

Claire Liu

Dec 7, 2023 12:13pm

Area of study: Life sciences, Environmental sciences

- Research based

Question: How might humans look in 10,000 years based on past evolution and environmental change?

Hypothesis: With increasing global warming, and thus our environments changing, we change faster and adapt to our reliance on technology, but our overall physical looks will not change much.

Conclusion: Homo sapiens have evolved to become what they are after millions of years of adaptation. Each dramatic increase in brain size and complexity is linked to environmental changes of that era. As of 2024, such climate change is happening. We can expect people to have slight increases in brain size similar to before, and have less hair to increase thermoregulation. Additionally, due to borders being more freely crossed, as well as the ozone layer thinning, the population's average skin tone will darken. Recessive genes such as blue eyes, blond hair, single-jointed people, those with straight hair and more will either become extinct traits or an extreme minority. In places we can't see, our diets will be the most notable change. Global warming will cause people to find different food sources, and as a result, our microbiomes will change through the years. The research supports the theory of not many extreme physical changes (due to the time limit being 10,000 and past stages to be across millions of years) but instead, introduces the idea of our bodies changing the most.

How climate change could affect human evolution:

<https://www.nbcnews.com/mach/science/climate-change-could-affect-human-evolution-here-s-how-ncna907276>

(Scott Solomon, evolutionary biologist)

<https://www.nasa.gov/news-release/nasa-analysis-confirms-2023-as-warmest-year-on-record/>
2023 was the warmest year on record as well global greenhouse emissions , global warming is getting worse.

Dec 21, 2023 12:12pm

Noticeable Changes in Animals

Summary of article:

- Some animals and plants have already started changing with climate change, squirrels & salmon developing at faster paces, flowers blooming earlier

<https://www.nbcnews.com/science/environment/climate-change-means-spring-could-come-three-weeks-earlier-across-n443856>

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Dec 28, 2023 1:50pm

Diseases and Future Food Availability

- <https://agriculture.canada.ca/en/environment/climate-change/climate-scenarios-agriculture> Food availability? Certain plants are unable to be cultivated due to rising temperatures, and long term, will cause a shift in diet, perhaps bugs (protein rich.) Viruses? Malaria will spread to areas once too cold for it (more mosquitos.)
- Pest survivability will become higher
- *"A rise in the incidence of days over 30 °C will bring challenges to both crop and livestock producers. Some crops, such as canola and wheat, are particularly vulnerable to heat stress during the flowering period, and high temperatures can result in lower weight gains in livestock, reduced reproductive capacity, reduced milk and egg production, and in extreme cases, livestock mortality. Longer, warmer summers and milder winters will result in greater overwinter survival of pests and diseases, as well as a northward expansion of pests and diseases"*
- *"Warmer spring weather will extend the growing season, however wetter springs may delay planting/seeding operations due to waterlogged fields and increase soil erosion and nutrient runoff."*

Summary: Change in temperature, notably warmer ones, will result in possibly protein based diets on insects. How might that change a person's diet after generations of the same eating habits? Entomaphagy might become even more common instead of being seen as 'disgusting.'

Feb 22, 2024

<https://www.discovermagazine.com/the-sciences/how-are-humans-still-evolving>

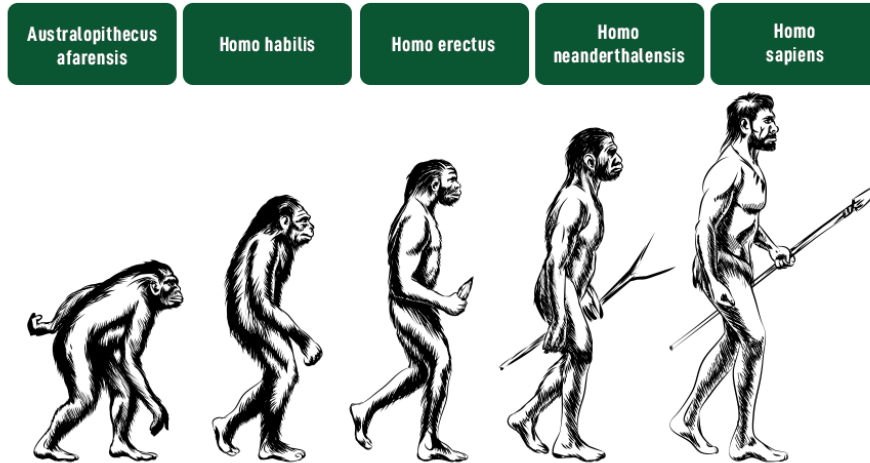
- Evolution comes from natural selection (as long as the species survives, it continues) organisms with better genes to survive in their environment will thrive and become more common than the organisms that don't (die out)
- **As long as a species keeps reproducing, it keeps evolving**
 - ^ However, humans (with technology, medicine) change slower full on species wise
- Modern medicine helps those who likely wouldn't have survived pass on their genes regardless (diseases, illnesses)

Mar 6, 2024

Noticed changes from the past to now

- <https://www.discovermagazine.com/the-sciences/how-are-humans-still-evolving> A more noticeable change is lactose intolerance in adults, an evolutionary trait from dairy farming. Not everyone can ingest the sugar in milk, but as years pass more and more people will be able to digest lactose.

- <https://www.bbcearth.com/news/what-will-humans-look-like-in-a-million-years> More people with darker skin, because areas are now more genetically diverse as people cross borders more often
- Less hair than neanderthal ancestors



- Thinner and lighter bones *also gravitating to upper body mass
- Taller
- Less hair
- Larger head
- Larger eyes

Summary: Human evolution is affected by their diets and behaviours.

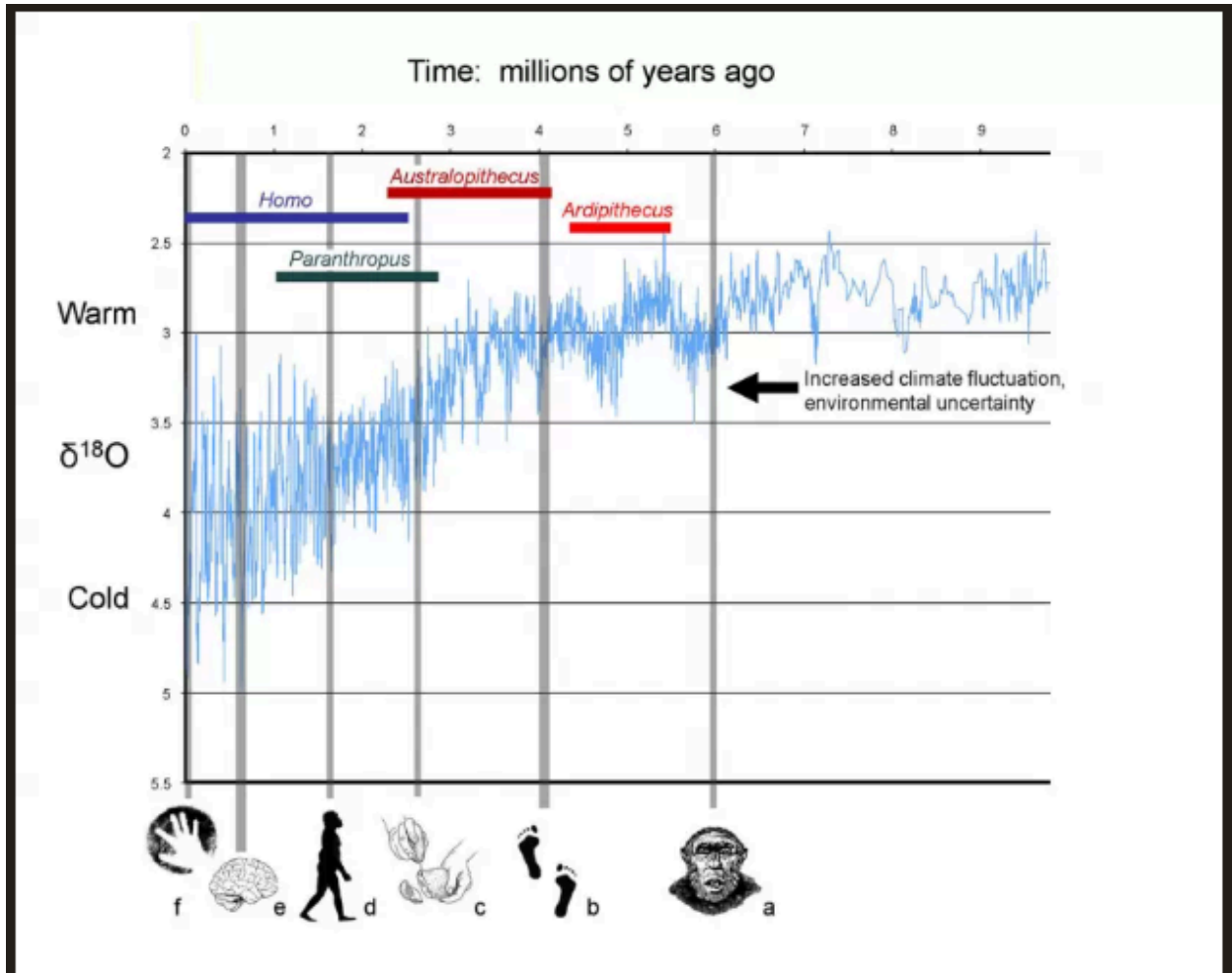
Mar 9, 2024

Melanin and the Ozone Layer

<https://www.healthline.com/health/skin/benefits-of-melanin>

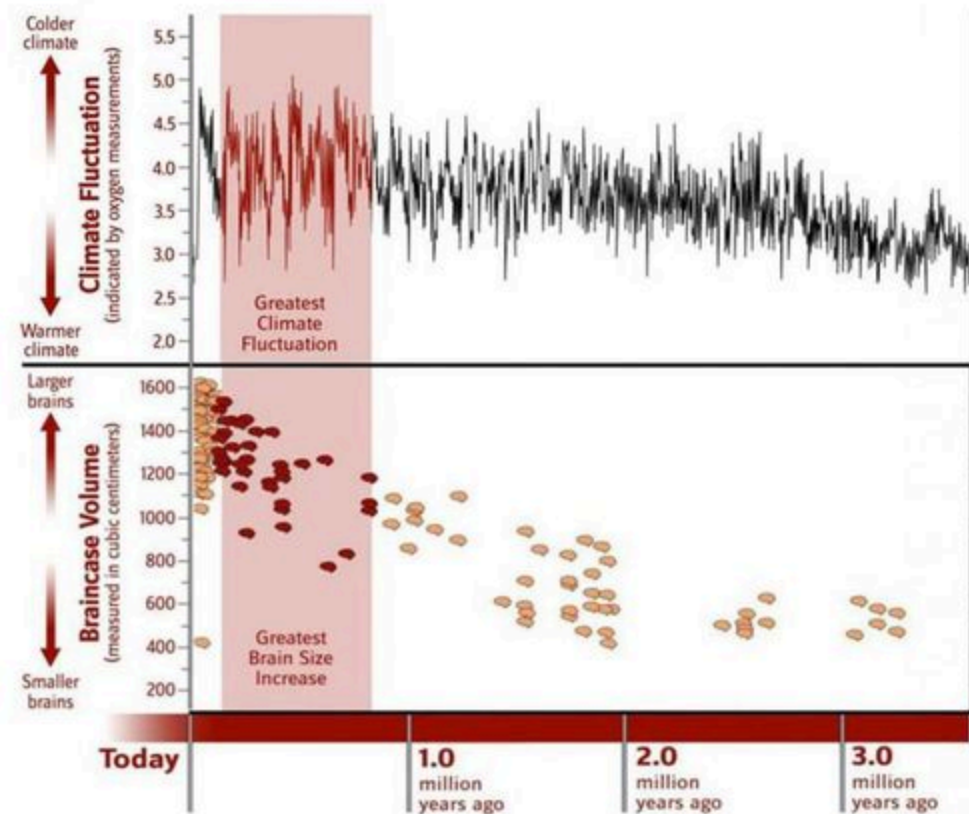
Melanin helps protect the skin from UV rays from the sun (supports the theory of the general population having darker skin)

<https://humanorigins.si.edu/research/climate-and-human-evolution/climate-effects-human-evolution>



Oxygen isotope curve ($\delta^{18}\text{O}$) for the past 10 million years (data from Zachos et al., 2001)
 (© Copyright Smithsonian Institution)

Oxygen isotopes are used to measure past climates.



- Climate fluctuation is linked to brain size increases

Mar 10, 2024

Main Questions Answered and Brain Size

Thermoregulation- humans lost hair so they could hunt in the hot day in the grasslands after they moved from shady forests

<https://www.smithsonianmag.com/science-nature/why-did-humans-evolve-lose-fur-180970980/#:~:text=A%20more%20widely%20accepted%20theory%20is%20that%2C%20when,the%20day%20in%20the%20hot%20grasslands%20without%20overheating.>

Dramatic climate change and the links to brain increase-

<https://humanorigins.si.edu/evidence/human-fossils/species/homo-sapiens#:~:text=During%20a%20time%20of%20dramatic%20climate%20change%20300%2C000,to%20the%20challenges%20of%20survival%20in%20unstable%20environments.>

Why did we grow complex brains? -

<https://humanorigins.si.edu/human-characteristics/brains#:~:text=As%20early%200humans%20faced%20new%20environmental%20challenges%20and,their%20social%20interactions%20and%20encounters%20with%20unfamiliar%20habitats.>

Heat waves are becoming more common/endangering or even killing more people

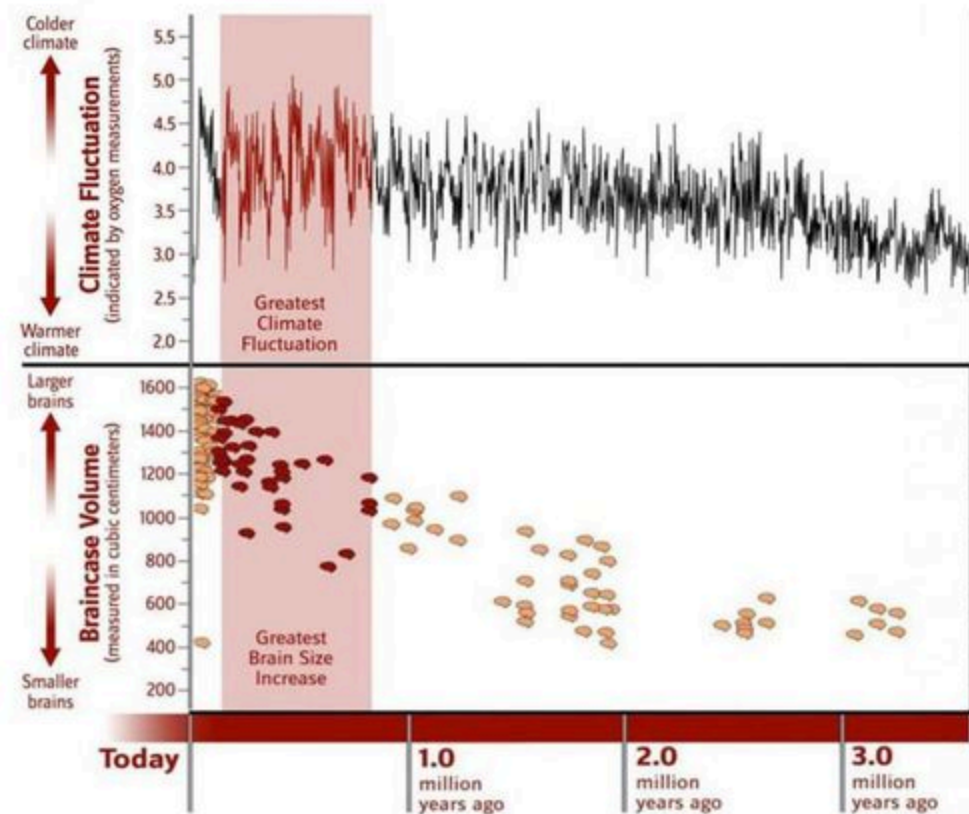
<https://www.nationalacademies.org/based-on-science/global-warming-makes-heat-waves-hotter-longer-and-more-common>

<https://www.epa.gov/climate-indicators/climate-change-indicators-heat-waves>

Questions:

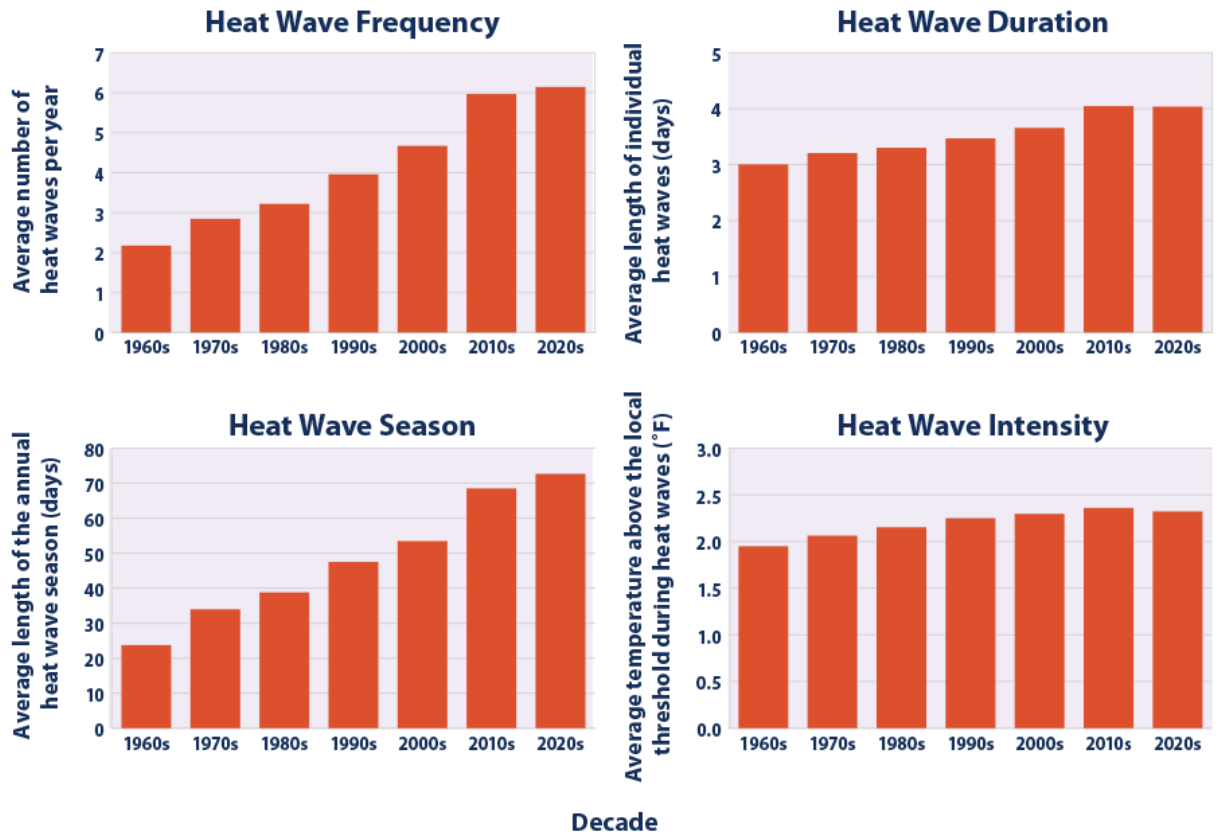
- How have humans evolved from the past? Why, how?

Every great climate fluctuation is linked to a great change in human evolution. When it comes to intense changes in the environment, it's not uncommon for many species to start changing in order to adapt and survive. *Homo sapiens* had also evolved during such a time, 300,000 years ago in Africa. Compared to the first speculated species in the *Homo* genus, *homo habilis*, *homo sapiens* have evolved to become taller, have a more lean head, gravitate to more upper body mass, less hair, and most notably, a greater brain size. All of the mentioned traits have to do with environmental changes. For example, when the *Homo* genus first started leaning towards the hunter-gatherer lifestyle, natural selection came to prove those with more upper muscle mass to run and reach performed better. As humans migrated to warmer climates, less hair became useful so that they could hunt in the hot days in the savannahs (thermoregulation). While these changes were happening, we also evolved to become more complex organisms. As a result of the hunter-gatherer lifestyle and the skill of tool handling, we developed intellectualism and the increased ability to store and process information; an advantage in social interactions, but also to adapt to new environments. One study from the *Smithsonian Institution* shows a dramatic increase in brain size among every large climate change.



- How is the environment?

2023 was the warmest year on record as well as the largest amount of released greenhouse gases (Nasa.gov) within the last 2,000 years (University of Bern), so it's not surprising to say we're currently going through environmental uncertainty seen in the past. In fact, heat waves, which are when very unusually high temperatures occur, have become increasingly intense and longer. These heat waves are especially dangerous because of the risk of illness and death. Since we need to regulate our body temperature through sweating, and heat waves cause the temperature at night to be more humid and warm (during the time we usually cool off), our heart pumps harder to help our body shed sweat, which strains the body. Other crises such as droughts and wildfires are becoming more common (Agriculture Canada). Thus, if it doesn't become too late, people could observe a pattern in behaviour as seen in our ancestors.



- How will our diets change?
- <https://www.verywellhealth.com/sickle-cell-and-malaria-5323165>
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The effects on the human body is only one of the consequences of global warming, as it would affect our food sources too. Insects and pests will likely show up more north due to warmer temperatures. With insects, meaning mosquitos, also comes diseases. Viruses such as malaria and West Nile will spread more north, and people who live in places where winter usually comes will need their immune systems to evolve to have defences against such diseases. One side effect will be the development of blood disorders like the inherited sickle cell disease, which causes someone's body to only develop an abnormal haemoglobin molecule in red blood cells called haemoglobin S and forms a "c" shape while making it rigid and sticky, rather than the usual disk size. If only one parent passes on a gene, then it would be a sickle cell trait, where the child produces both forms of haemoglobin. Malaria infects the haemoglobin and makes it become toxic. Sickle cell is mainly dangerous because it can clot the bloodstream and stop the haemoglobin's main function, which is to exchange carbon dioxide for oxygen. However, it provides protection against malaria. Although not totally known why, a theory is that the malaria parasite dies from lack of oxygen, it can't stick so easily to the wall of blood vessels, and put together, provides more time for the immune system to destroy the infected haemoglobin. In the future, there may be more people with the sickle cell trait or disease. Longer, hotter seasons also means a change in livestock and produce availability: our diets will change. Not all species have sweat glands and instead in order to regulate heat, need to cool

down or pant. In extreme temperatures, this could become harder and decrease livestock mortality as they cannot decrease their body temperature outside. It's most probable that humans will become mainly vegetarian due to high prices of meat in the future. Microbiomes, the bacteria that helps us digest food and keep up healthy, will change as well. Since a vegetarian's microbiomes are different from a meat eater's, an extreme future of global warming will essentially make the majority of humans have similar microbiomes. Furthermore, raising cattle for milk becomes more and more common as less people develop lactose intolerance. In 10,000 years, the percentage of those with lactose intolerance will become miniscule. Although humans can already digest the exoskeletons of bugs, it's interesting to note that because warmer seasons consequently equal heat stress during flowering stages, eating bugs will become a more commonplace in Europe and North America as they're protein rich and cheaper. Biologically, there won't be a change in the far future with prolonged insect-majority diets, but this behaviour leads to different ways of harvesting our food source.

Physically, how might we look different?

This research mainly focuses on the biological aspect of how humans may evolve; where the eye can't see. Though, physically, our appearance will still change. Every living organism continuously is evolving, and so such do humans as well. Generally, as extreme climates change, people will adapt and move to places more suitable and so the overall skin colour of people will darken. Firstly, compared to the past, more people cross borders and have interracial relationships. As the majority of the population already has darker skin, the overall population in places like Europe, east Asia, and western countries will become more diverse. People with darker skin have more melanin, produced by skin cells called melanocytes, which helps protect them from the UV rays of the sun. This is also the reason why those with less melanin (lighter skin) are more likely to experience harsher sun burns. As the ozone layer becomes thinner, having more melanin would be an evolutionary advantage. One study from the Smithsonian Institution shows a dramatic increase in brain size as well as body height among every large climate change: meaning one could assume the same would happen now. Reliance on technology could stall such huge increases as in the past that led to new species across the thousands of years, but as the past has shown us, humans keep becoming more complex, so our mass could still become a bit larger when you consider the diet changes and migration. Due to the graph spanning across millions of years, and this search with a set time of only 10,000, the physical change would be small at best. The evolution from homo neanderthals to only homo sapien was a course of 300,000 years.

Mar 13, 2024

More Physical Genes

- Recessive genes such as blue eyes, blond hair, single-jointed will become extinct/an extreme minority

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