23andMe Genome View

The Genome View tool is available under the Family Traits tab in a 23andMe account. This tool enables the user to compare genetic profiles between two individuals. Using the SNP genotypes determined from each individual's DNA, each chromosomal region is color coded; white when the segment of the chromosome is not identical between the individuals, light blue when a matching segment is present on only one member of the chromosome pair, and dark blue when matching segments are present on both chromosomes. Here, I include examples of the pattern expected for comparisons between individuals with a variety of known relationships. Within a 23andMe account, the profile settings can be used to enable access to sets of example profiles that can be used in the Genome View. The profiles for the Mendel Family are especially useful because they include individuals representing 3 generations: 3 of 4 grandparents (Fred Mendel; Ron Fisher and spouse Margo Fisher), their children (Greg Mendel and spouse Lily (Fisher) Mendel), and three grandchildren (Ian, Alan & Erin Mendel).

Parent-Child Comparison

Here I show comparisons between a son and his two parents. The comparison on the left-hand side is Lily Mendel with her son, Alan Mendel. All chromosomes are colored light blue in this comparison indicating that at SNPs along each chromosome Lily and Alan always have one variant in common (and no long stretches of two variants in common, which would be colored dark blue). This pattern results from the Principle of Segregation, chromosome pairs separate and are transmitted individually and equally to offspring. At each chromosome pair, Alan inherited one copy from each of his parents. Note the difference in the X chromosome when Alan Mendel is compared with his father. Alan inherited a Y chromosome from his father, and his only X chromosome from his mother, so Alan’s X chromosome does not have identical segments when compared with his father as indicated by the lack of shading. There is no other biological relationship that would produce the patterns shown here, so 23andMe genetic tests of two individuals and the comparisons in the genome view can effectively serve as a test of parentage (a female compared to each of her parents would appear the same as the comparison of Alan to his mom on the left-hand side). I haven’t seen this myself, but a parent-offspring comparison with the chromosomes colored light blue and also containing dark blue segments, would indicate that the parents are related.

Grandparent-Grandchild Comparison

Here I show comparisons between two grandchildren and a common grandfather. The first comparison is again using Alan Mendel, but in this case compared with his maternal grandfather, Ron Fisher. Note that the autosomes are now a patchwork of light blue and white segments. Light blue segments represent regions where the individuals share at least one variant in common at each SNP, whereas SNPs in the white regions lack a common variant. This comparison is an excellent visualization of the genetic principles of Independent Assortment and Recombination. Independent Assortment refers to fact that segregation of the different chromosome pairs is independent, so that Alan either inherited through his mother the chromosome of Ron Fisher or of Margo Fisher, his maternal grandmother. Note that at Chromosomes 11 and 21, Alan did not inherit anything from Ron Fisher. For all other chromosome, some segment(s) in Alan Mendel was inherited from Ron Fisher. The patchwork pattern along each chromosome reflects Recombination, which occurs by exchange between the grandparents chromosomes in their daughter before transmission of a single member of each chromosome pair to the grandchild.
Compare the distinct pattern of identical segments in each grandparent-grandchild comparison. This is a consequence of the independence of transmission for the pairs of chromosomes and the randomness in the positions of exchanges between chromosomes, which together produce genetically distinct offspring. Also note the dark blue segments indicating complete identity between the single X chromosomes of Ron Fisher and Alan Mendel. In contrast, the X chromosome of Erin Mendel appears the same as the autosomes in comparison with her maternal grandparents.
Full Siblings

Here is a comparison between full siblings. Because in this case the two individuals are descendants of two common ancestors, each can inherit the same chromosome segment from both parents (with a probability of 0.25), and each of these chromosome regions is colored dark blue. In regions colored light blue, the siblings share an identical segment on one of each of their chromosome pairs. Importantly, and especially relevant to the use of genetic matching with relatives to support genealogical research, the shared autosomal segments do not provide any indication from which parent they were inherited.

Examples below are comparisons where the relationship between the individuals is known and/or strongly supported by historical records. The observed percentage of the genome shared between the individuals, and the number of segments shared, is included along with the relationship predicted by 23andMe. The expected percentage of the genome shared between the individuals based on the relationship shown is also provided.
Half First Cousins

This comparison is between male descendants of a common grandfather. In addition to having 10 segments shared throughout the autosomes, the tested individuals share the same Y chromosome haplogroup.
4th Cousins

This comparison is between 4th cousins connected through common 3rd Great Grandparents. Two different autosomal segments are shared; one on Chromosome 3 and the other on Chromosome 14.

Observation:
0.33% DNA shared across 2 segments

Expected Relationship: 4th Cousin
(3rd to 6th Cousin)

Expectation:
0.195% shared