

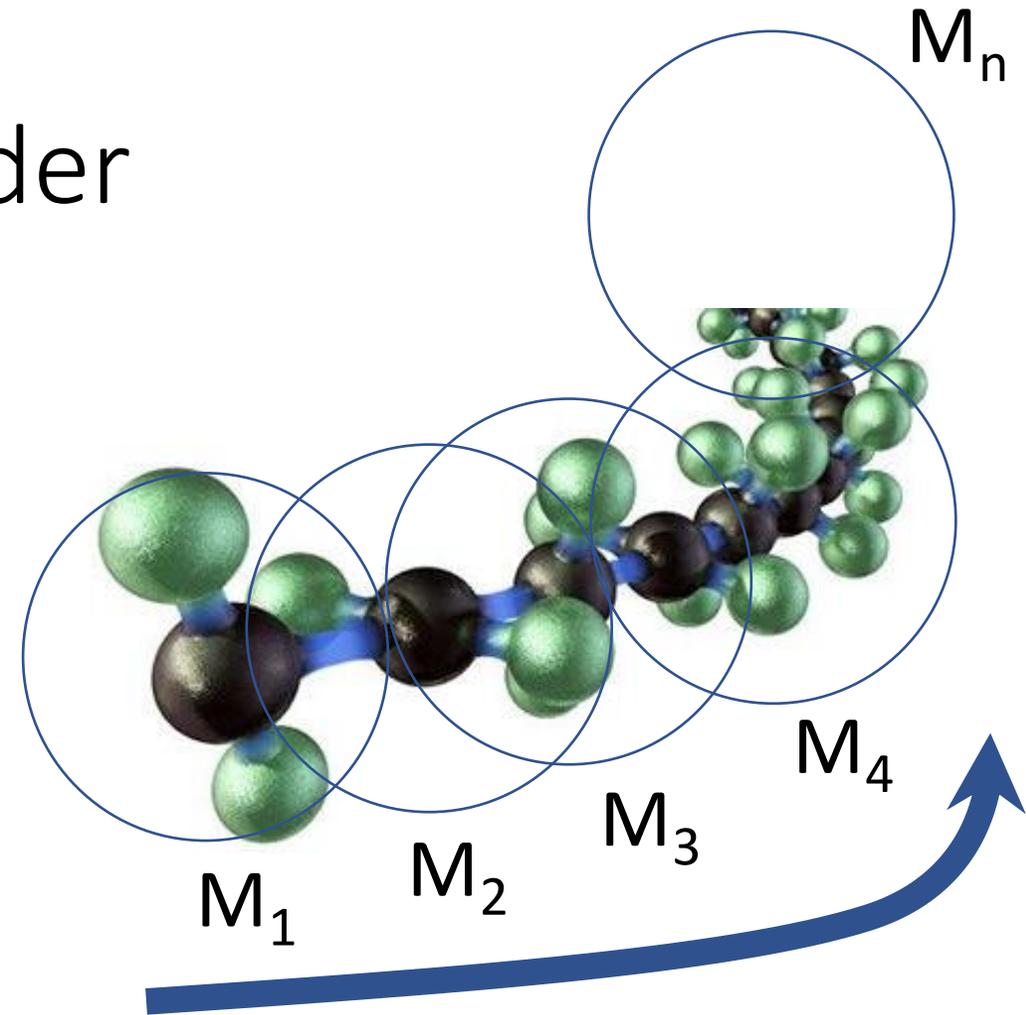
Lesson 3

Nucleic acids - polarity and structure



Macromolecules' Law & Order

- Macromolecules carry information as:
 - They have two ends (starting and terminal end)
 - They have a direction (from start to end)

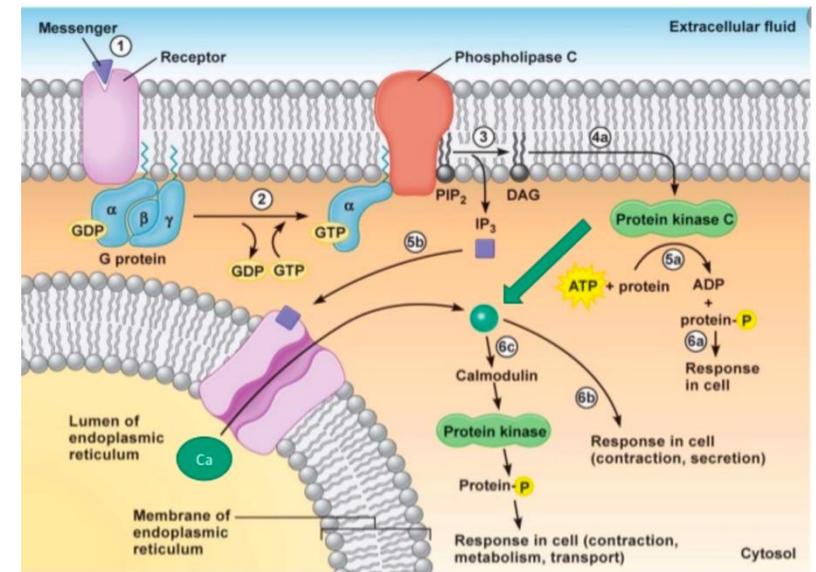
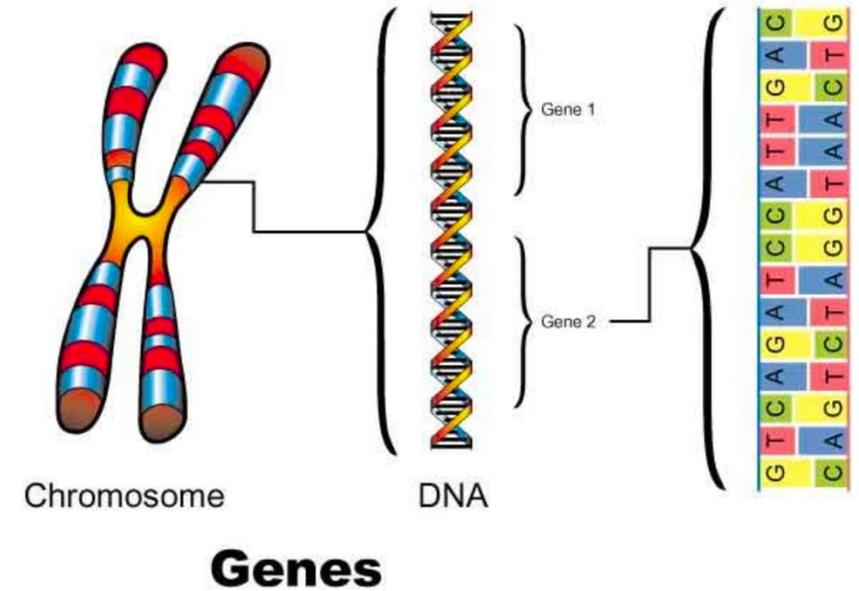


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- Macromolecules possess **ORDER** and **POLARITY**
 - These two features constitute the **FUNDAMENTAL INFORMATION** cellules can read and understand

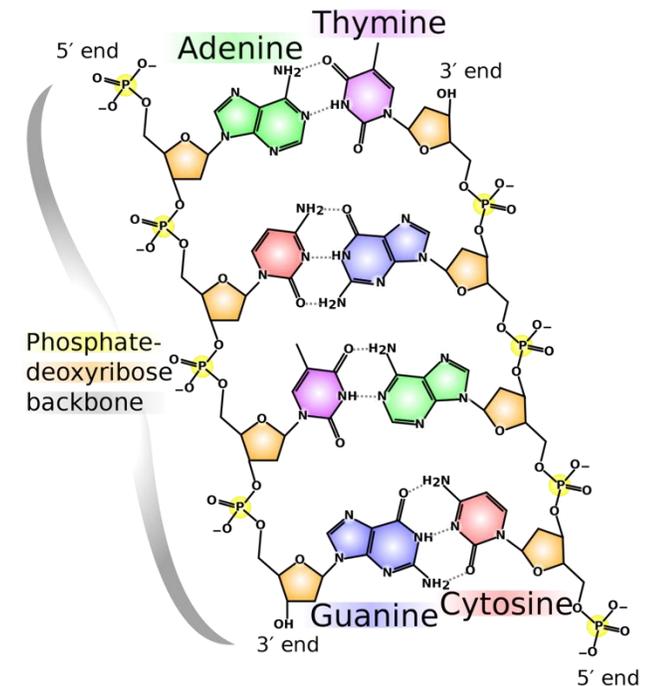
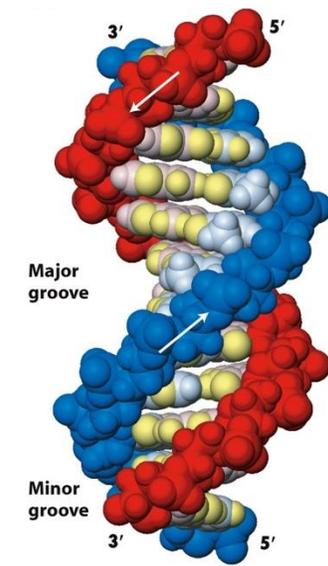
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- **NUCLEIC ACIDS** = carries of hereditary information
- **PROTEINS** = all other info/instructions



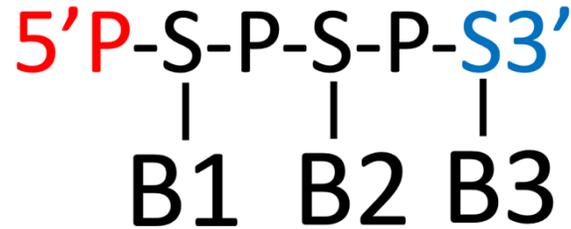
Nucleic acid polarity

- Have two hands: 5' e 3' $5'P-S-P-S-P-S3'$
 $\begin{array}{c} | \quad | \quad | \\ B1 \quad B2 \quad B3 \end{array}$

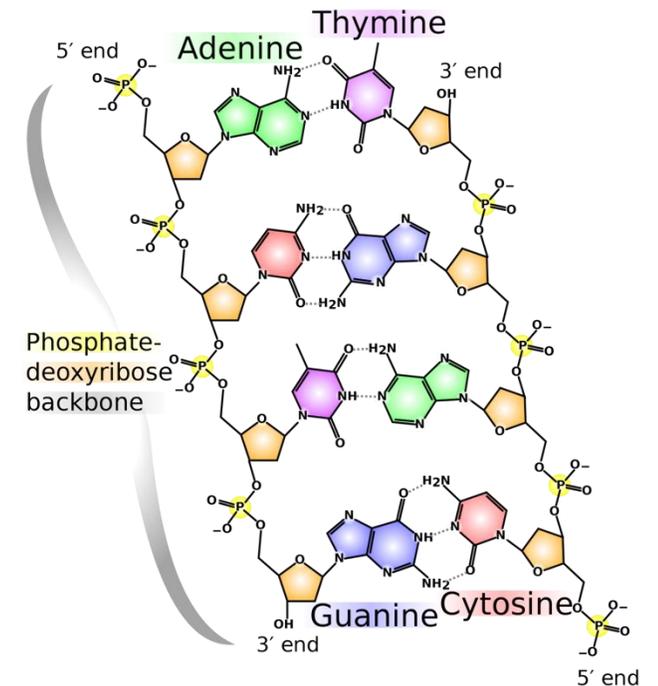
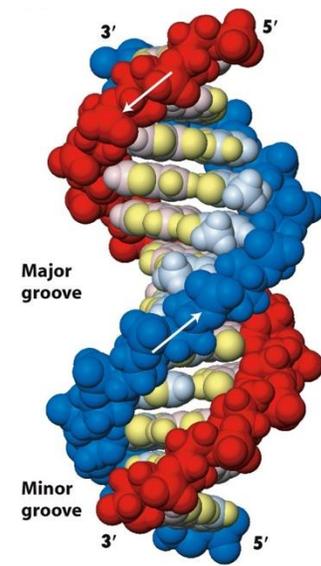


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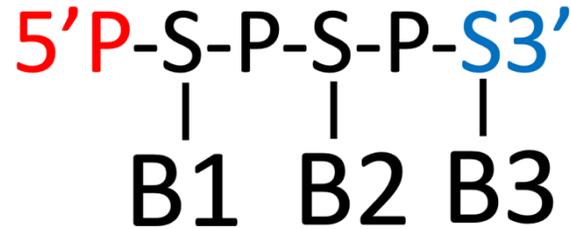


- P-S = sugar-phosphate backbone joined by phosphodiester bonds
- 5' and 3' ends are **CHEMICALLY DIFFERENT ENDS** and cells can distinguish them from one another
- Polarity:
 - 5' end = P-5'C on sugar
 - 3' end = 3'OH on sugar
- Base order along the polymer

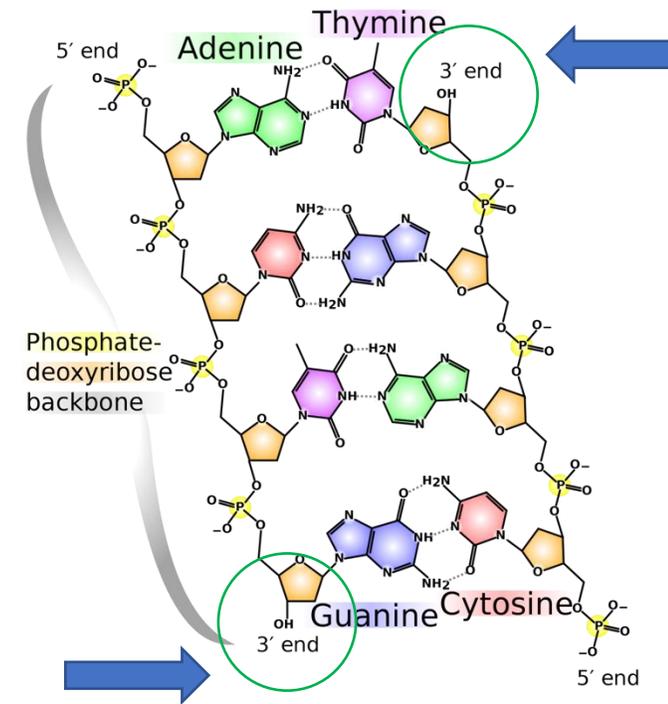
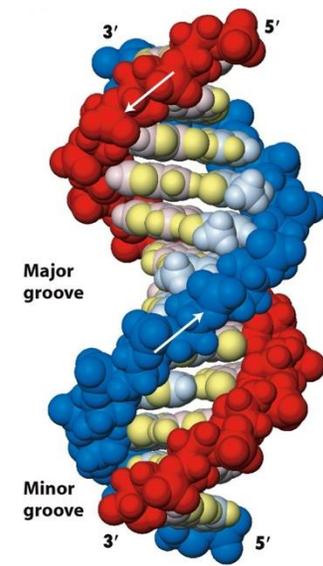


Nucleic acid polarity

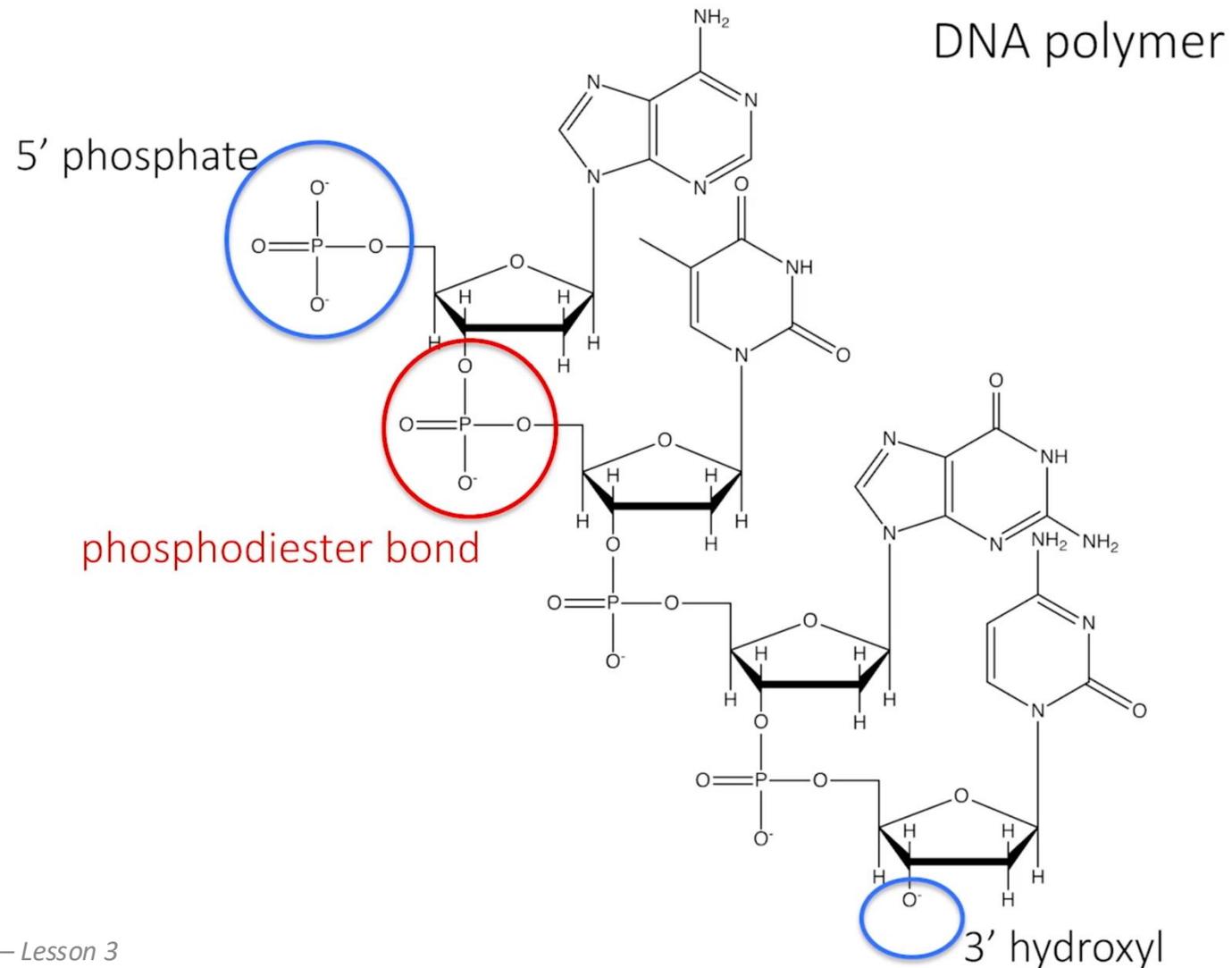
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- 3' is the last base added (any new incoming base will be added to 3'OH)



Nucleic acids



Nucleic acids polarity

- S-P backbone is not written, just the bases + polarity

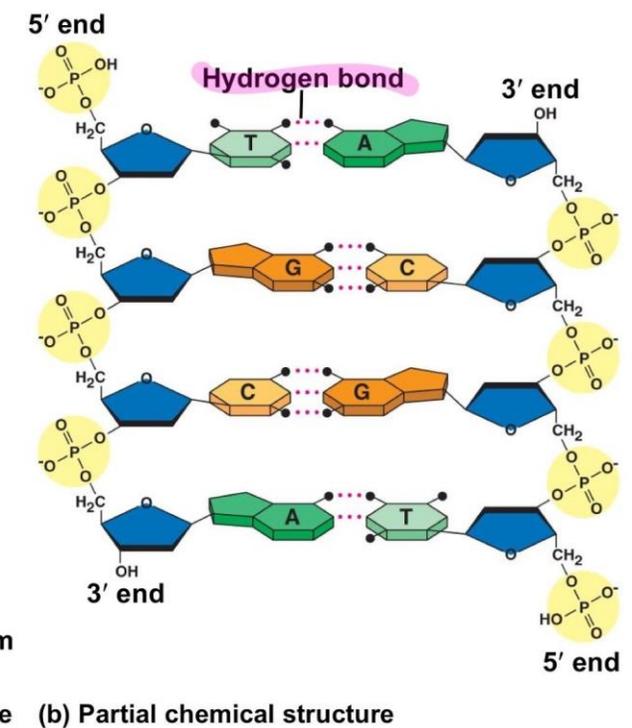
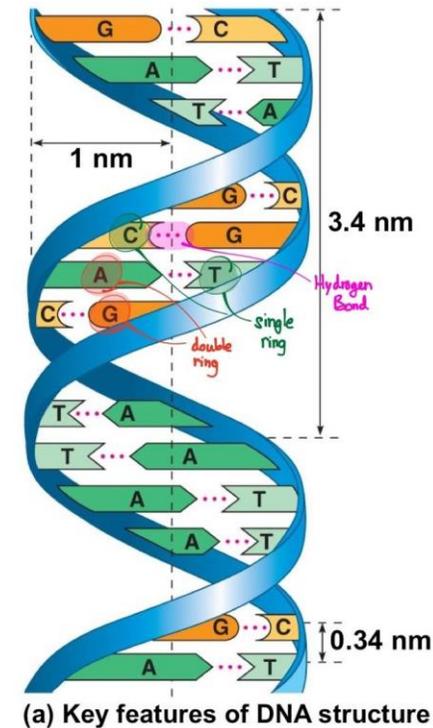
Nucleic acids polarity

- S-P backbone is not written, just the bases + polarity
- **ALWAYS write 5' and 3' on each nucleic acid strand**



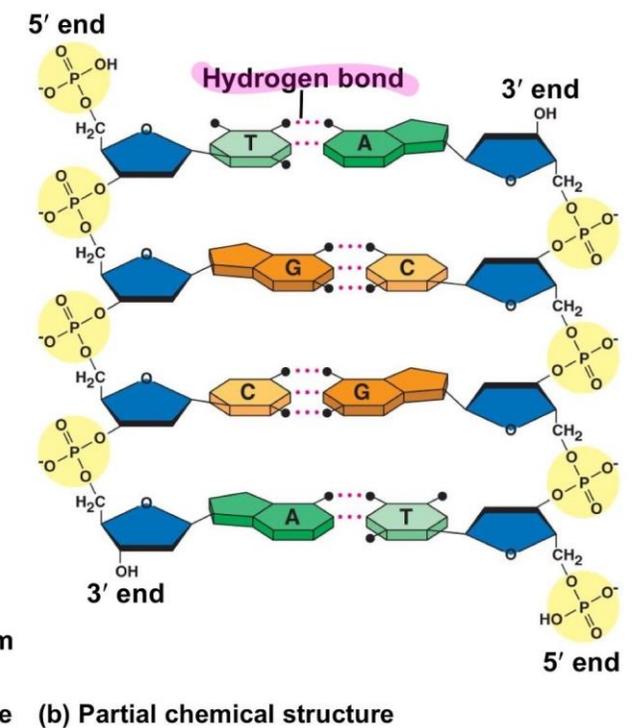
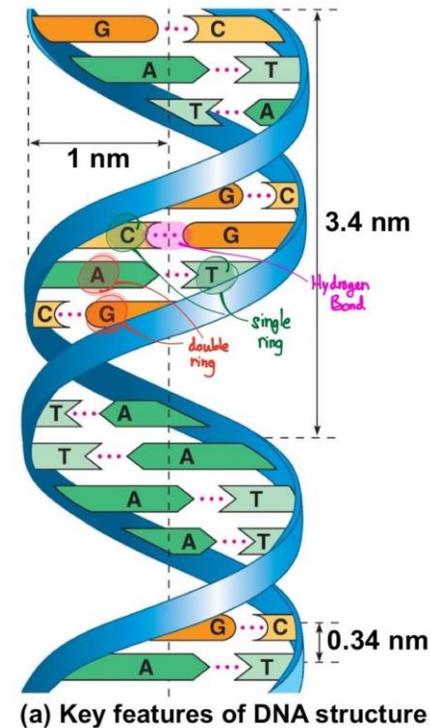
Get to know your DNA structure

- DNA has a right-handed double-helix (DH) structure (2 nm diameter)
 - Ss and Ps lie on the outside of the helix (backbone)
 - Bs are stacked in the interior, in pairs
 - B pairs (BPs) are bound to each other by H-bonds
 - Every BP in the DH is separated from the next base pair by 0.34 nm (**axial rise**)
 - There are 10.4 BPs per helical turn
 - The distance to complete one helical turn (**helical pitch**) = 3.4 nm



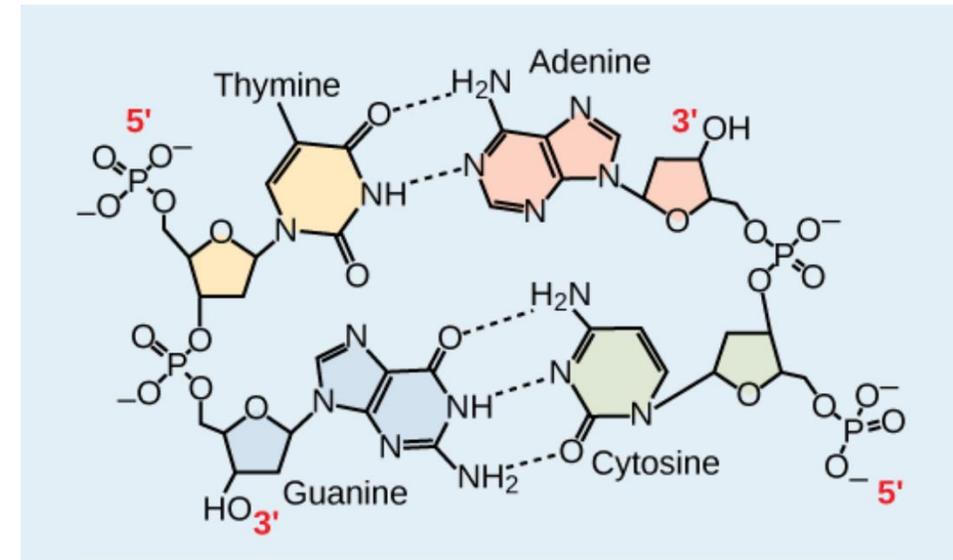
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 - Every BP in the DH is separated from the next base pair by 0.34 nm (axial rise)
 - There are 10.4 BPs per helical turn
 - The distance to complete one helical turn (helical pitch) = 3.4 nm
- The two strands of the helix run in opposite directions
 - the 5' carbon end of one strand will face the 3' carbon end of its matching strand
- This is referred to as **antiparallel orientation**
 - **Key DNA PROPERTY** (for DNA replication and in many nucleic acid interactions)



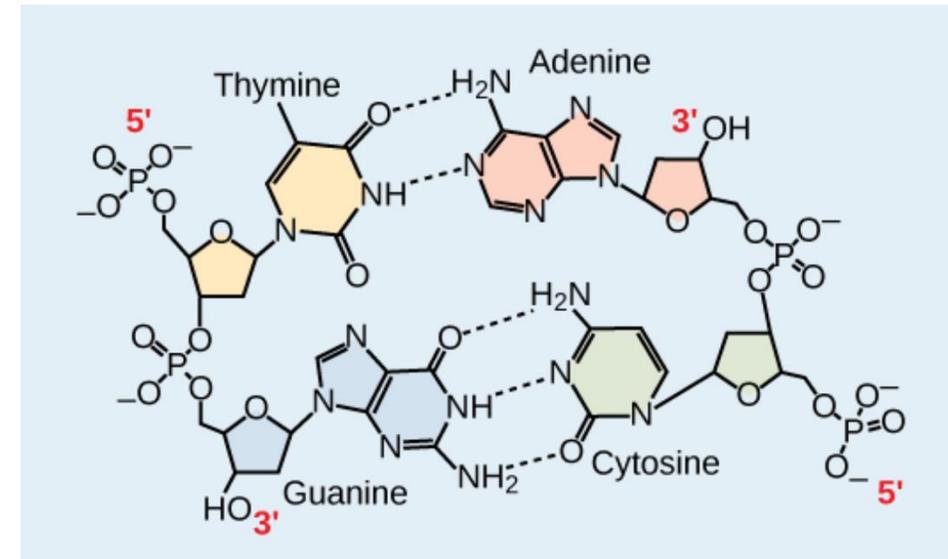
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- Only certain types of base pairing are allowed:
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- In other words, the DNA strands are complementary to each other
 - If the sequence of one DNA strand is **5'AATTGGCC3'**, the complementary strand would have the sequence **3'TTAACCGG5'**

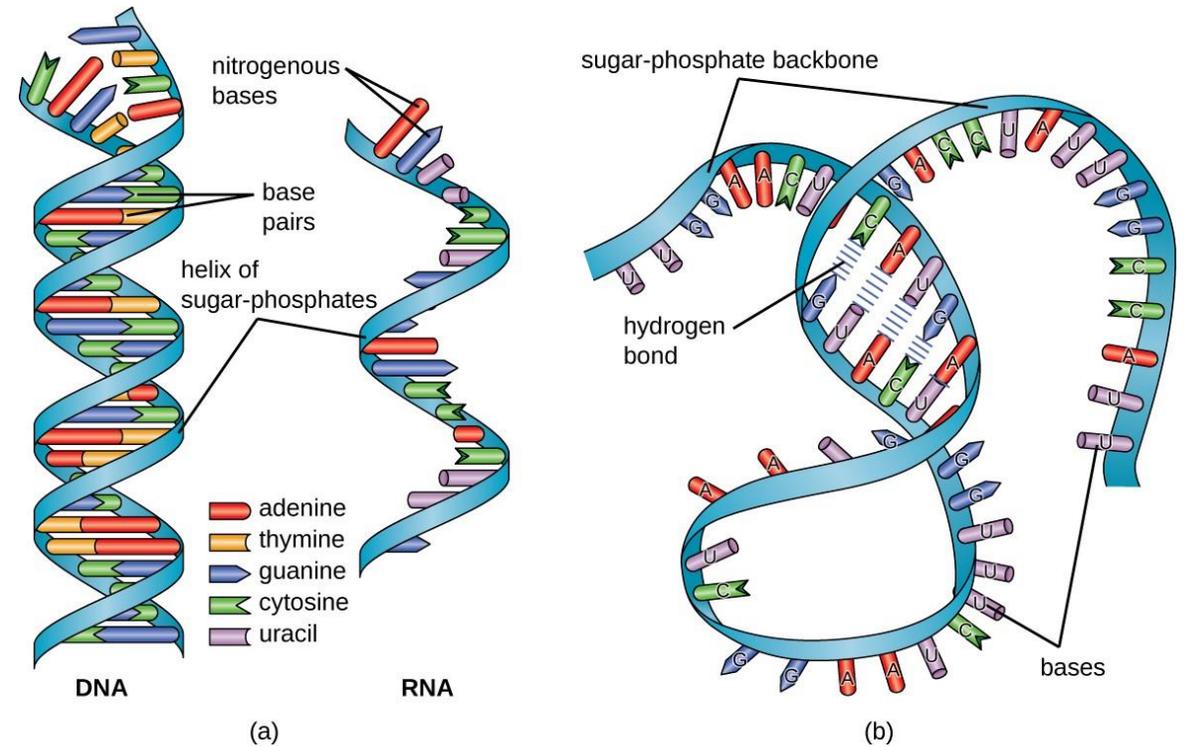


RNA structure

- RNA (ribonucleic acid) → mainly involved in the process of protein synthesis under the direction of DNA

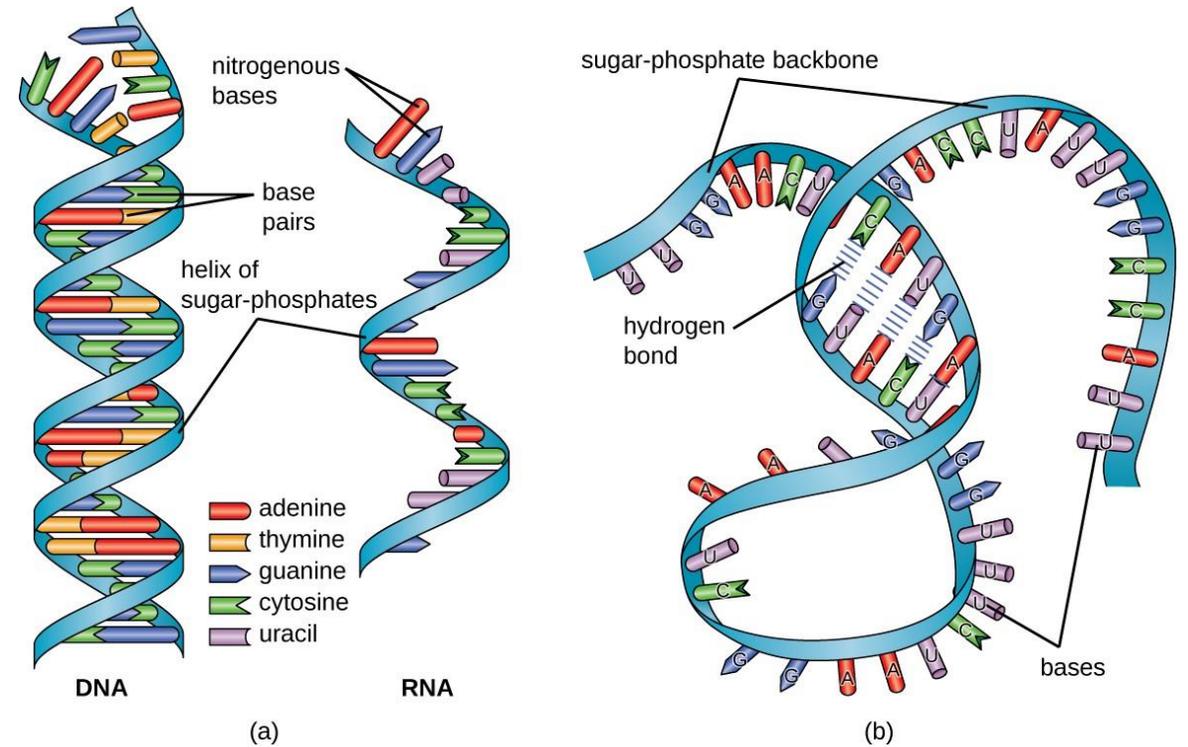
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- The RNA four nitrogenous bases are A, **U**, G, and C



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- RNA is usually single-stranded
- The RNA four nitrogenous bases are A, U, G, and C
- There are four major types of RNA
 - messenger RNA (mRNA), ribosomal RNA (rRNA), transfer RNA (tRNA), and microRNA (miRNA) (more later)



RNA structure

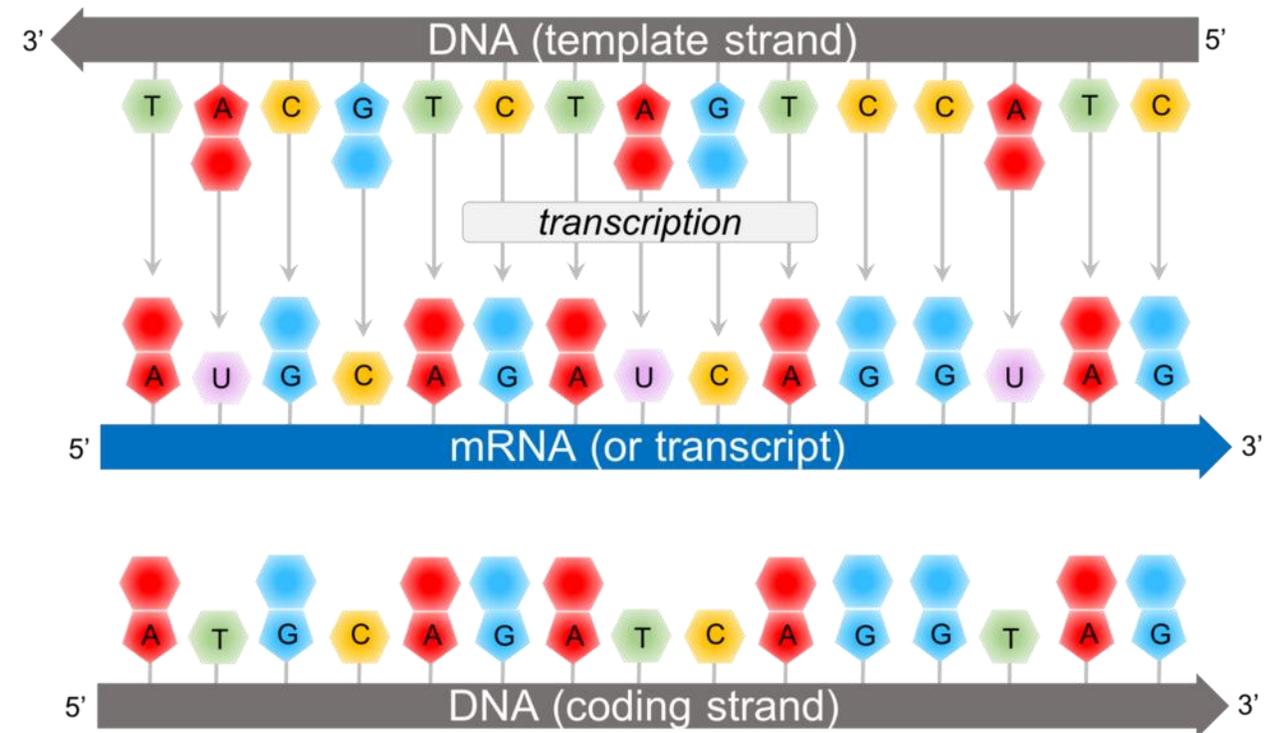
- The mRNA carries the message from DNA
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- The RNA base sequence is complementary to the coding sequence of the DNA which it has been copied from but
- If the DNA strand to be copied (**template strand**) has a sequence **3'TACGTCTA...3'**, the sequence of the complementary mRNA strand (**transcript**) is **5'AUGCAGAU...3'**



Note: template strand reading is 3' → 5'
mRNA synthesis is 5' → 3'
(more later)