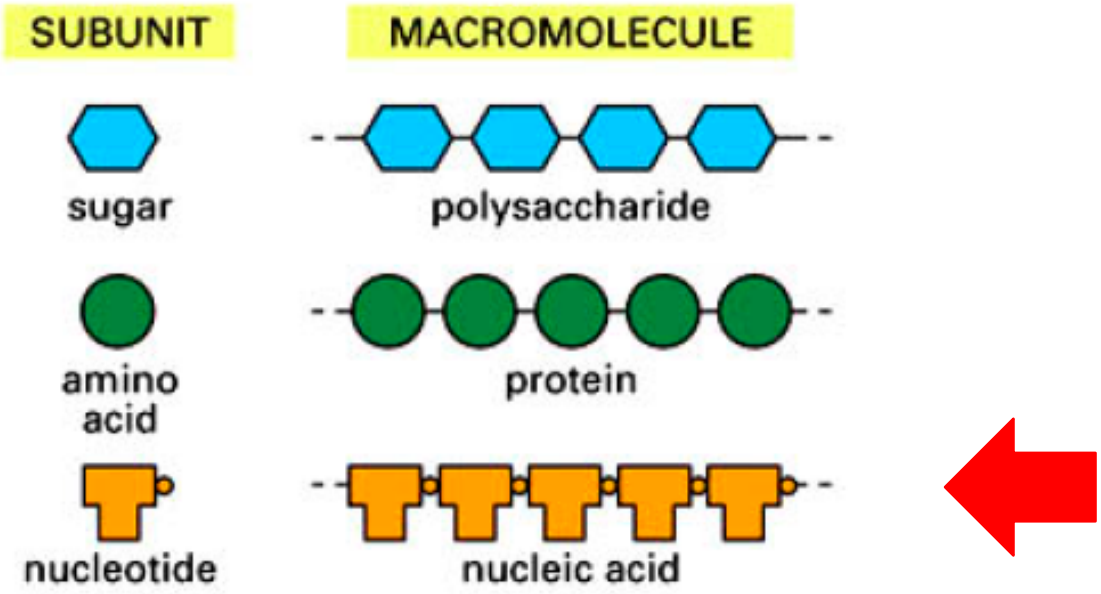
Macromolecules made of subunits

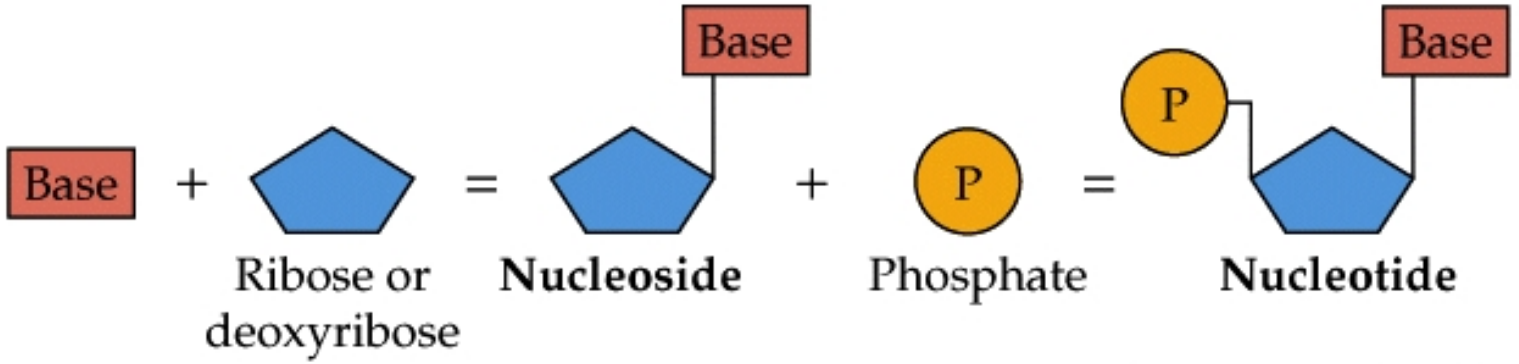


(Lipids are not polymers)

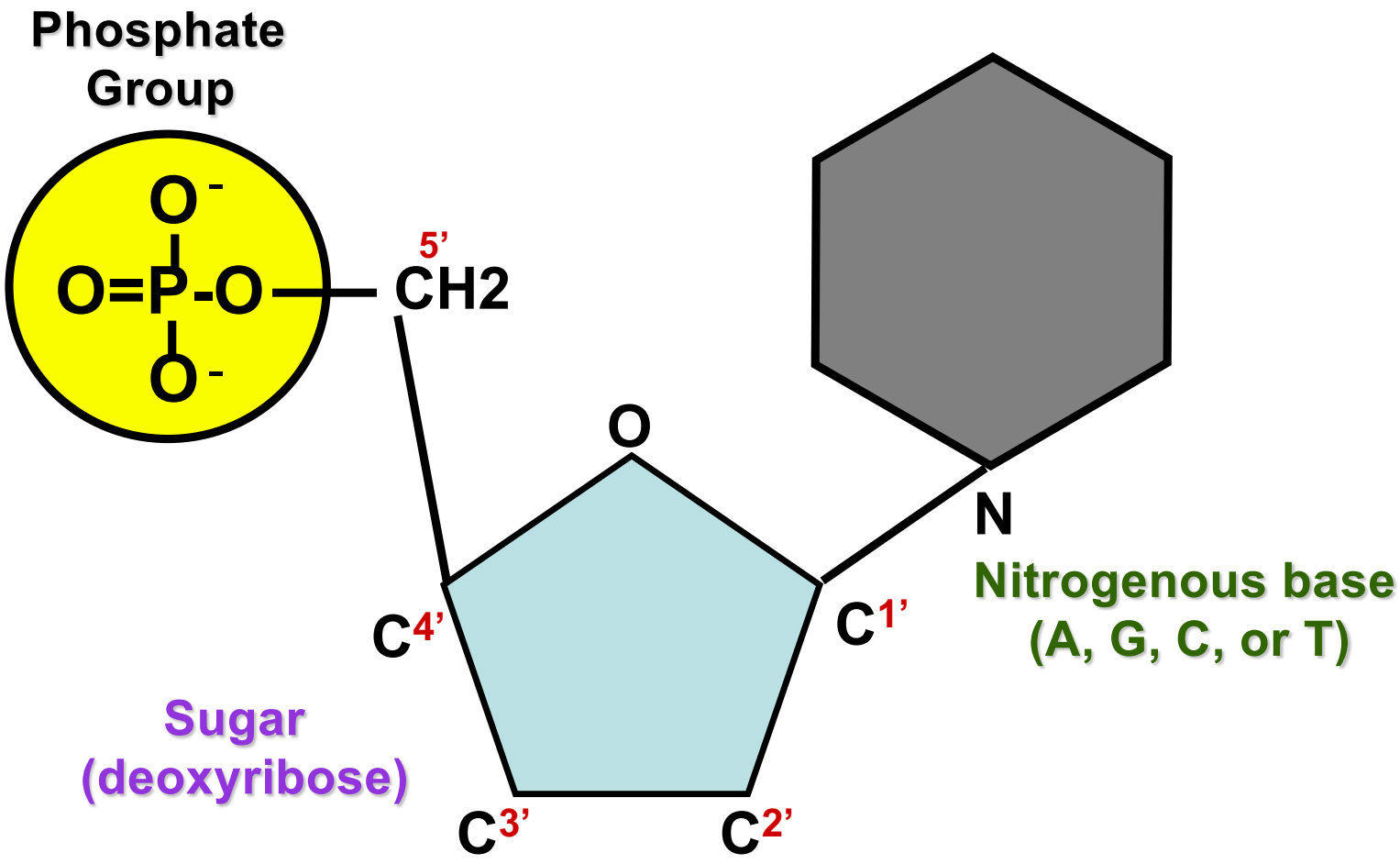
Nucleic Acids

A D N

A R N



Nucleotide


Phosphate Group
O -
O=P-O
O -
5'
CH2
O
N
Nitrogenous base (A, G, C, or T)
C4'
C1'
Sugar (deoxyribose)
C3'
C2'

General structure of nucleotides

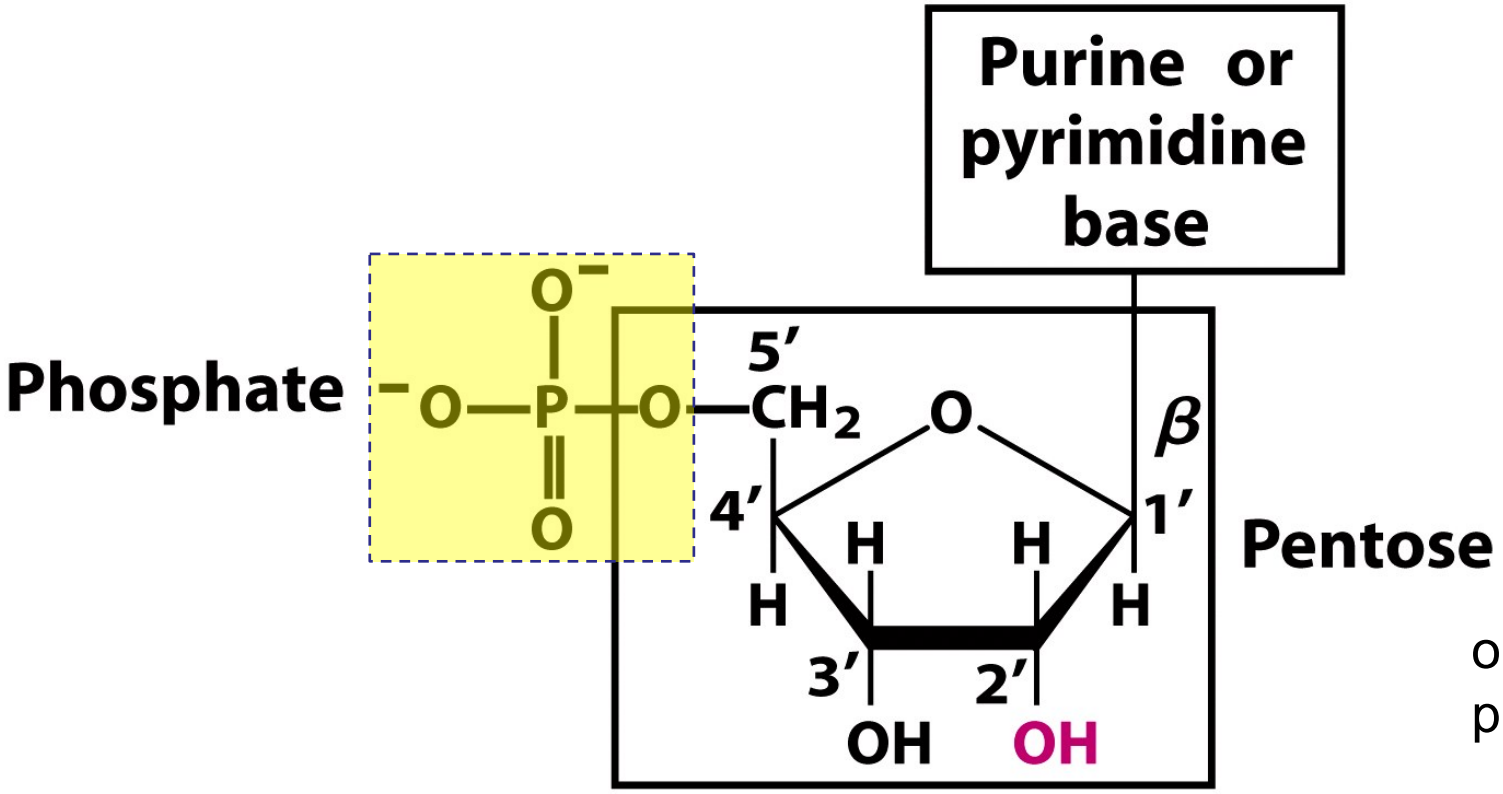
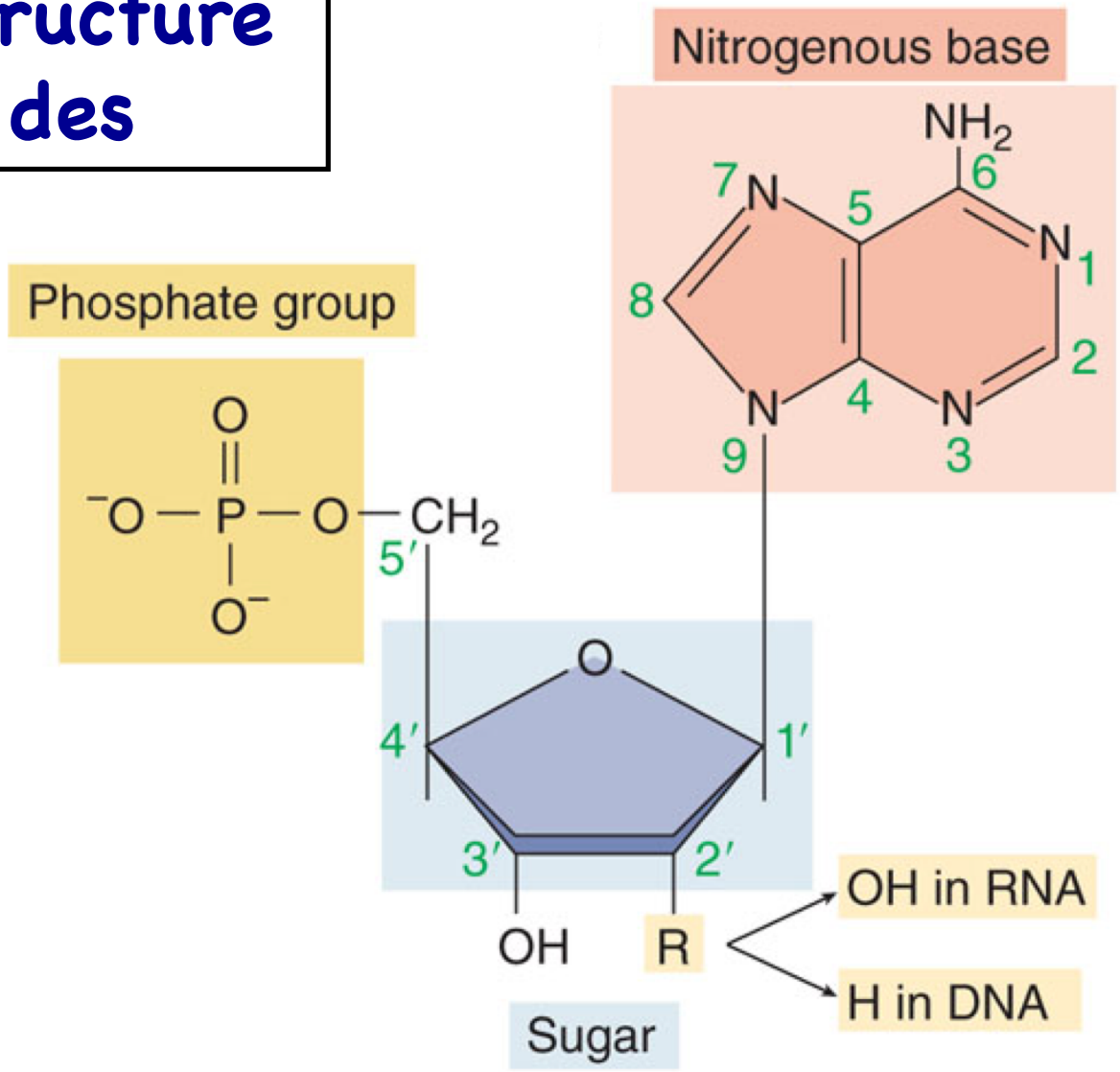


Figure 8-1a
Lehninger Principles of Biochemistry, Fifth Edition

the numbering convention for the pentose ring

ose : sugar
penta ; five

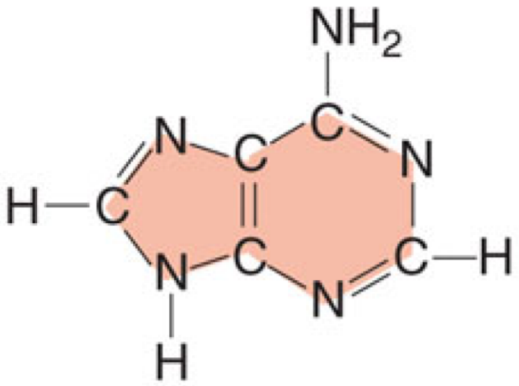
General structure of nucleotides



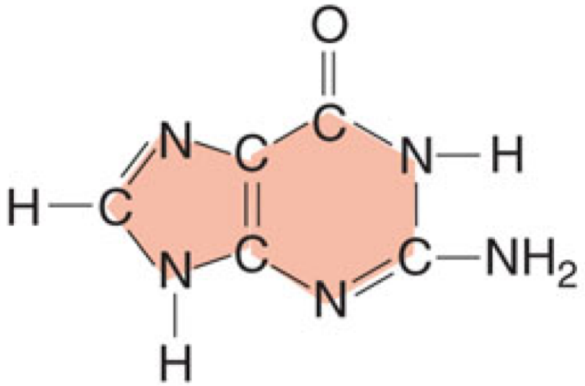
Numbering without prime

Nitrogenous bases

Large : purine

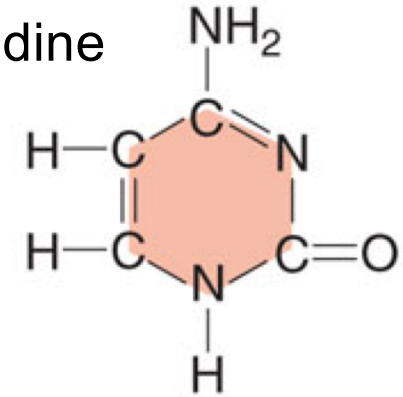


Adenine

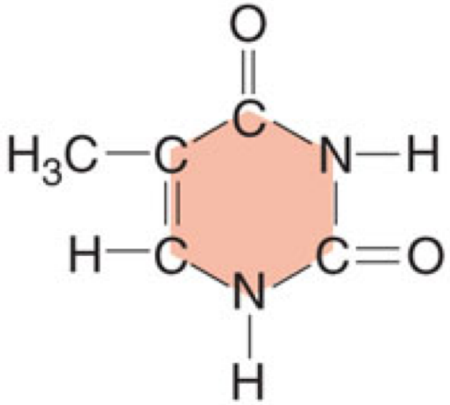


Guanine

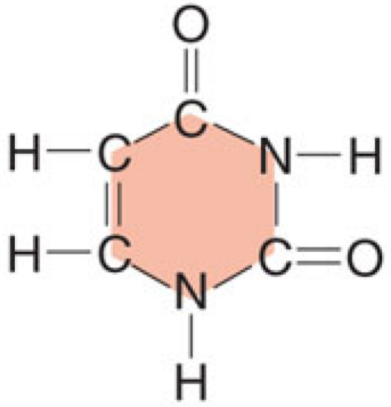
Small : pyrimidine



Cytosine

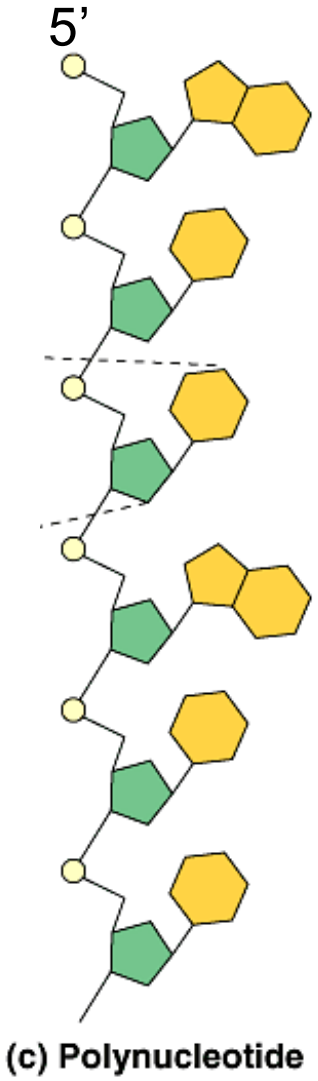


Thymine (DNA only)



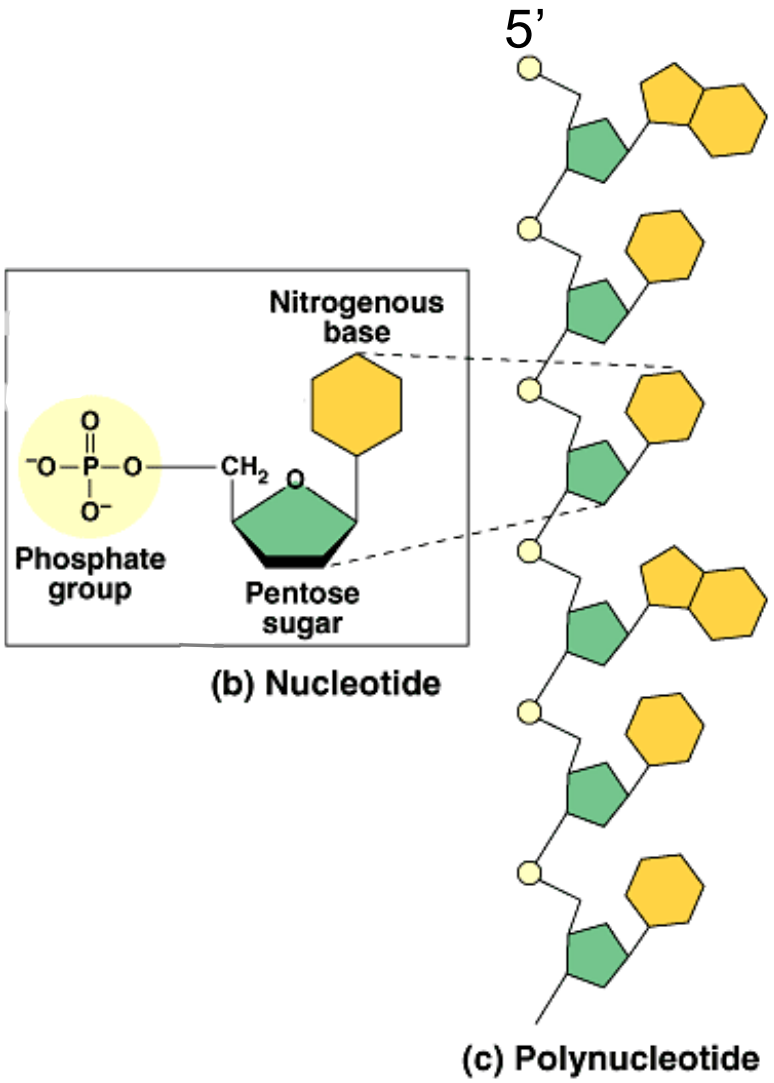
Uracil (RNA only)

A nucleic acid strand :

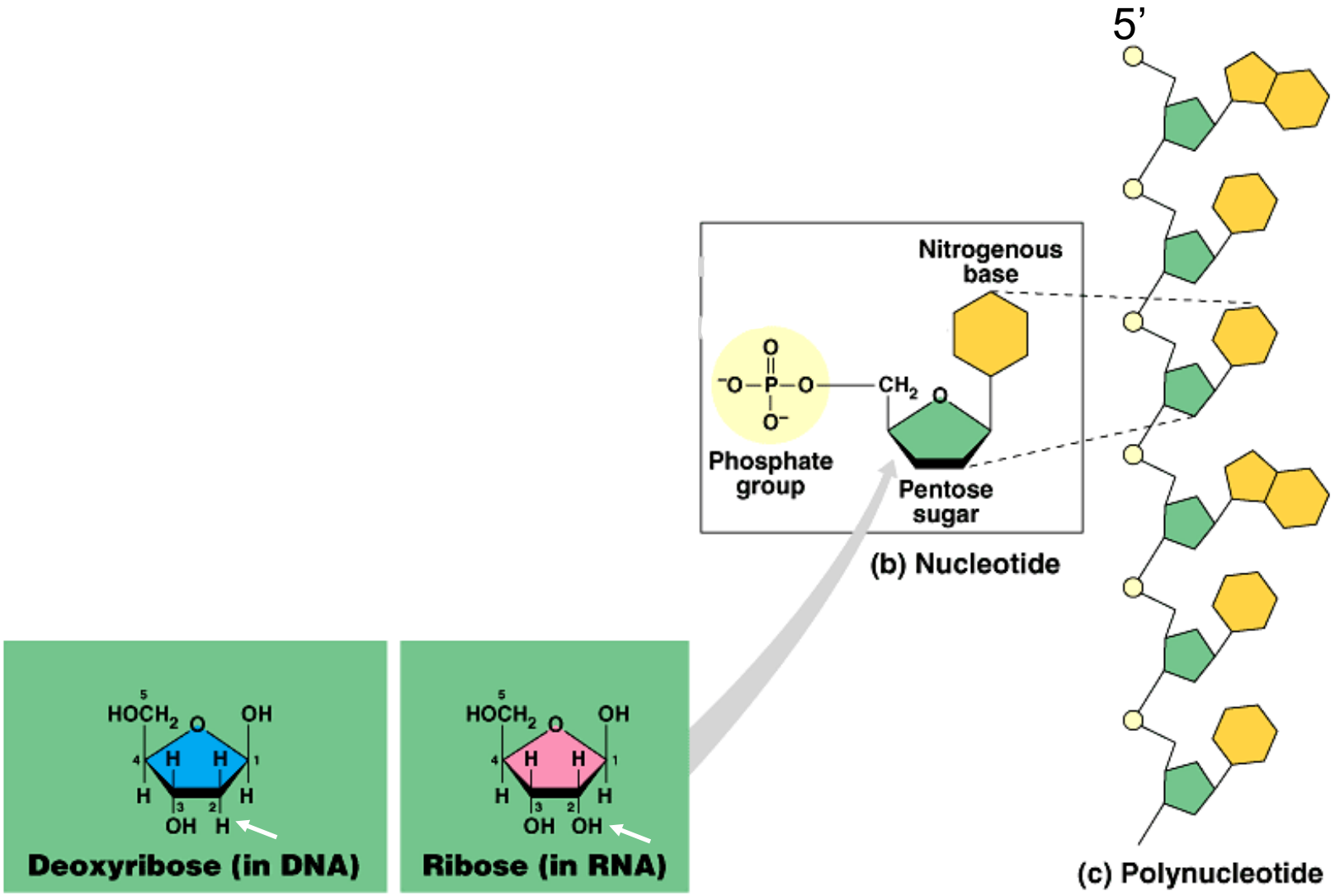


(c) Polynucleotide

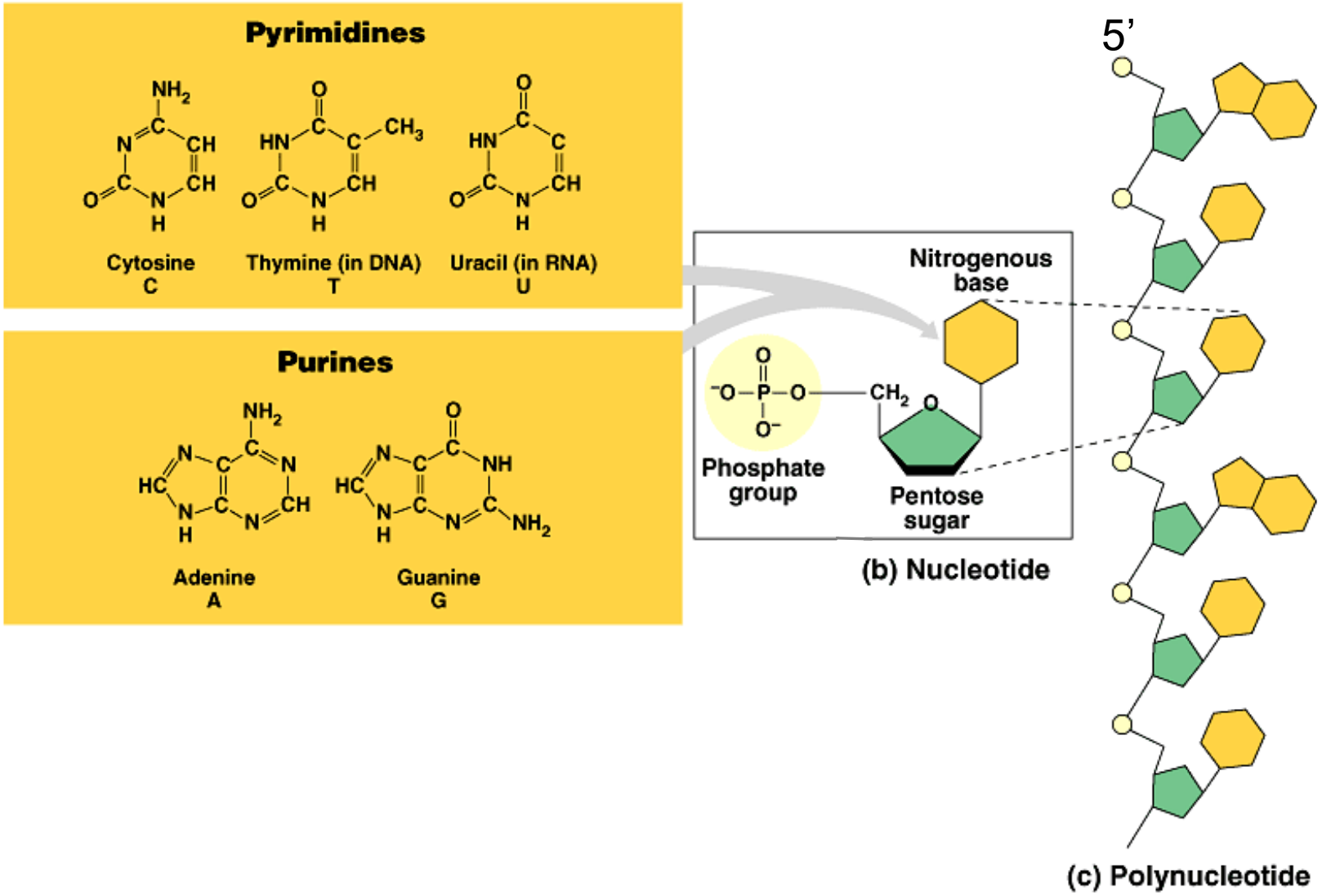
From Campbell



From Campbell

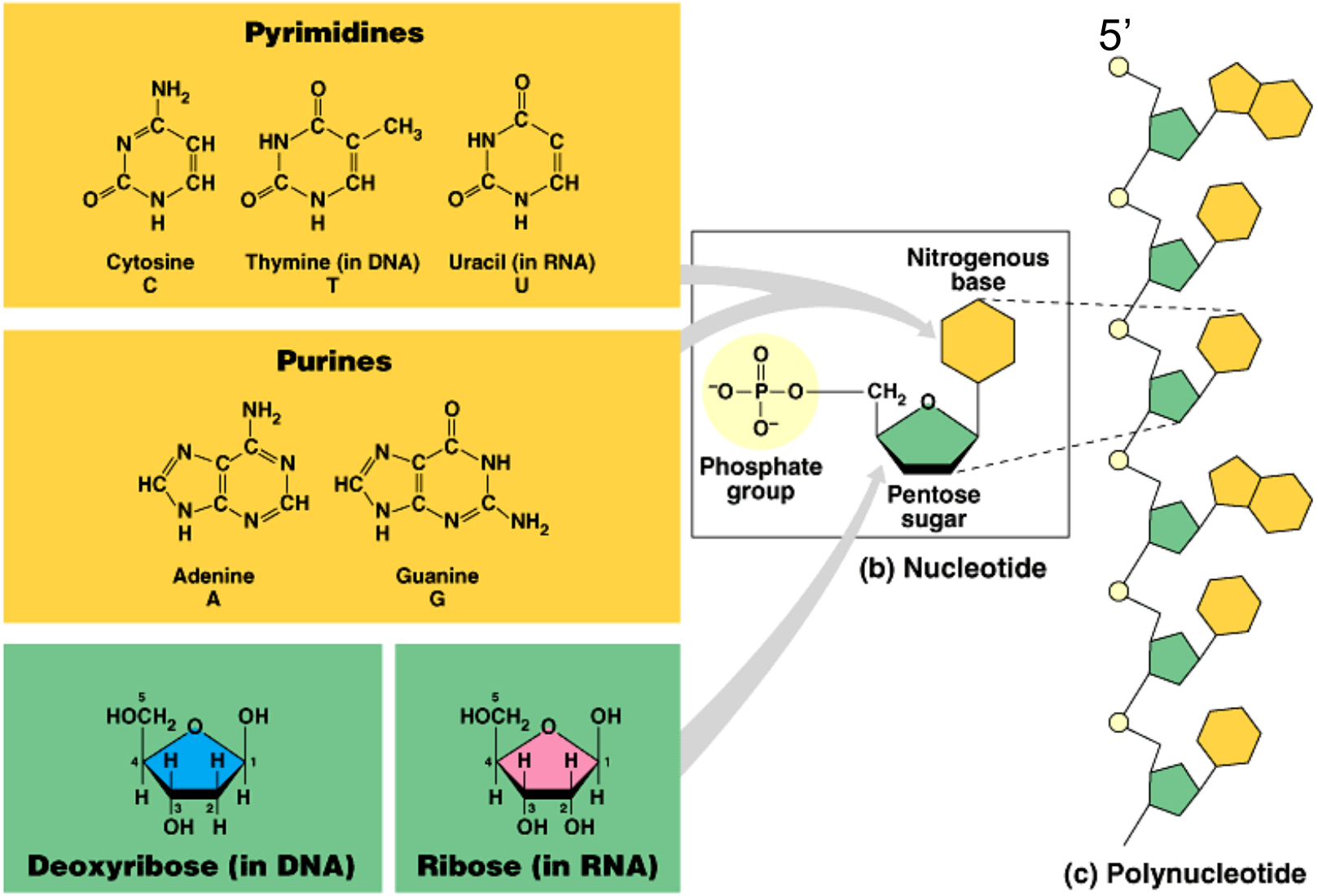


From Campbell



(a) Nucleotide components

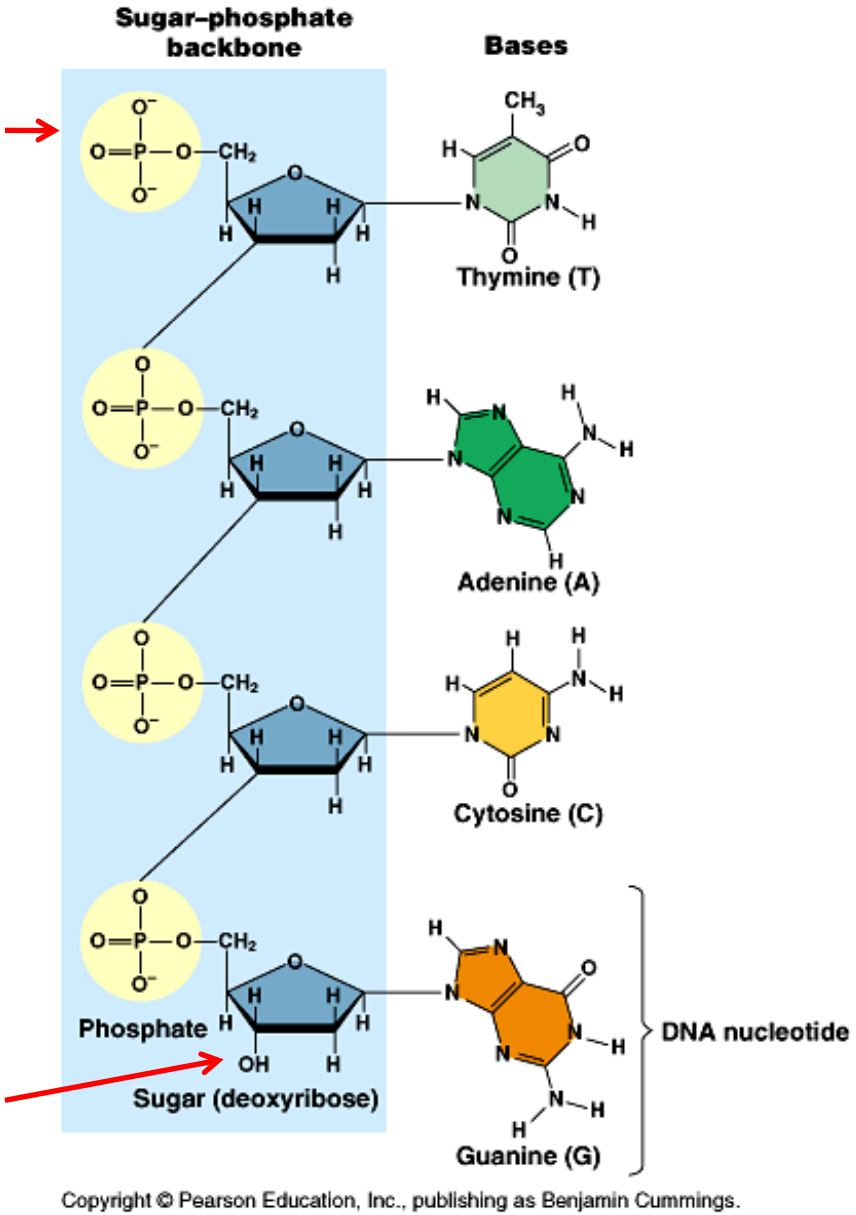
From Campbell



From Campbell

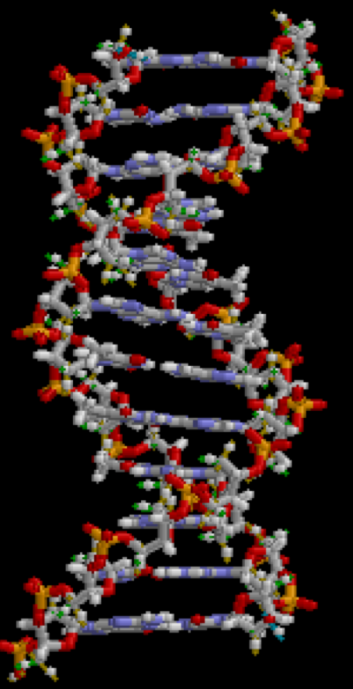
5’ phosphate end

Polarity of nucleic acid strands :



3’ OH end

DNA



Deoxyribo

Nucleic

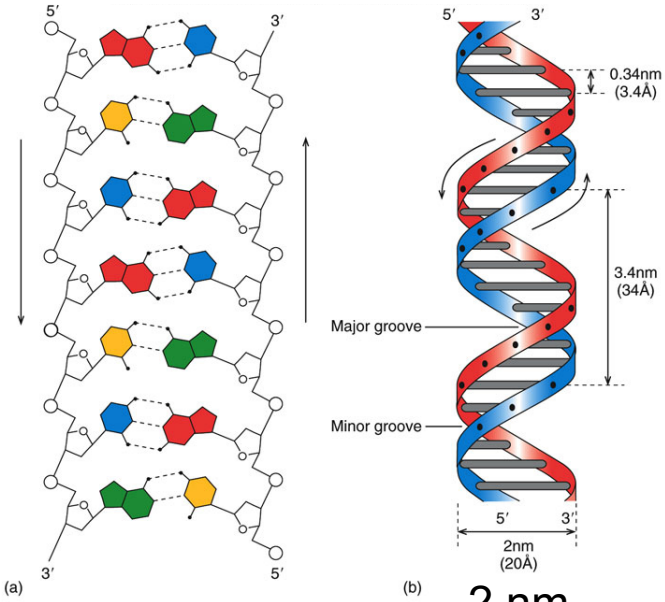
Acid

DNA :

The 2 strands are

complementary

antiparallel



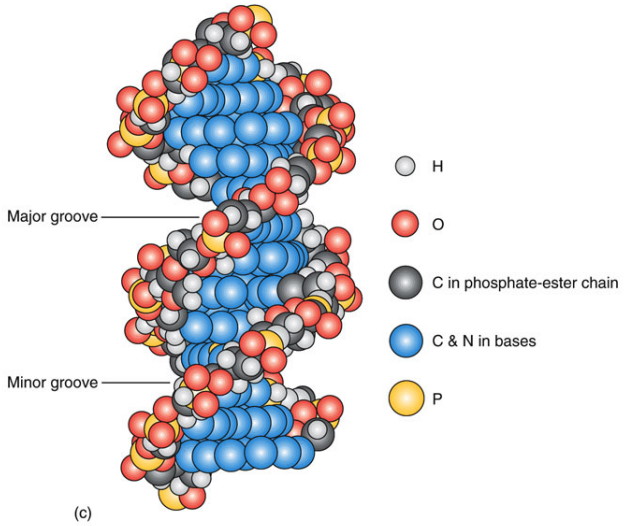
0.34 nm

Note the sizes

2 nm

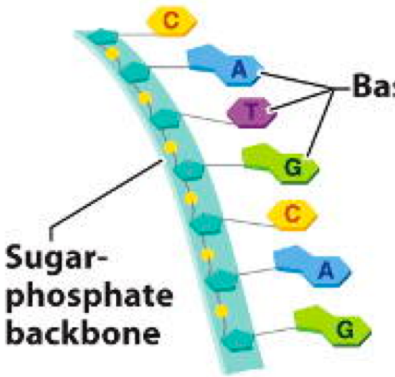
Major groove

Minor groove

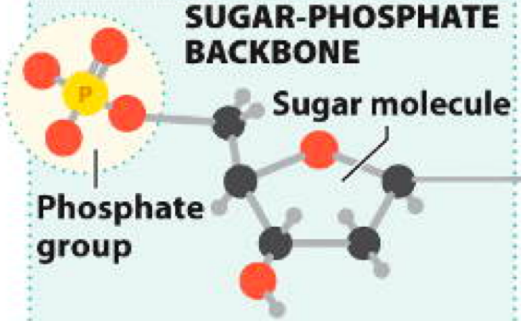


NUCLEIC ACIDS

NUCLEIC ACID STRUCTURE

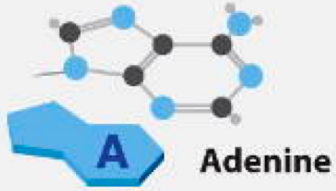


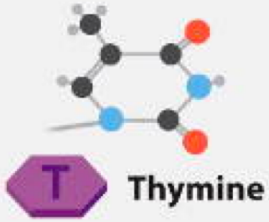
SUGAR-PHOSPHATE BACKBONE

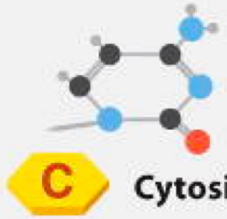


A nucleotide contains a phosphate group, a sugar molecule, and a nitrogen-containing base.

NITROGEN-CONTAINING BASES

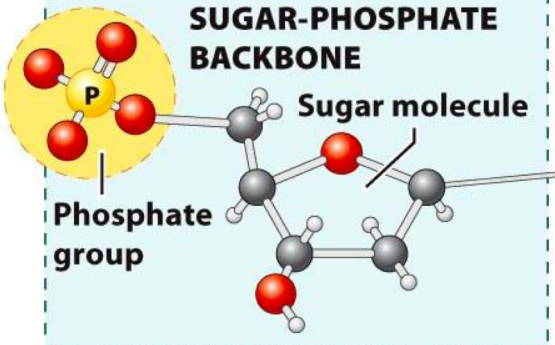




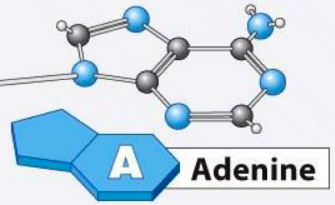


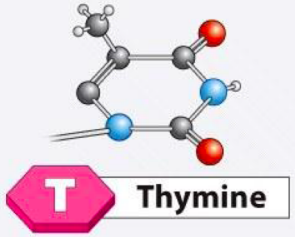
NUCLEIC ACIDS (IN DNA)

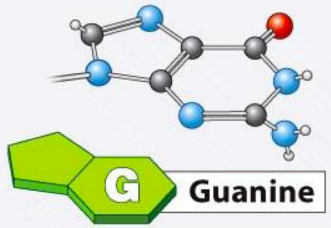
SUGAR-PHOSPHATE BACKBONE

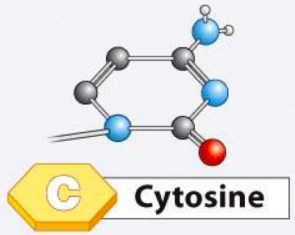


NITROGEN-CONTAINING BASES

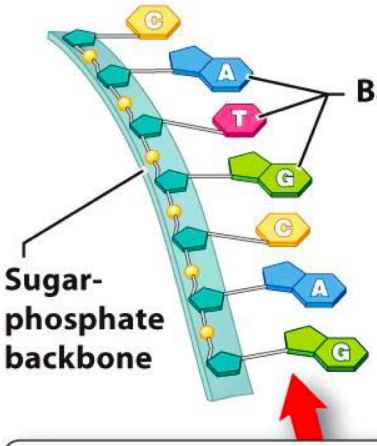




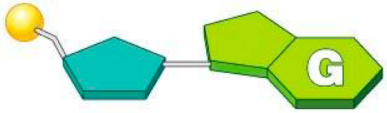


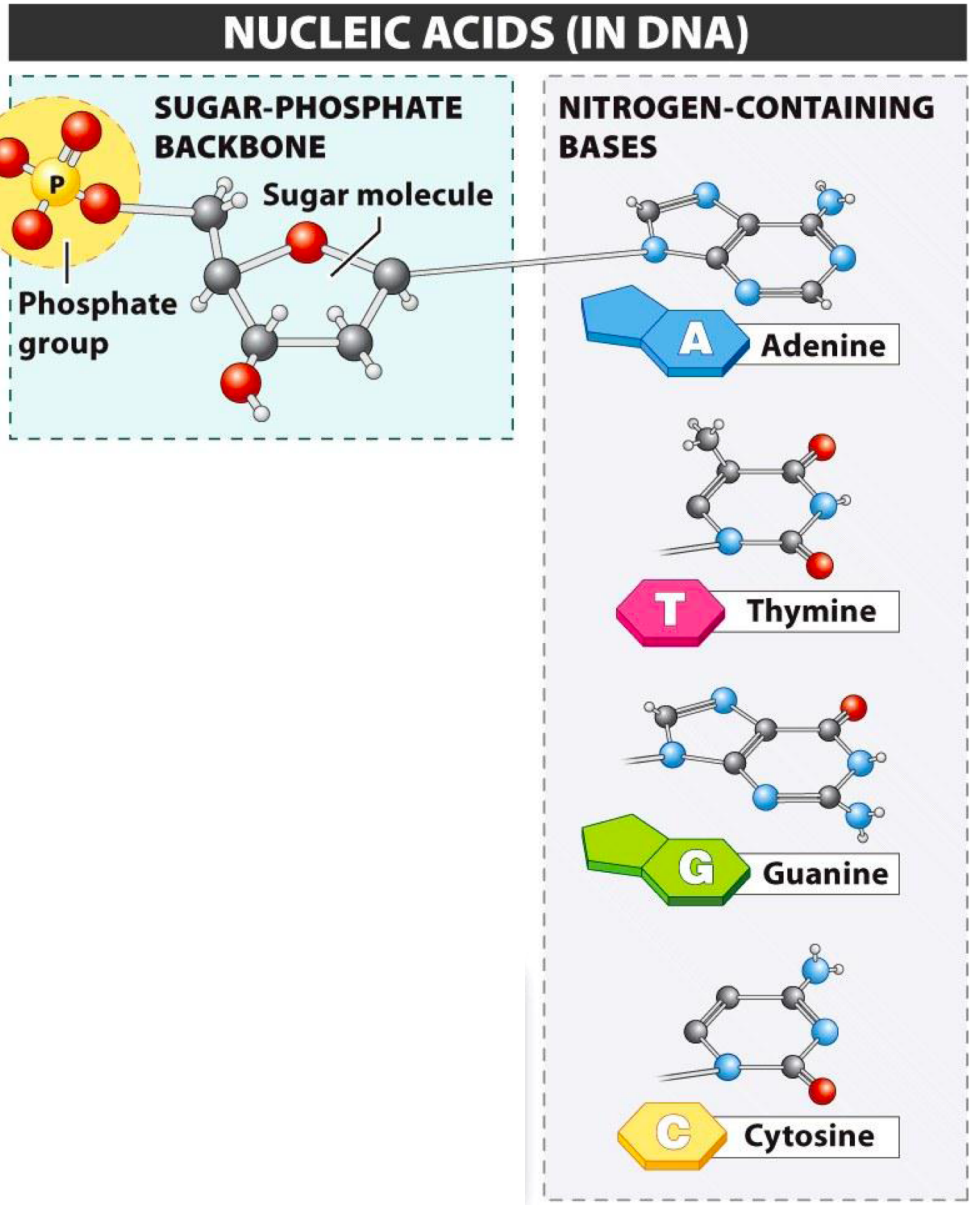


NUCLEIC ACID STRUCTURE



A nucleotide contains a phosphate group, a sugar molecule, and a nitrogen-containing base.



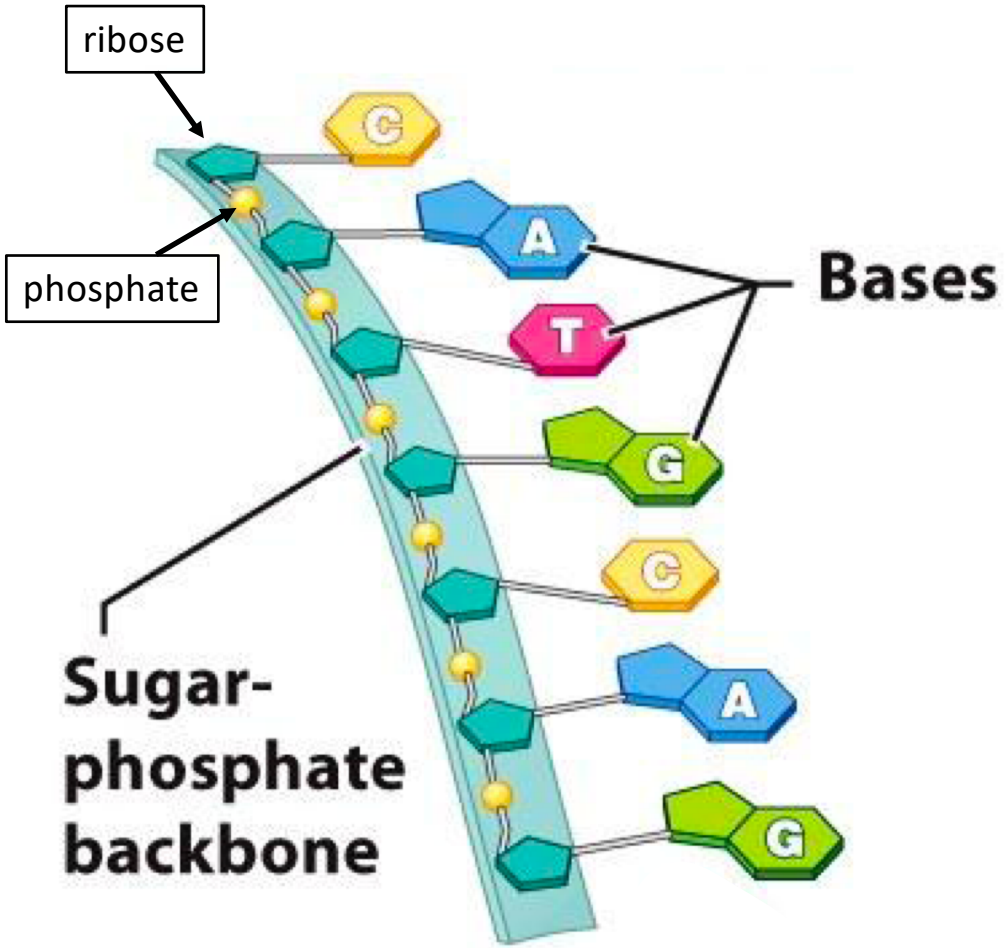


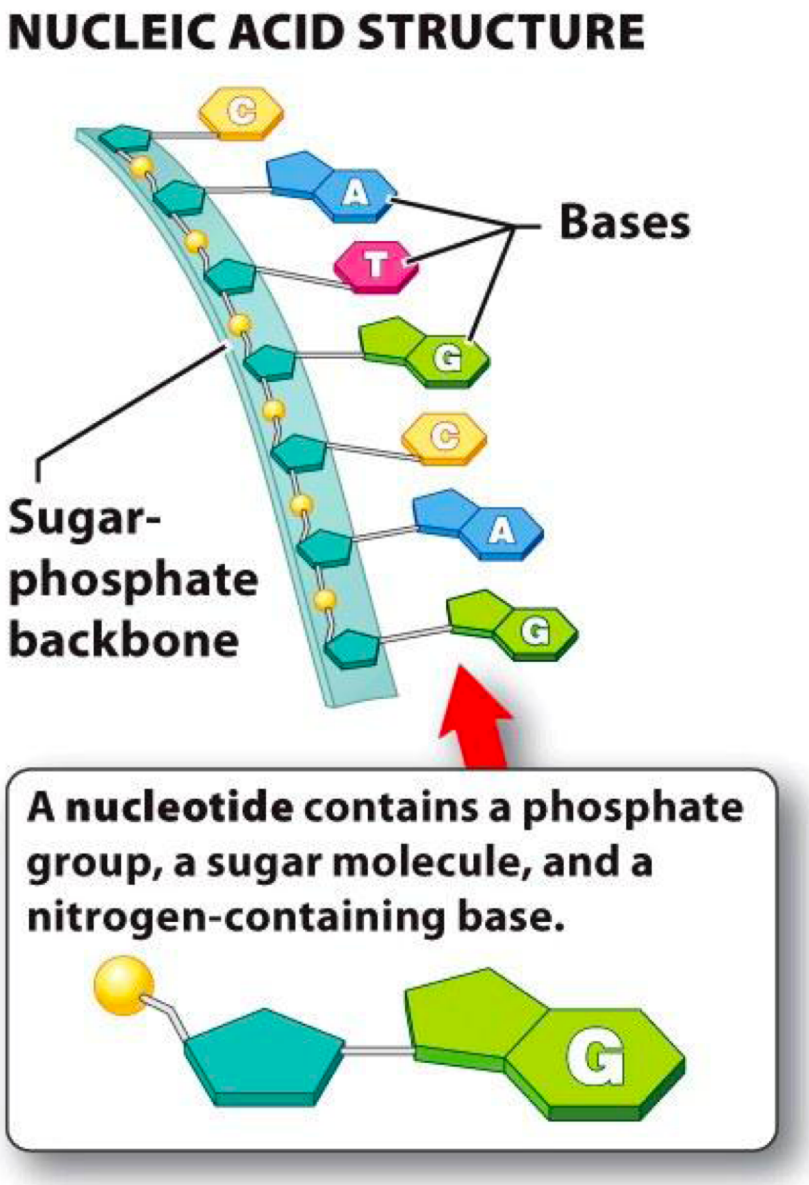
Purine

Pyrimidine

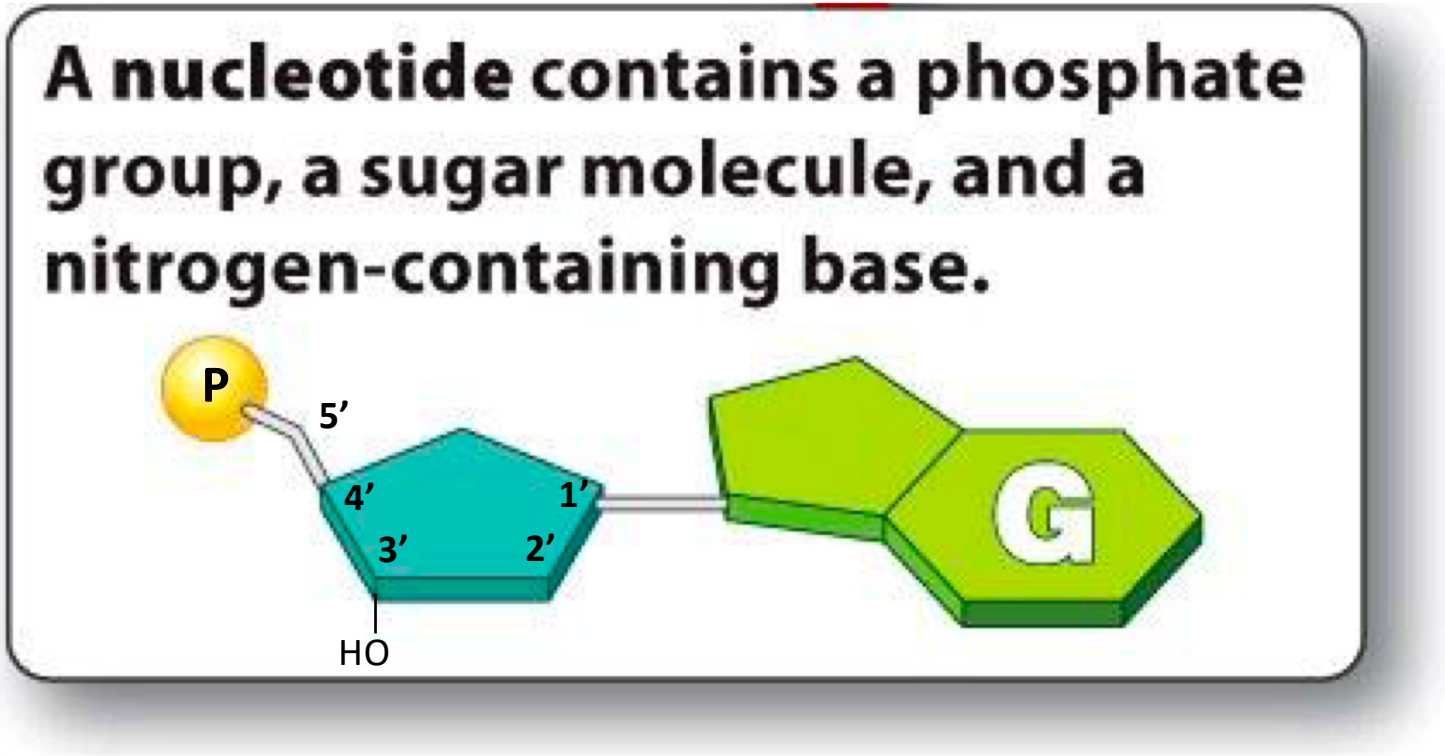
Purine

Pyrimidine


ribose
phosphate
C
A
T
G
C
A
G
Bases
Sugar-
phosphate
backbone


NUCLEIC ACID STRUCTURE
C
A
T
G
C
A
G
Bases
Sugar-
phosphate
backbone
A nucleotide contains a phosphate group, a sugar molecule, and a nitrogen-containing base.
G

Ribose carbons are numbered from **1’** to **5’**.

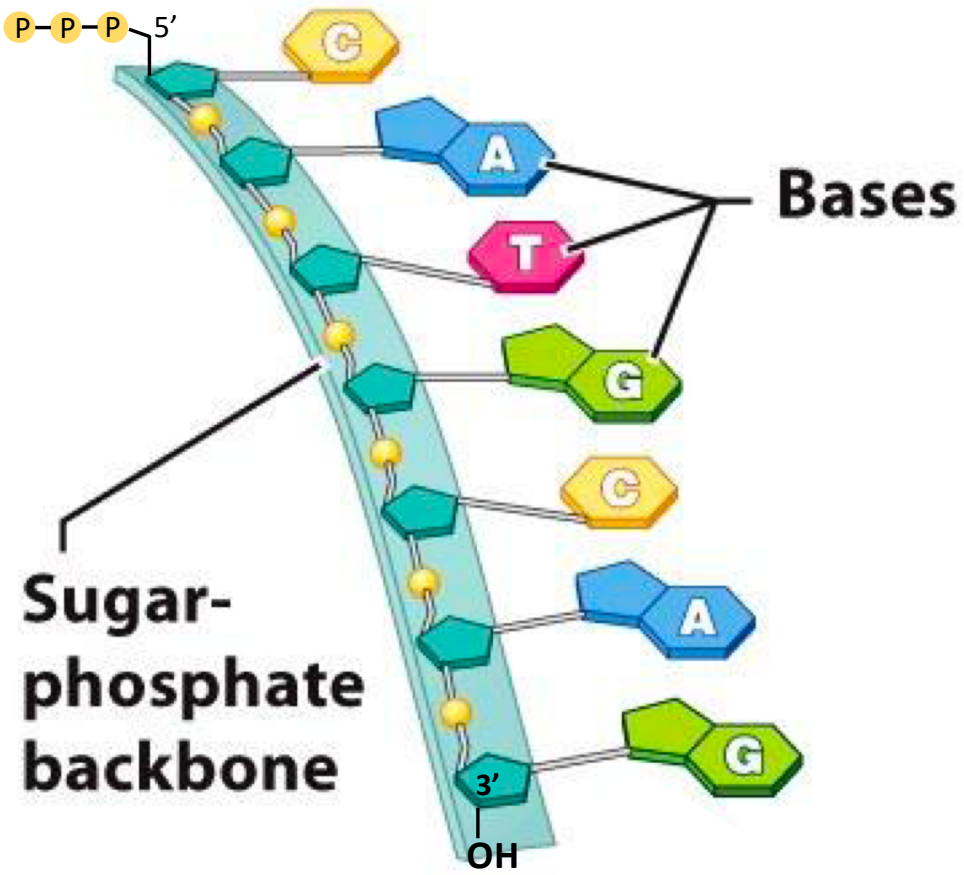


Pentose = 5-carbon sugar

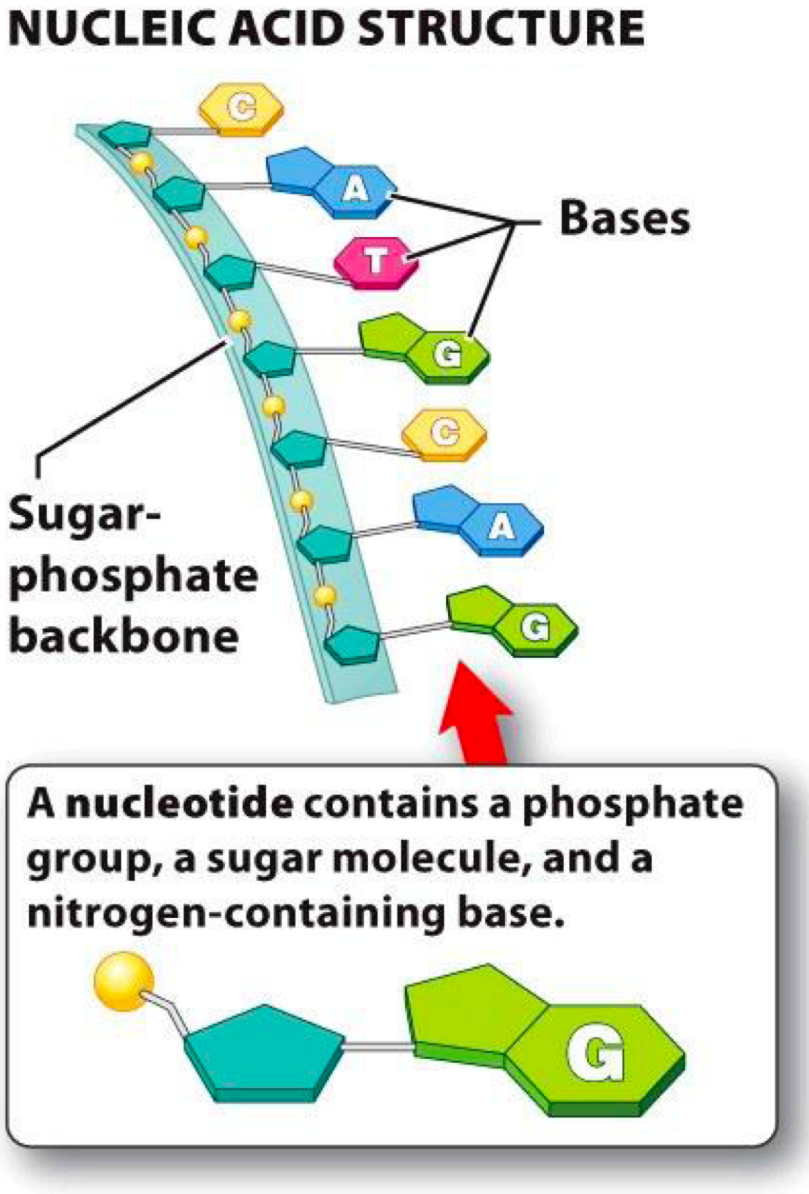
Heptanucleotide

5’ C A T G C A G 3’

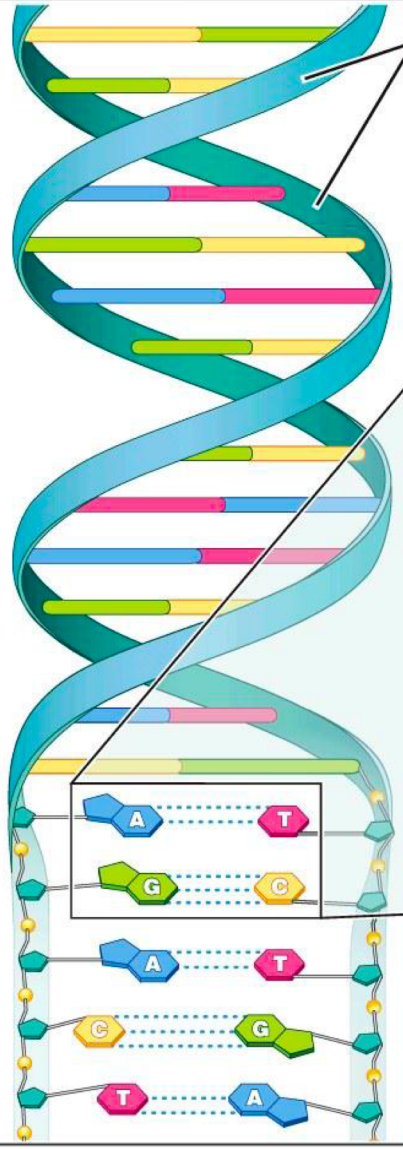
5’ terminus



3’ terminus



DEOXYRIBONUCLEIC ACID (DNA)

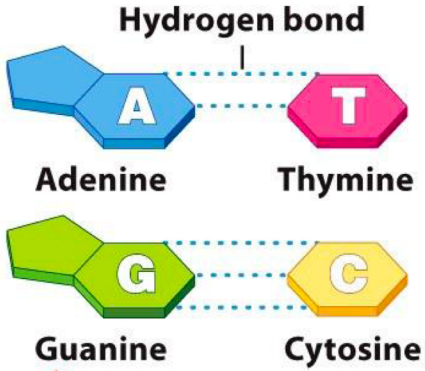


DOUBLE HELIX

Two sugar-phosphate backbones spiral around each other, forming the vertical structure of DNA. They are connected by the bases sticking out from their sugar molecules.

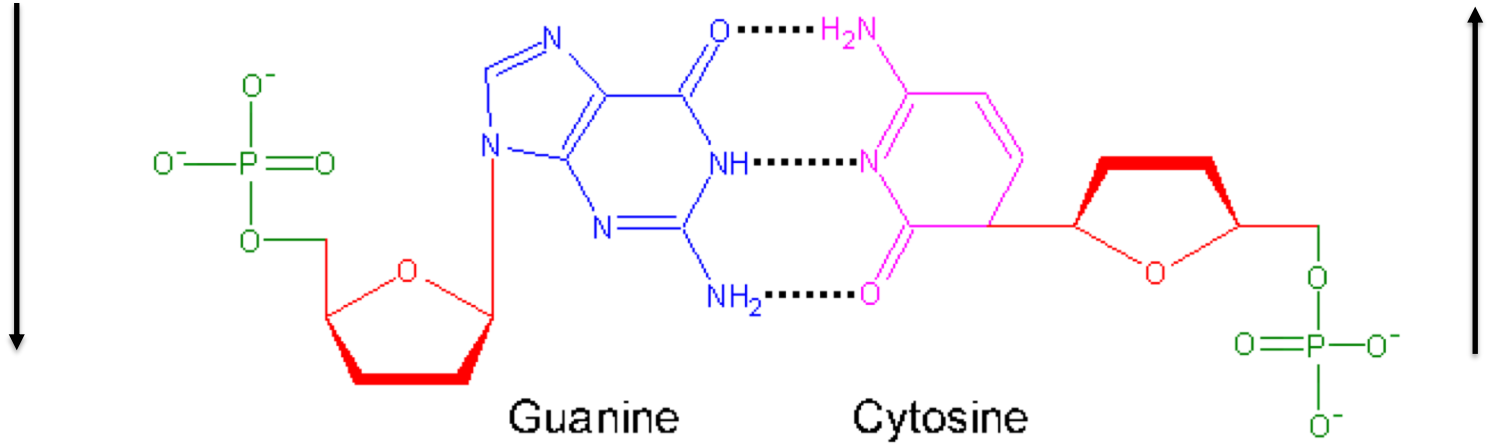
BASE PAIRS

DNA bases are connected with hydrogen bonds.

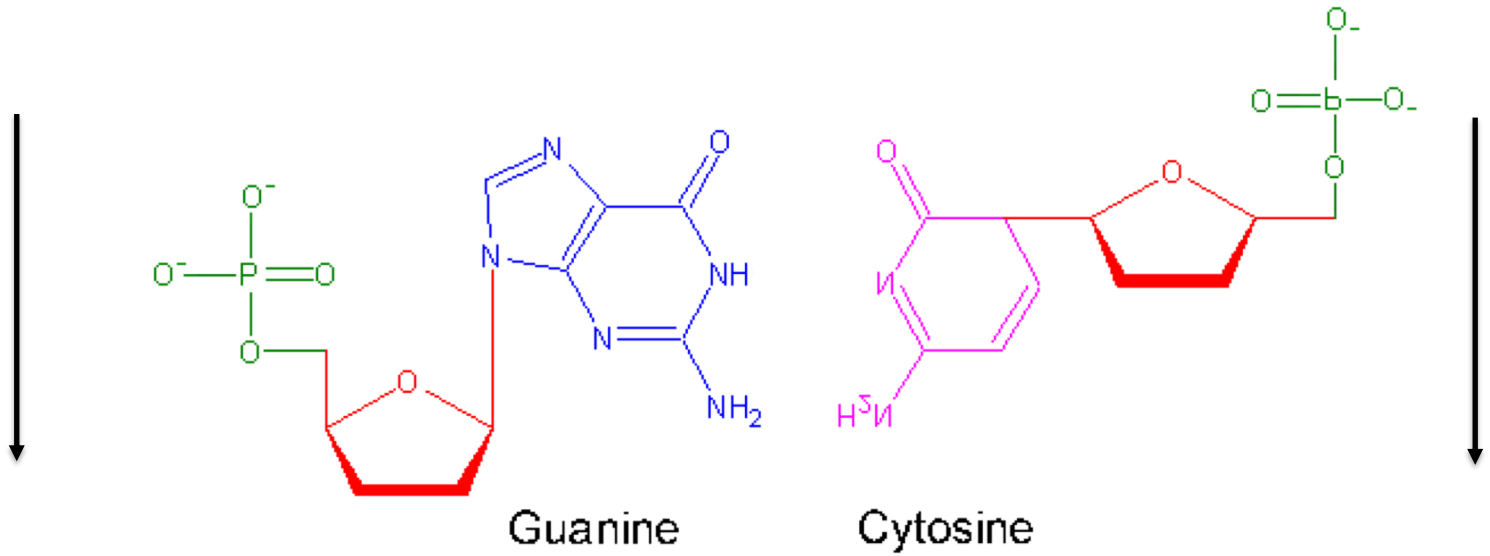


In DNA, adenine ALWAYS pairs with thymine, and guanine ALWAYS pairs with cytosine.

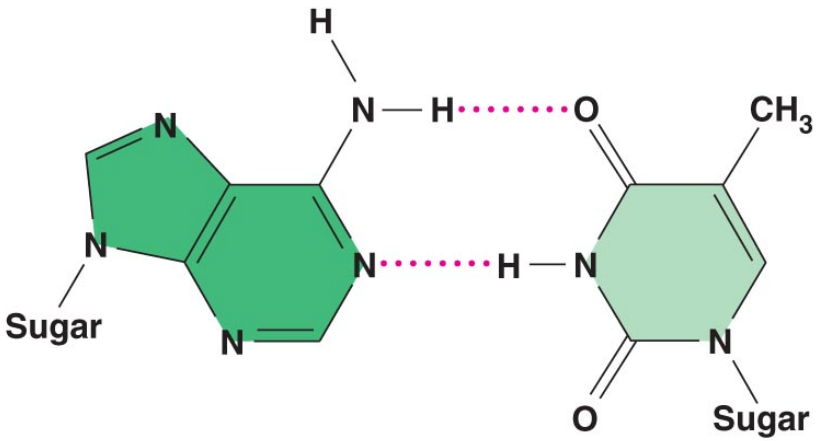
Why DNA strands must be antiparallel ?



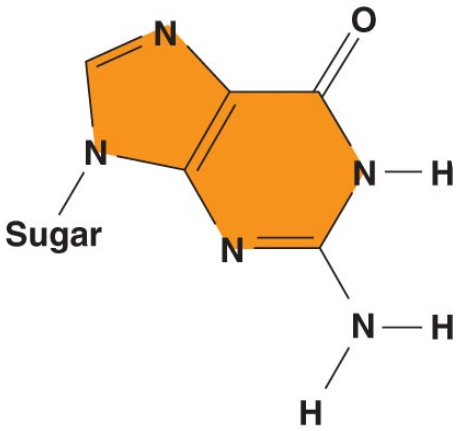
Guanine and Cytosine can pair only when antiparallel



Parallel strands : **G** and **C** cannot form hydrogen bonds.



Adenine (A) Thymine (T)



Guanine (G) Cytosine (C)

Fig 16.8

Campbell 8th

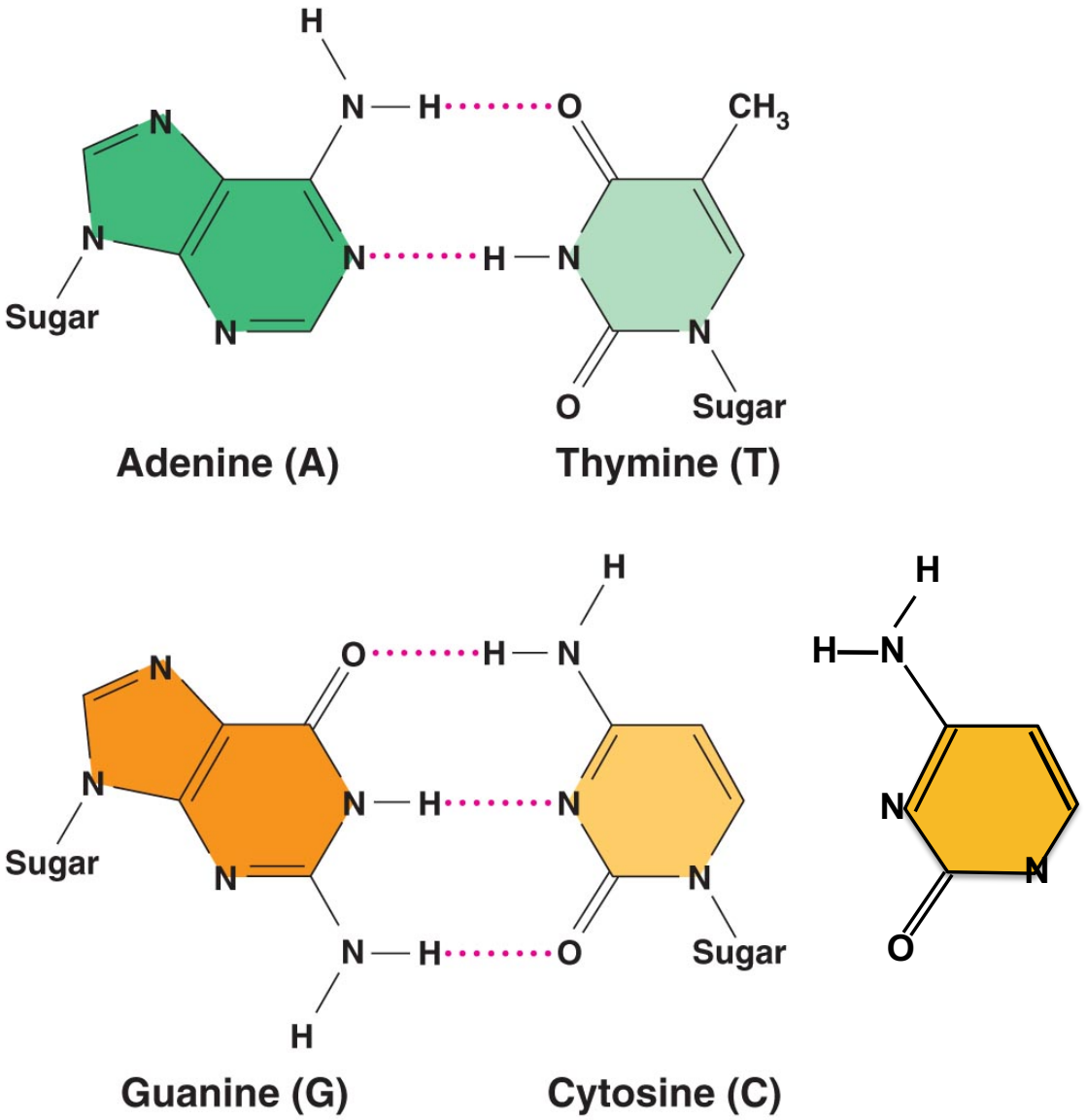
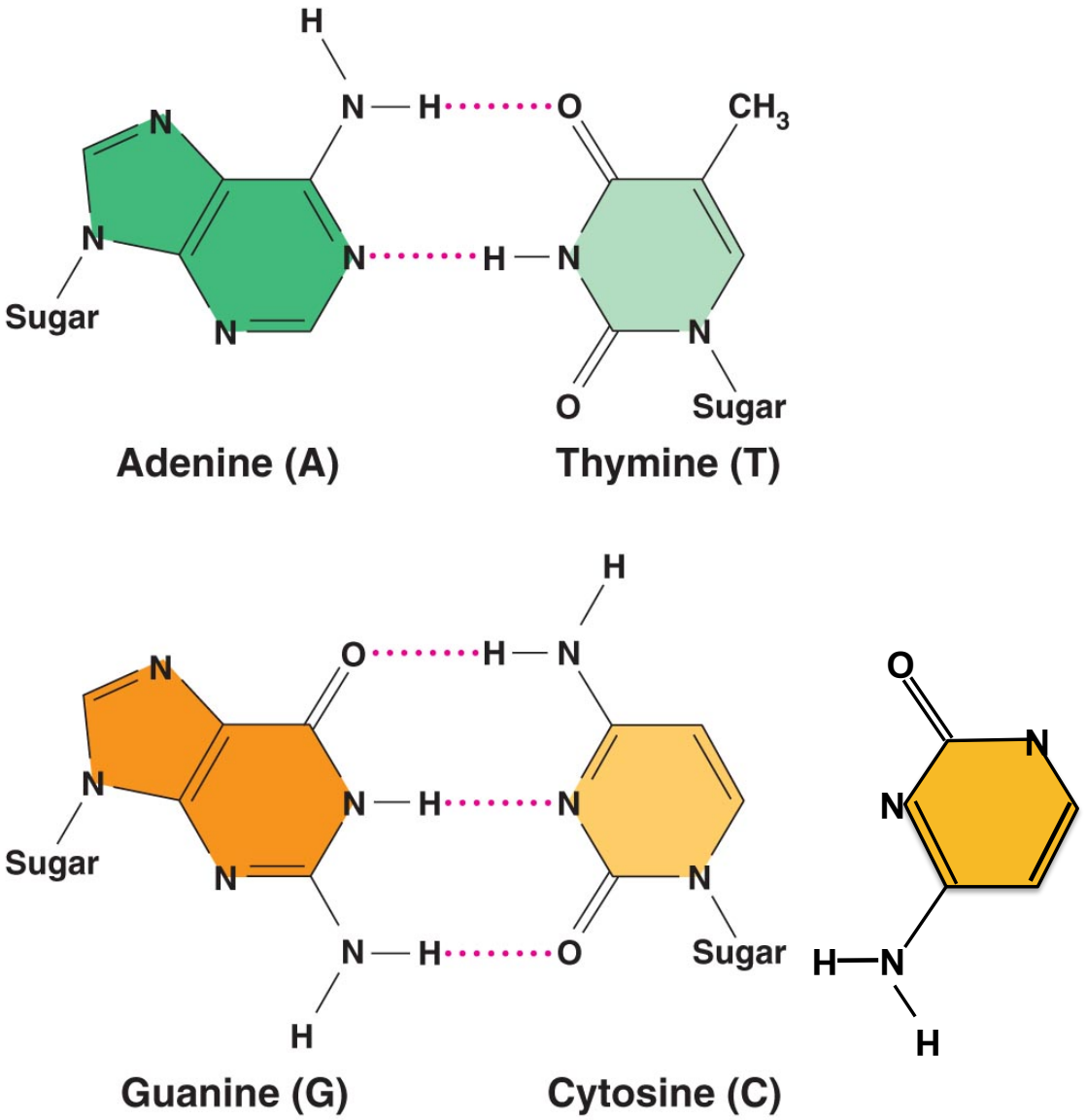


Fig 16.8

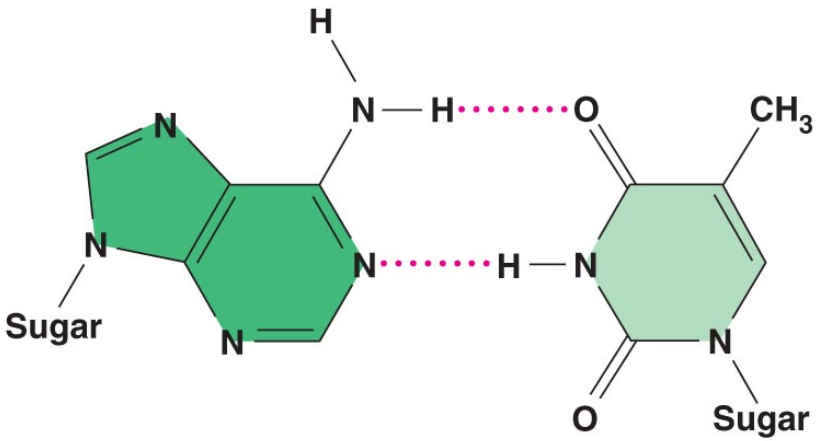
Campbell 8th



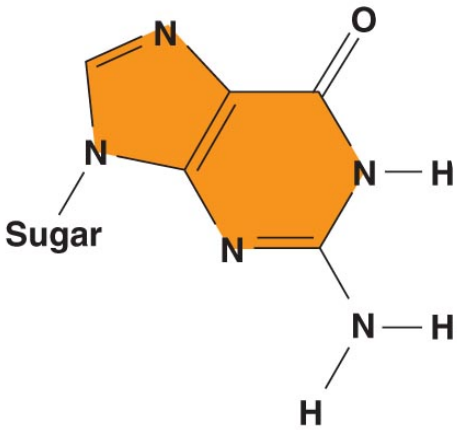
Guanine (G) Cytosine (C)

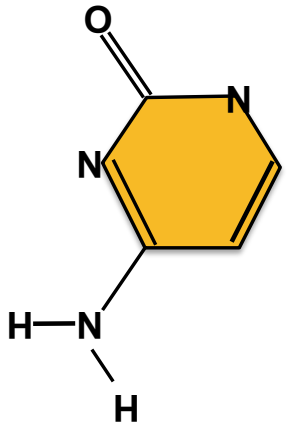
Fig 16.8

Campbell 8th



Adenine (A) Thymine (T)





Guanine (G) Cytosine (C)

Fig 16.8

Campbell 8th

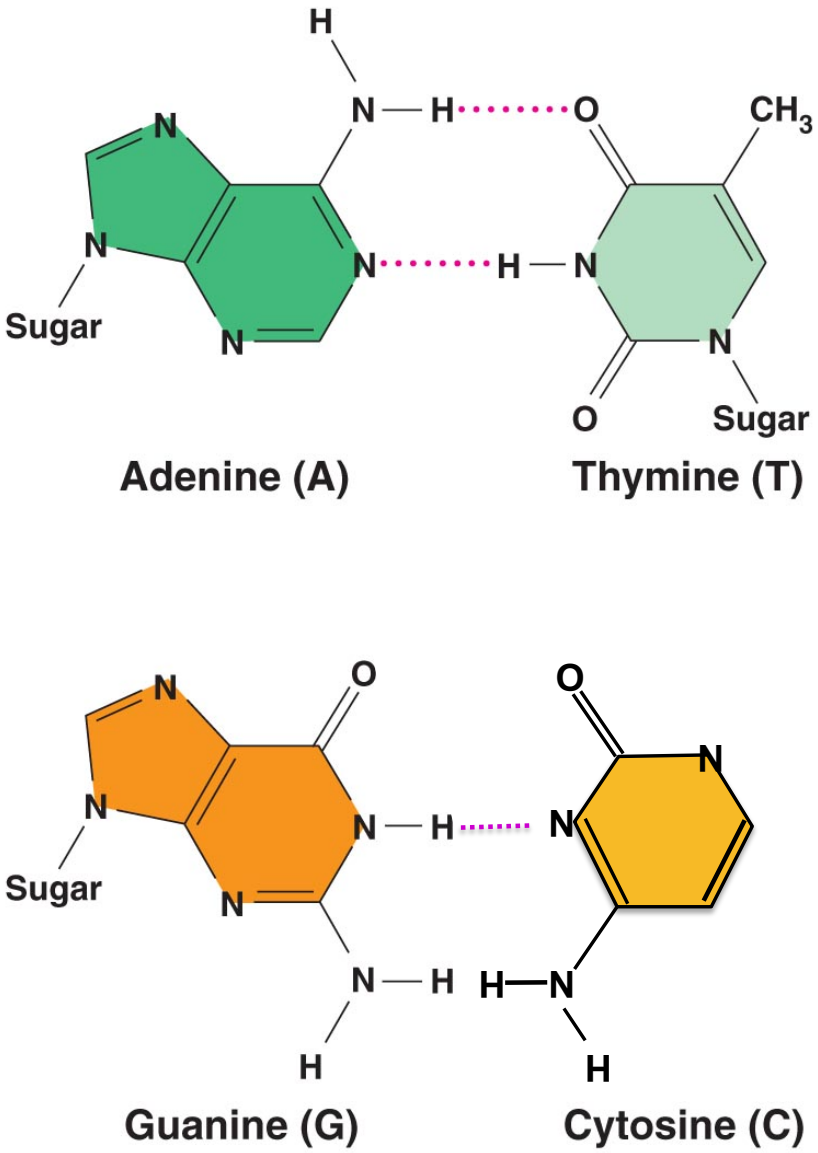
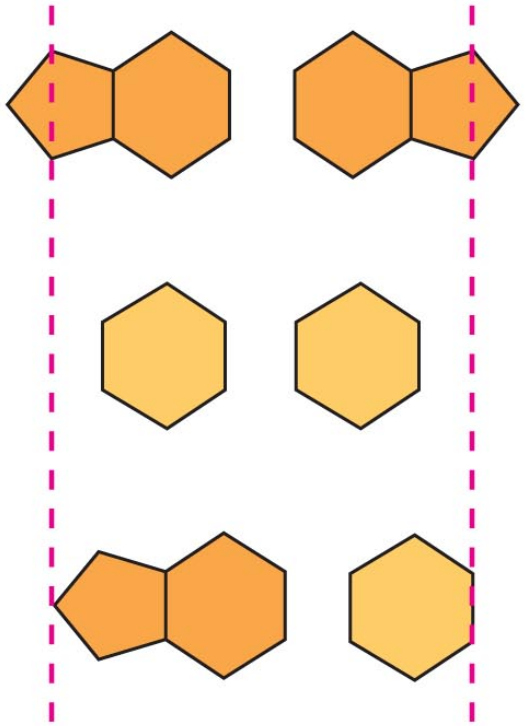


Fig 16.8

Campbell 8th

Bases pairing rule : purine with pyrimidine



Purine + purine: too wide

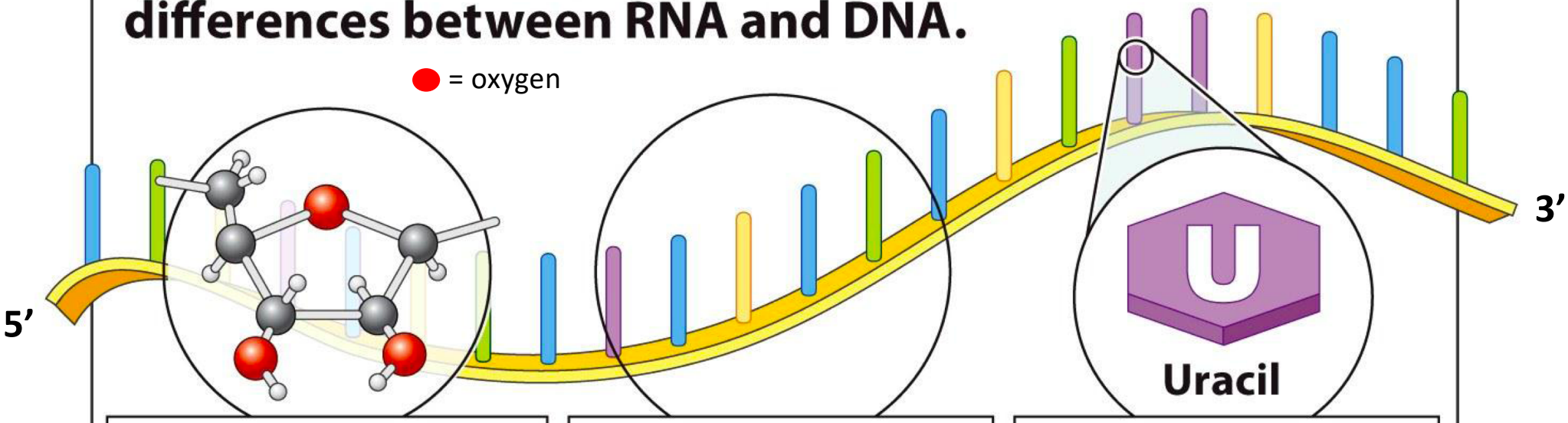
Pyrimidine + pyrimidine: too narrow

Purine + pyrimidine: width consistent with X-ray data

RIBONUCLEIC ACID (RNA)

RNA STRUCTURE

There are three important structural differences between RNA and DNA.



The sugar molecule in the RNA backbone contains an extra oxygen.

RNA has only one sugar-phosphate backbone, while DNA has two.

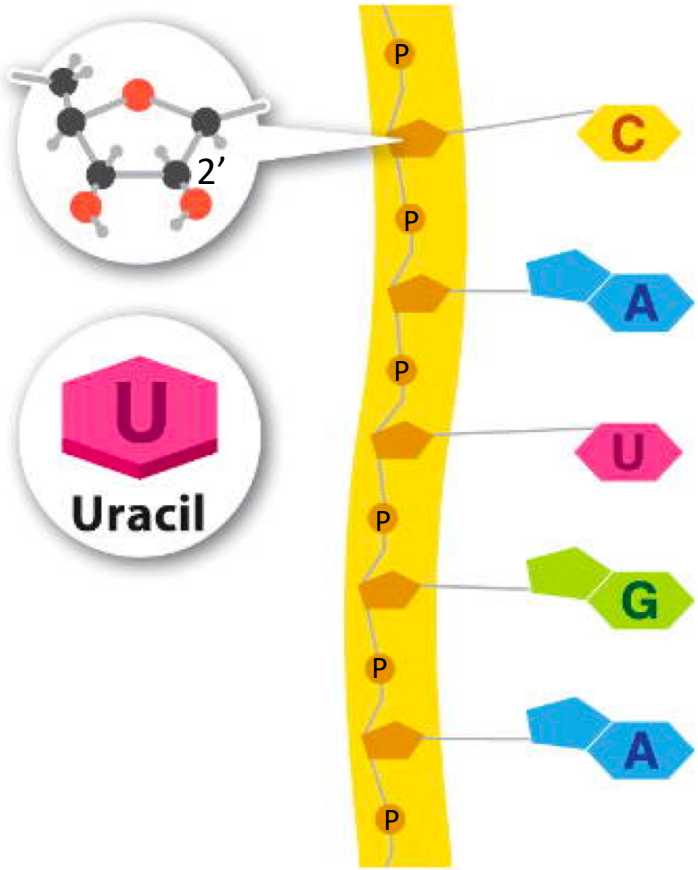
Instead of thymine, RNA has a similar base called uracil.

RIBONUCLEIC ACID (RNA)

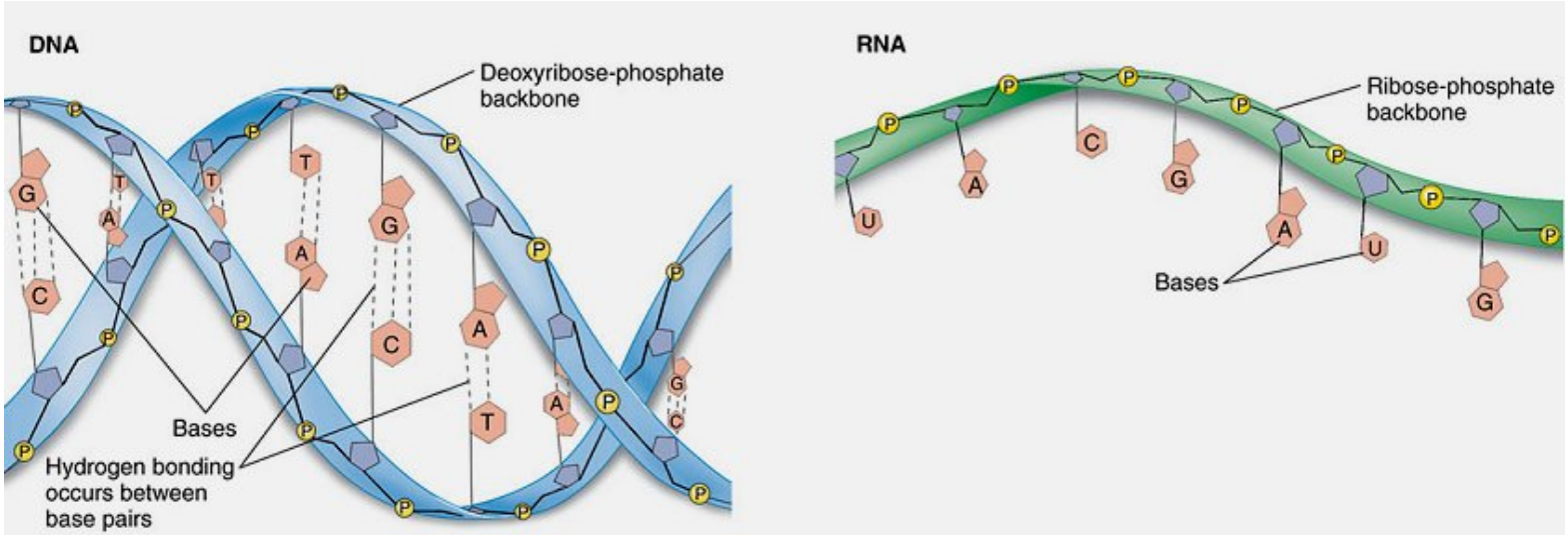
RNA STRUCTURE

● = oxygen

- **The sugar molecule in the RNA backbone contains an extra oxygen.**
  on carbon 2'
- **Instead of thymine, RNA has a similar base called uracil.**



Differences between DNA and RNA

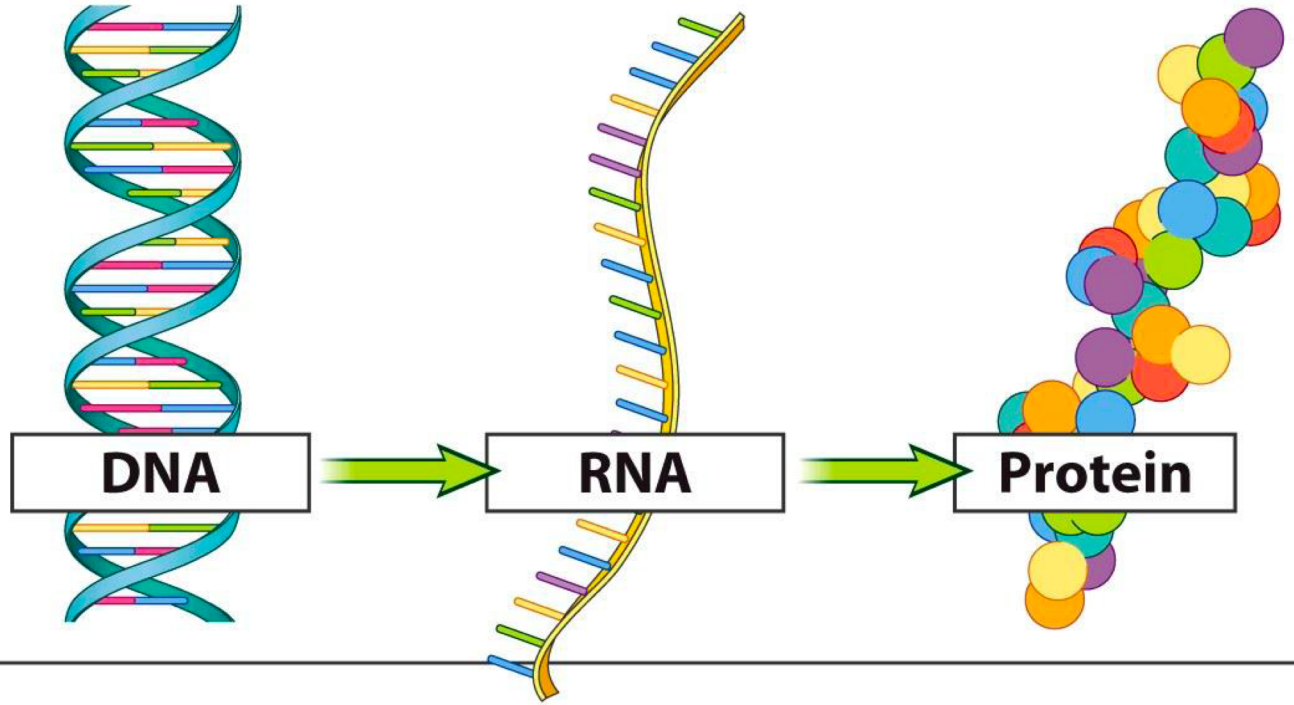


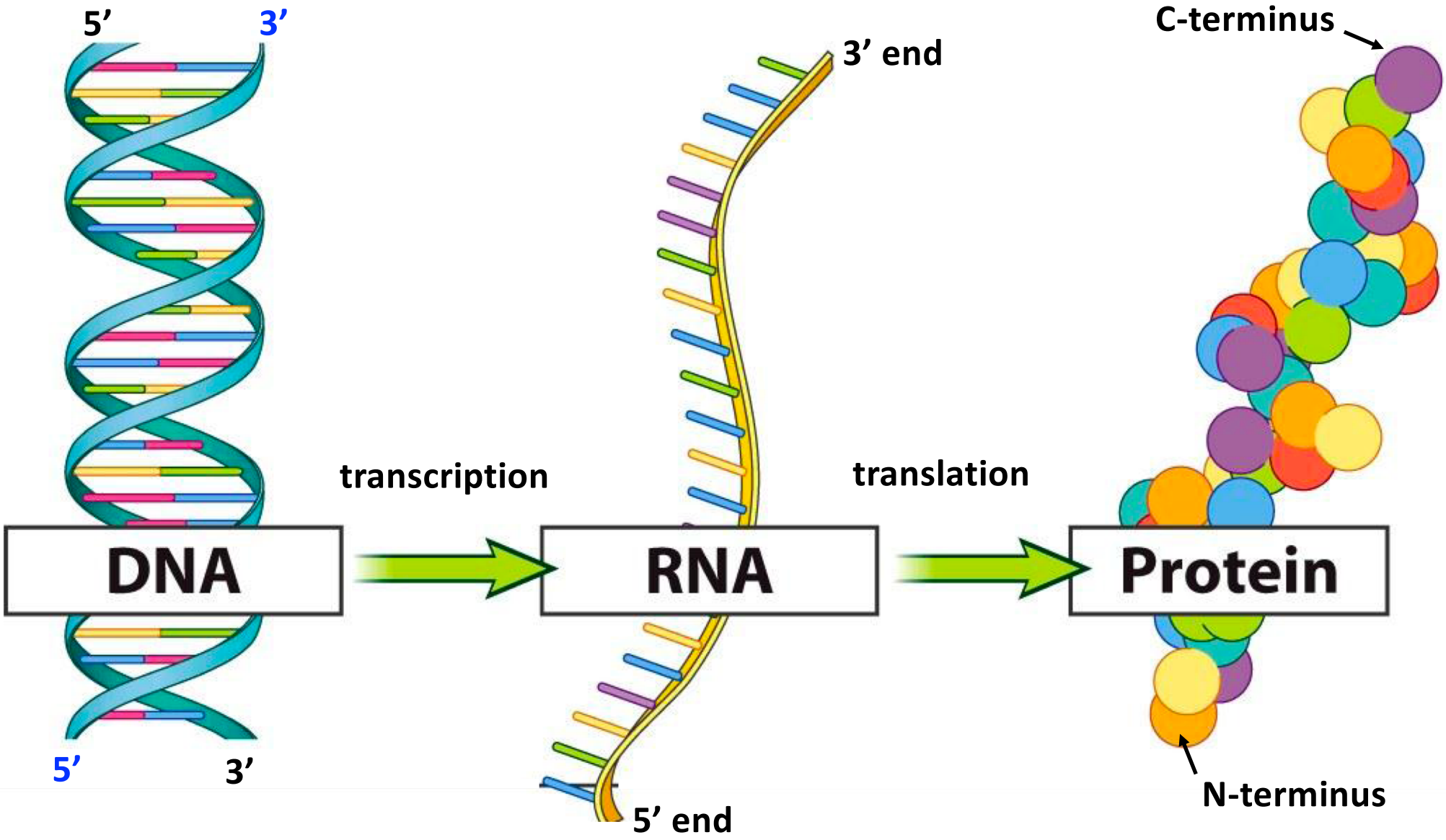
Sugar :	desoxyribose	ribose
Base :	Thymine	Uracil
Structure :	double stranded (mostly)	Single stranded (mostly)

RIBONUCLEIC ACID (RNA)

RNA FUNCTION

RNA acts as a middleman molecule. It takes instructions for production of a protein from DNA, moves them to another part of the cell, and directs the building of a protein.

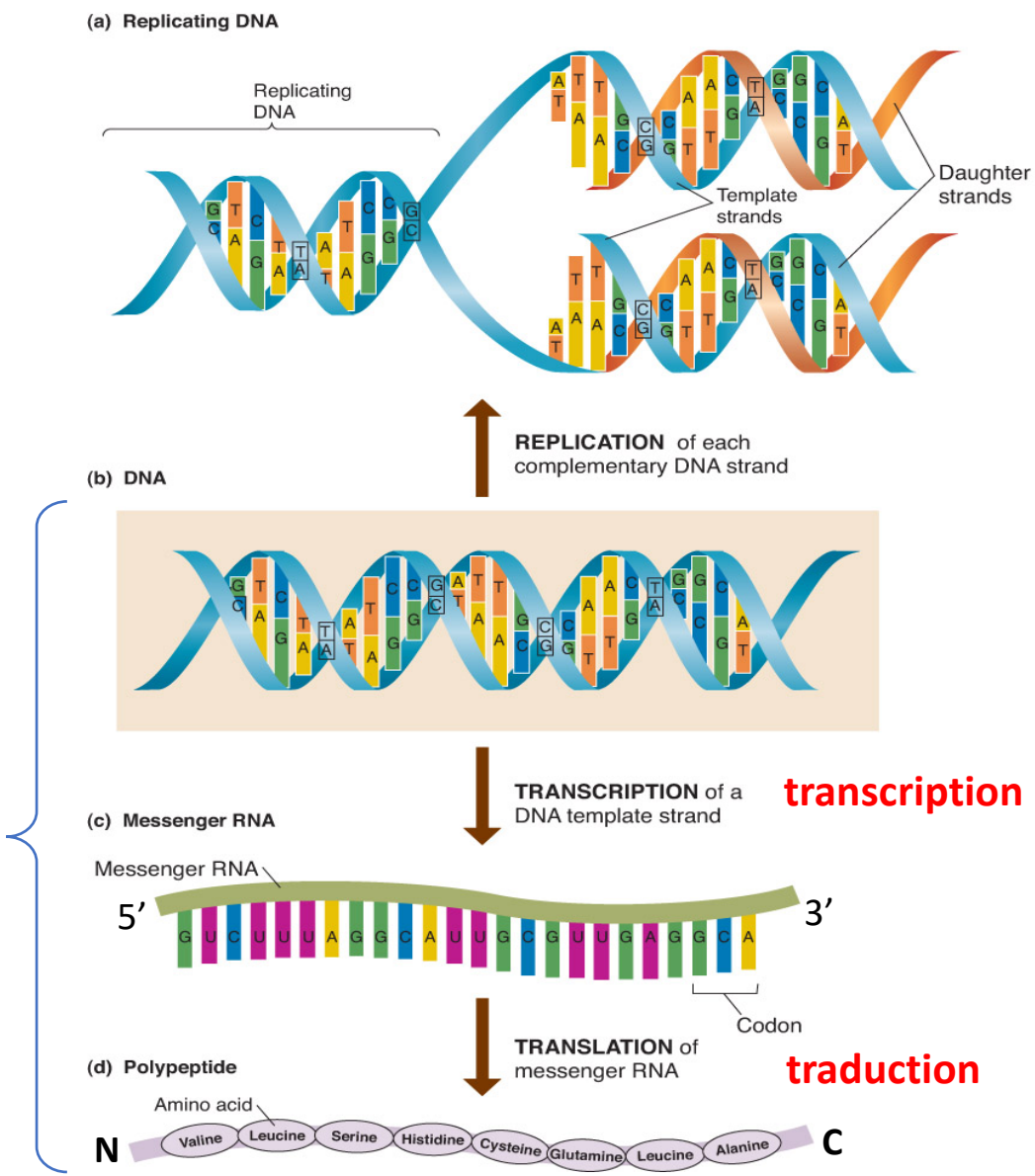



5’
3’
5’
3’
DNA
transcription
3’ end
RNA
5’ end
translation
C-terminus
Protein
N-terminus

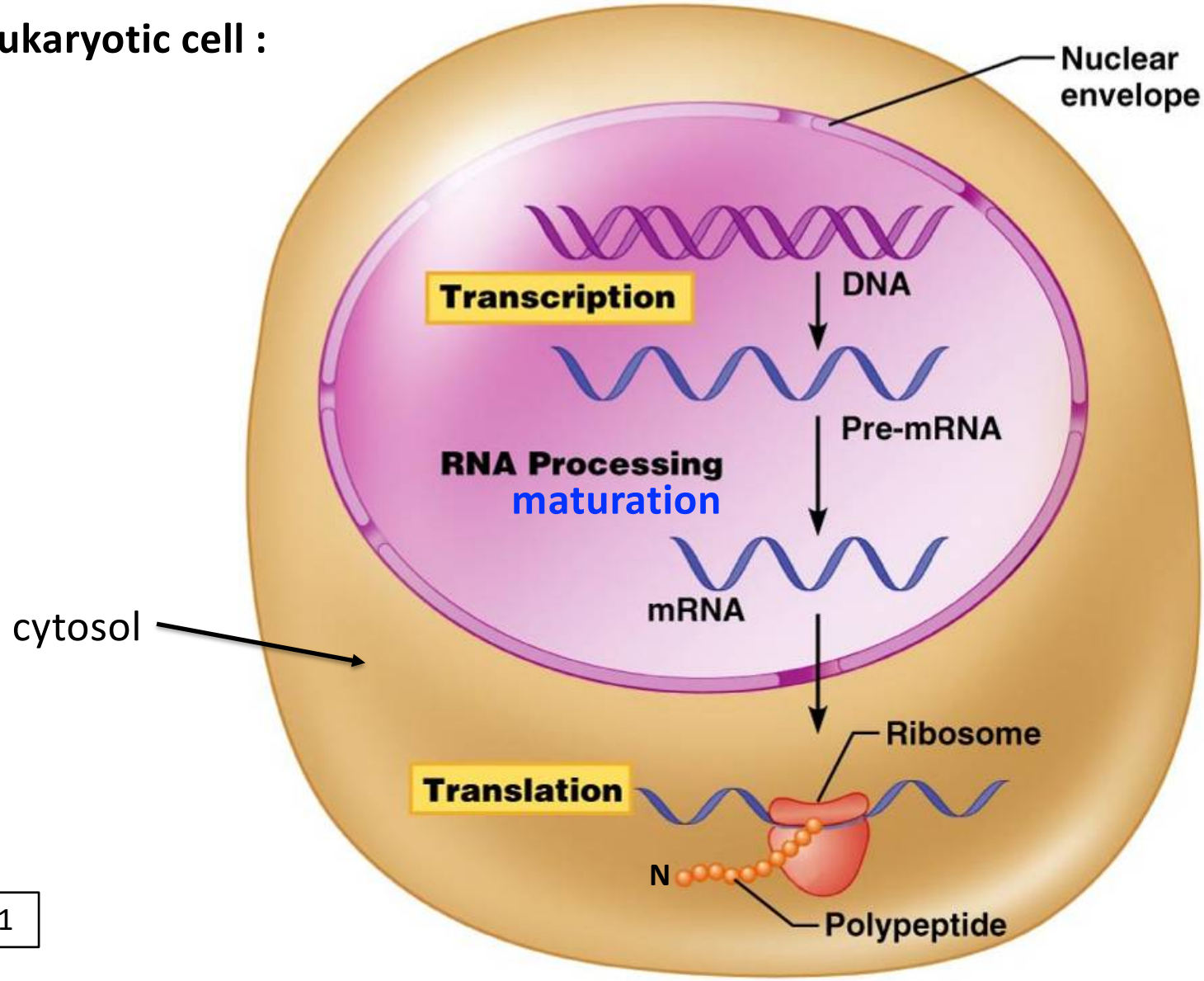
Overview

Copy
(replication)

Gene
Expression



In a eukaryotic cell :



See tutorial 9.1 part 1

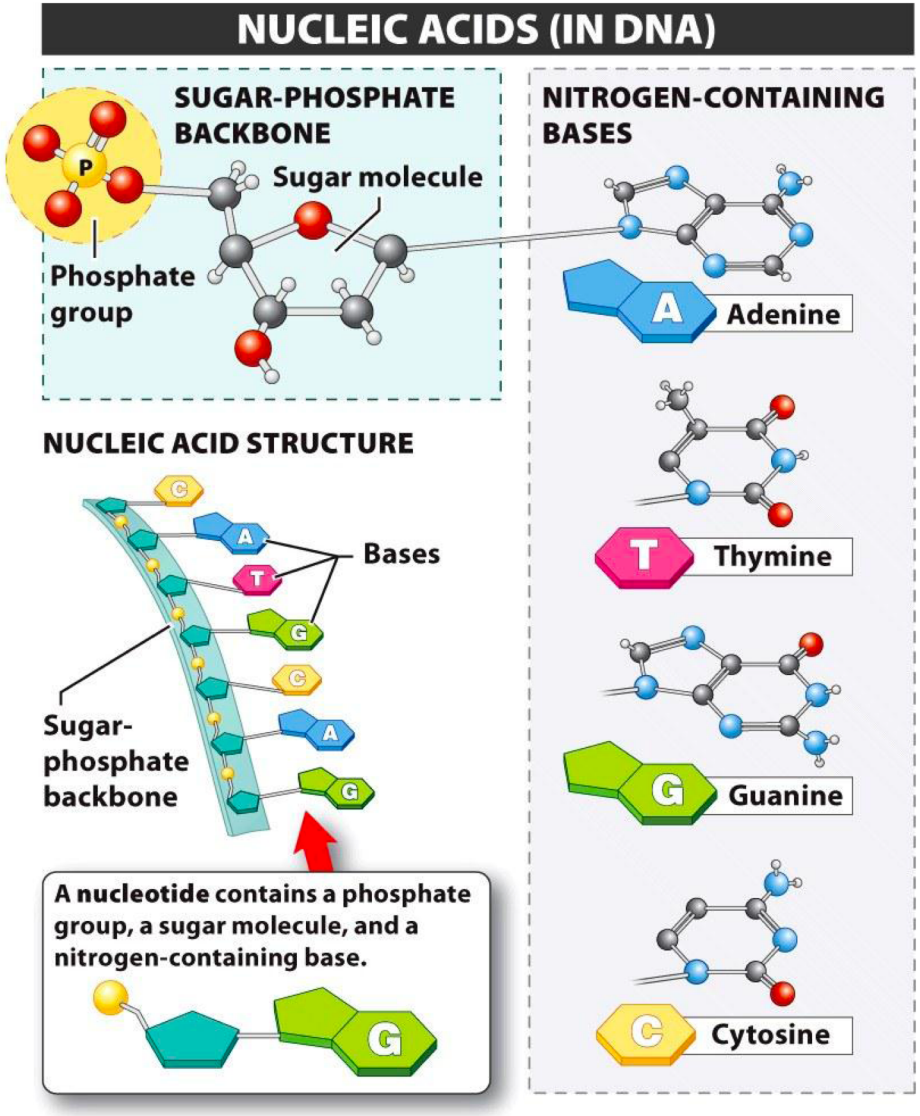


Figure 2-45
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