Objective is to set some basic foundations for the lectures of next week:

- B and A and Z forms of DNA and their parameters,
- purines and pyrimidines, and pairings
- elements of statistical mechanics of homo-polymers, Kuhn and persistence lengths, static and dynamic persistence lengths, worm like chain WLC and twisted WLC or TWLC models
- Link, Twist and Writhe.

There are lots of resources out there for the basic material:

- jhm's group has a DNA modelling course with home page at

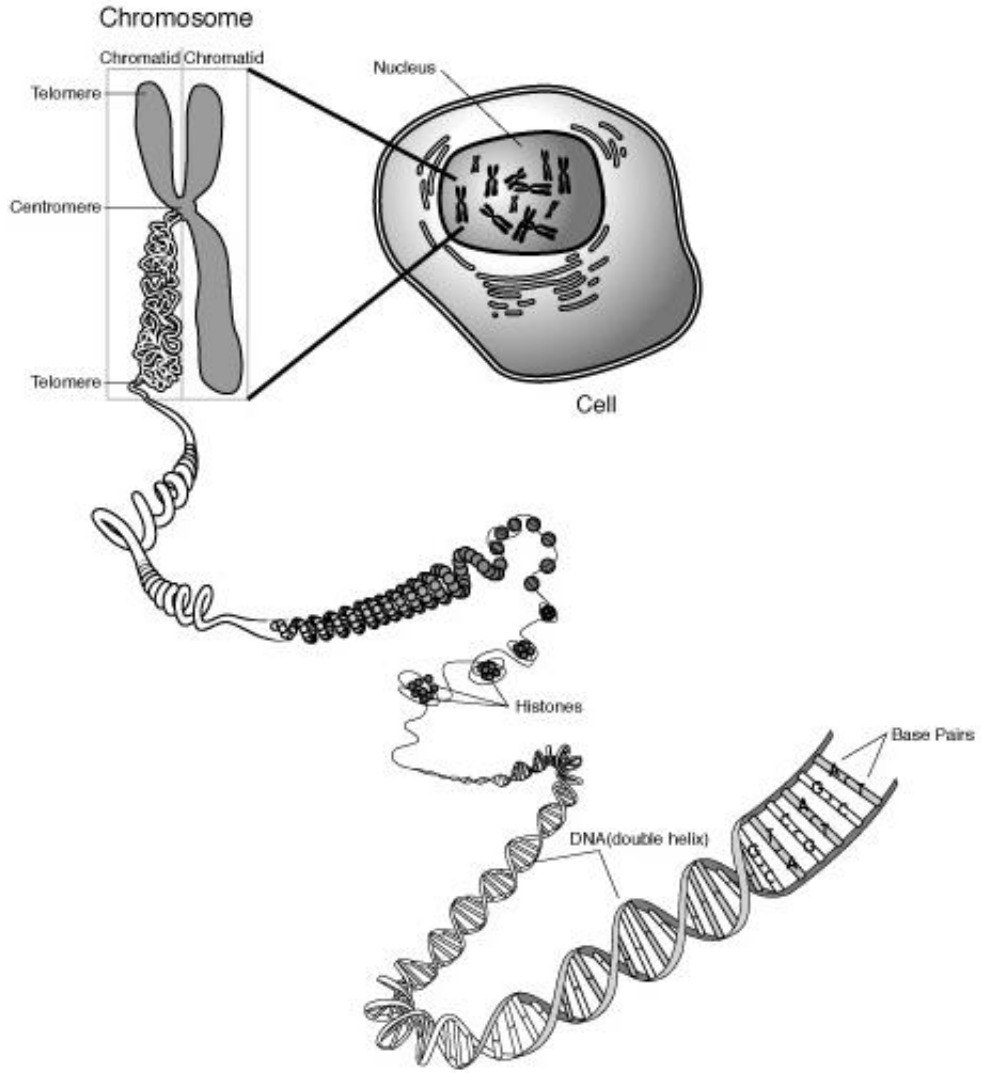
  `http://lcvmwww.epfl.ch/teaching.html`

  and that page has lots of sub-links to pages and citations to books that we have found useful, for example

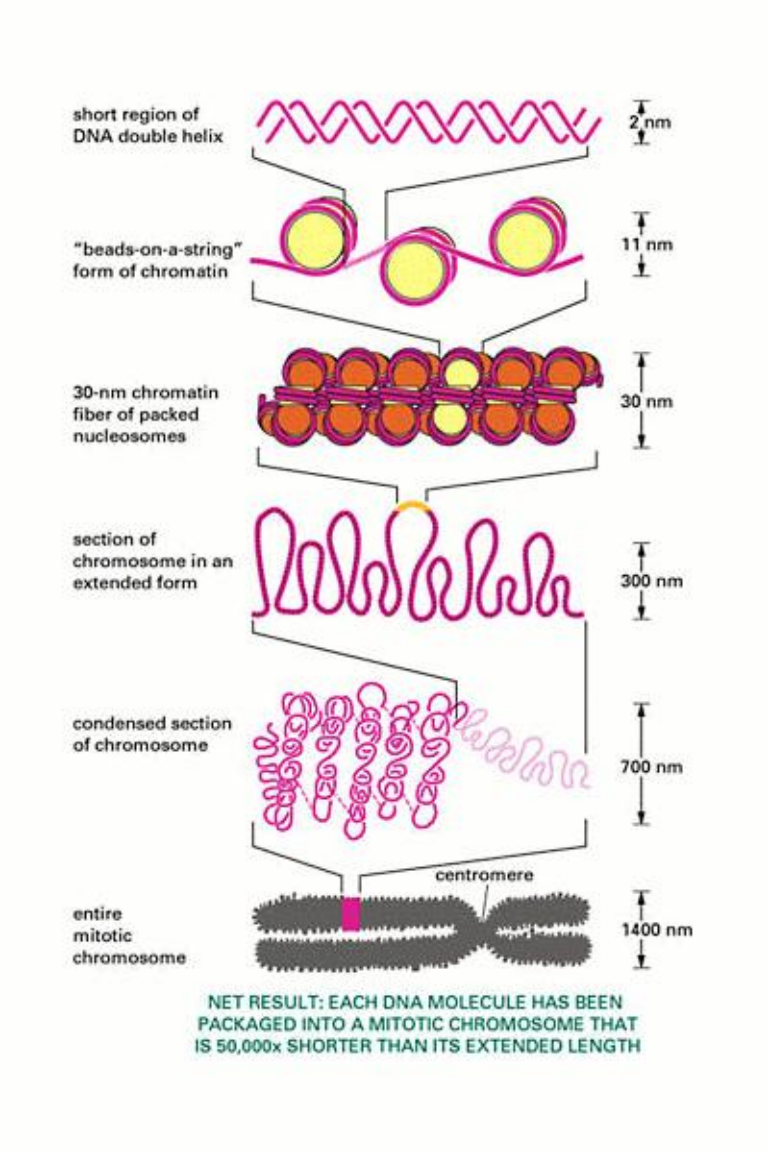
- `http://www.accessexcellence.org/RC/VL/GG/`

- `http://www.biophysics.org/education/resources.htm`

Basics of Chromosome 1



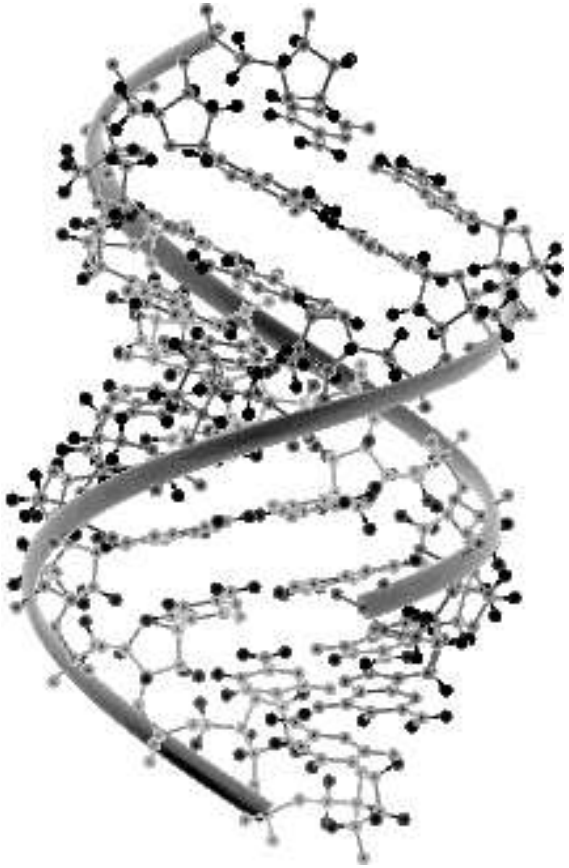
Basics of Chromosome 2

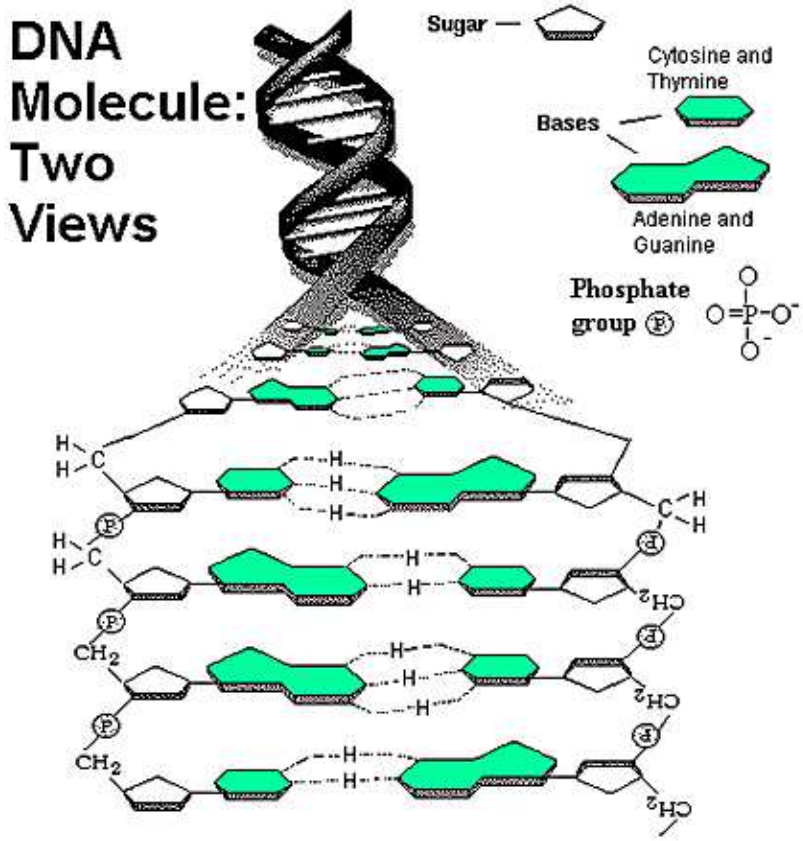


Basics of DNA 1

- Four bases, two Purines A and G, and two Pyrimidines T and C
- Purines are bigger (two carbon rings), and Pyrimidines are smaller (one carbon ring)
- A pairs with T with two hydrogen bonds, C pairs with G with three hydrogen bonds

Individual atoms can be grouped into relatively rigid units

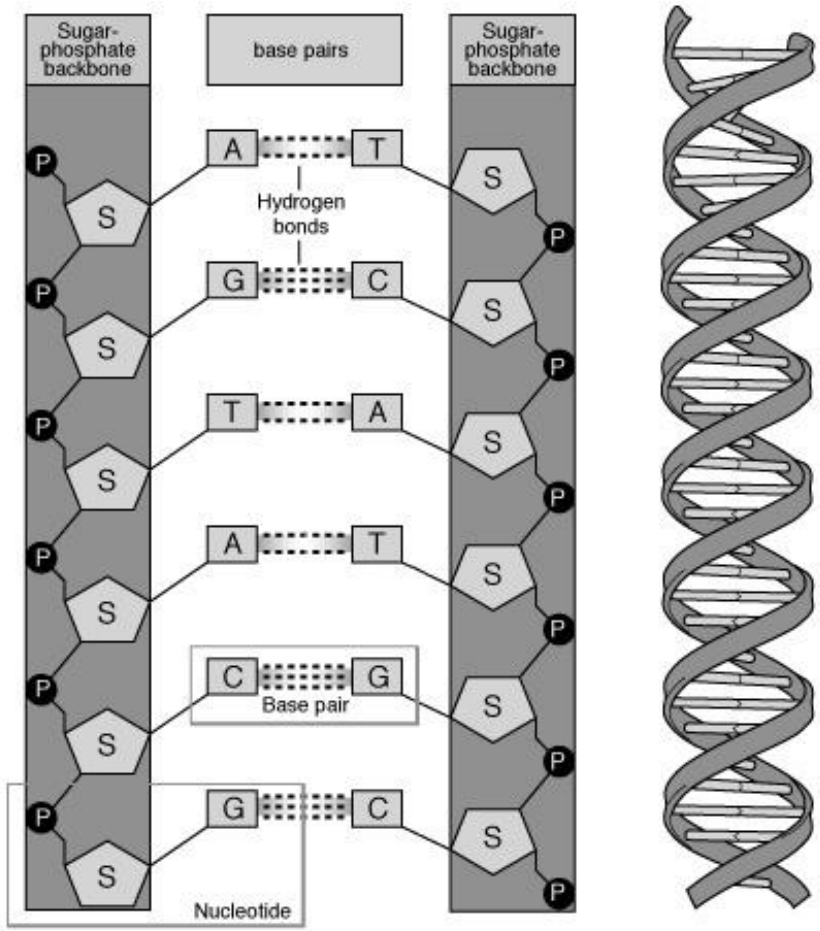




Basics of DNA 2

- Geometry of AT pair almost identical with geometry of CG pair. Each pair forms a flat rectangle, with links to the backbones at the two adjacent corners of a long side, and there is a rotational axis of symmetry through the short diameter.

- Leads to the idealized Crick-Watson B-form double-helix (the secondary structure) with arbitrary base sequence along one backbone (the primary structure).



Approximate sequence-independent parameters of the B-form double helix: Diameter 2 nm, rise per base-pair 0.34 nm, one full turn every 10.5 base pairs.

MOST IMPORTANT POINT

Because of the differences between purines and pyrimidines, and because of the different numbers of hydrogen bonds, the base pair sequence modulates both the intrinsic shape, and local stiffness properties of the double helix.

Quantifying these modulations via experiments is an objective of much of the work that will be described next week.

Basics of DNA 3

- Regarded as an isotropic, homopolymer DNA has a persistence length of around 170 base pairs (bps) or so.

- at longer scales entropic effects dominate, largely sequence-independent