking-out-about-its-not-likely-to-happen-103079#:~:text=The%20inevitable%20rise%20of%20designer,the%20limits%20of%20nature%20by

https://getanimated.uk.com/meet-lulu-and-nana-the-worlds-first-crispr-genome-edited-babies/

https://www.nature.com/articles/d41586-018-07545-0