

Advanced Cell Biology. Lecture 18

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Outline

DNA and chromosomes

Previous final question: the answer

What is better for the cell, nonhomologous or homologous reparation? Why?

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What is better for the cell, nonhomologous or homologous reparation? Why?

- ▶ Homologous reparation is better if there is enough time. If not, nonhomologous reparation will do the job.

Lab 4 schedule

- ▶ 1 pm section:
 1. Avery et al. (1944). Murray, Heitkamp, Namanny
 2. Watson & Crick (1953): 2 papers. **Simons**, Wolfe, Rosin, Evanoff
 3. Wilkins et al. (1953). Wagner, Eaton, Bauer, Morse
- ▶ 3 pm section:
 1. Avery et al. (1944). **Beyer K.**, Beyer Sh., Elder, Coffin, Rohlk, Glaspie
 2. Watson & Crick (1953): 2 papers. **Wilson**, Clark, DesRoches, Bruckhard, Aguilar
 3. Wilkins et al. (1953). Davis, **Kaur**, Gilles, Yates

Structure of DNA movie

- ▶ Koltsov (1928, 1936) hypothesized that hereditary molecule should be polymer with radicals (genes)
- ▶ Radicals of daughter molecules will be positioned on the same places (molecule is a template to itself)
- ▶ However, Koltsov thought that this should be a protein, because nucleic acids seems to be “too simple”

- ▶ He used pathogenic and non-pathogenic strains of pneumococci
- ▶ Showed that killed pathogenic strain could modify non-pathogenic
- ▶ The nature of modification agent was not yet discovered

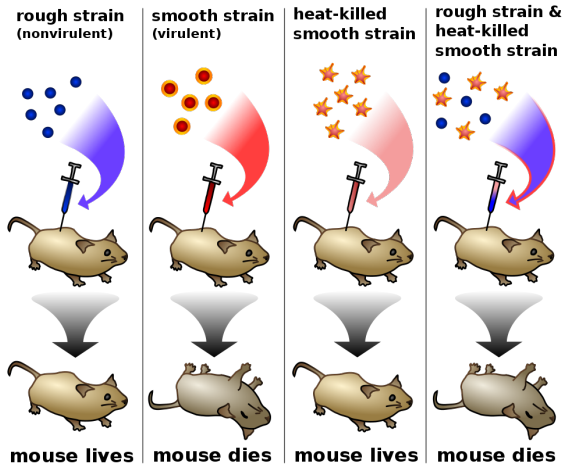
Rough (nonvirulent) and smooth (virulent) pneumococci



The smooth strain has a polysaccharide capsule that protects it from the host's immune system, while the rough strain doesn't have that protective capsule and is defeated by the host's immune system.



Griffith experiment



- ▶ Will be covered in today's lab
- ▶ In all, Avery group demonstrated that DNA, not proteins is a modification agent

- ▶ They used bacterial virus (phage) T2 where capsid (protein envelope) was marked with ^{35}S whereas virus DNA was marked with ^{32}P
- ▶ Infected bacteria contain only ^{32}P
- ▶ Therefore, infection was due to DNA

Hershey & Chase experiment

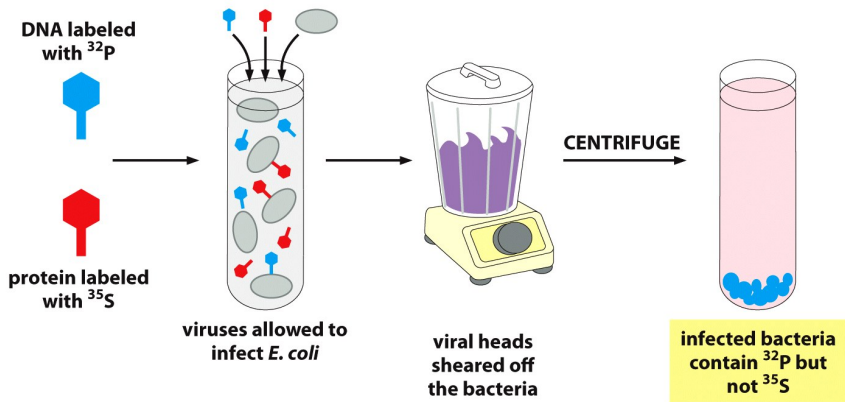


Figure 5-5b Essential Cell Biology 3/e (© Garland Science 2010)

- ▶ In eukaryotes, DNA comprises of multiple long filaments which are condensed during cell division (mitosis or meiosis)
- ▶ These filaments are interphase DNA, or “interphase chromosomes”, they are ≈ 500 times shorter than completely non-condensed DNA (which is not exist in eukaryotic cells)
- ▶ Chromosomes normally compacted in 10^5 times comparing with non-condensed DNA

Histones, chromatin and nucleosomes

- ▶ 50% of chromosome mass are different histone proteins
- ▶ Histones + non-histones + DNA = chromatin
- ▶ Histones are responsible for nucleosome and 30 nm fiber levels of packing

30 nm fibers and nucleosomes

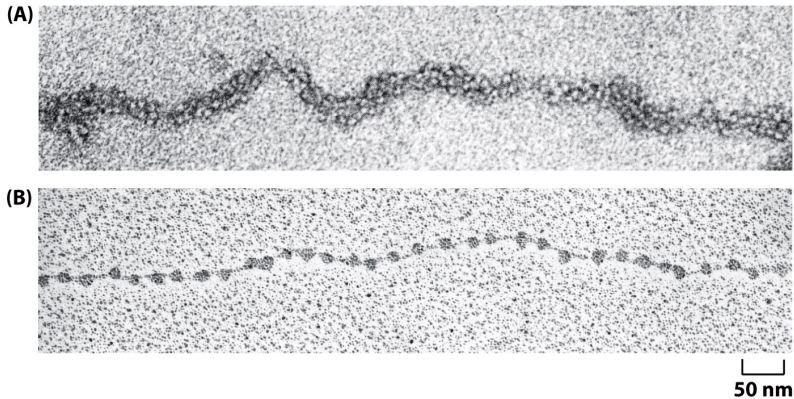
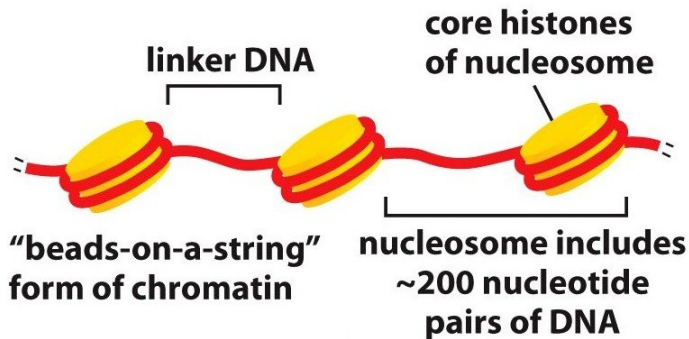


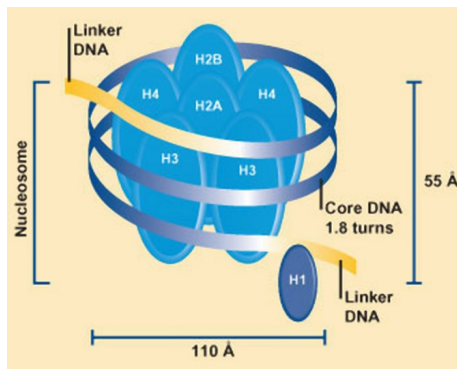
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Beads on a string



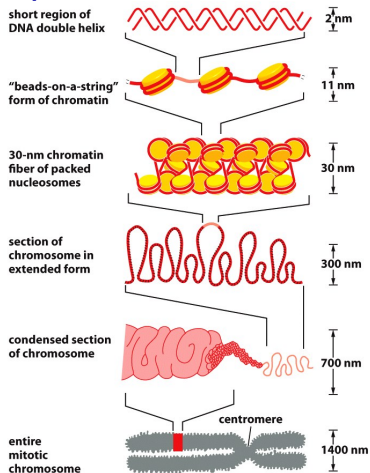
- ▶ Histone octamer consists of H2A, H2B, H3 and H4 histones
- ▶ Linker histone H1 helps to create a 30 nm fiber

Histones



- ▶ Nucleosome
- ▶ Chromatin 30 nm fiber
- ▶ Chromatin loops
- ▶ Condensed chromatin loops
- ▶ Chromosome

Five levels of compactization



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

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Chromosome coiling movie

- ▶ Telomeres and centromeres are specialized, meaningless DNA sequences which mark centers and ending regions of chromosome
- ▶ Chromatids are DNA molecules in one chromosome (normally two)
- ▶ Every chromatid has two arms (again, in most cases)

- ▶ Chromosomes are different in size and form
- ▶ Standard set of chromosomes is a karyotype
- ▶ Banding patterns allow to distinguish between chromosomes through the location of A-T rich parts (dark bands)

Banding patterns in human karyotype

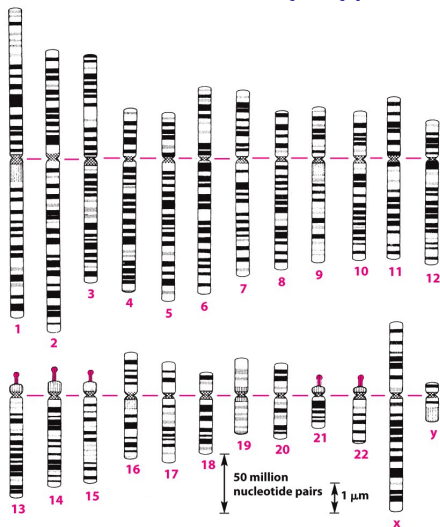


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Final question (1 point)

What is the transformation of bacteria?

- ▶ DNA in cells have two states: unpacked (interphase DNA, “interphase chromosomes”) and packed (chromosomes)
- ▶ Histones are proteins responsible for first two levels of chromosome packing

For Further Reading



A. Shipunov.

Advanced Cell Biology [Electronic resource].

2011—onwards.

Mode of access: [http:](http://)

[//ashipunov.info/shipunov/school/biol_250](http://ashipunov.info/shipunov/school/biol_250)



B. Alberts et al.

Essential Cell Biology. 3rd edition.

Garland Science, 2009.

Chapter 5: pages 171–187.