



Chromosomal Organization

Carl Andersen Tan – November 6 Textbook Presentation



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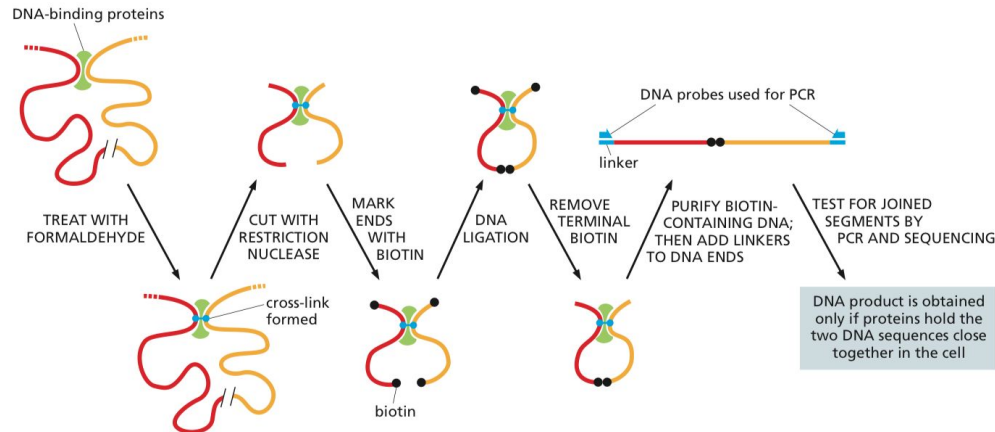
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Packing by SMC complex

*Speaker notes has more detailed information

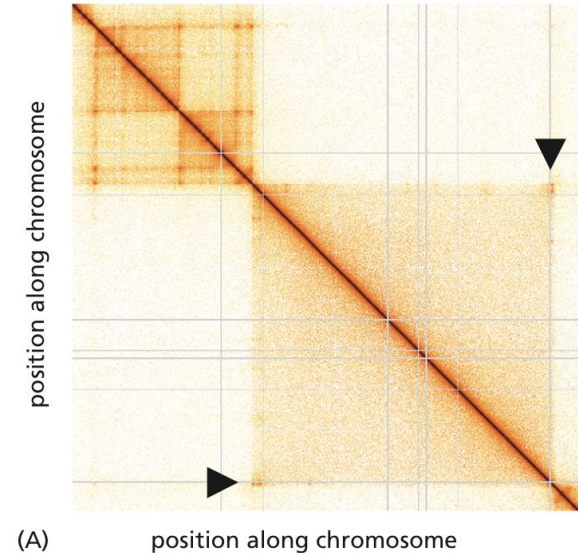
Biomolecular technique “Hi-C” used to elucidate Chromosome Organisation

- Chromosomes occupy its own discrete territory within the nucleus.
- Hi-C provided a way to map chromatin interactions throughout the genome by cross-linking chromatin, cutting DNA, ligating it, and then sequencing the interacting fragments.



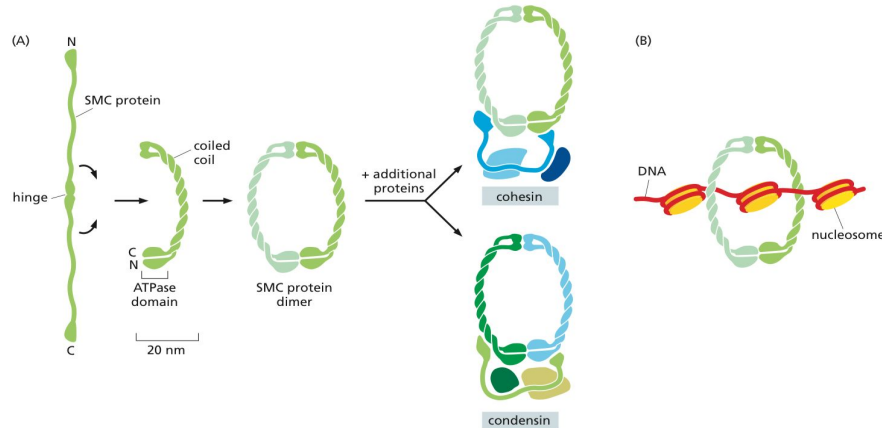
Biomolecular technique “Hi-C” used to elucidate Chromosome Organisation

- Figure shows a plot of any DNA sequence from a 2kb region (position indicated by x axis) was found to be ligated to another 2kb region (position indicated by y axis)
- Hi-C allows for determination of topologically associated domains (TAD)
- TADs are thought to play crucial roles in gene regulation by influencing which genes and regulatory elements can interact within the same domain.



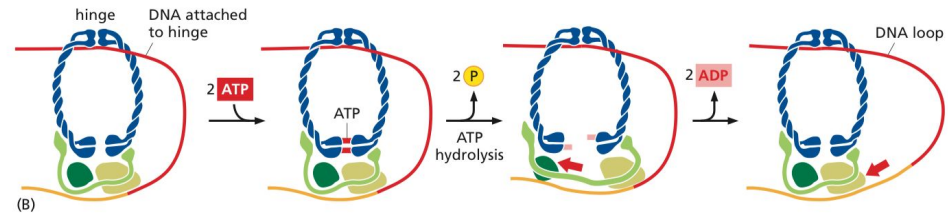
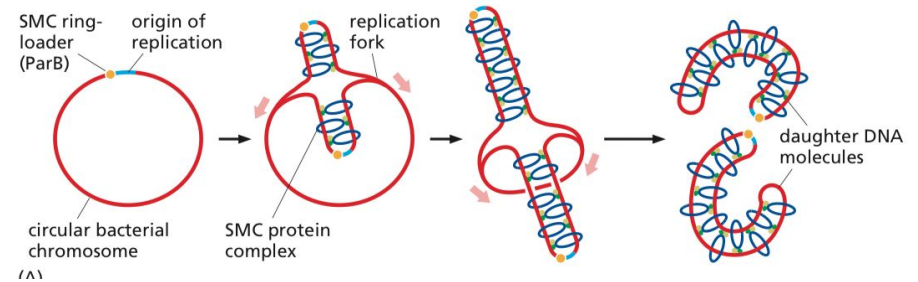
Chromosomal DNA is organized into large loops

- DNA is folded into loops by an SMC protein complex
- The condensin complex is essential for the condensation of chromosomes during mitosis and meiosis
- The cohesin complex is essential for holding sister chromatids together from the time they are duplicated until they are separated during anaphase.



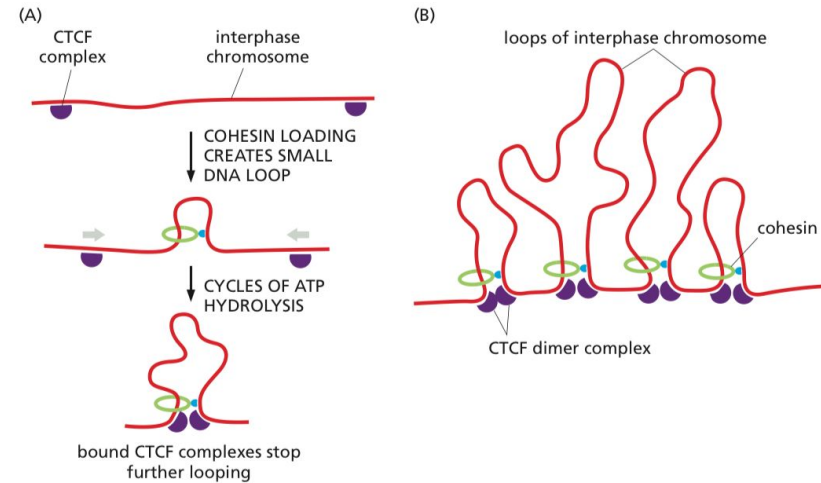
Chromosomal DNA is organized into large loops

- Moving SMC containing protein rings function to separate bacterial chromosomes
- Par B binds adjacent to the origin of replication of the circular chromosome.
- ATP hydrolysis drives movement until two DNA replication forks formed at the origin meet



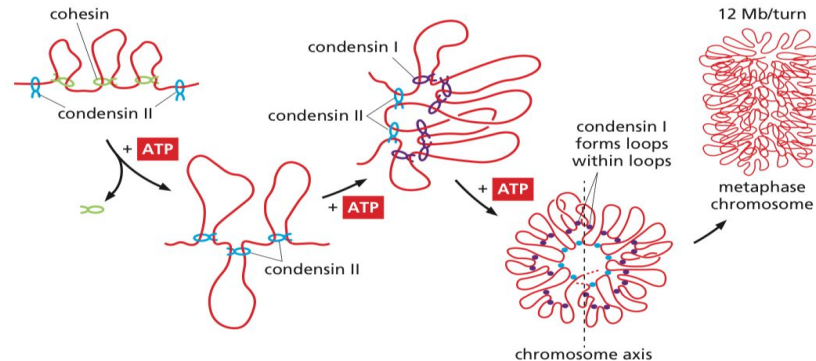
Chromosomal DNA is organized into large loops

- During interphase cohesin rings are loaded at multiple sites along a chromosome. They serve to fold linear chromosomal DNA into loops.
- The cohesin rings stop at favored stopsties marked by CTCF
- CTCF are insulator proteins that help maintain discrete domains of chromatin function (e.g. enables function of reader-writer remodeling complexes)

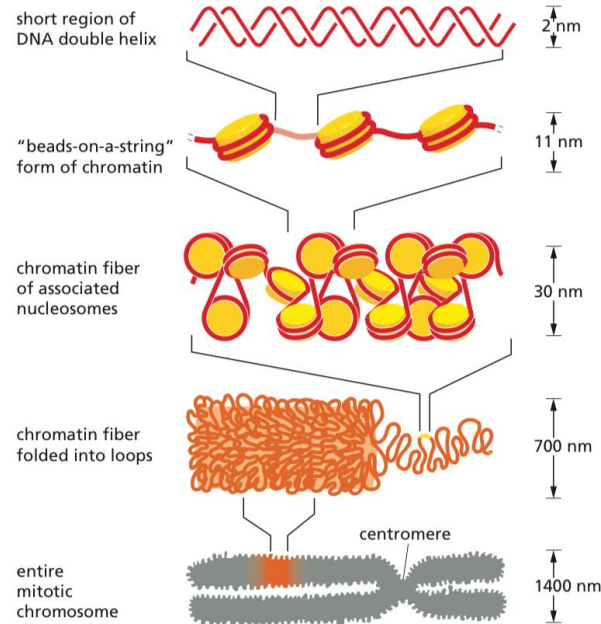


Mitotic Chromosomes are highly condensed

- As cells enter mitosis, the interphase organisation of chromatin loops created by cohesin is lost
- Another SMC protein, Condensin II forms larger new chromatin loops
- A second set of loops is formed with condensin I
- Loops within loops are formed packaging the DNA tighter



Chromosome Organisation



NET RESULT: EACH DNA MOLECULE HAS BEEN PACKAGED INTO A MITOTIC CHROMOSOME THAT IS 10,000-FOLD SHORTER THAN ITS FULLY EXTENDED LENGTH



Thank you

