

Chromosome Structure

- DNA is packaged into chromosomes
 - This is achieved by the use of **proteins to wind up the DNA**
 - **Each human chromosome has 22-48 million nucleotide pairs**
 - End to end, this is **1.5m**
 - During **mitosis**, it is only **2µm in length**
- During mitosis, the chromosomes condense and are at their shortest. Whereas, **during interphase, they decondense and become ~20x longer**
 - During interphase, the chromosomes are hard to visualise because they are long and thin
- Chromatin is DNA that is package with proteins, of which, there are two types:
 - **Non-histone proteins**
 - These include DNA polymerase, scaffold proteins and heterochromatin protein 1, among other proteins
 - **Histone proteins**
 - Breaking open a chromatin fibre during the cells interphase allows us to see the **nucleosome core particles** (see right)
 - They are observed as **beads on a string**
- The **nucleosome core particles are defined as being DNA plus the histone octamer**
 - The stretches of DNA between the core particles are known as strands of **linker DNA**
 - **One linker strand is ~4-80 nucleotide long**
 - **Each nucleosome is technically classified as one core particle and one linker strand**
- Once the nucleosome core particle has been released from the rest of the DNA strand (using the enzyme **nuclease**) you can **disassociate the DNA from the protein using a high salt concentration**
 - This leaves the **histone octamer** and the **147bp DNA strand** that was wrapped around the octamer (right)
 - The DNA wrapped around the protein will **always be 147 nucleotides long**
 - You can further split the histone octamer into the 8 proteins that comprise it (see below):
 - **2x H2A**
 - **2x H2B**
 - **2x H3**
 - **2x H4**
 - The **octamer proteins all possess many negatively charged amino acids** (such as arginine and lysine)
 - These **tightly bind to the negatively charged DNA phosphate**
- The histone protein **H1** helps pull the nucleosomes together to bundle them and condense the chromatin fibre

