

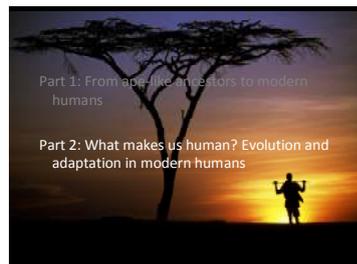
The Story of Human Evolution Part 2: What makes us human?

Slide 1



This powerpoint presentation tells the story of who we are and where we came from - how humans evolved from ape-like ancestors in Africa to become a dominant, cultural species occupying almost every part of the globe.

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In part 1 of this story, we saw how researchers have used genetic and fossil evidence to discover how humans evolved within the last 5 million years from ape-like creatures to modern humans, who migrated out of Africa only recently to occupy almost every part of the globe.

In this presentation, we see how many of the differences among humans in different part of the world are only skin deep, and discover some of the ways in which humans are still evolving.

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We are all close relatives in our DNA



The Mitochondrial Eve study showed that we are all closely related to each other – as we are all descended from a small population of humans who lived in Africa only about 10,000 generations ago.

Although the different races of human look quite different from one another, we are all very similar in our DNA. Differences in skin colour and eye colour that distinguish Asian, African and European individuals are the result of only small changes in our genes.

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Modern humans continued to evolve as they encountered new environments, new diseases and new ways of living



However, humans have continued to evolve as they migrated around the globe and encountered new environments, new diseases and established new ways of living.

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Evolution is a gradual change in genetic makeup from one generation to the next



Evolution can happen by chance, or by natural selection

At the simplest level, evolution is just a gradual change in genetic makeup from one generation to the next. These changes can happen by chance, or as a result of natural selection.

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How natural selection works

1. Individuals are variable



Natural selection works with the variation found among individuals.

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How natural selection works

1. Individuals are variable



Some of these variations will be inherited (passed down from generation to generation).

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How natural selection works

1. Individuals are variable

2. Some variations are inherited

3. Individuals with the most favourable variations have more offspring



Favourable variations become more common

The individuals with the most favourable variations for their environment will be most successful at reproducing, so these favourable variations will become more common in the population.

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Over time, natural selection changes organisms in response to their environment



So over time, natural selection can produce organisms that are well-adapted to their environment

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Evolution in action: Lactose tolerance



An example of natural selection in humans is the ability to digest lactose, or lactose tolerance

A change in the lactase gene gave us the ability to digest milk as adults. In all other mammals the ability to digest milk is lost after the infant stage.

Until we started to domesticate animals (which only happened within the last 10,000 years) we didn't need the ability to digest milk as adults.

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Domestication of cattle drove selection for lactose tolerance



Individuals with this genetic change were able to make use of a new source of nutrition – cow's milk. This would have improved their chances of survival, and therefore their chances of having children and passing this genetic variant on.

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Percentage of people with lactose intolerance around the world

The new gene variant was quickly selected for and today only around 20% of Europeans are lactose intolerant. In areas of Africa and Asia where dairy products are not a common part of the diet the variant has not been selected for and most of the population is still lactose intolerant.

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Evolution in action: Blue eyes



Sometimes changes don't confer a biological advantage and might just arise by chance..

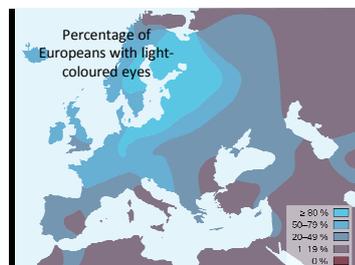
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The evolution of blue eyes is a good example of this. Blue eyes are the result of a single change in a gene called OCA2 which results in less melanin being produced in the iris. This mutation probably occurred in single person living in the middle/near east area 6-10,000 years ago, and has since spread throughout Europe.

Blue eyes don't confer a biological advantage, so it is not known exactly why the mutation spread so successfully. It's possible that blue eyes were deemed attractive so blue-eyed people had more offspring. The lower sunlight levels in Europe meant melanin wasn't as important so the mutation was able to spread through the population.

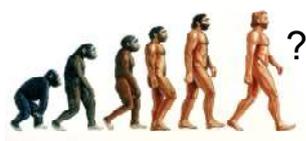
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These days in some parts of Europe more than 80% of the population have either blue or green eyes

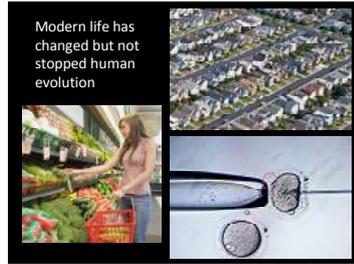
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Are we still evolving?



These are examples of recent evolution in humans. But these days, life isn't so hard. Is it possible that with all the technological advances we have made to protect us from the environment, that we have stopped evolving?

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We no longer have to forage for our food so strength and size are now not as relevant, we can build houses to protect us from the heat and the cold, and we are able to treat many illnesses with modern medicine. Many people who would not have been able to have children in the past can now reproduce thanks to fertility treatment.

But this hasn't stopped evolution - humans, just like all other living things, are evolving all the time. However, the direction of evolution has changed as the selective pressures have changed.

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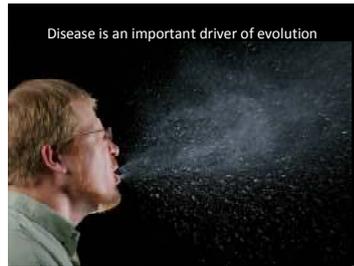
Over the last 10,000 years humans have undergone a dramatic lifestyle and environmental change.

We evolved as hunter-gatherers over millions of years, but then in a short space of time we invented agriculture, started eating different food, stopped travelling large distances on foot, and started living in cities in close contact with thousands of other people. New infectious diseases became common as agriculture became more widespread and population densities increased.

These changes continue to drive evolution in humans today as our bodies adjust to this new lifestyle.

A study in 2007 of the human genome found thousands of gene variants that have evolved over the last few thousand years. These include variants that are involved in dietary changes, such as the ability to digest lactose and starches, as well as genes involved in brain development and disease resistance. Many of these variants are still being selected for in humans today.

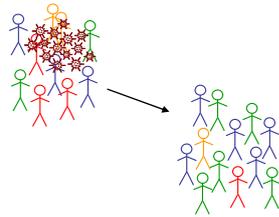
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Disease is a strong driver of evolution in humans today. Living in close contact with domestic animals and cities where population densities are high creates perfect conditions for new diseases to arise and spread quickly.

Although modern medicine means many diseases can now be treated, not all diseases can be cured, and in many cases when a new strain of a disease arises it can take a while for medicine to catch up.

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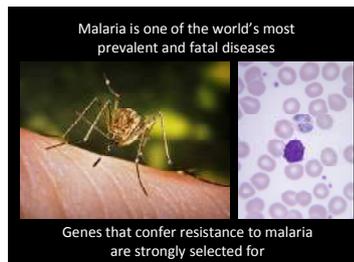


When a new disease arises, some people will naturally be more resistant to it than others because they have a slightly different genetic makeup.

For example in this figure, the blue and green individuals are more resistant to the disease than the red and yellow individuals (click 1). These people will be more likely to survive and have children, so there will be more blue and green people in the next generation (click 2) – the disease resistance genes will gradually increase in frequency.

Because new strains of diseases like influenza and E.coli are constantly arising, the particular gene variants that are selected for is changing all the time.

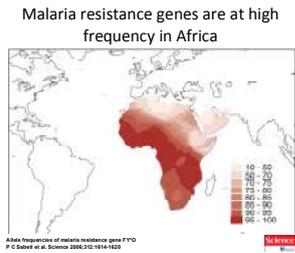
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A good example of how disease drives evolution in humans is resistance to malaria.

Malaria is caused by a small blood parasite that is transmitted by mosquitos. It is one of the world's most prevalent diseases and as it often strikes young people, the gene variants that confer resistance to malaria are strongly selected for.

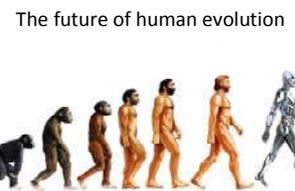
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In Africa, where malaria is common, gene variants that confer resistance to malaria are maintained at high frequencies in the population as they are selected for from generation to generation. In contrast, Europeans have low frequencies of these gene variants as they do not need to be able to resist malaria.

This figure shows the frequency of the FY*O gene (a variant of the Duffy red cell antigen which confers resistance to malaria). The variant is prevalent or fixed (100% frequency) in many African populations, but virtually absent outside Africa.

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In the future it will not just be nature that drives human evolution.

Our ability to change the environment – through climate change, technology and manipulating nature - will drive the way we evolve just as much as nature itself does.

- What do you think humans will look like in another 1000, or 10,000 years?
- Will we look the same?
- Will we live longer?
- Will we still be affected by disease?
- Will a new type of human species evolve?
- How will technologies like artificial intelligence, nanotechnology and genetic engineering influence the future of human evolution?