Match Your **Chromosomes** with a Chimpanzee's!

Each giant puzzle piece illustrates a giant chromosome from either a chimpanzee or a human. They are similar but there are many differences too! Can you match the human chromosomes with the chimpanzee equivalents?

What is a chromosome?

Chromosomes are little rods made of long, coiled sequences of DNA. This is where your genetic code, or genome, is stored. Each of your cells contains 23 pairs of each chromosome, unless you are male, in which case one of your pairs is made up of one 'X' and one 'Y' chromosome. You inherited half of your chromosomes from your father and half from you mother. Chromosomes were copied through many generations from your distant ancestors, down to you.

Chimpanzee chromosomes

Chimpanzees are our closest relatives and around 98% of our DNA is identical to theirs, so perhaps we should expect our chromosomes to look similar too? We shared an ancestor with chimpanzees around six million years ago, and chromosomes have been copied across many generations since. Changes or 'mutations' have occurred during the evolution of each species.

Sorting chromosomes

The dark bands on your chromosomes appear when they are stained in a laboratory. Each chromosome has a different pattern that we can use to identify them. Scientists number chromosomes by length; longest first. Here we follow the numbering system for the human chromosomes.

Matching the chromosomes

If we first order the chromosomes by size, and then try to match the grey bands, we should be able to match up the chromosomes from the two species. Scientists used to match up chromosomes in this way to see how closely related different animal species are - now we have more sophisticated ways of comparing their DNA!

Chromosome 1

Many of our chromosomes appear almost identical to chimpanzee chromosomes. The red band in each of the chromosomes is the 'centromere' and is used by the cell to pull duplicated chromosomes away from each other when the cell divides.

Chromosome 2

Chimpanzees have 24 pairs of chromosomes rather than 23. In humans, two chromosomes fused together. Some residual DNA sequence of the deactivated centromere and telomere 'ends' can still be found.

Chromosome 3

Chromosome 3 appears identical in chimpanzees and humans. This means that the ancestor that we share with the chimpanzees almost certainly had chromosomes that look like this too.

Chromosome 4

In chromosome 4, most of the bands match, but there is a section around the red centromere that appears to have been removed and inserted upside down. This is exactly what has happened in the chimpanzee lineage. It is called an 'inversion'.

Chromosome 5

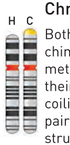
Your chromosomes carry 'genes' that code for proteins. Both human and chimpanzee genomes contain around 20,000 protein coding genes. Most of these are located in the pale sections of the chromosomes between the bands.

Chromosome 6

When chromosomes are copied, some DNA is lost from each end, making them a little shorter at each cell division. To protect the important information, the are repetitive DNA sequences called 'telomeres' at the ends that do not contain genes.

Chromosome 7

Both human and chimpanzee versions of chromosome 7 contain a gene called 'FOXP2'. It is thought that a mutation in the human version of this gene was important in the development of our speech.



Chromosome 8

Both humans and chimpanzees have about 2 metres of DNA in *each* of their cells! It is packed in by coiling the long strand of base pairs around small protien structures called 'histones'. Chromosome 8 is about 9cm long.

Chromosome 9

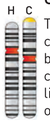
The chimpanzee chromosome 9 likely arose by an 'inversion' in an ancestor that had chromosomes like ours. When the section that is inverted includes the centromere, we call this a 'pericentric inversion'.

Chromosome 10

The DNA in chromosomes is made of long paired sequences of 4 chemicals called 'bases'. Adenine (A) paired with Thymine (T), and Cytosine (C) paired with Guanine (G). Chromosome 10 is a chain of 135 *million* such bases strung together!

Chromosome 11

The dark areas on the chimp and human chromosomes take up more stain because they are more tightly bound together. The lighter bands are rich in the bases A and T (G-negative) and the darker bands are rich in the bases G and C (G-positive).



Chromosome 12

The chimp and human chromosome 12's differ by an inversion around the centromere. Although changes like this rearrange the order of genes on regions of those chromosomes, most of these are thought to leave gene function unchanged.

Chromosome 13

The blue bars show a group of genes that code for your body's 'protein making factories' known as 'ribosomes'. The ribosomes translate genetic information into proteins, which have a central role in the growth and function of all living things.

Chromosome 14

Another perfect match! When heterochromatin is not considered, humans and chimpanzees have 13 identical looking chromosome pairs. Humans and more distantly related gorillas share nine, and humans and orangutans eight.

Chromosome 15

Humans have genes that code for ribosomes on chromosomes 13, 14, 15, 21, and 22, but in the chimpanzee, they are on 13, 14, 18, 21, and 22. In one lineage, the ends of chromosomes 15 and 18 may have switched places.

Chromosome 16

Areas marked in yellow are called 'heterochromatin'. These contain tightly bound DNA that in some cases might restrict the expression of any genes it contains. Heterochromatin often occurs near telomeres or the chromosome centromere.

Chromosome 17

Chimpanzee chromosome 17 has 'terminal' bands of heterochromatin on each end (marked in yellow) these are found in about half of all chimpanzee chromosome arms, but are conspicuously absent in those of humans.

Chromosome 18

As well as the difference in location of the ribosome between chimpanzee and human versions of chromosome 18, there was also an inversion around the centromere that occurred in the human lineage.

Chromosome 19

Reversal of the inversions and fusion that have taken place since humans and chimpanzees diverged would result in virtually 100 percent matching of G-negative and G-positive bands.

Chromosome 20

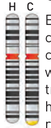
Chimpanzees share versions of virtually *all* the 20,000 protein coding genes found in humans! Changes in *when* and *where* some genes are used to make proteins is what makes Chimpanzees and humans different.

Chromosome 21

Chromosome 21 is one of the shorter chromosomes. The human version contains 48,129,895 base pairs and 308 genes, whist the largest human chromosome 1 contains 249,250,621 base pairs and 2724 genes.

Chromosome 22

Like chromosomes 6, 13 and 19, the banding in human chromosome 22 is identical not only to that of chimps, but also to that of gorillas and orangutans. Despite its small size, this chimp chromosome is 50,165,558 bases long.



Chromosome X

Because male humans and chimpanzees only have one 'X' chromosome, they often show what are called 'X-linked' traits. An example of this in humans and chimpanzees is red-green colour blindness.

Chromosome Y

Apart from the addition of the heterochromatin marked in yellow, the 'Y' chromosomes of chimpanzees and humans are similar. Both contain the 'SRY' gene that acts like a switch to tell the rest of the genome to make a male baby.

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