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Introduction to Medical Genetics: Properties of DNA

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At the end of this resource, you should be able to

- Describe the properties of DNA & comprehend the variations in DNA structure

Topics

- DNA is a dynamic molecule (supercoiling & conformation)
- DNA can denature and renature (base pairing)
- DNA is flexible
- DNA can form hybrid molecule
- DNA has grooves
- DNA has sense and antisense strands

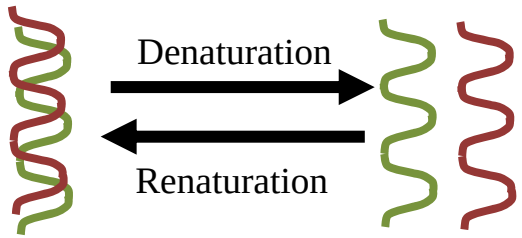
DNA: Dynamic molecule

- DNA exists as a **pair of molecule**
- Forms **double helix**
- Helix shape **stabilized by hydrogen bond**
- 3 forms of DNA: **B, A and Z**

	B	A	Z
Helix direction	R-handed	R-handed	L-handed
Bp per turn	10.4	11	12
Helix diameter	1.9 nm	2.3 nm	1.8 nm
	Watson Crick model		Methyl base

DNA: Denature/Renature

- DNA **denaturation** (melting): separation of two complimentary strands of DNA by ↑ temperature.
- DNA **renaturation** (re-annealing): two complimentary strands of DNA base pairing together to form double-stranded DNA when there is a ↓ in temperature.



DNA: Flexible

- Biological manipulation and packaging of the molecule often depend crucially on local variations in both **bending and torsional flexibility**
- The binding of proteins, drugs or chemical compounds can **distort the structure of DNA**
- DNA behaves locally as an **anisotropic heterogeneous rod**. This bending anisotropy is sequence dependent.
- Anisotropy means having different physical properties in different directions (properties that differ according to the direction of measurement)

DNA: forms hybrid molecule

- The hybrid DNA-RNA helix remains the bedrock of **information transfer** in biological systems.
- DNA:RNA hybrid duplex d(GTCACATG):r(caugugac) assumes **neither A nor B form structure**
- This duplex forms **intermediate heteromerous duplex structure**
- DNA and RNA strands show prominent sequence-dependent variations in their helical parameters.
- RNase H **discriminates** between DNA:RNA hybrid duplexes and pure RNA:RNA duplexes.

DNA: forms hybrid molecule

- Telomeres are **heterochromatic**
- They are transcribed into noncoding telomeric repeat–containing RNA (**TERRA**).
- **RNA-DNA hybrids** form at telomeres are removed by RNase H enzymes.
- Telomeric RNA-DNA hybrids **promote recombination-mediated elongation** events that delay the onset of cellular senescence.

DNA: has grooves

- Two kinds: major and minor (**Why are there 2 types of grooves?**)
- Grooves are **results of double helix structure of DNA**
- there are characteristic patterns of hydrogen bonding and of overall shape that are exposed in the **major groove** that distinguish an A:T base pair from a G:C base pair, and for that matter, A:T from T:A, and G:C from C:G

DNA: has grooves

- The **minor groove** is not as rich in chemical information and what information is available is less useful for distinguishing between base pairs. The small size of the minor groove is less able to accommodate amino acid side chains.
- Grooves allow necessary **proteins to make contact with bases** i.e Transcription factors, significant for cell development and communications.
- Serves to keep the **cellular process occurring effectively**

DNA: has sense and antisense strands

- **Antisense strand** - DNA strand that carries important information to make proteins by binding to the RNA
- **Sense strand** - is the one that does not code for RNA. Sense strand is identical to mRNA except for thymine is replaced by uracil in mRNA

Summary

- DNA is a **dynamic molecule** (supercoiling & conformation)
- DNA can **denature and renature** (base pairing)
- DNA is **flexible**
- DNA can form **hybrid molecule**
- DNA has **grooves**
- DNA has **sense and antisense strands**