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Questions Packaging of DNA

December 2021

1) The human genome consists of 3 x 10^9 bp. Furthermore the adult human body has about 10^{14} cells. If the DNA of all cells were put in a straight line, how long would this thread be?

$3 \times 10^9 \times 10^{14}$

2) Organisation of nucleosomes: How do histones influence folding in eukaryotic DNA?

Histones are the basic proteins of the nucleosome. DNA wrapped around DNA is rapped around the octameric H_2A. H_2B. H_3. H_4 Complex. H_1 serves as a clamp Histones and tighten the binding Histones and DNA together form the 10nm and the 30nm fiber. respectively

3) What is the difference between heterochromatin and euchromatin? How does acetylation of histones affect the chromosome structure?

Euchromatin is chromatin that becomes less compacted during Interphase and is accessible to the cellular machinery responsible for gene activity. Heterochromatin, on the other hand, remains quite condensed during Interphase and contains genes that are largely inaccessible to this machinery. Histones in transcriptionally active DNA regions are often acetyled. The acetyl group binds to the positively charged NH_3 group of Lys on histone tails → histones lose positive charge and, therefore do not bind DNA tightly.

4) The bacterial chromosome is usually a circular DNA molecule with some associated proteins. Although the proteins that cause the E.coli chromosome to coil are not histones, what property would you expect them to share with histones?

Since DNA is acidic and proteins bind to it, we expect the proteins to be basic with positively charged amino acids (which are most lys and arg) (+ve) charge to bind -ve charged DNA backbone

5) *Rider* is a transposon in tomatoes and by moving around in the genome it can duplicate DNA segments. *Rider* transposons caused a segment of chromosome 10 in tomatoes to be duplicated and transported to chromosome 7, which resulted in the overexpression of *IQD12* and the production of elongated fruits. How might movement of a gene such as *IQD12* to a new location cause it to be overexpressed?

The Rider element generated an additional IQD12 locus on chromosome 7 that encompassed the ancestral IQD12 locus presented on chromosom 10. This large "hybrid" retroelement landed in the fruit-expressed gene, resulting in high and fruit-specific expression of the IQD gene containing the retroelement.