

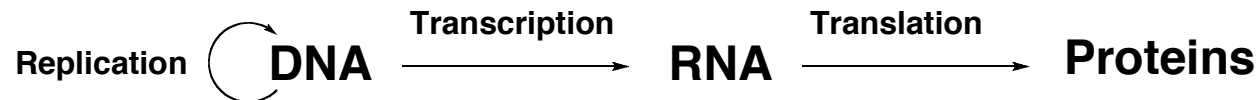
# Nucleosides, Nucleotides, Nucleic acids (DNA; RNA) McM chapt. 28

**DNA: Deoxyribonucleic acid**

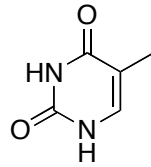
**RNA: Ribonucleic acid**

## Chemical carriers of the cells genetic information

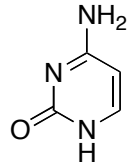
- Structure
- Function



# DNA bases



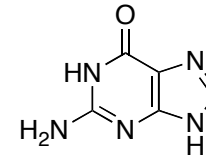
**Thymin**



**Cytosin**



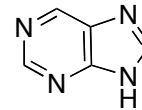
**Adenine**



**Guanine**



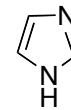
**Pyrimidine**



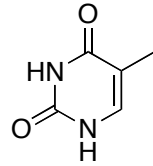
**Purine**



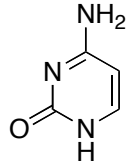
**Pyrimidine**



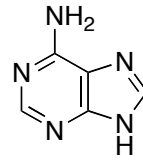
**Imidazole**



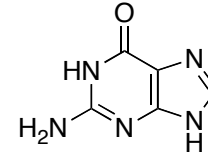
Thymin



Cytosin



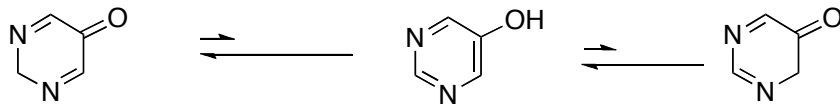
Adenine



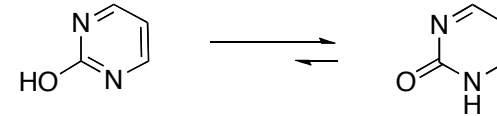
Guanine

## Tautomerism - Hydroxy and aminopyrimidines

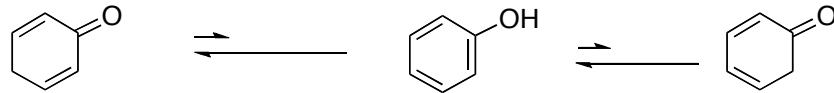
Hydroxy major tautomer



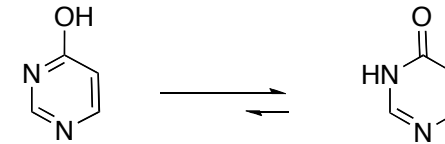
Oxo major tautomer



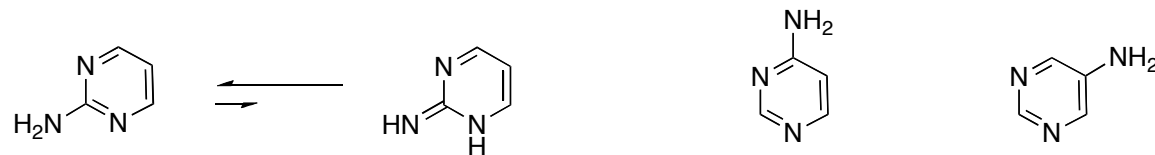
C.f.



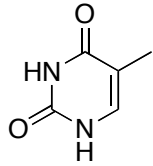
Phenol



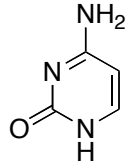
Amino major tautomer, all regioisomers



## DNA bases



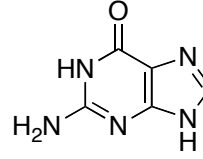
Thymin



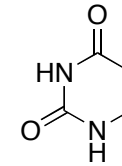
Cytosin



Adenine



Guanine



Uracil

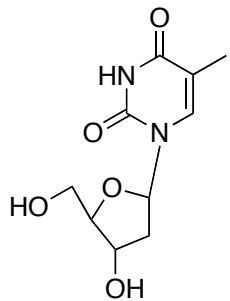
Cytosin

Adenine

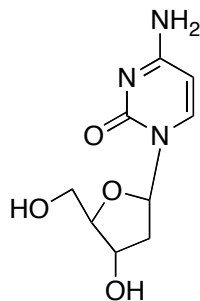
Guanine

## DNA Nucleosides

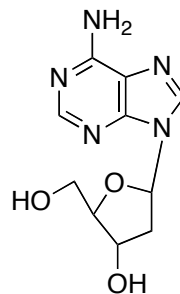
Thymidine



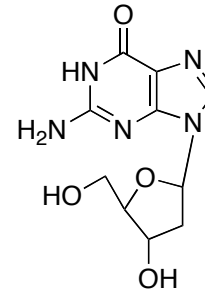
Deoxycytosine



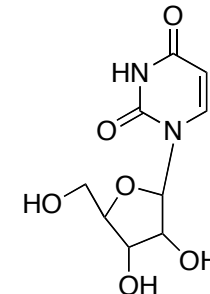
Deoxyadenosine



Deoxyguanosine



Uridine



## 2-Deoxyribosides

## RNA Nucleosides

Cytosine

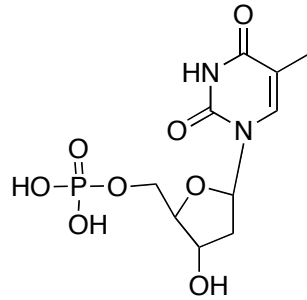
Adenosine

Guanosine

## Ribosides

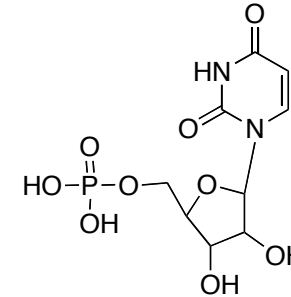
# DNA Nucleotides

## Ex. mononucleoside

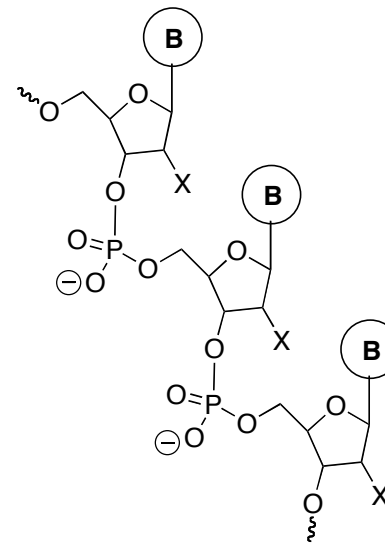
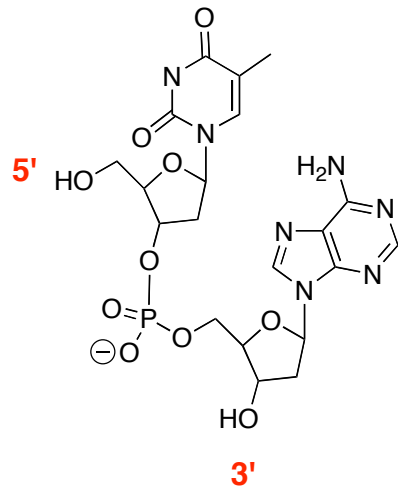


# RNA Nucleotides

## Ex. mononucleoside

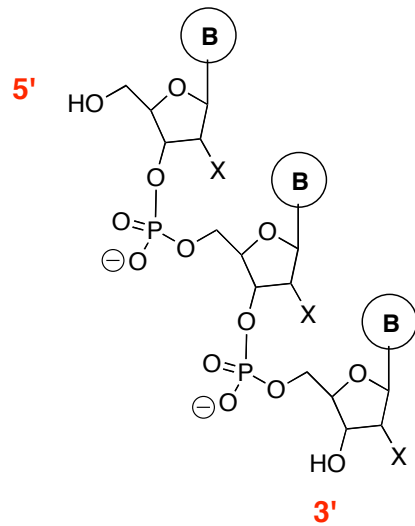


## Ex. dinucleoside

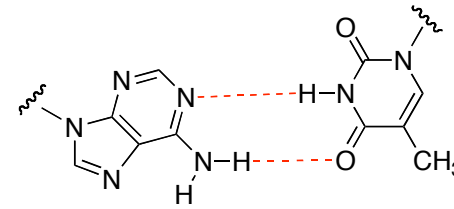


**X = H; DNA**  
**X = OH, RNA**

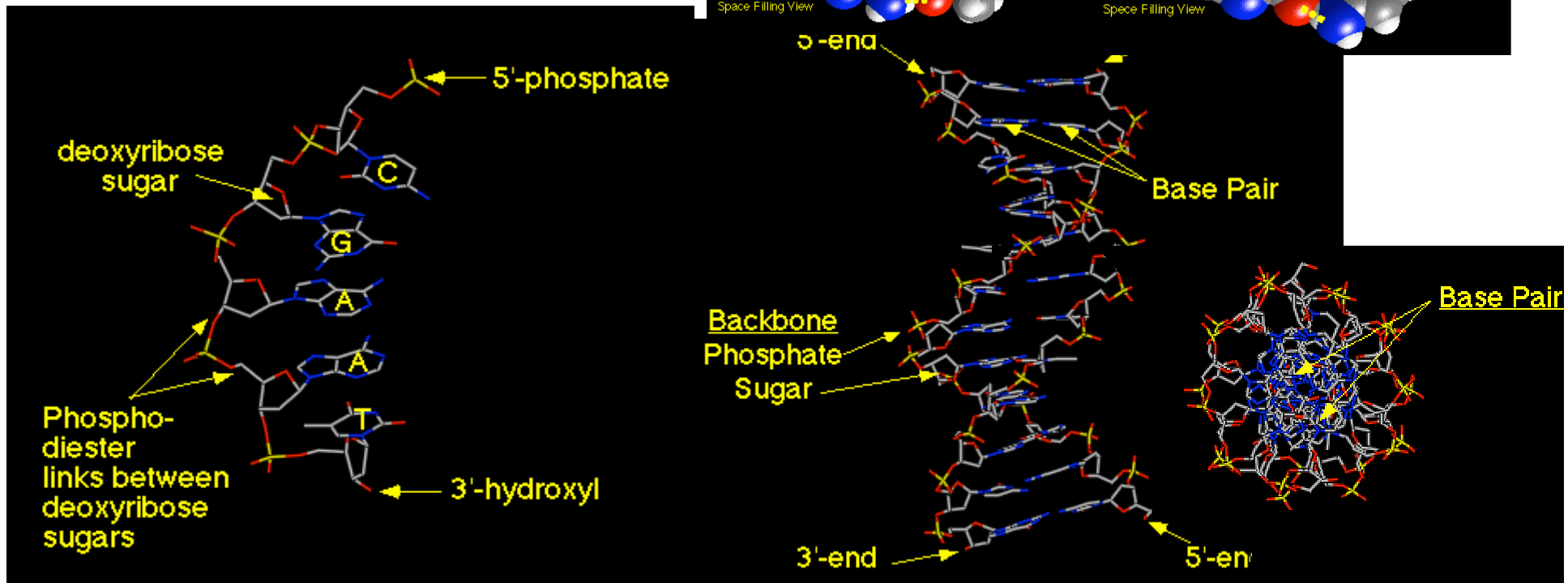
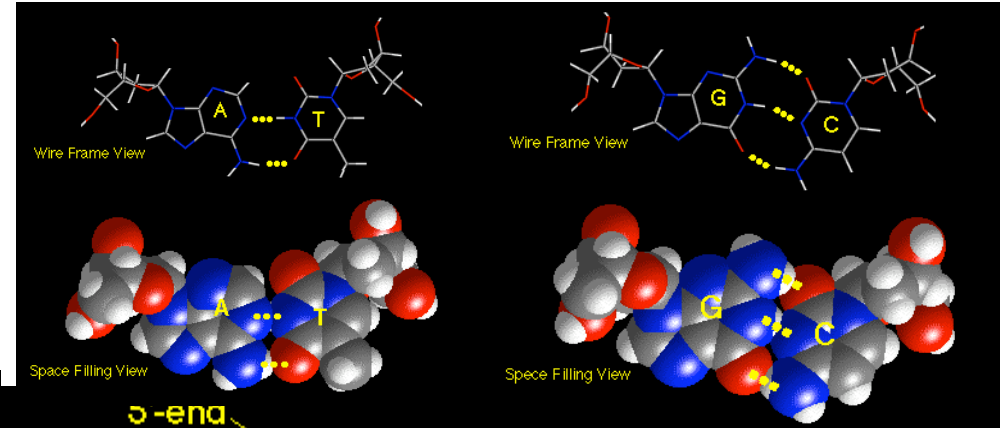
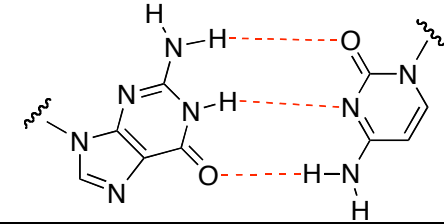
# Nucleotides



## A-T and G-C Base pairs



## Double $\alpha$ -helix (DNA)

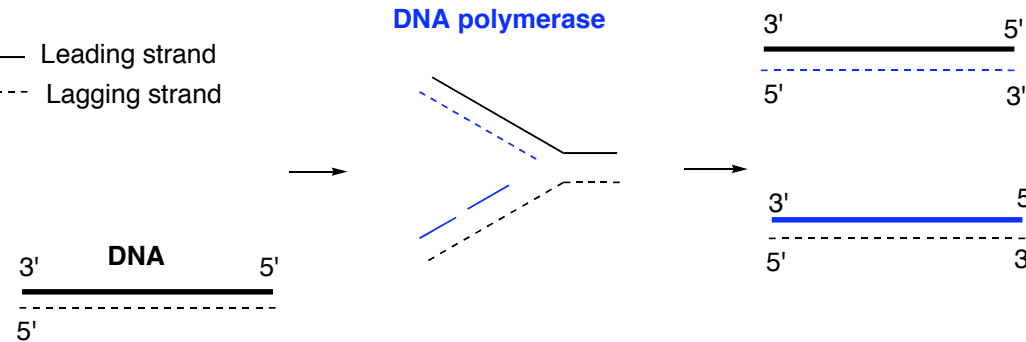


# Nucleotide sequence in DNA - genetic information

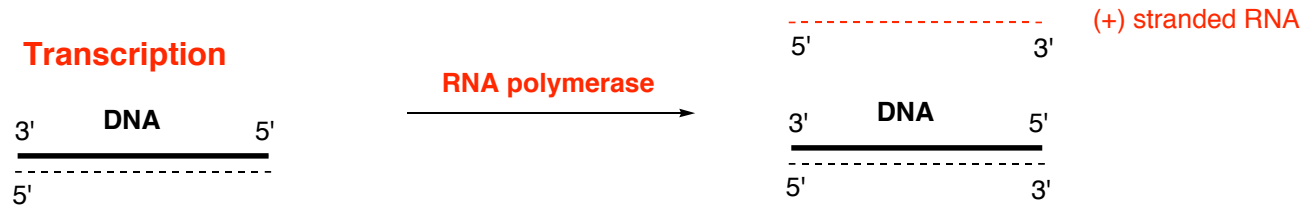
## Prokaryotes and eukaryotes

### Replication

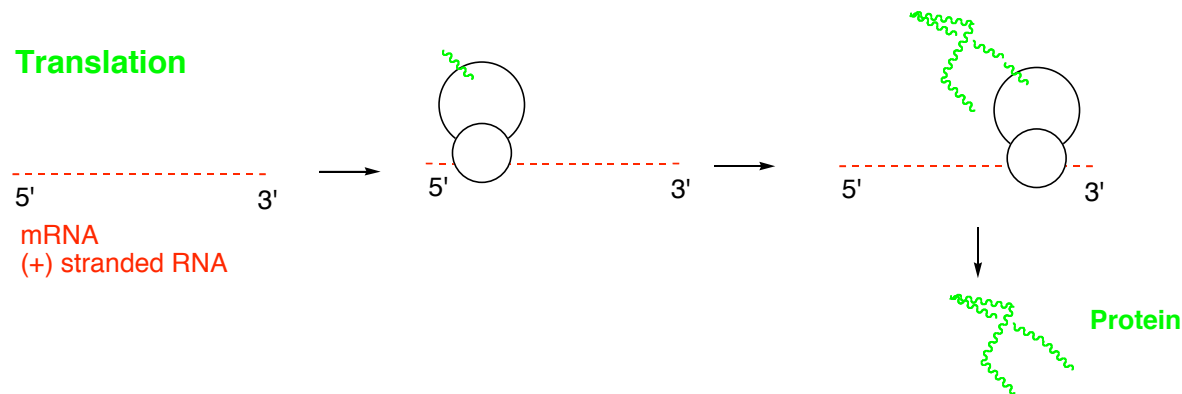
— Leading strand  
- - - Lagging strand



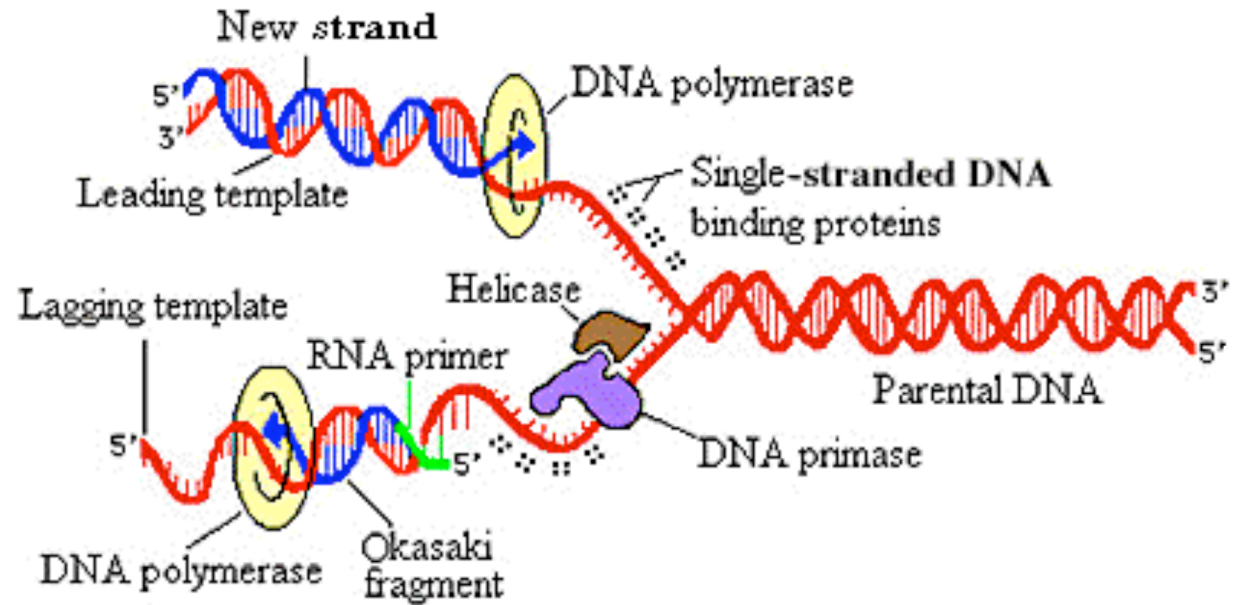
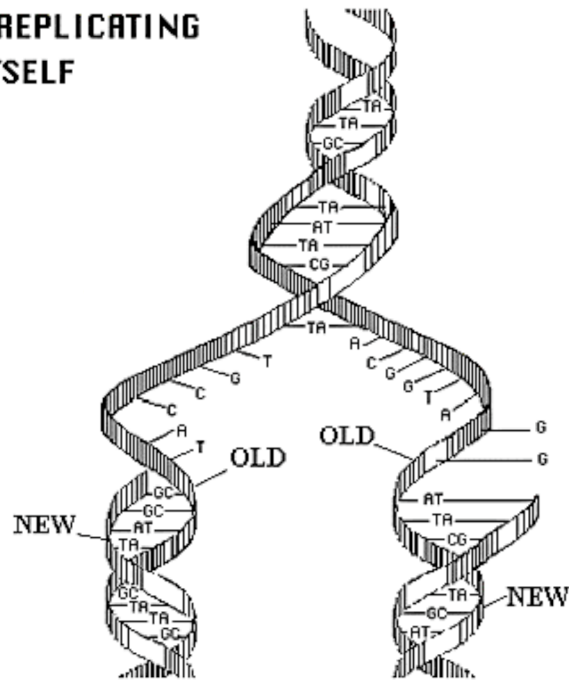
### Transcription



### Translation



## DNA REPLICATING ITSELF



**DNA helicases: Unwinding**

**DNA binding proteins: Prevents winding back**

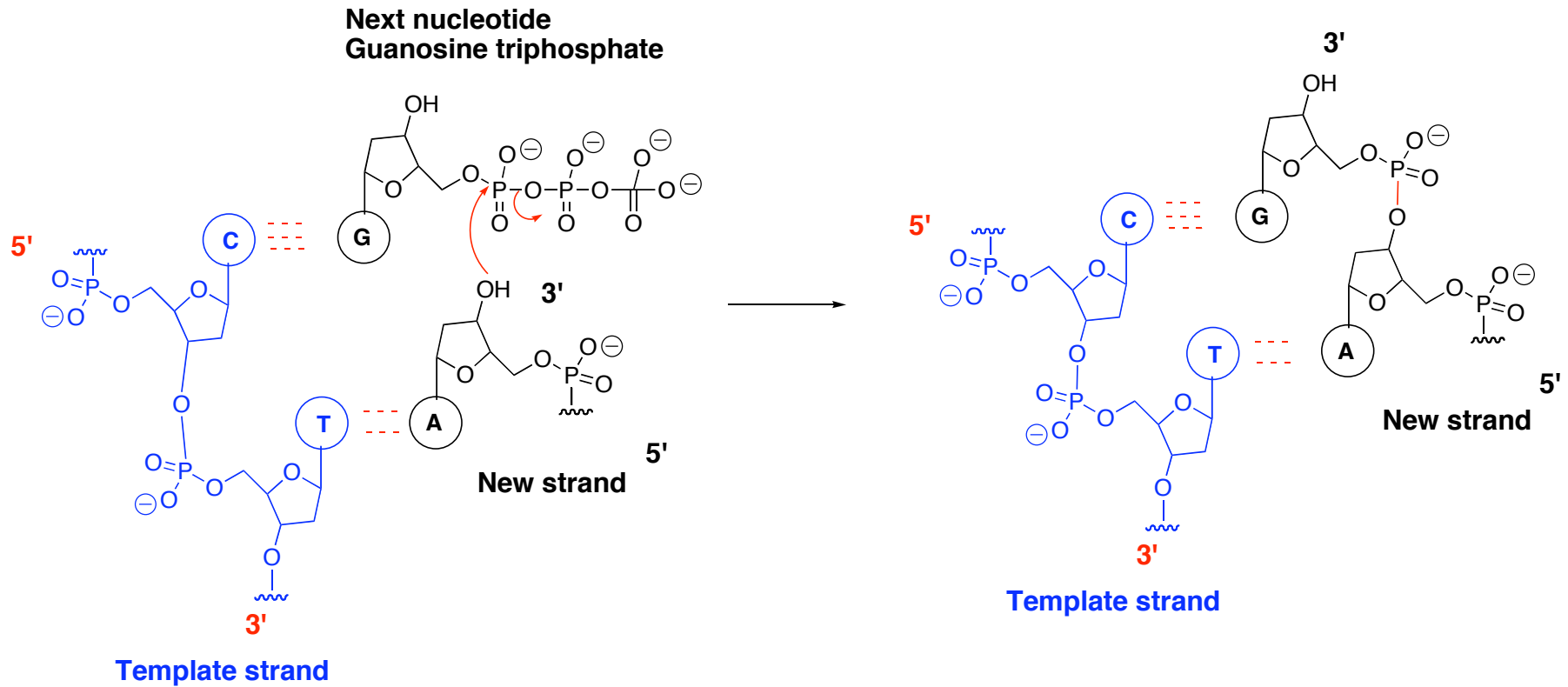
**DNA primase: formation of DNA/RNA primer (from free nucleosides in cell)**

**DNA polymerase: Catalyse elongation of new strand (5' - 3')**

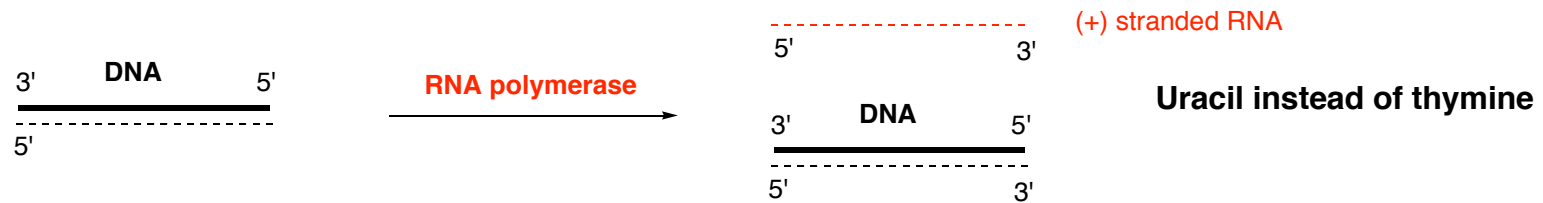
**Lagging strand:**

**DNA ligase: Connects Okasaki fragments**





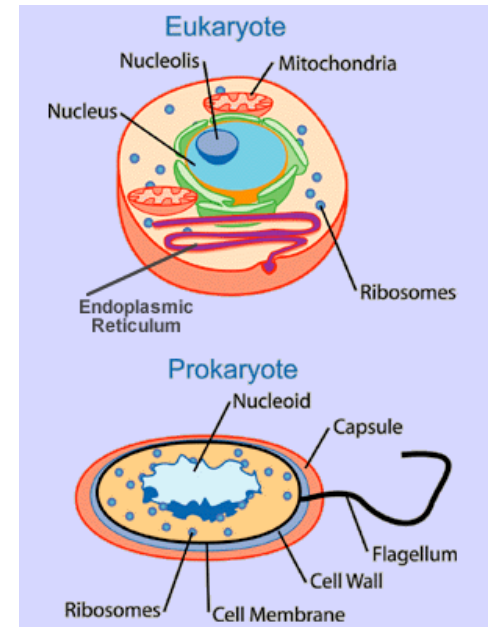
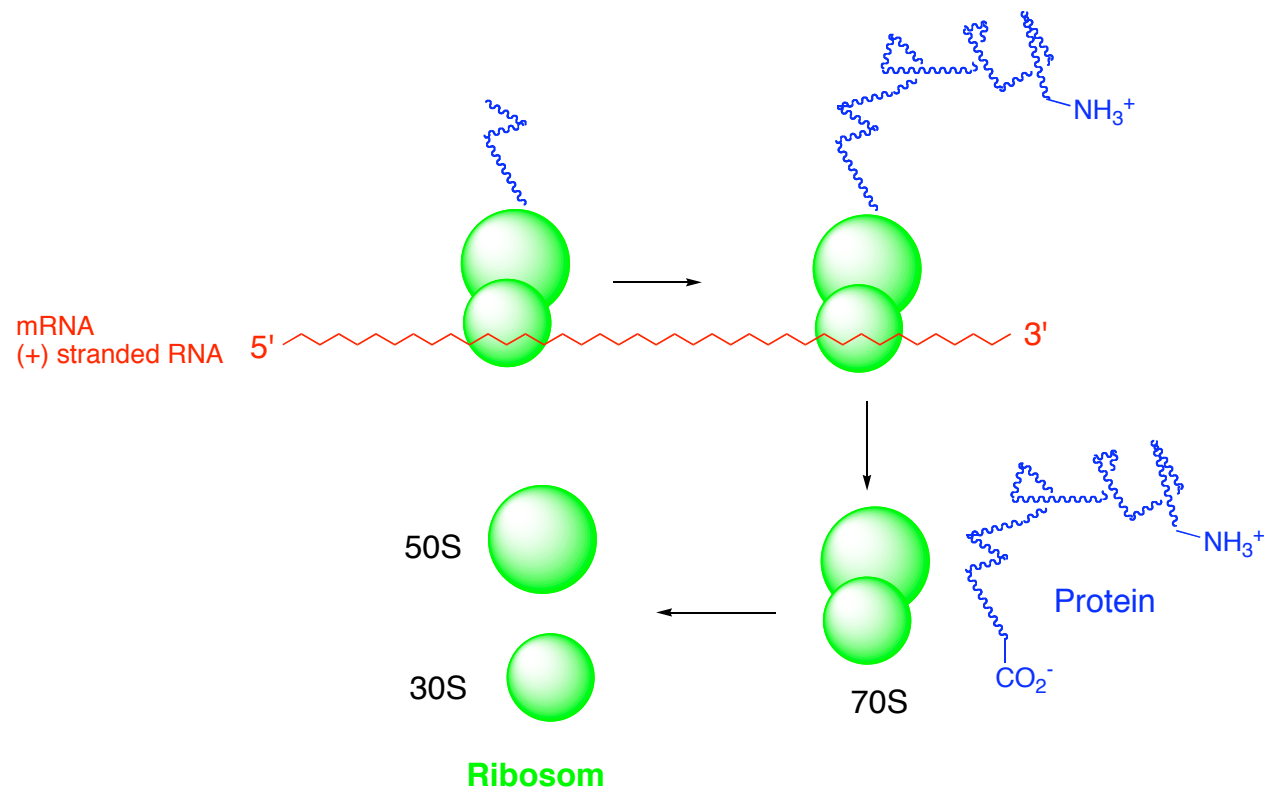
## Transcription: DNA - RNA

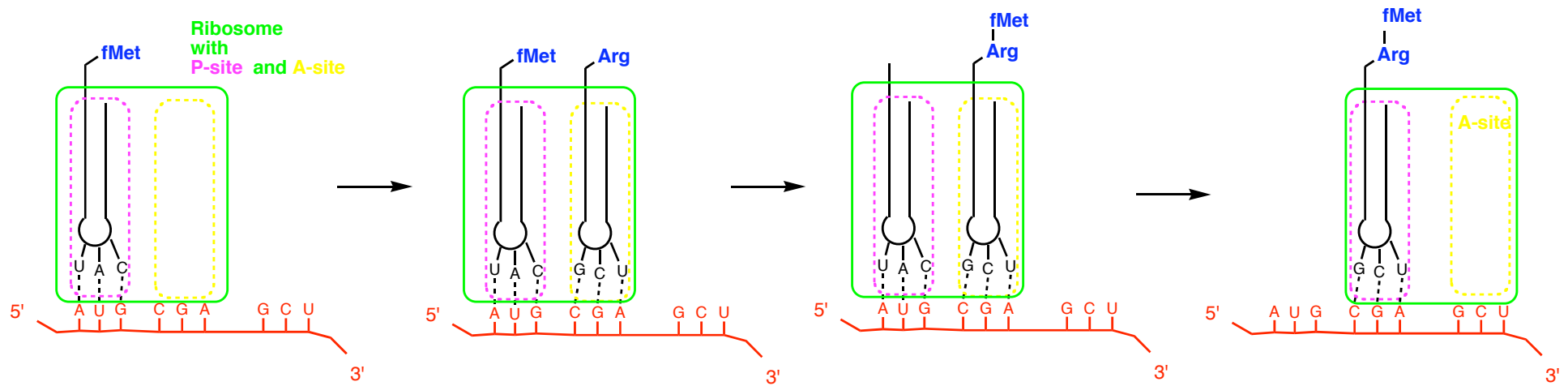
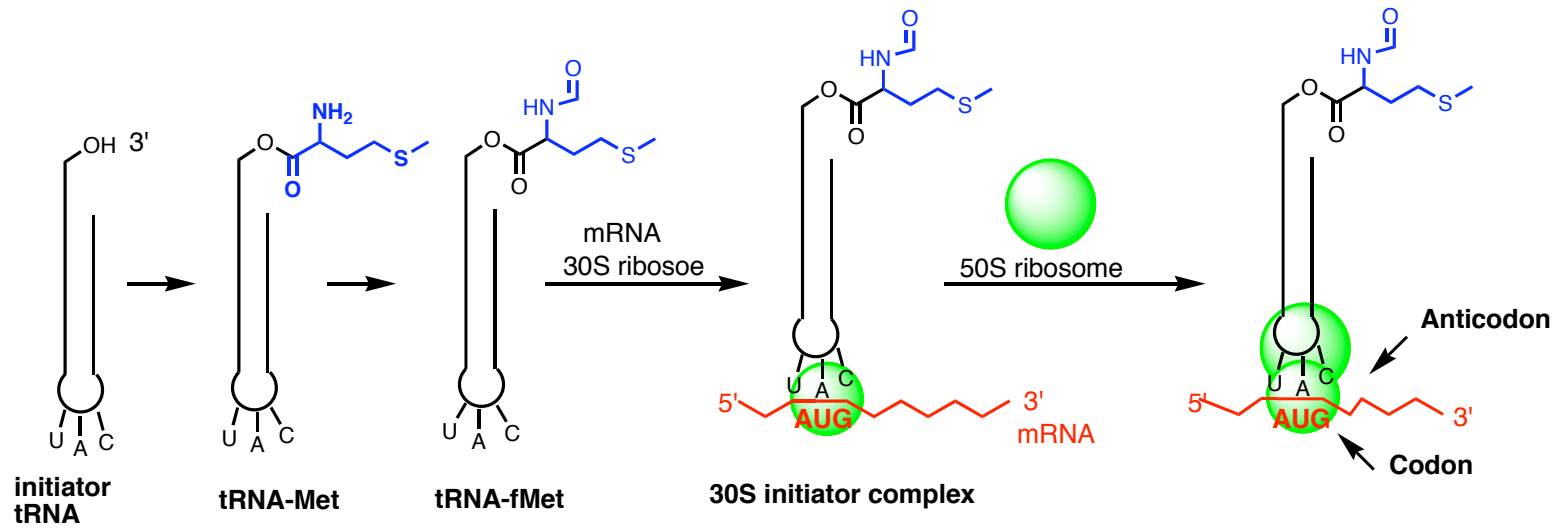


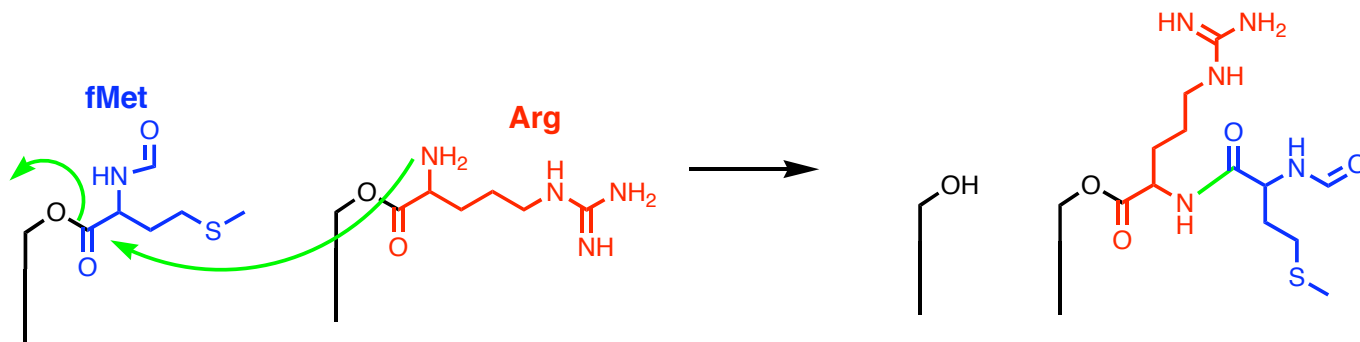
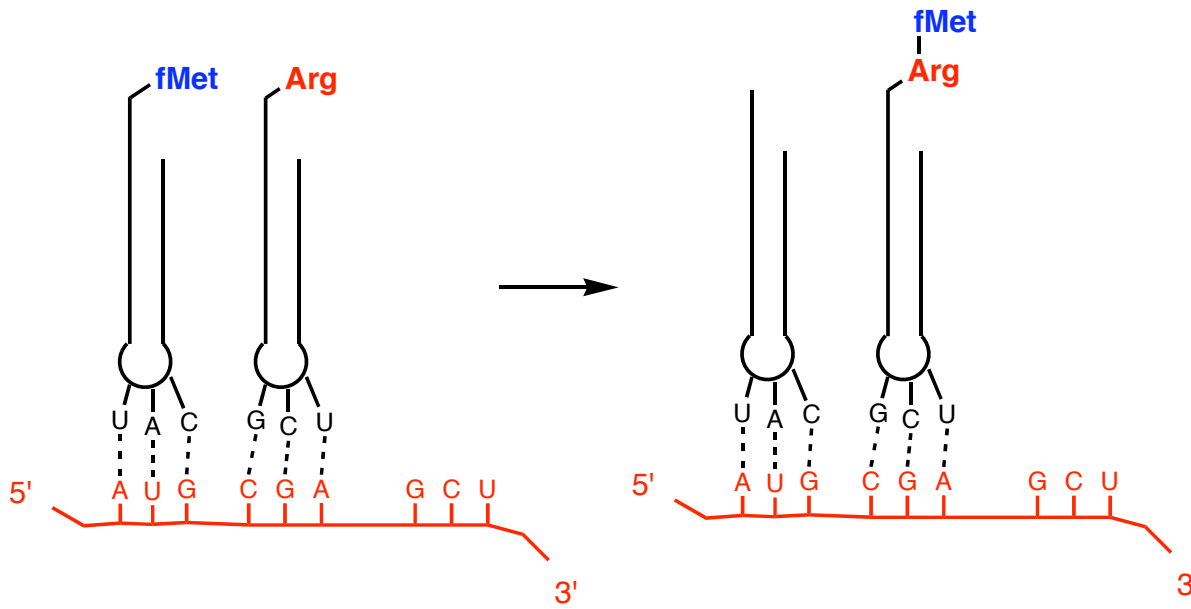
# Translation: RNA - Protein

3 RNA bases coding for one AA (see Table 28.1)

Protein synthesis occurs at ribosomes

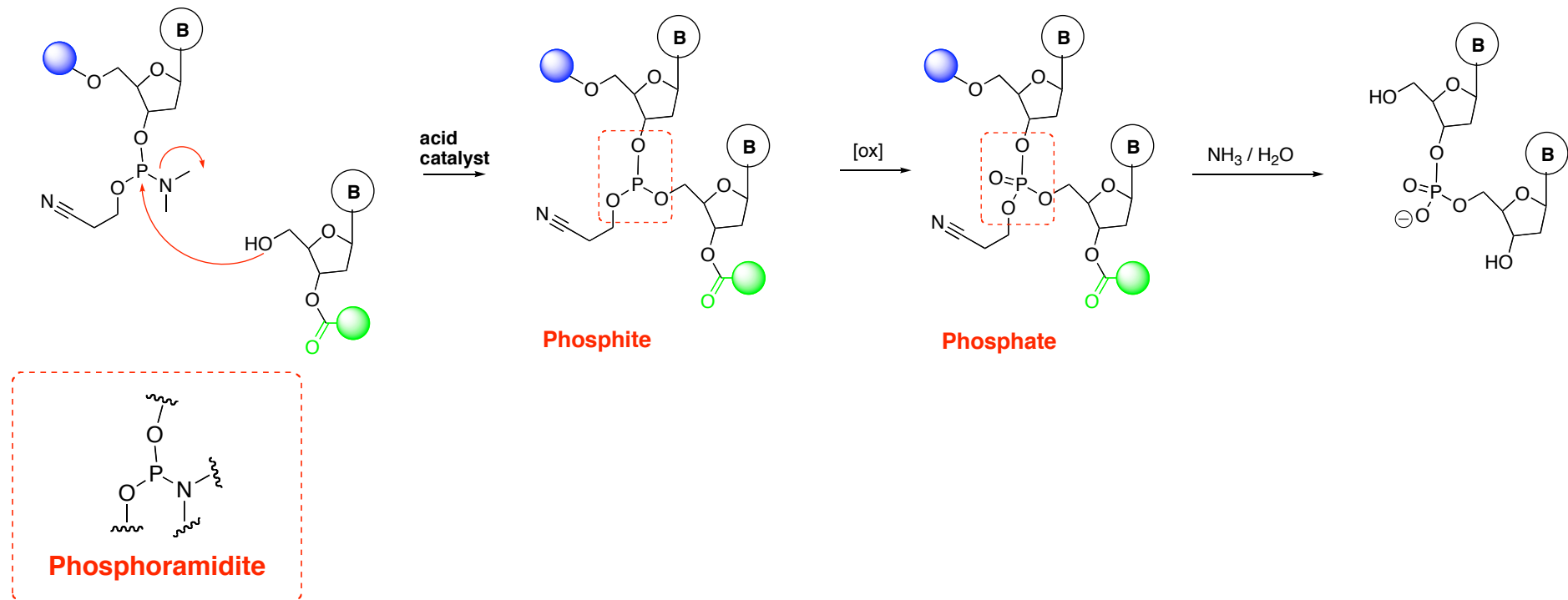






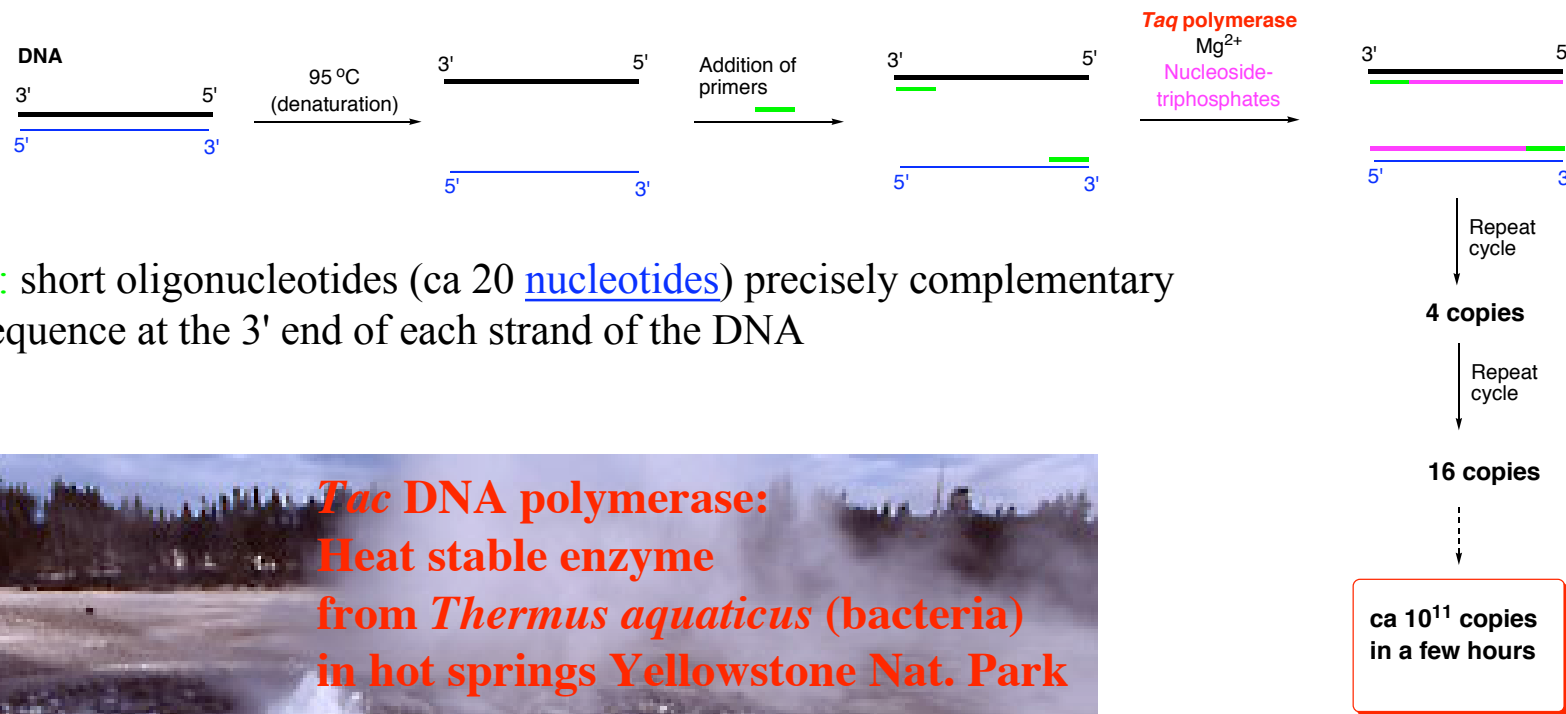
**Formyl group  
Protection of N-terminal**

# DNA / RNA Synthesis: Protecting groups and activating groups (cf. peptide synth)



# The Polymerase Chain Reaction (PCR, 1986)

technique for quickly "cloning" (make many copies of)  
a particular piece of DNA in the test tube (rather than in living cells like *E. coli*).



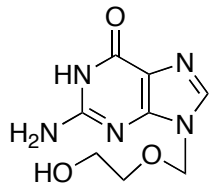
**primers:** short oligonucleotides (ca 20 nucleotides) precisely complementary to the sequence at the 3' end of each strand of the DNA



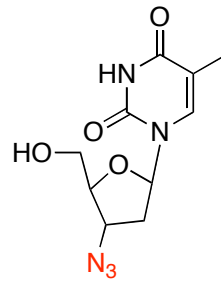
# Nucleoside Derivatives - Drugs

Most important - Antimetabolites

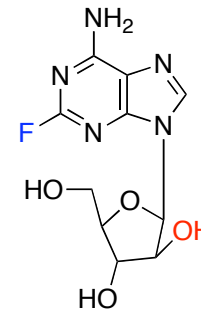
Cancer, viral infections



**Acyclovir**  
Herpes



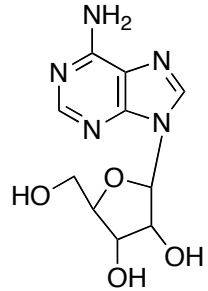
**Zidovudine - AZT**  
HIV



**Fludarabine**  
Cancer

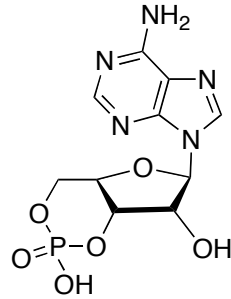
# Nucleoside Derivatives - Other functions

**Adenosine**



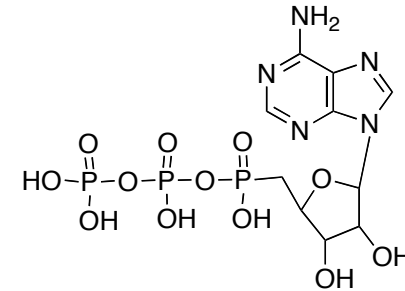
**Signaling substance**

**Cyclic adenosine monophosphate (cAMP)**



**Second messenger**

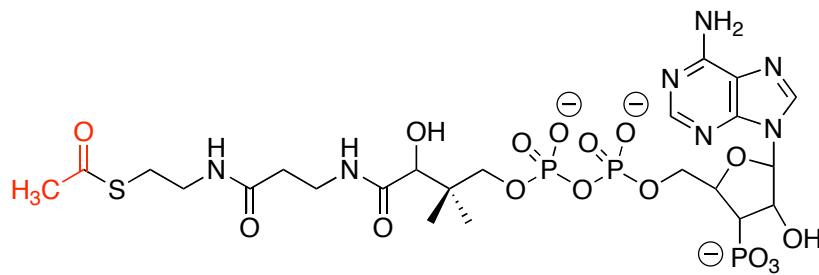
**Adenosine triphosphate (ATP)**



**Energy storage**

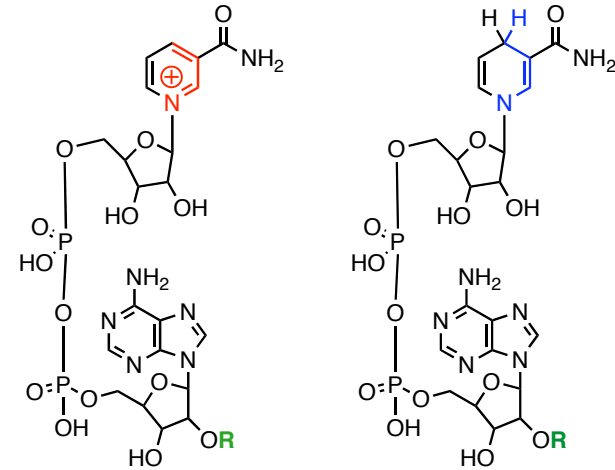
## Co-enzymes

**Ex.**



**Acetyl-CoA**

**Nicotinamid adenine dinucleotide**



**R=H NAD<sup>+</sup>**

**NADH**

**R=Phosphate: NADP<sup>+</sup>, NADPH**