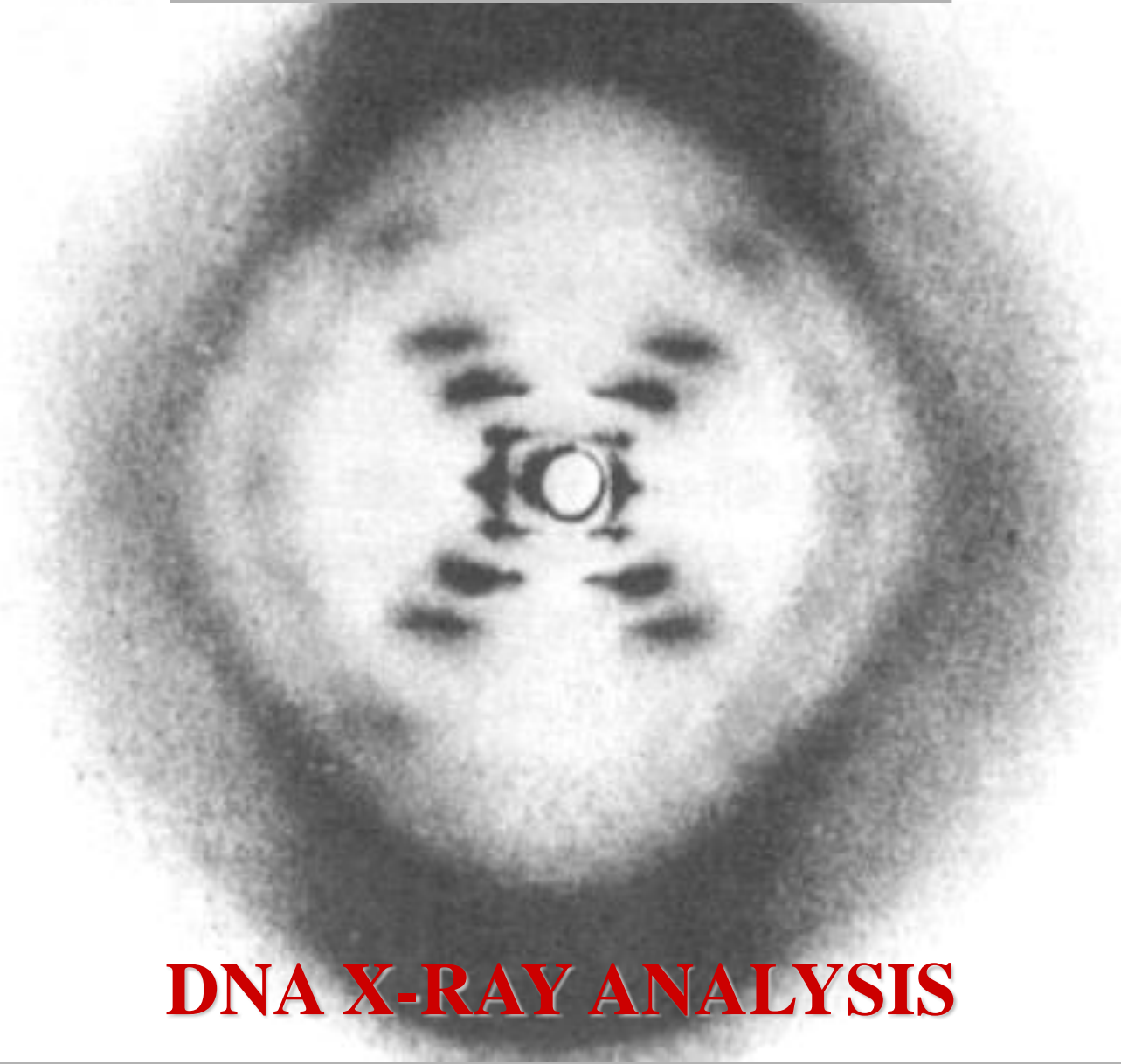
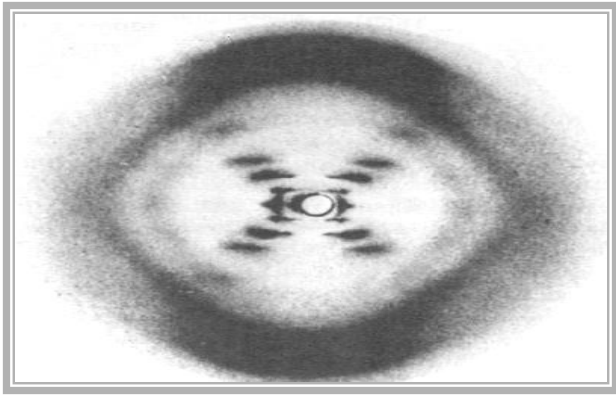


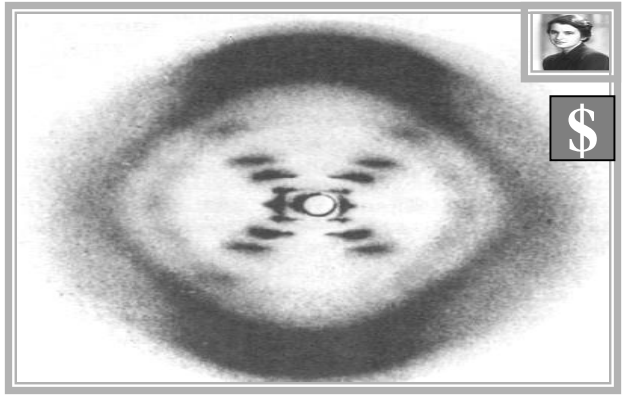
PHOTO 51



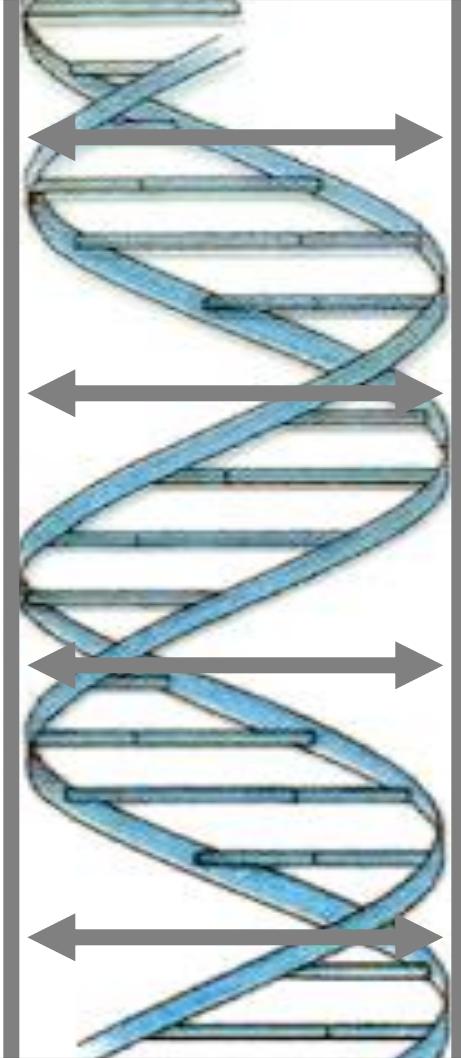
**DNA X-RAY ANALYSIS**



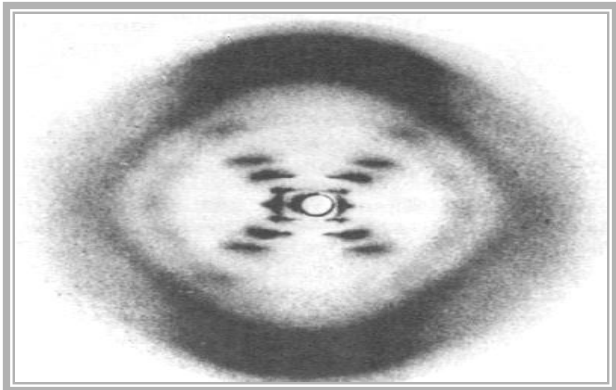
**DNA**



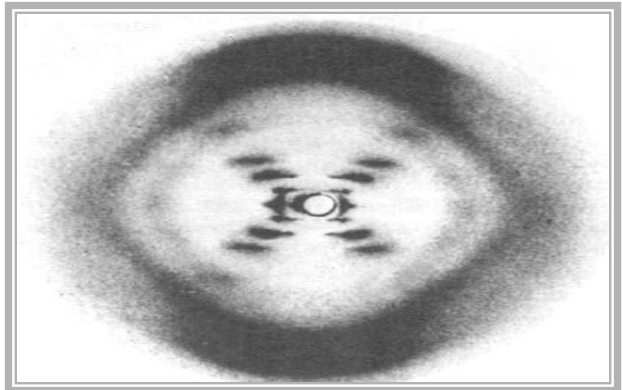
**DNA  
UNIFORM  
MAXIMUM  
DIAMETER**



**DNA  
UNIFORM  
MAXIMUM  
DIAMETER**

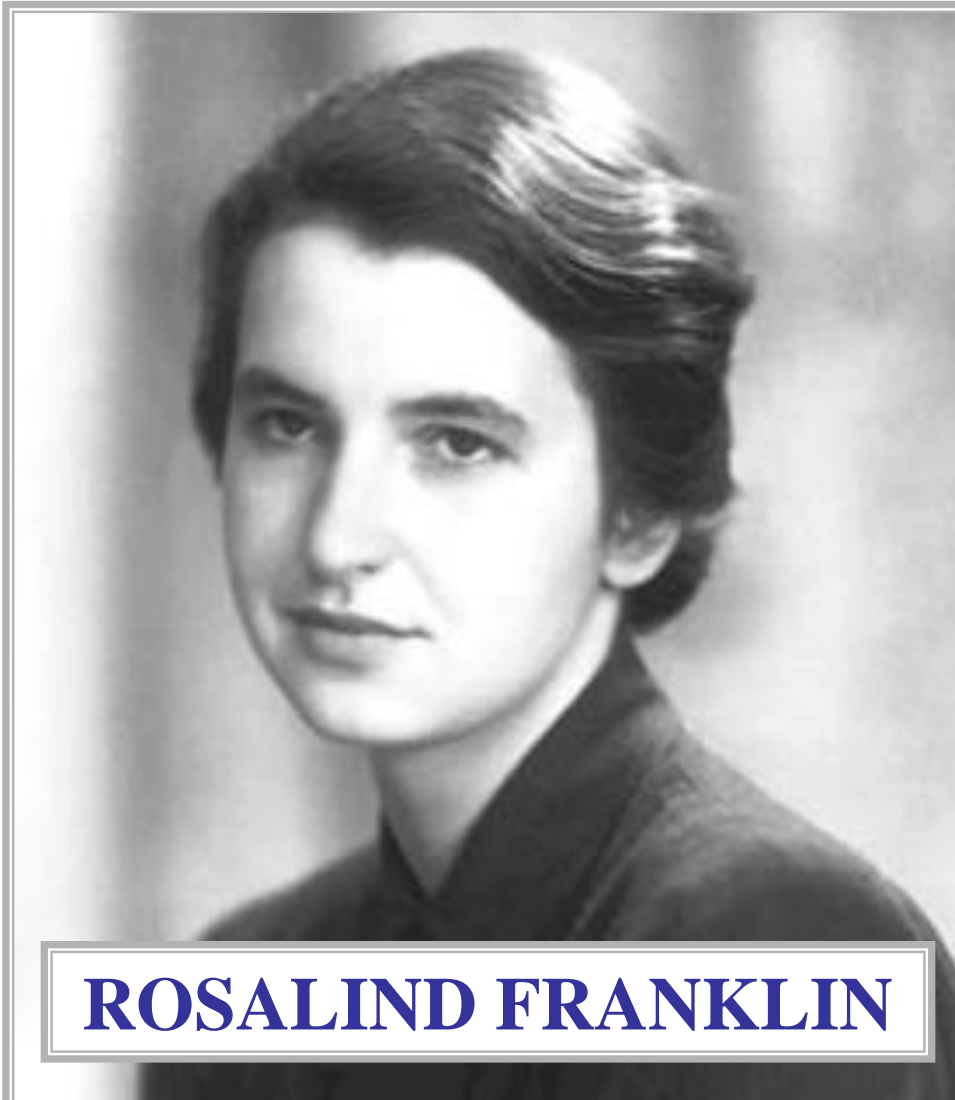


**DNA**



**DNA  
X-RAY  
ANALYSIS**

**DNA  
X-RAY  
ANALYSIS**



**ROSALIND FRANKLIN**

**DNA  
X-RAY  
ANALYSIS**

**DNA  
X-RAY  
ANALYSIS**

**DETERMINED DNA HELICAL STRUCTURE**

**DETERMINED DNA UNIFORM DIAMETER**



**DNA  
STRUCTURE  
DISCOVERY  
CHRONOLOGY  
1953**

# QUESTION

WHO WHERE THE  
BIOLOGISTS THAT  
DETERMINED  
DNA STRUCTURE?

# QUESTION



**ANSWER**

**JAMES WATSON  
&  
FRANCIS CRICK**

**ANSWER**



**JAMES WATSON**  
**AMERICAN**  
**&**  
**FRANCIS CRICK**  
**ENGLISHMEN**



**JAMES WATSON**

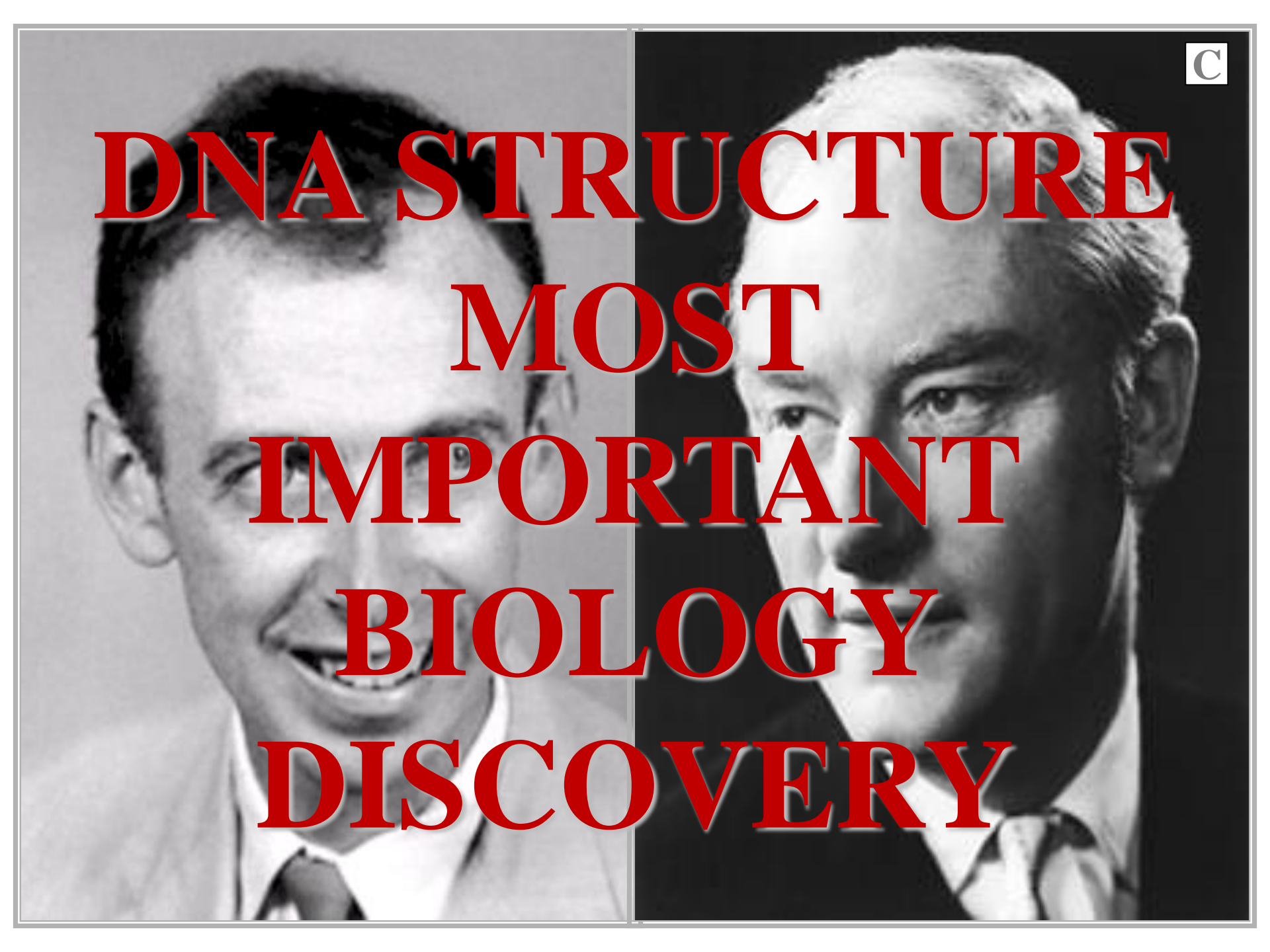


**FRANCIS CRICK**





**DETERMINED DNA STRUCTURE**

A black and white photograph of two men, James Watson and Francis Crick, from the chest up. They are both wearing suits and ties. The man on the left is smiling and looking towards the right. The man on the right is looking towards the left. The background is dark. The text is overlaid on the image in a large, bold, red font.

**DNA STRUCTURE**  
**MOST**  
**IMPORTANT**  
**BIOLOGY**  
**DISCOVERY**



**CONDUCTED NO FORMAL EXPERIMENTS**

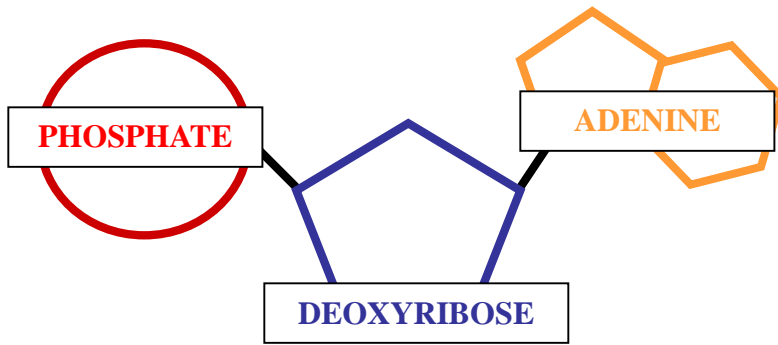


**COLLECTED ALL PERTINENT DNA LITERATURE**

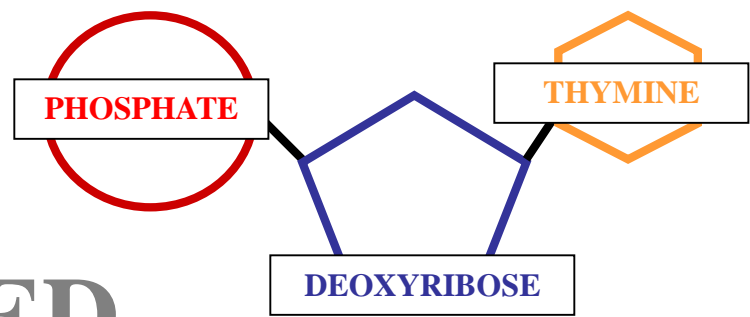
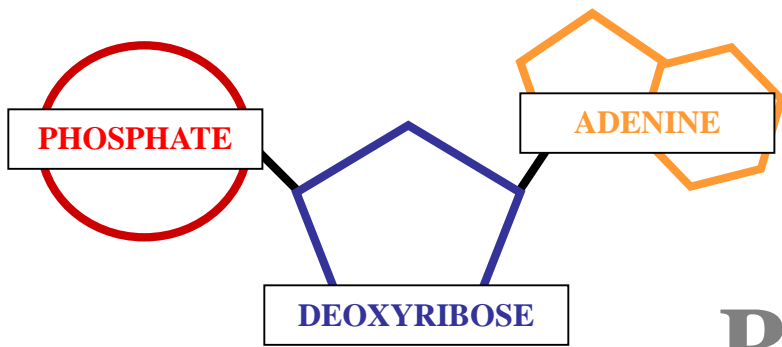


**USED OTHER SCIENTIST'S DATA**

**JAMES WATSON  
&  
FRANCIS CRICK  
REASONED**



**ADENINE**

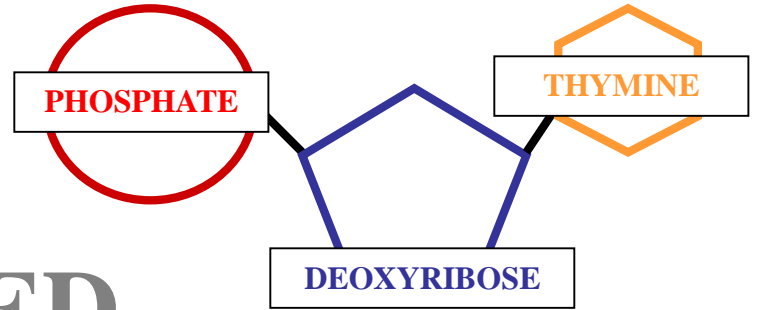
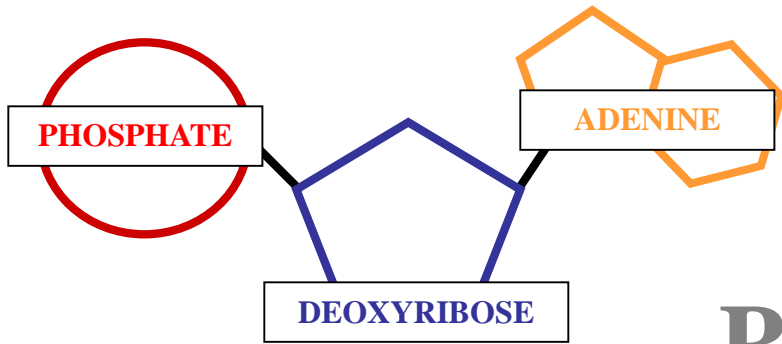


PAIRED

ADENINE

THYMINE

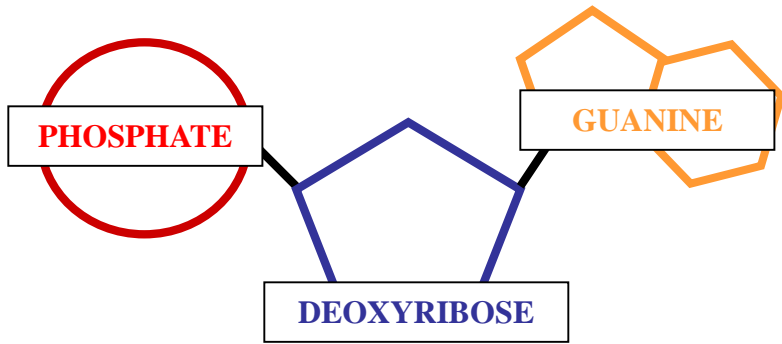




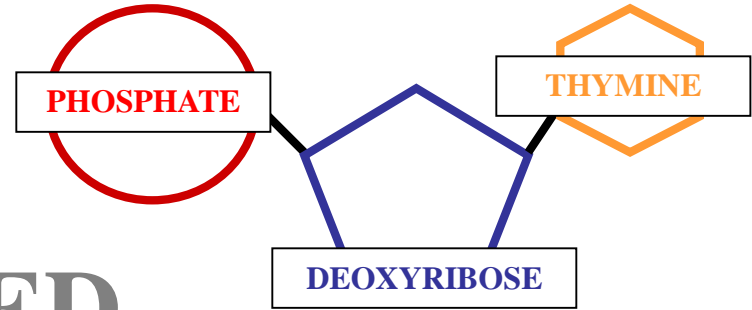
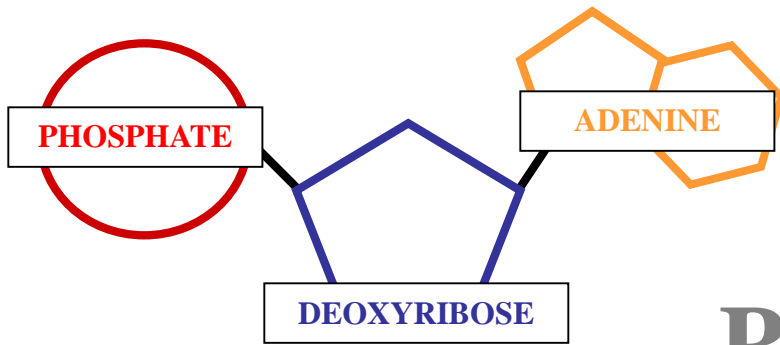
PAIRED

ADENINE

THYMINE



GUANINE



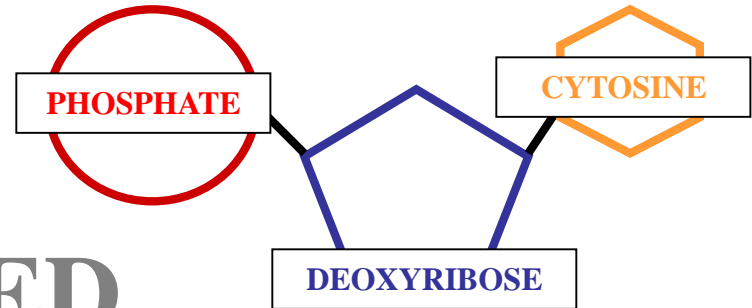
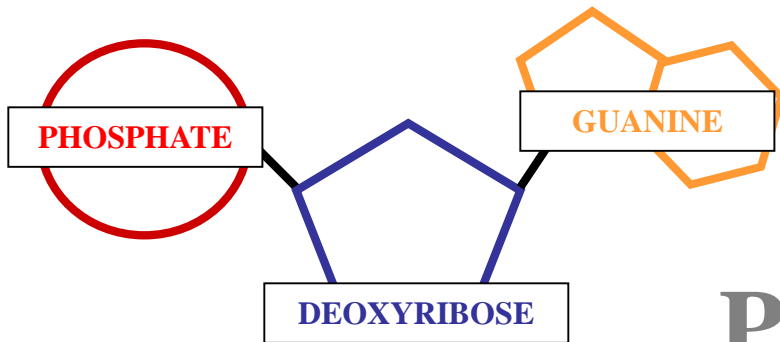
?

P

PAIRED

ADENINE

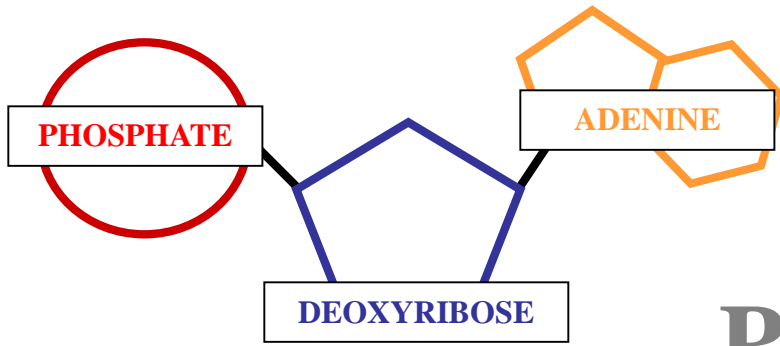
THYMINE



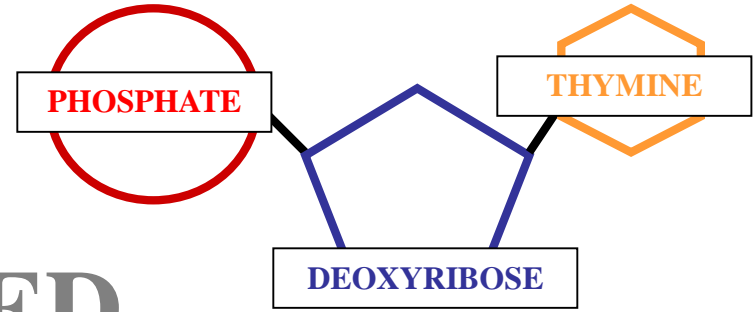
PAIRED

GUANINE

CYTOSINE

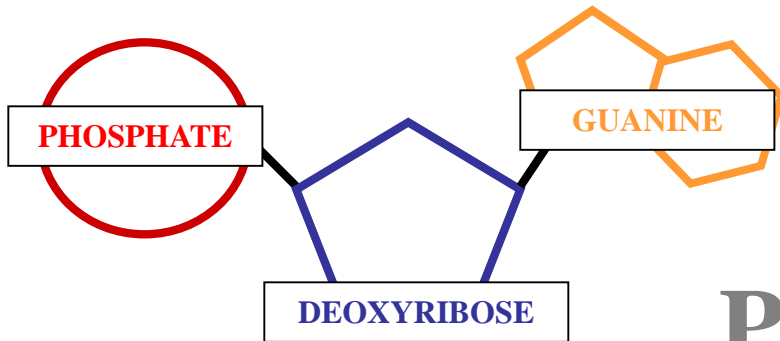


**ADENINE**  
**PURINE**

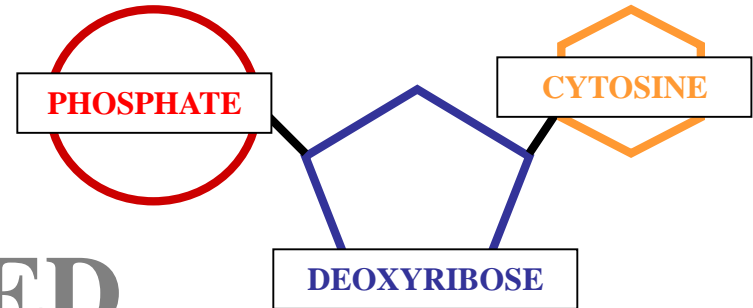


**THYMINE**

**PAIRED**



**GUANINE**

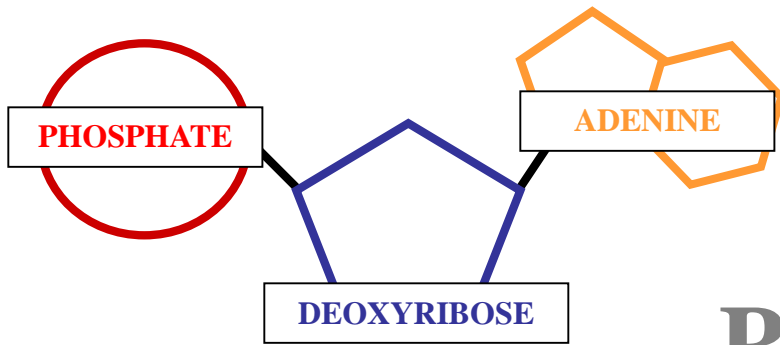


**CYTOSINE**

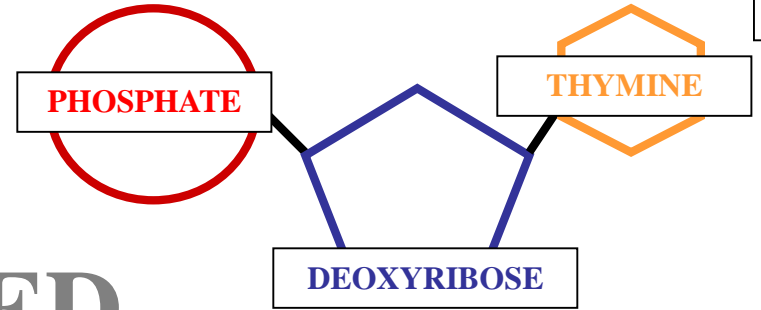
**PAIRED**

?

P



**ADENINE**  
**PURINE**

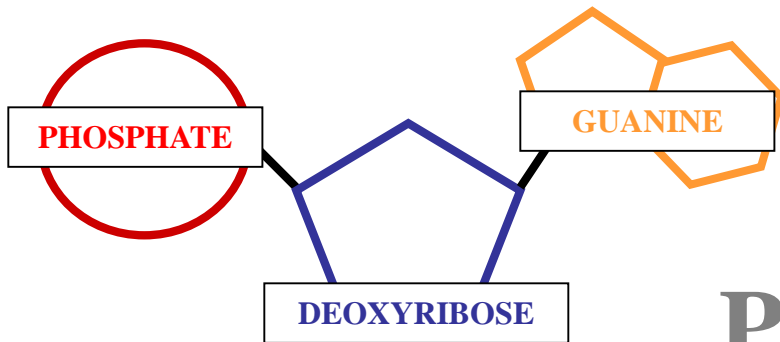


**THYMINE**  
**PYRIMIDINE**

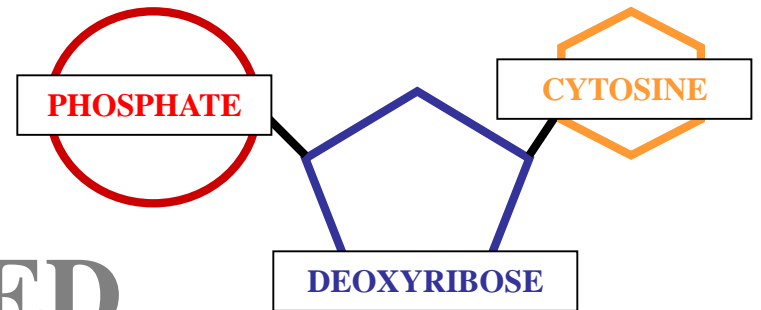
**PAIRED**

?

P

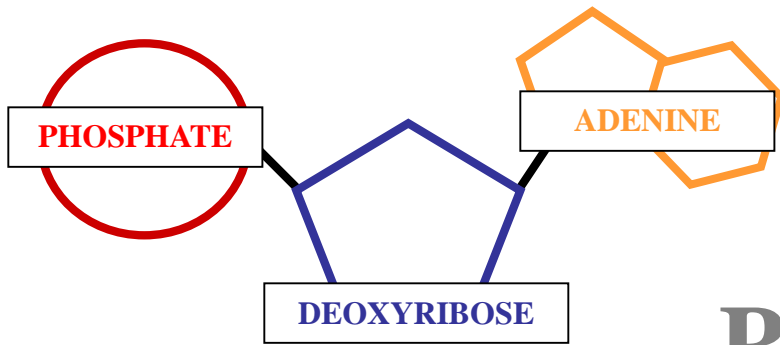


**GUANINE**

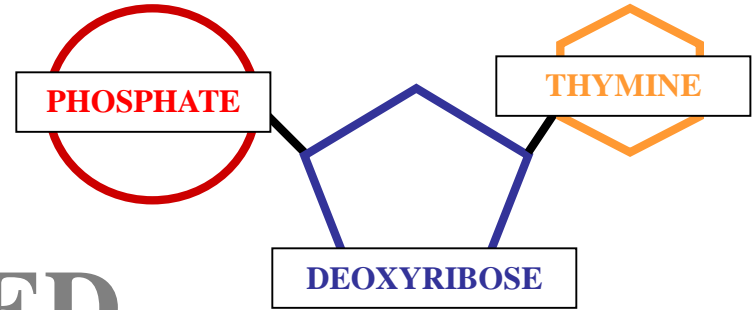


**CYTOSINE**

**PAIRED**

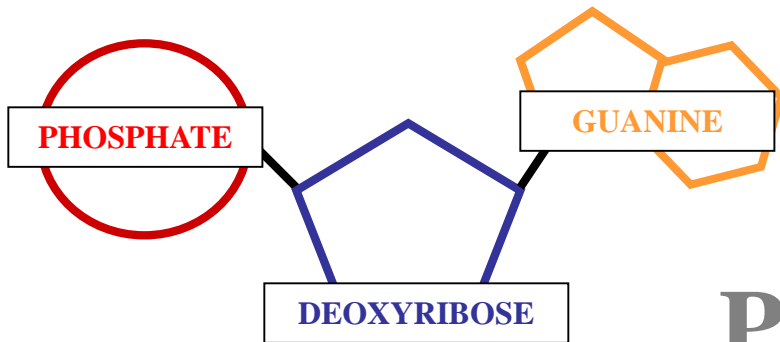


ADENINE  
PURINE

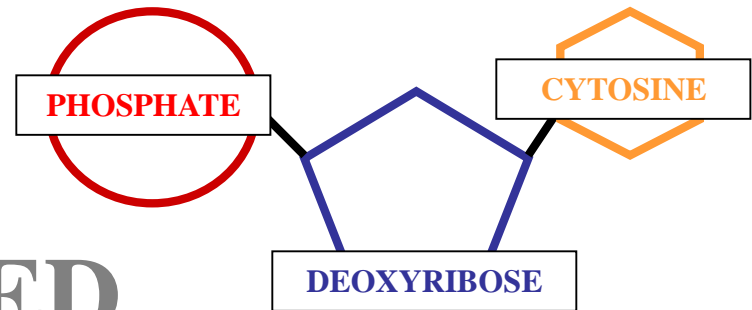


THYMINE  
PYRIMIDINE

PAIRED

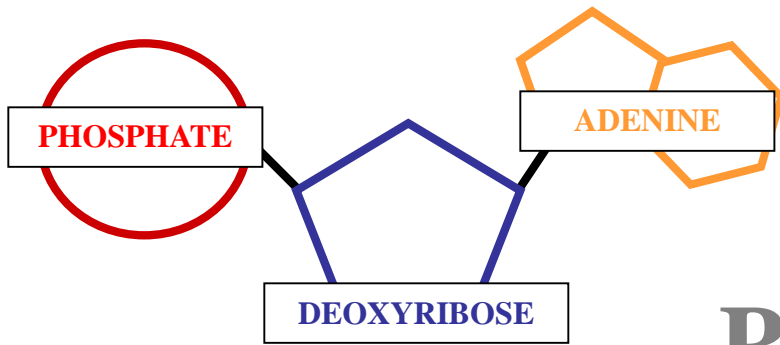


GUANINE  
PURINE

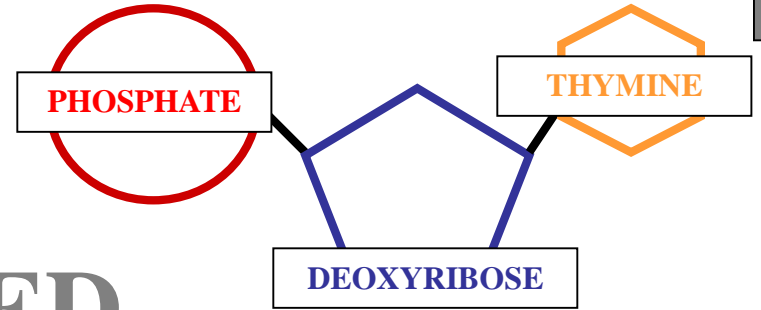


CYTOSINE

PAIRED

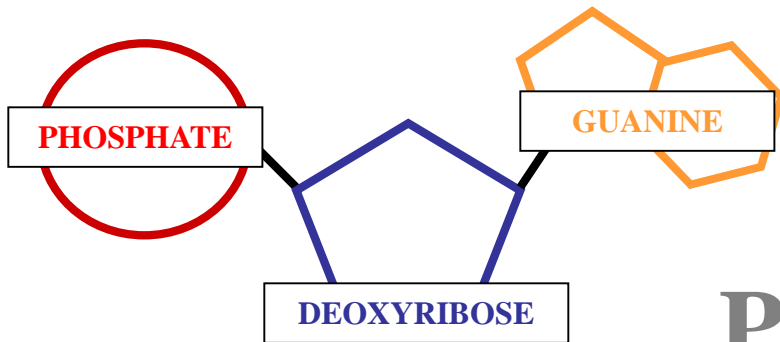


ADENINE  
PURINE

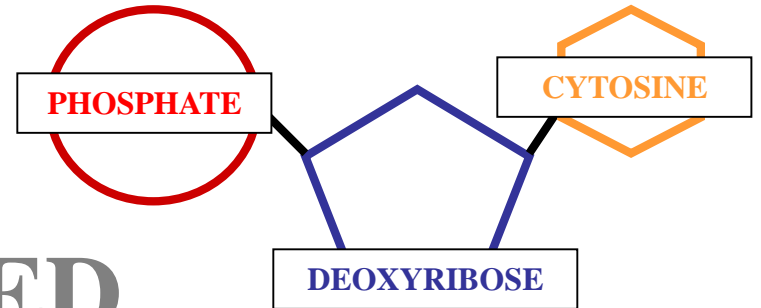


THYMINE  
PYRIMIDINE

PAIRED

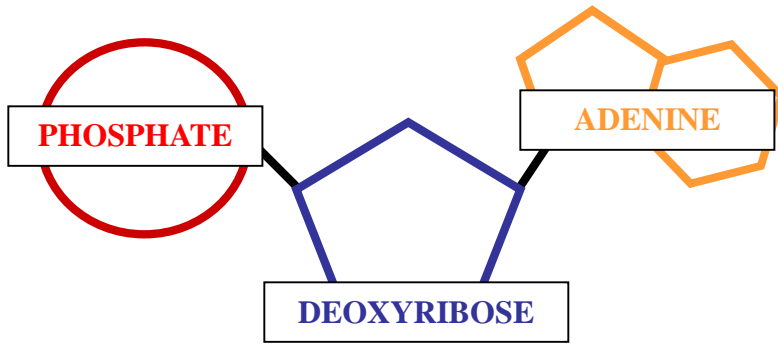


GUANINE  
PURINE



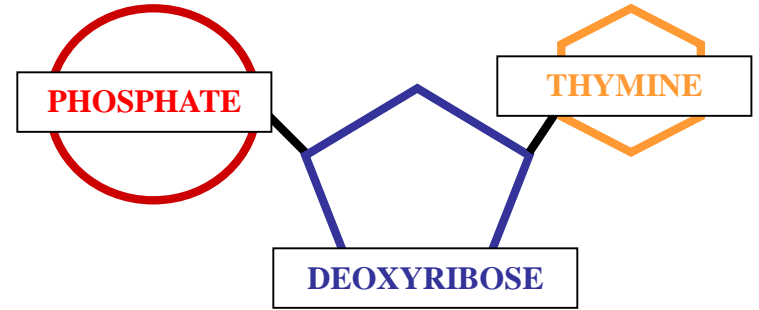
CYTOSINE  
PYRIMIDINE

PAIRED



ADENINE

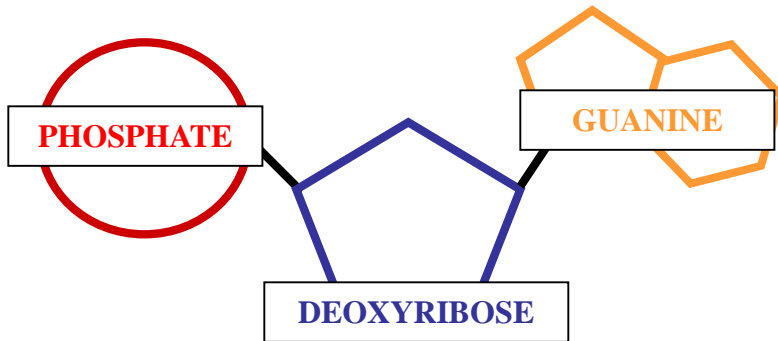
PURINE



THYMINE

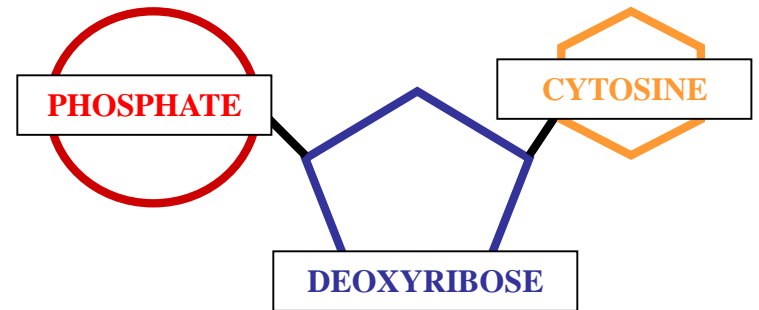
PYRIMIDINE

**PURINE CONTENT = PYRIMIDINE CONTENT**



GUANINE

PURINE



CYTOSINE

PYRIMIDINE

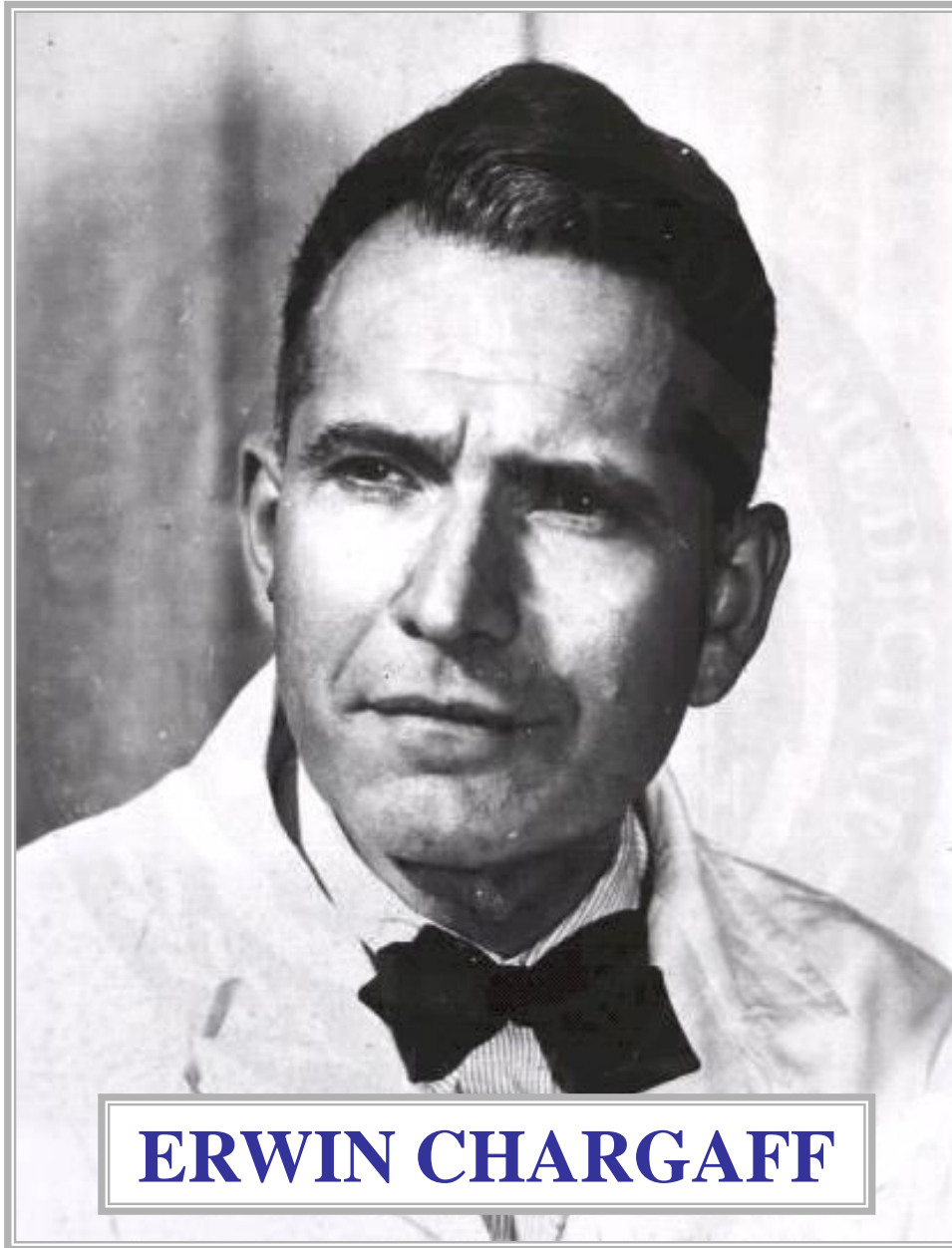


**DNA  
CHEMICAL  
ANALYSIS**

**DNA  
CHEMICAL  
ANALYSIS**

**DNA  
CHEMICAL  
ANALYSIS**

**DNA  
CHEMICAL  
ANALYSIS**

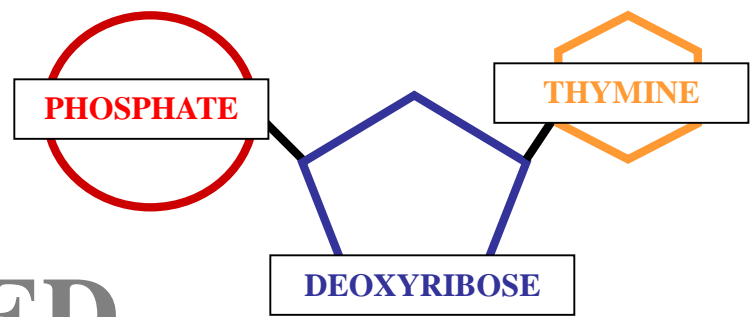
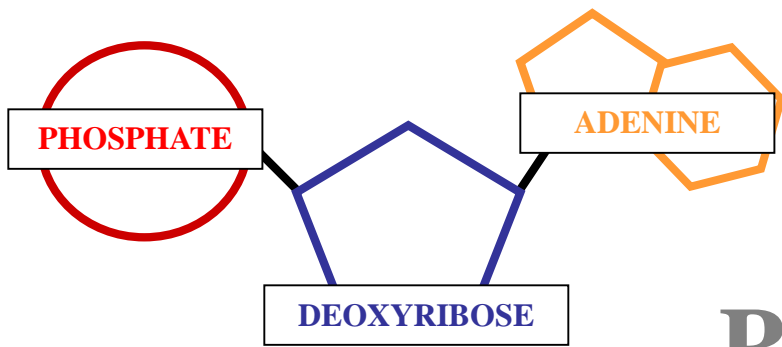


**ERWIN CHARGAFF**

**PURINE CONTENT = PYRMIDINE CONTENT**



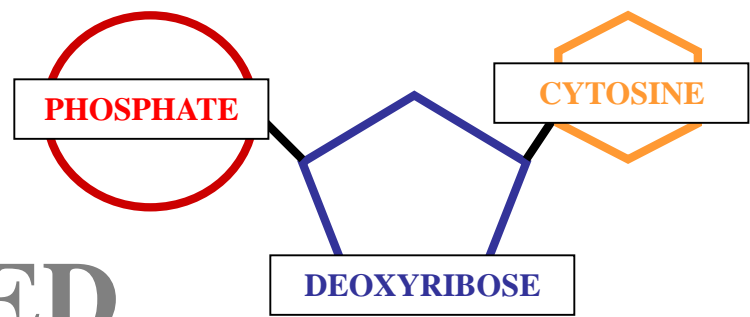
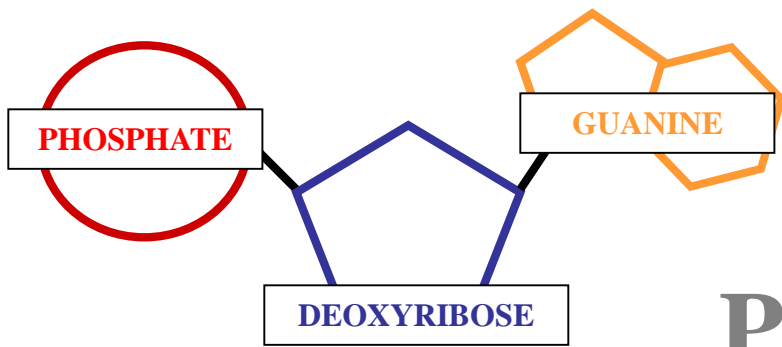
**JAMES WATSON  
&  
FRANCIS CRICK  
REASONED**



PAIRED

ADENINE

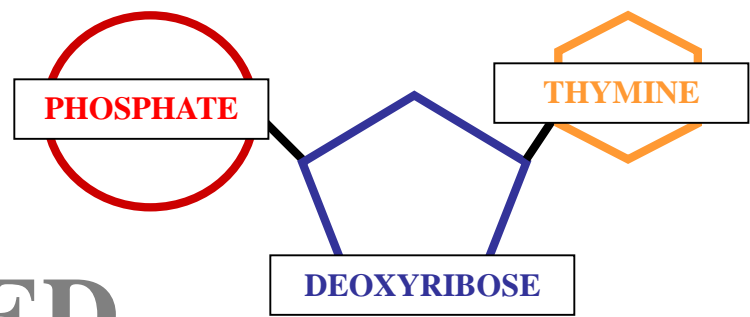
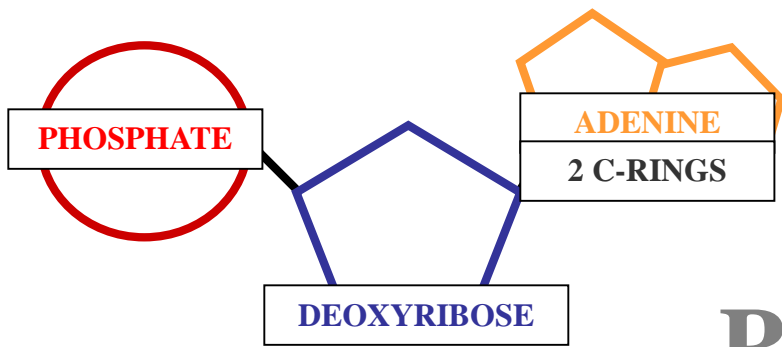
THYMINE



PAIRED

GUANINE

CYTOSINE

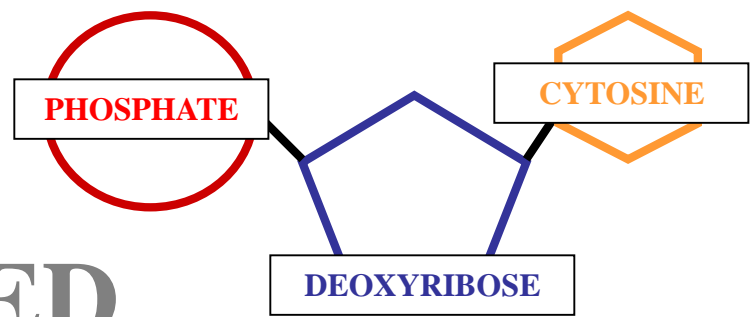
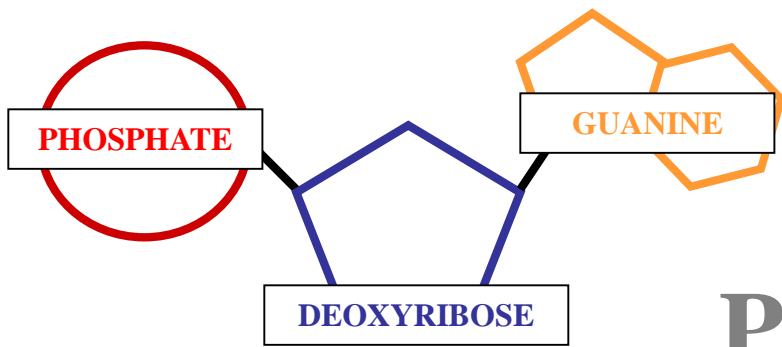


PAIRED

LARGE NT-BASE

ADENINE

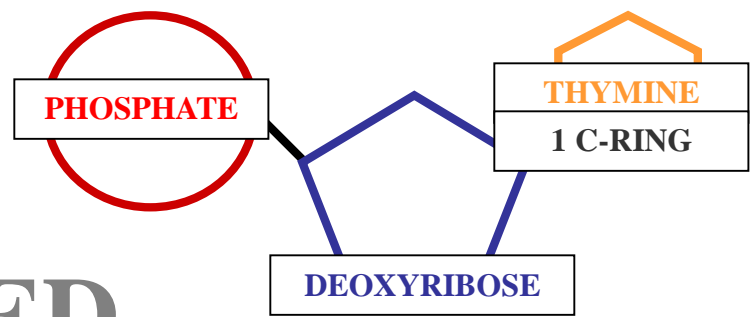
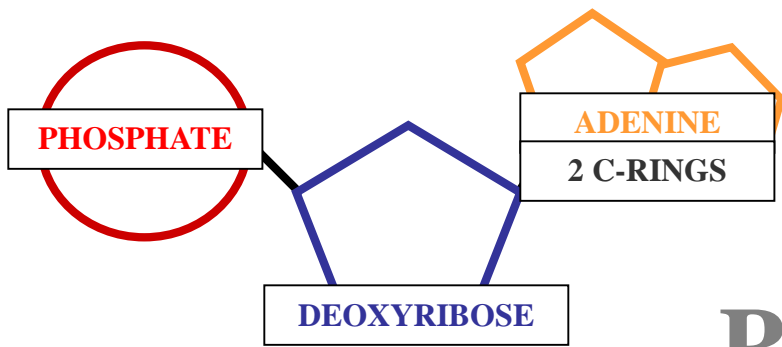
THYMINE



PAIRED

GUANINE

CYTOSINE



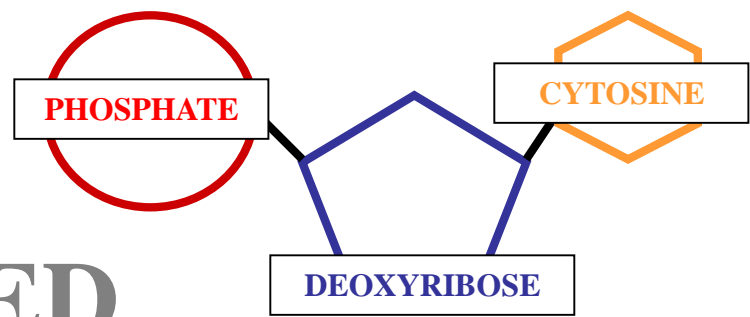
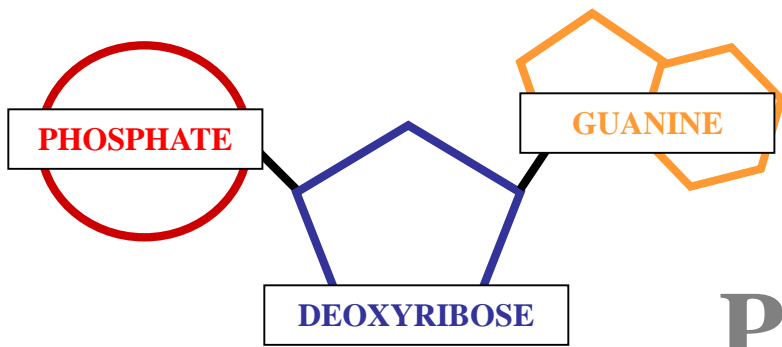
PAIRED

LARGE NT-BASE

SMALL NT-BASE

ADENINE

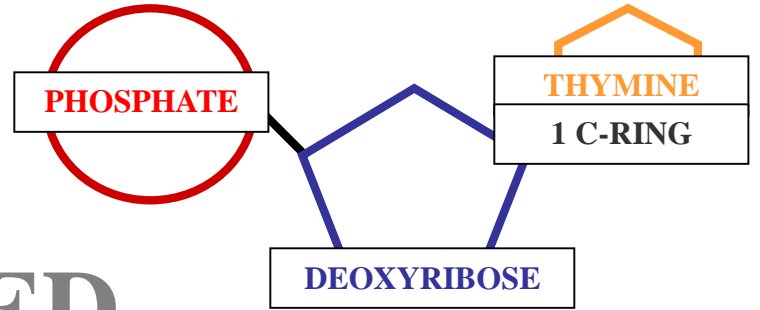
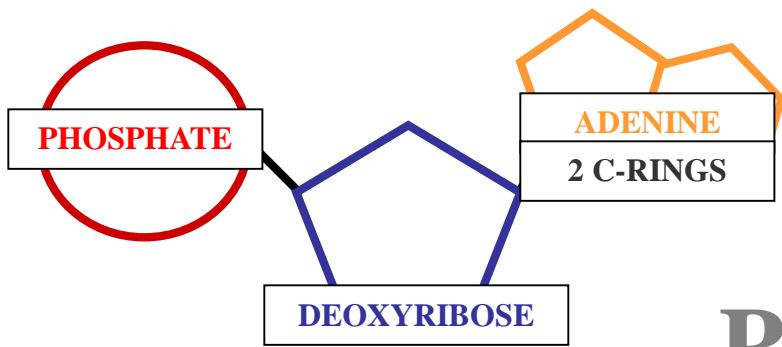
THYMINE



PAIRED

GUANINE

CYTOSINE



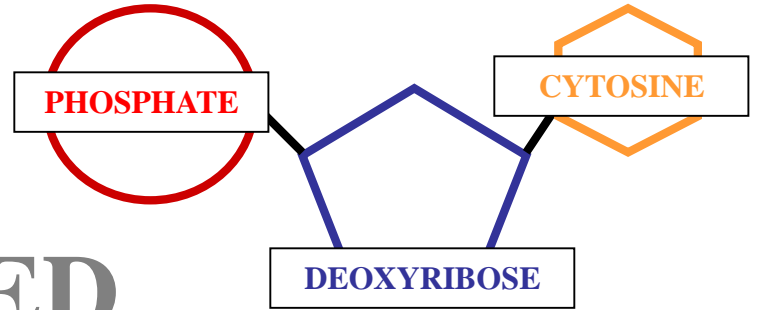
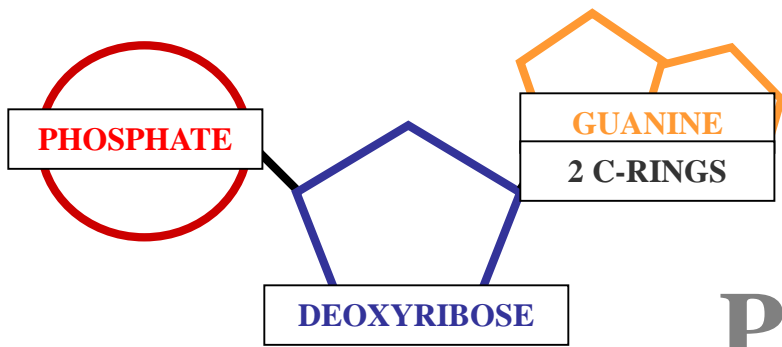
PAIRED

LARGE NT-BASE

SMALL NT-BASE

ADENINE

THYMINE

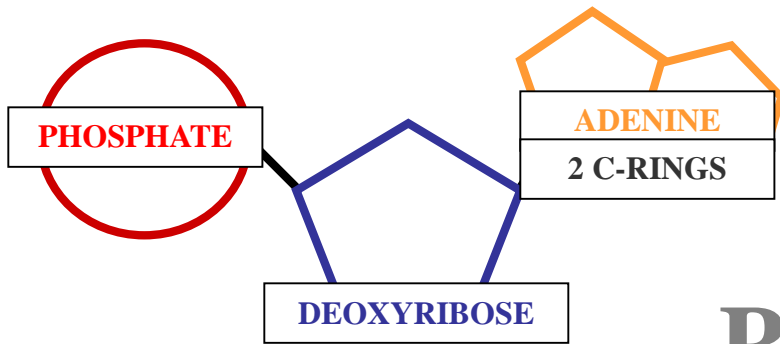


PAIRED

LARGE NT-BASE

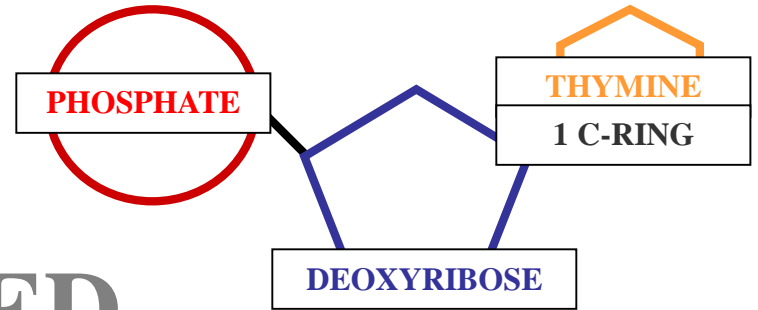
GUANINE

CYTOSINE



LARGE NT-BASE

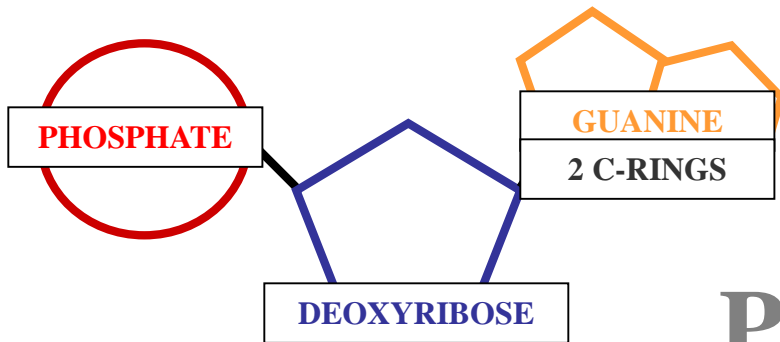
**ADENINE**



SMALL NT-BASE

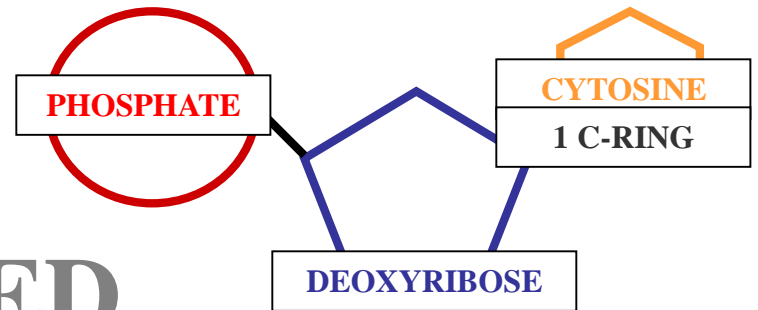
**THYMINE**

**PAIRED**



LARGE NT-BASE

**GUANINE**

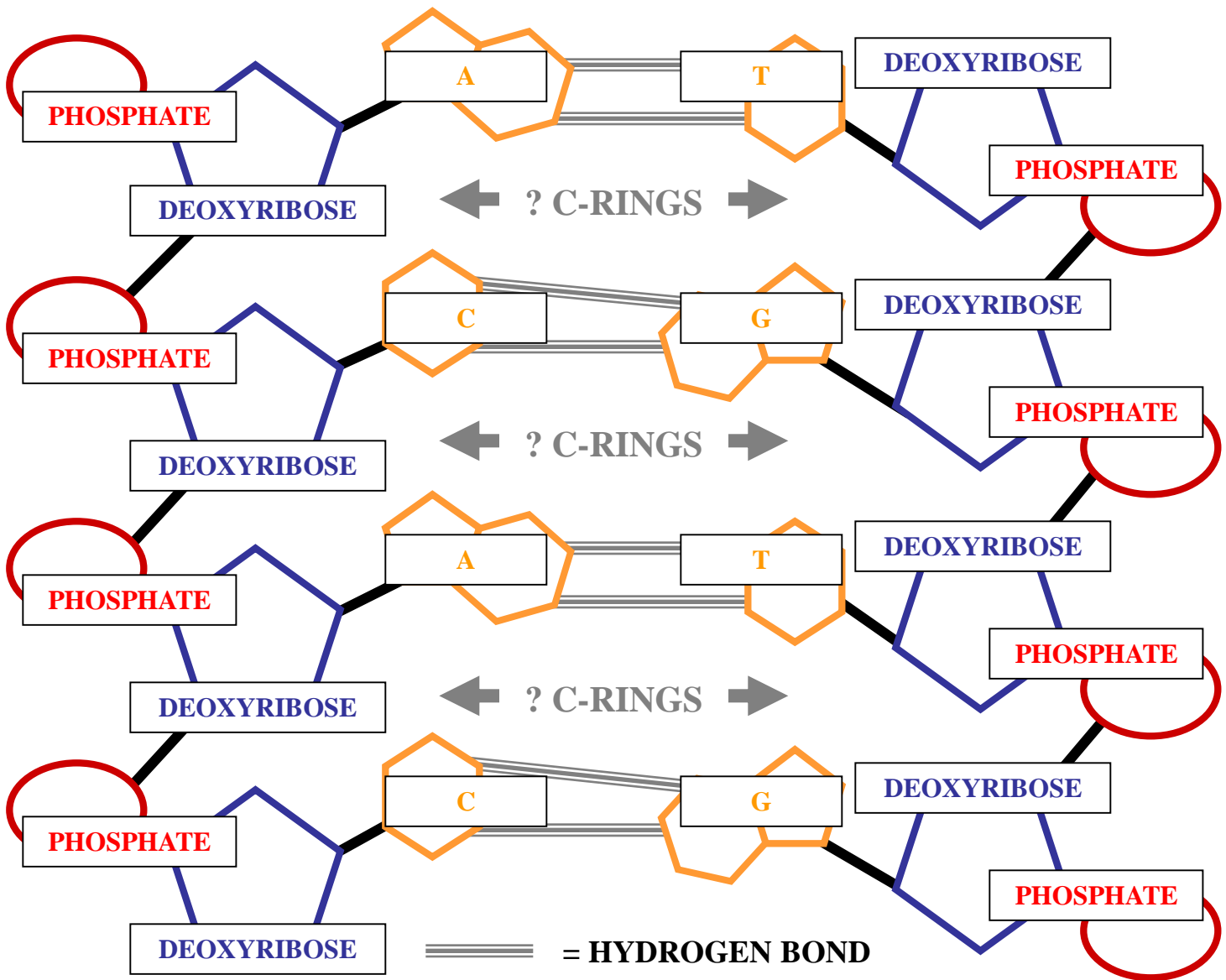


SMALL NT-BASE

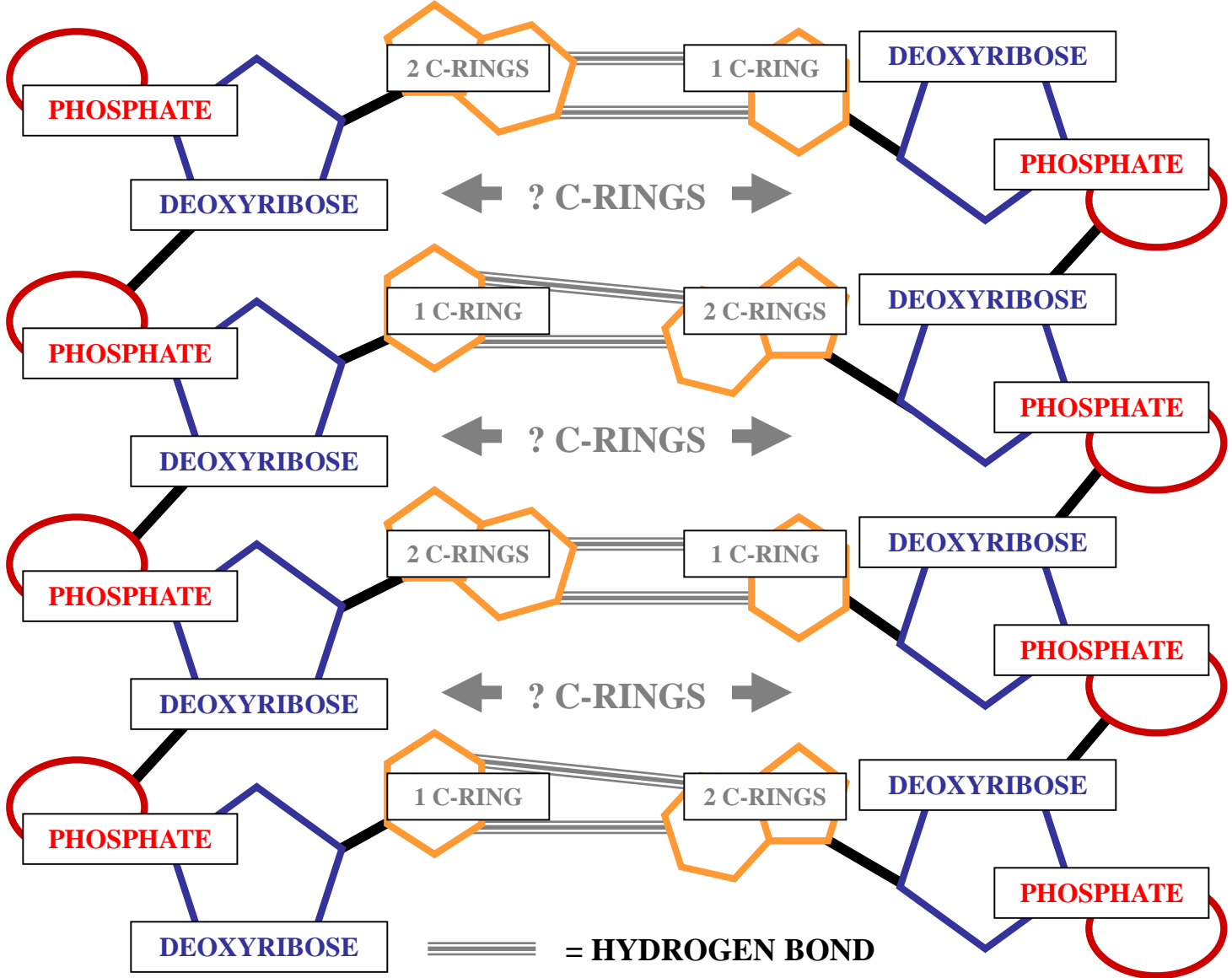
**CYTOSINE**

**PAIRED**

# DNA DOUBLE HELIX MODEL

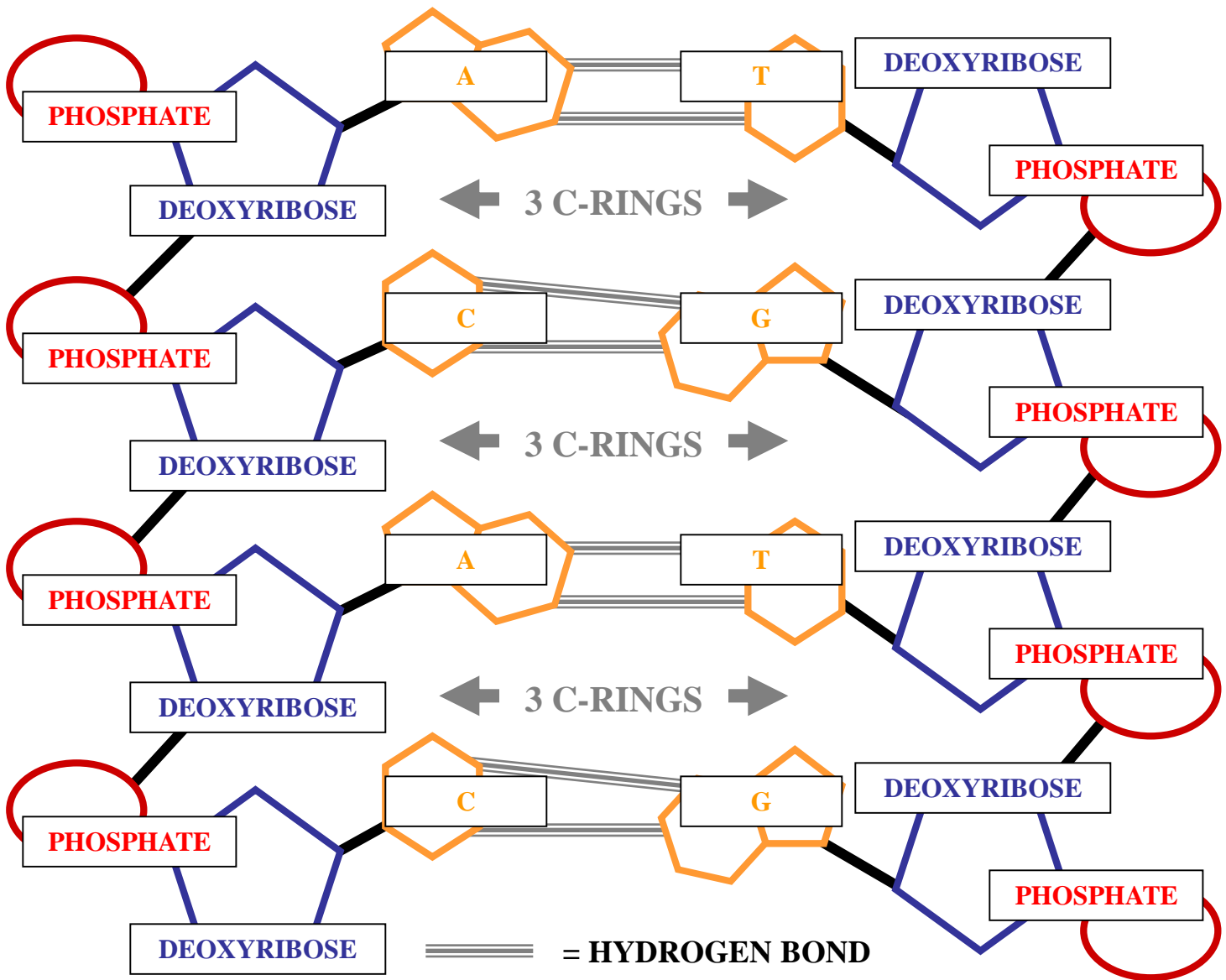


# DNA DOUBLE HELIX MODEL



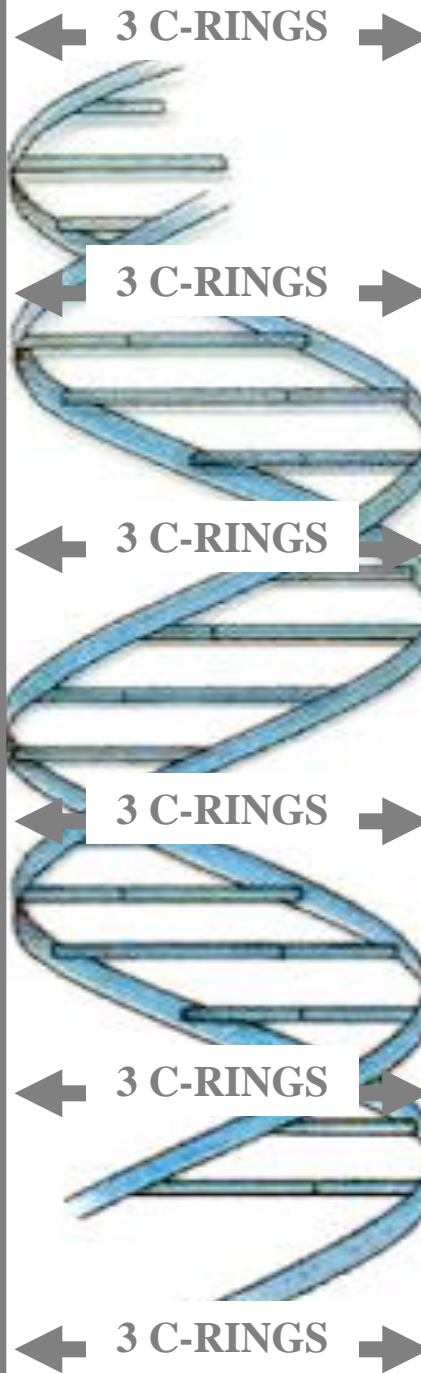


# DNA DOUBLE HELIX MODEL

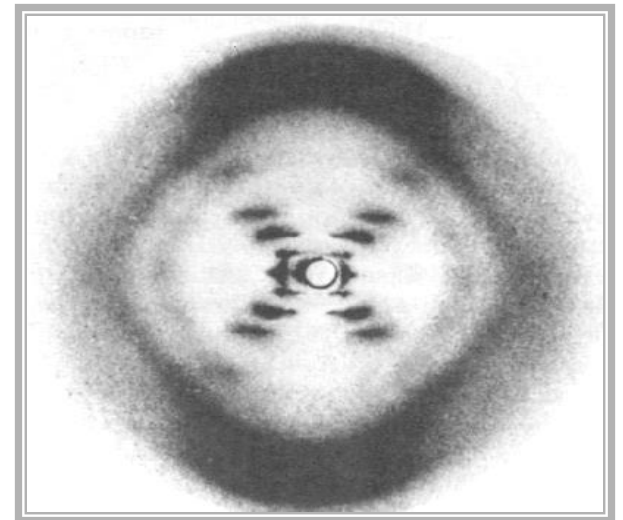
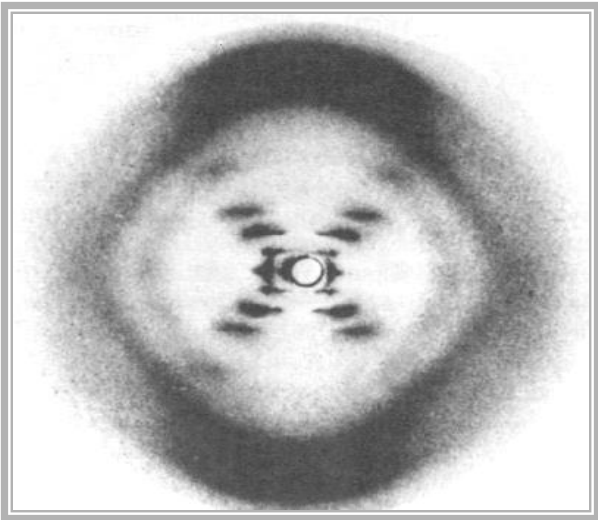




**DNA  
UNIFORM  
MAXIMUM  
DIAMETER**

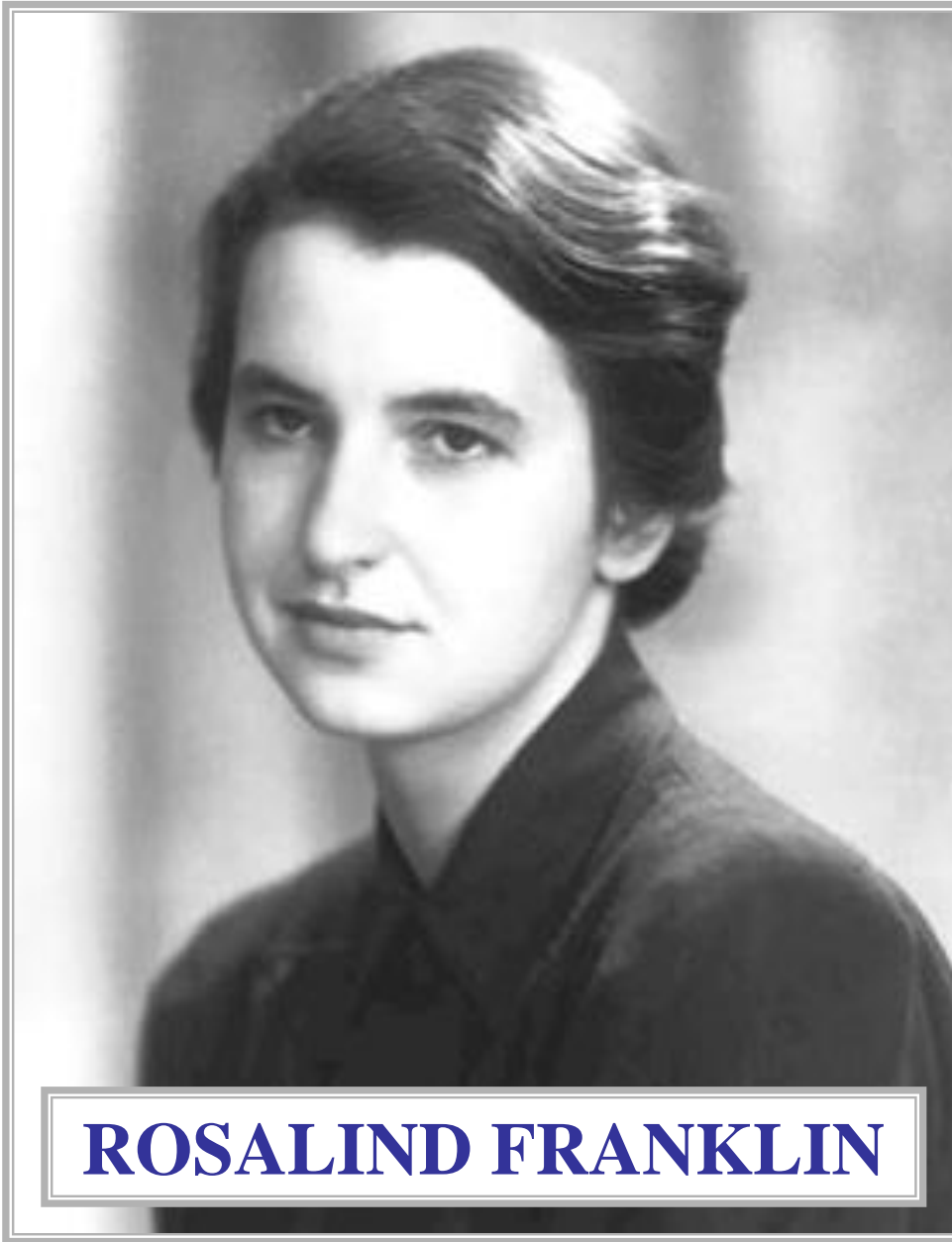


**DNA  
UNIFORM  
MAXIMUM  
DIAMETER**



**DNA  
X-RAY  
ANALYSIS**

**DNA  
X-RAY  
ANALYSIS**



**ROSALIND FRANKLIN**

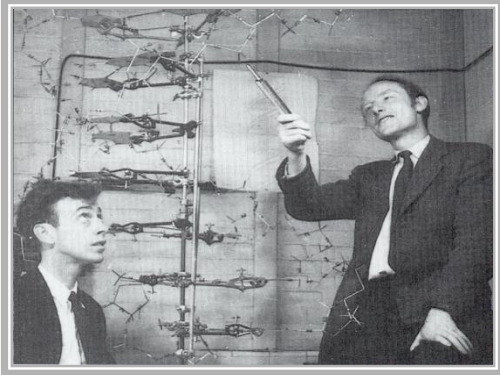
**DNA  
X-RAY  
ANALYSIS**

**DNA  
X-RAY  
ANALYSIS**

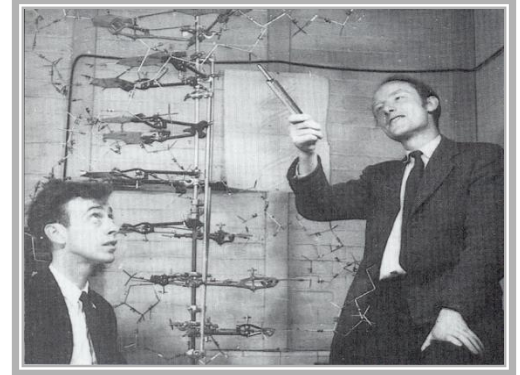
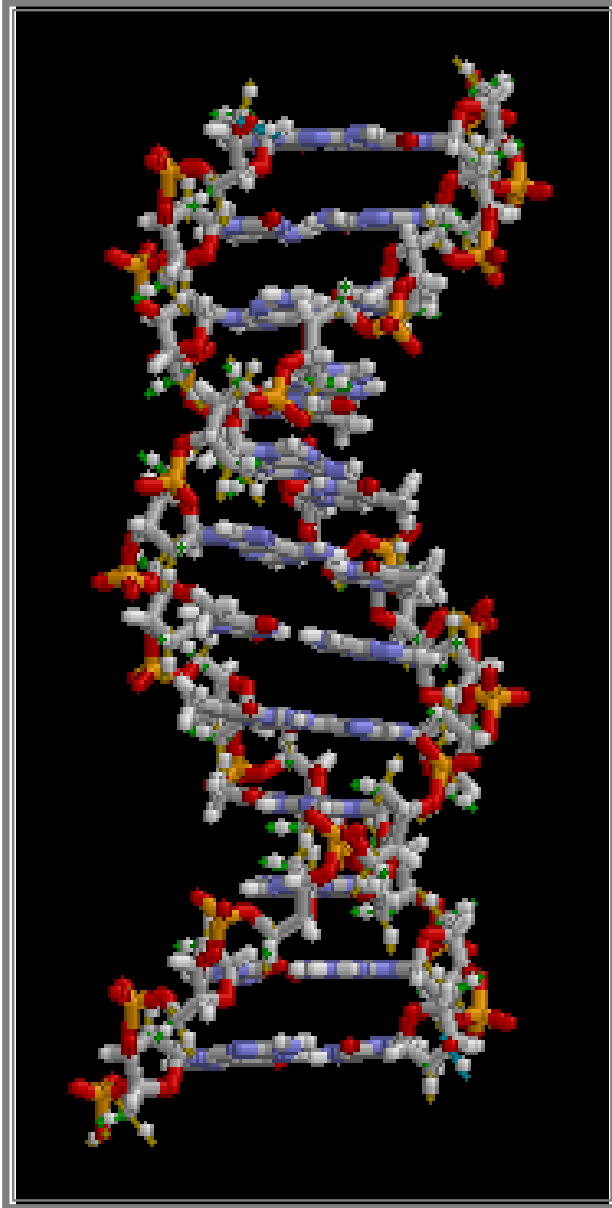
**DETERMINED DNA UNIFORM DIAMETER**



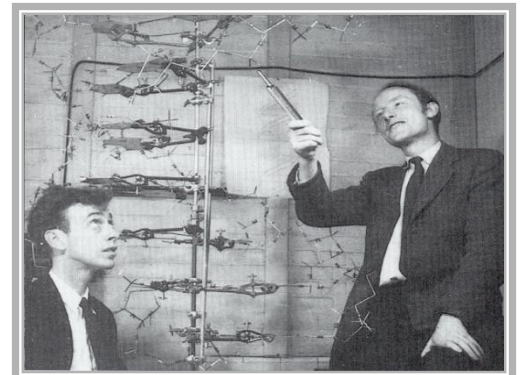
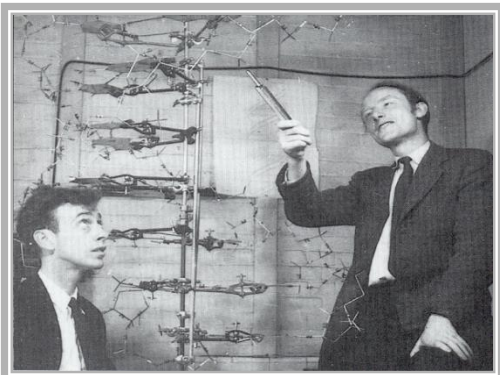
**JAMES WATSON**  
**&**  
**FRANCIS CRICK**  
**PROPOSED**

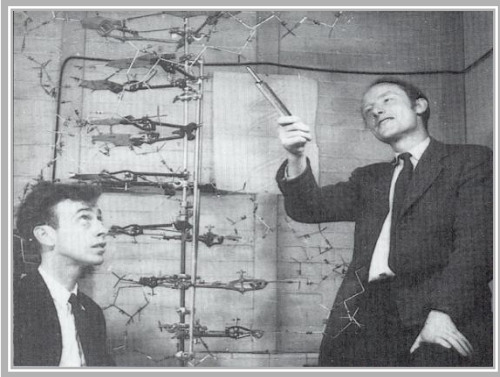


?

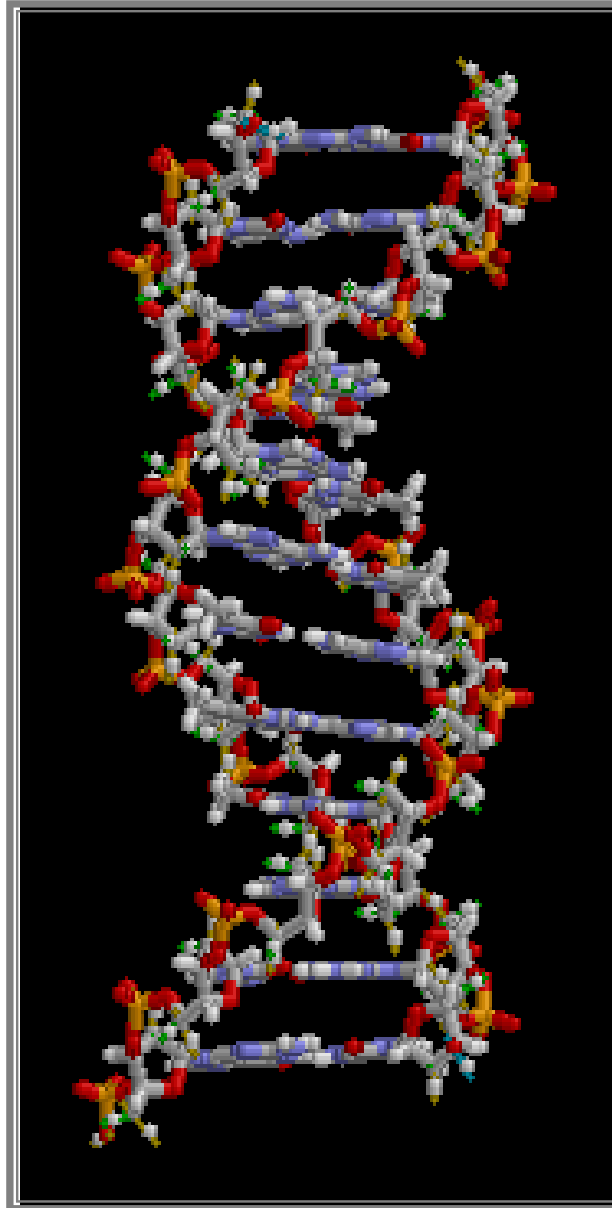
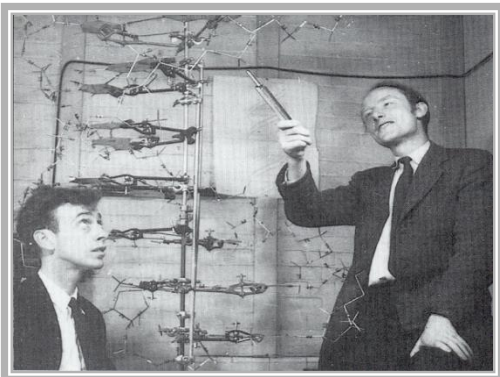


?

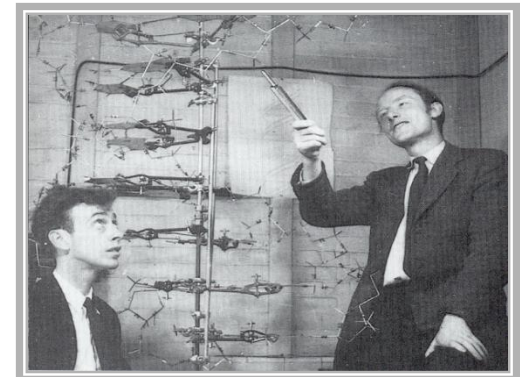




# DOUBLE HELIX MODEL



# DOUBLE HELIX MODEL

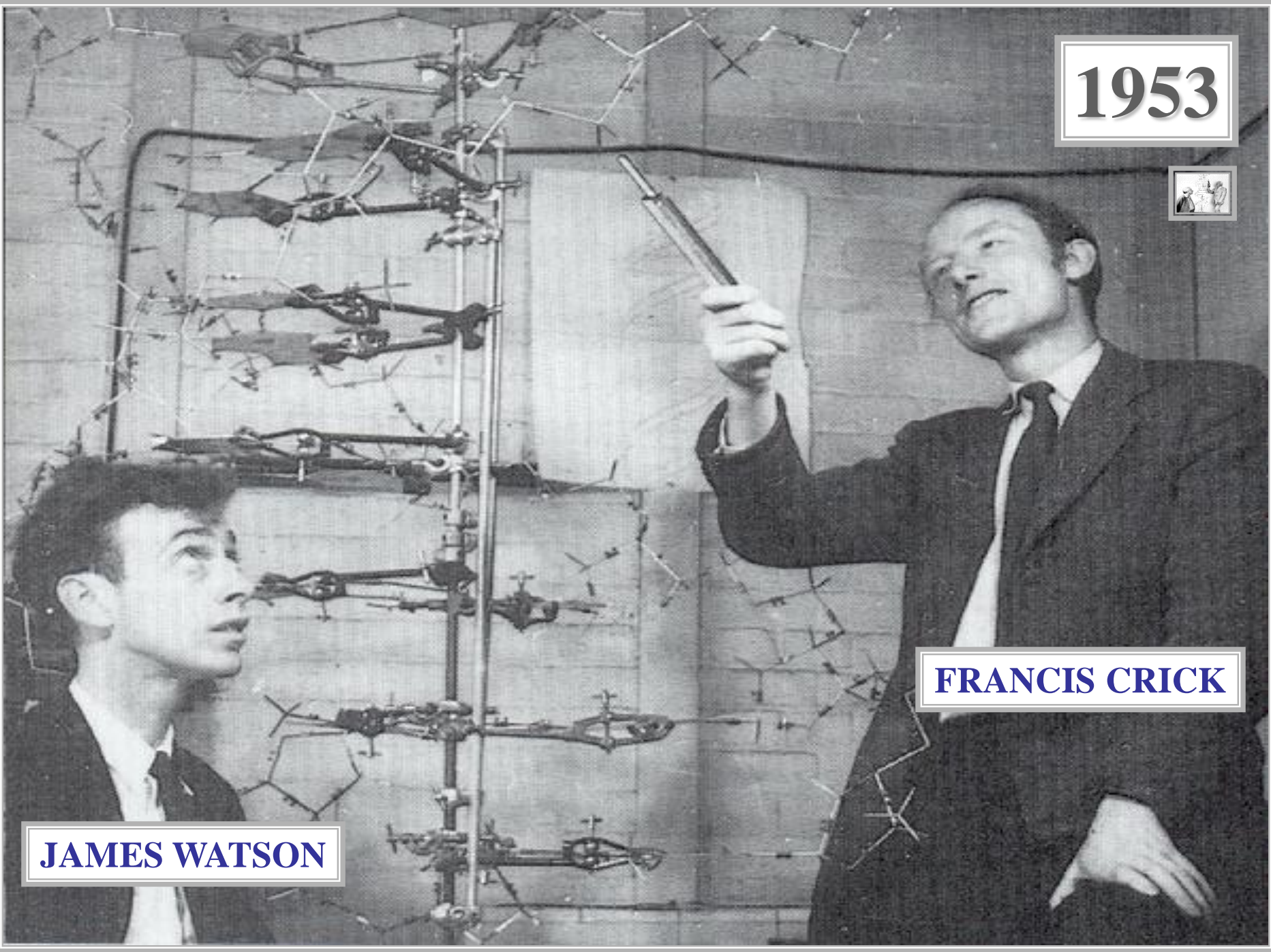


1953

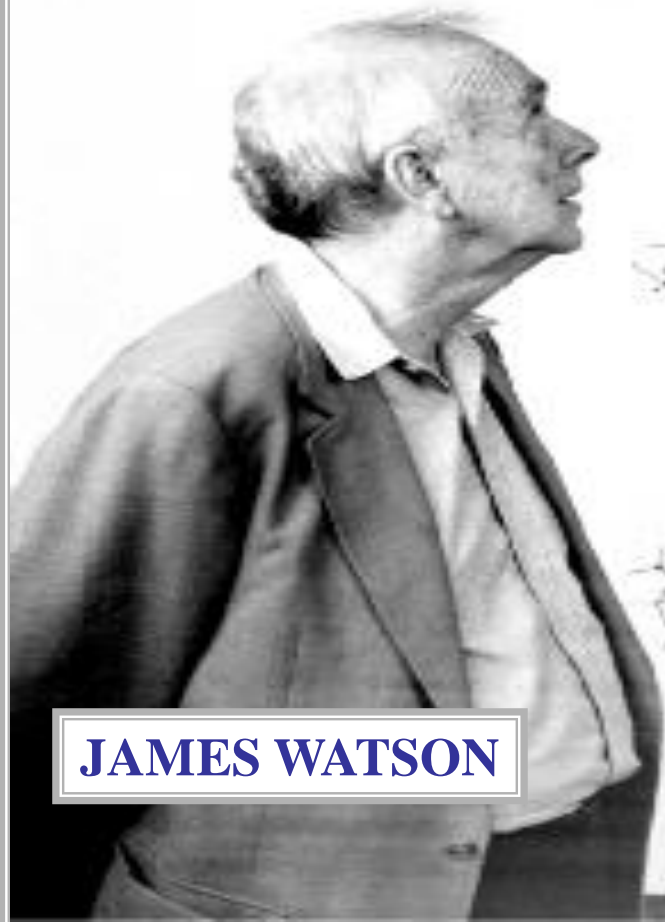


FRANCIS CRICK

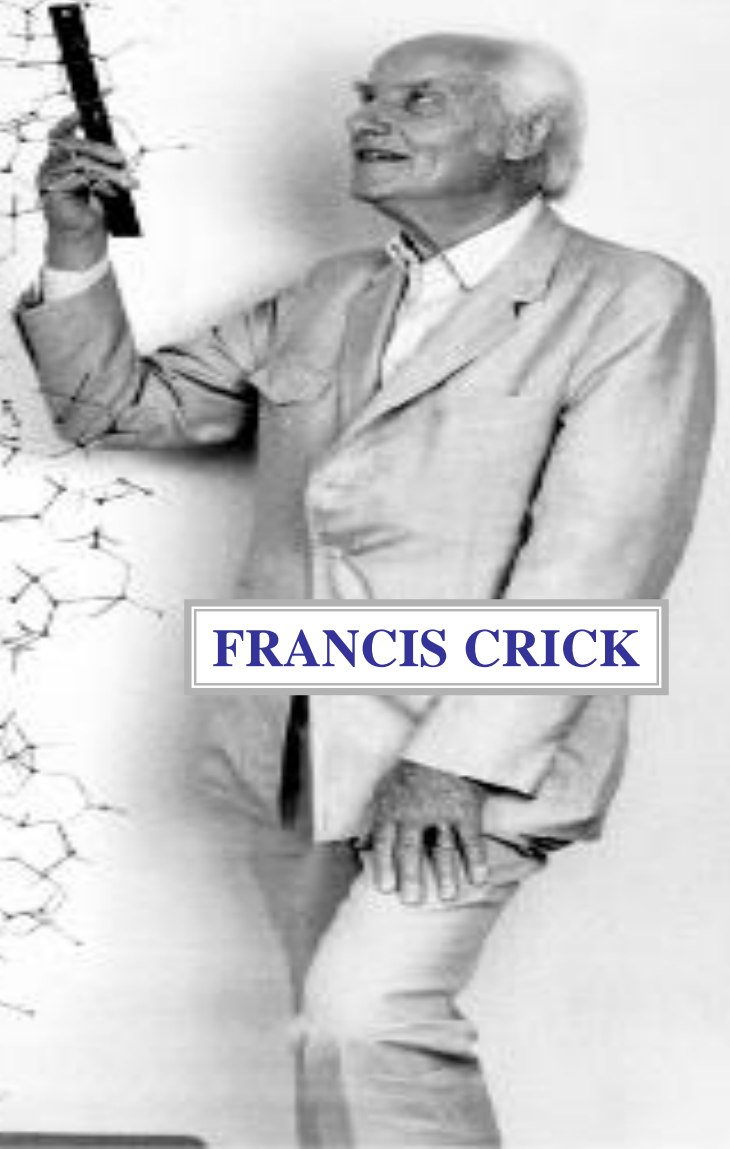
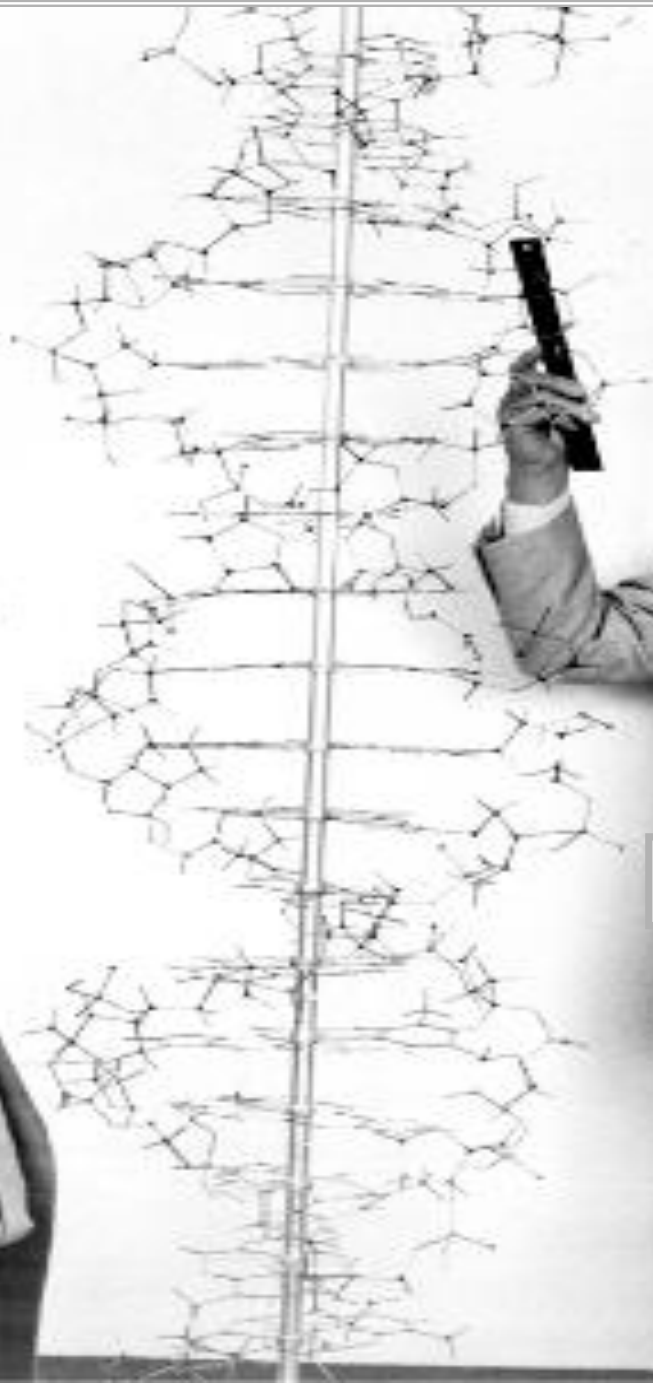
JAMES WATSON



**2003**



**JAMES WATSON**



**FRANCIS CRICK**

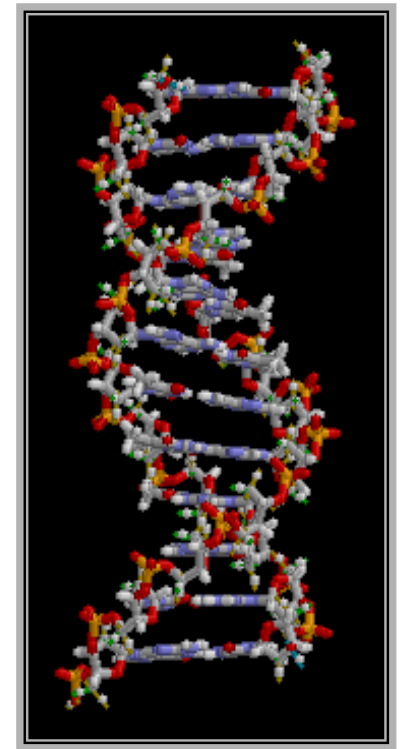
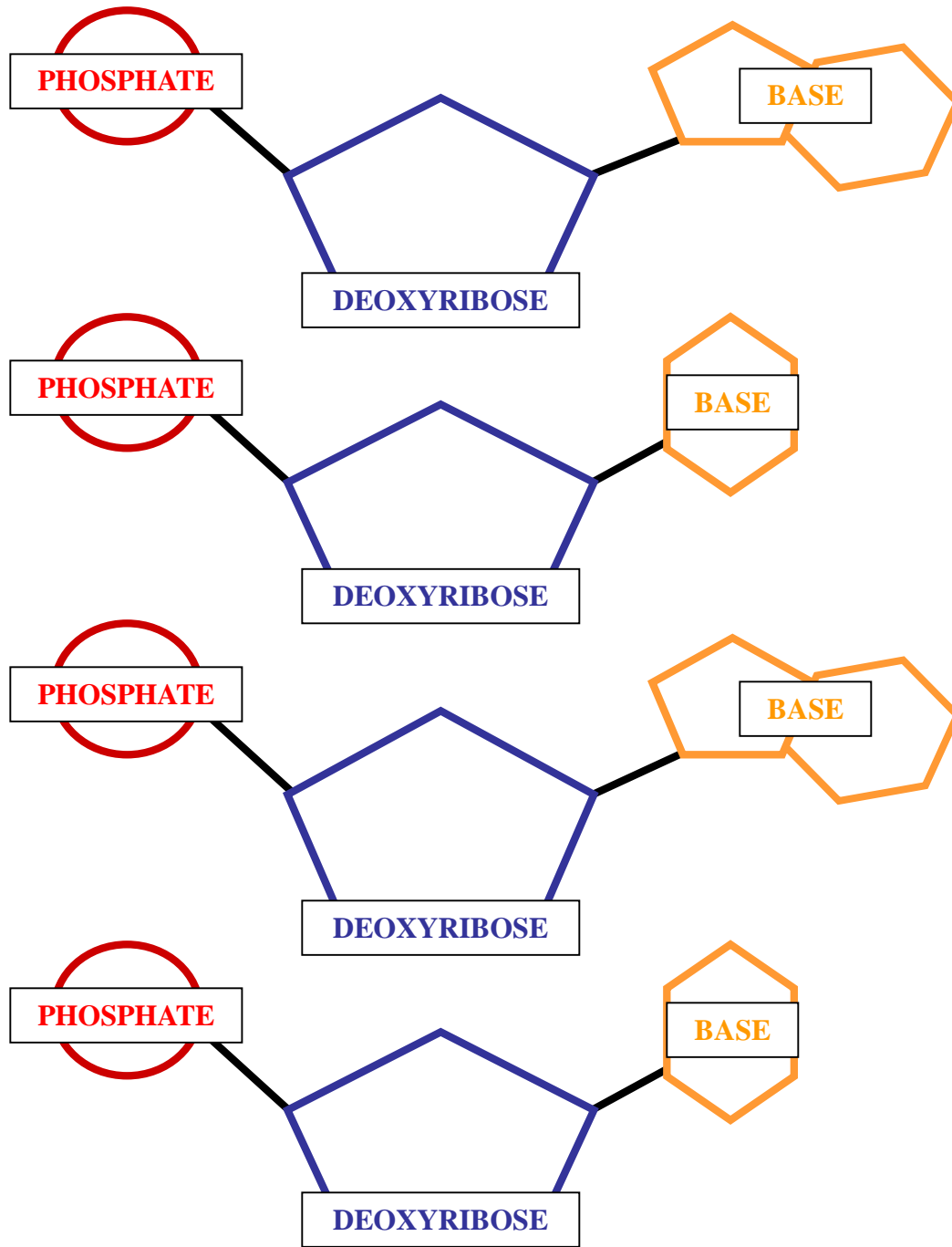


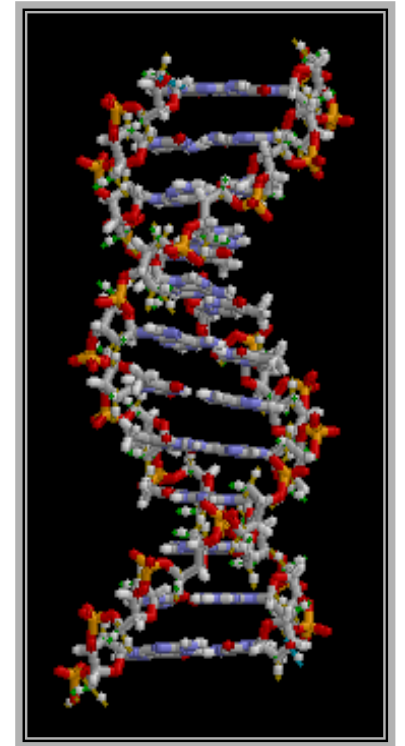
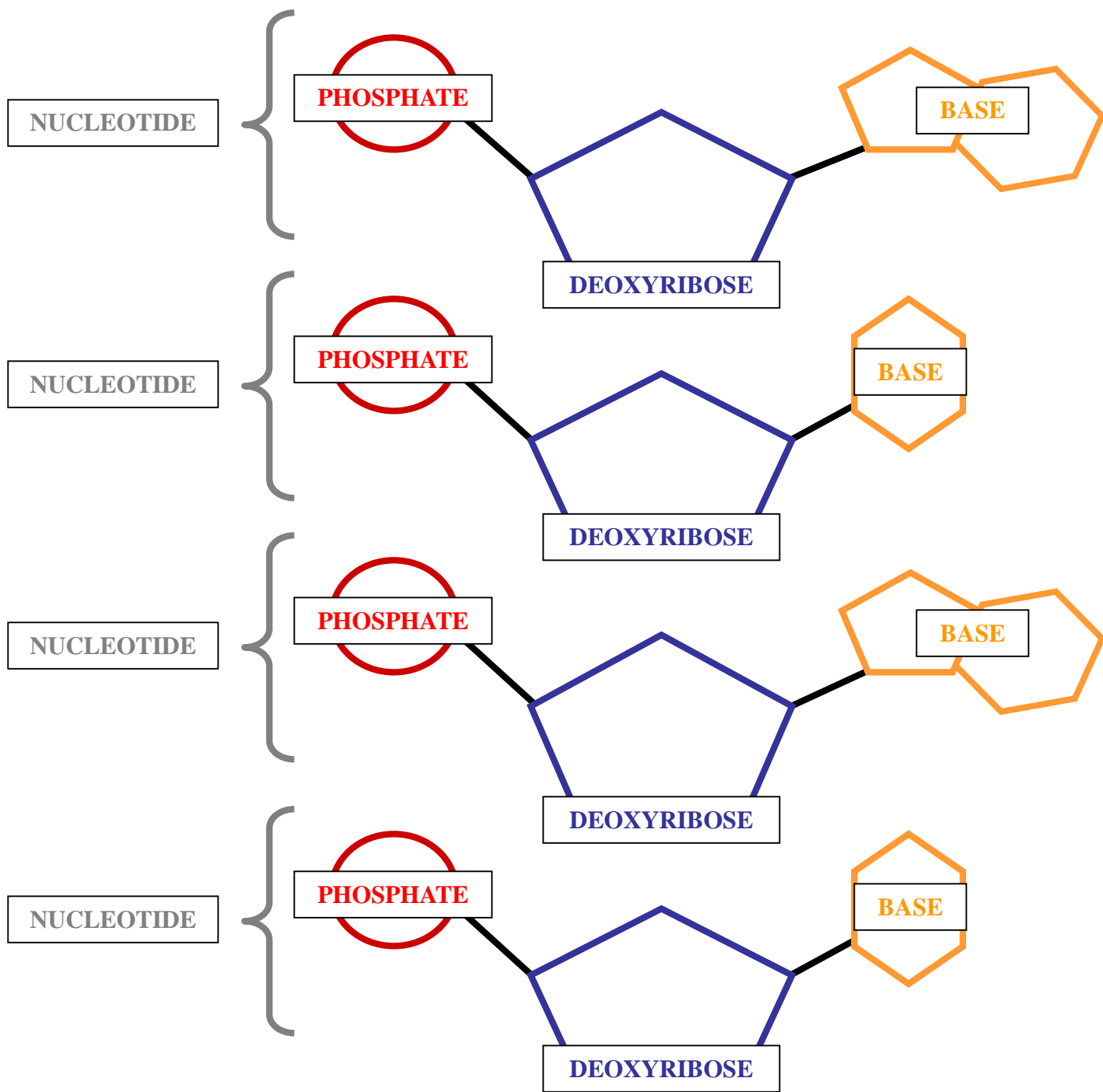


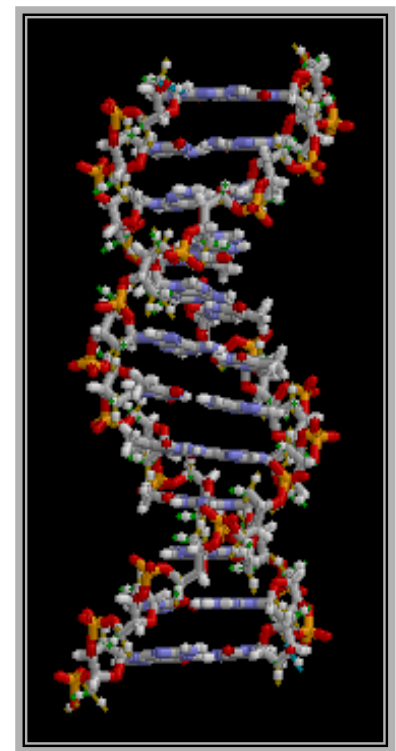
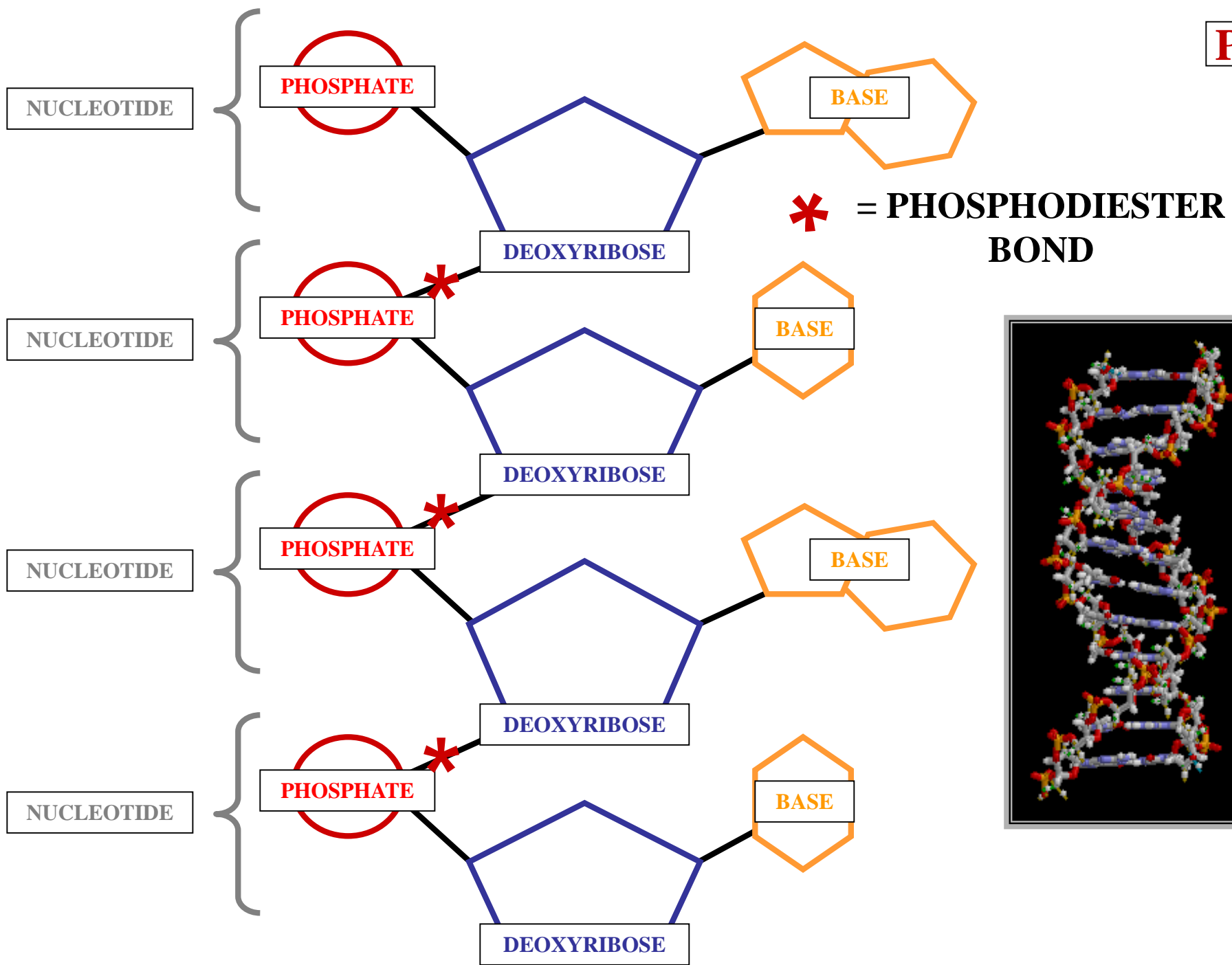
# DNA DOUBLE HELIX MODEL

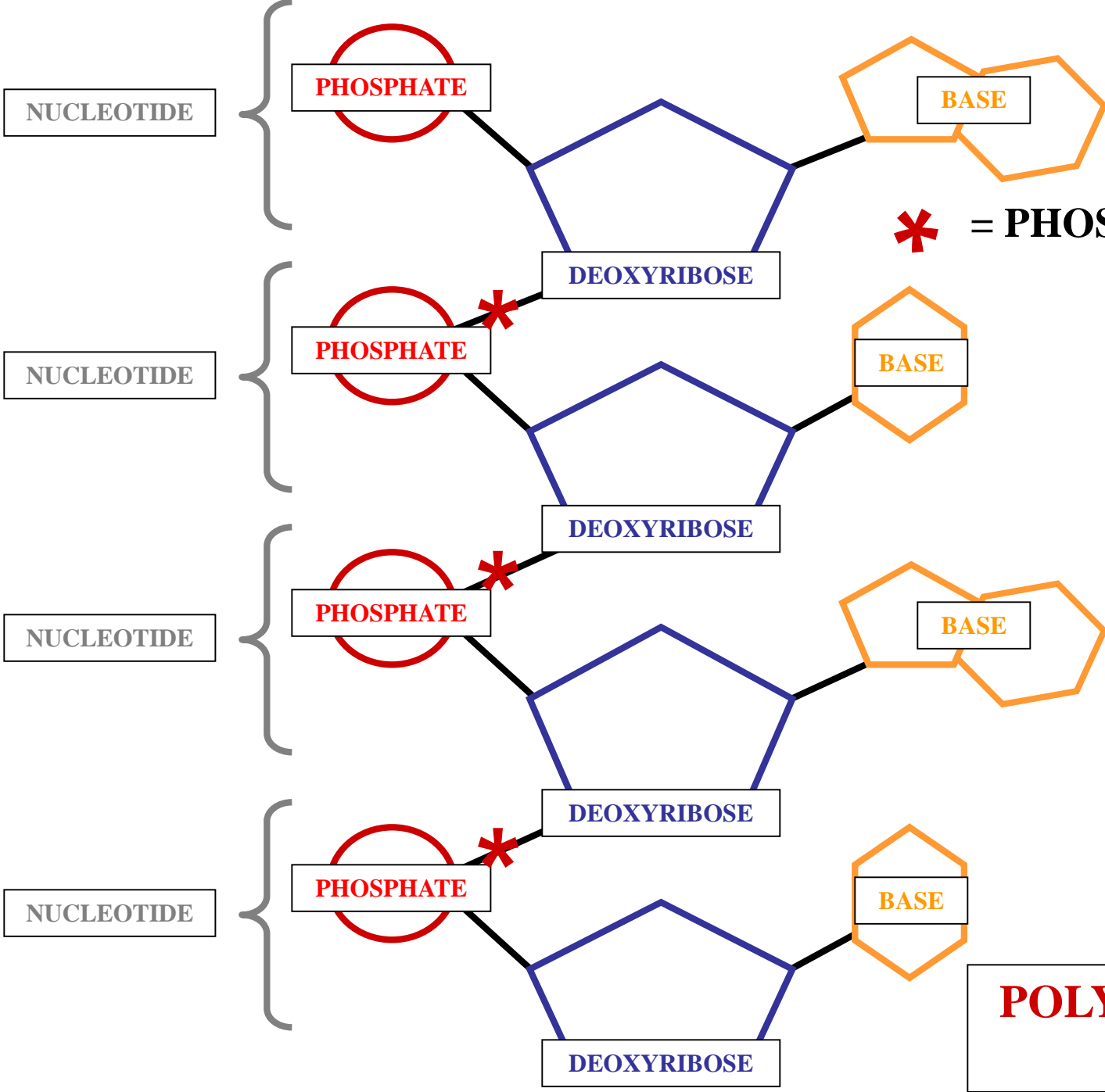


# DNA POLYNUCLEOTIDE CHAINS

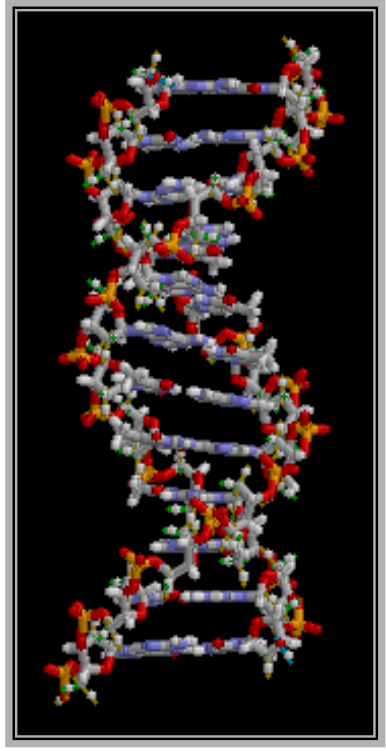






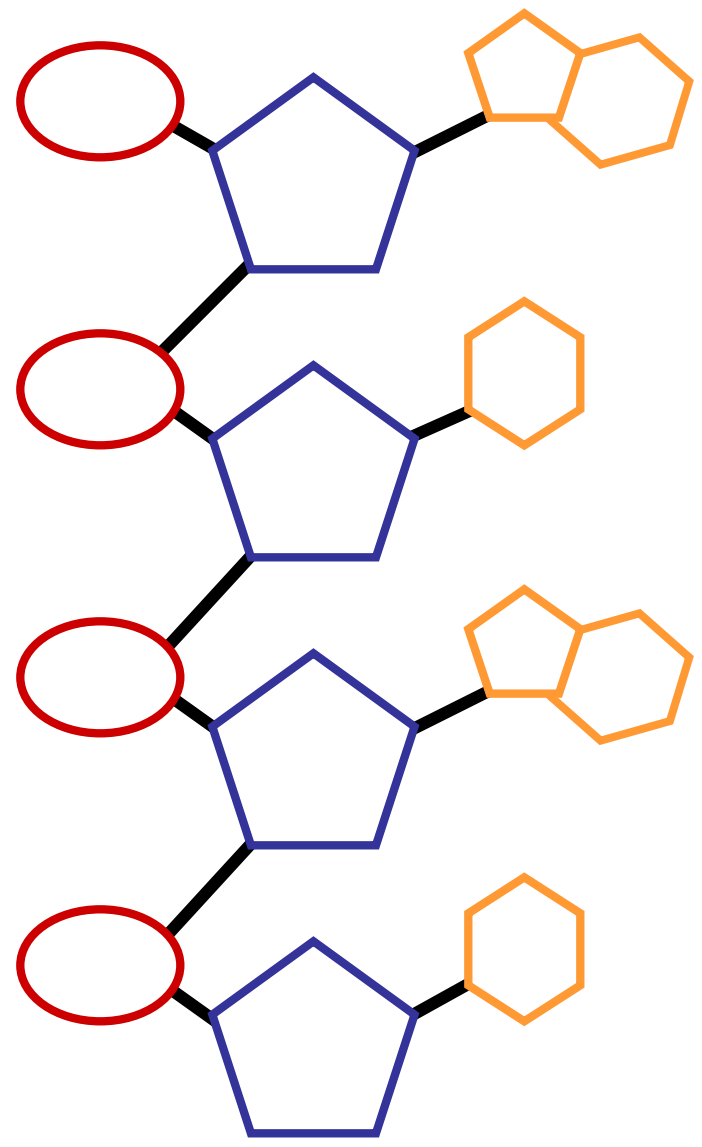


\* = PHOSPHODIESTER BOND



**POLYNUCLEOTIDE CHAIN**

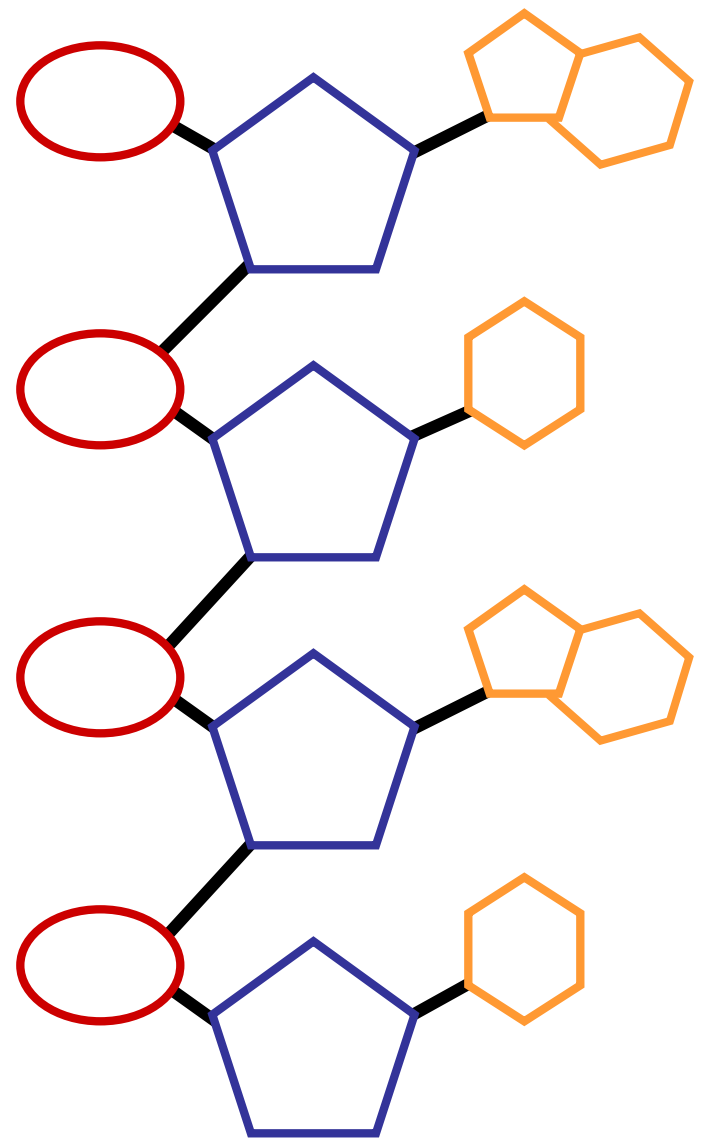
**POLYNUCLEOTIDE CHAIN**



**FIRST  
POLYNUCLEOTIDE  
CHAIN**

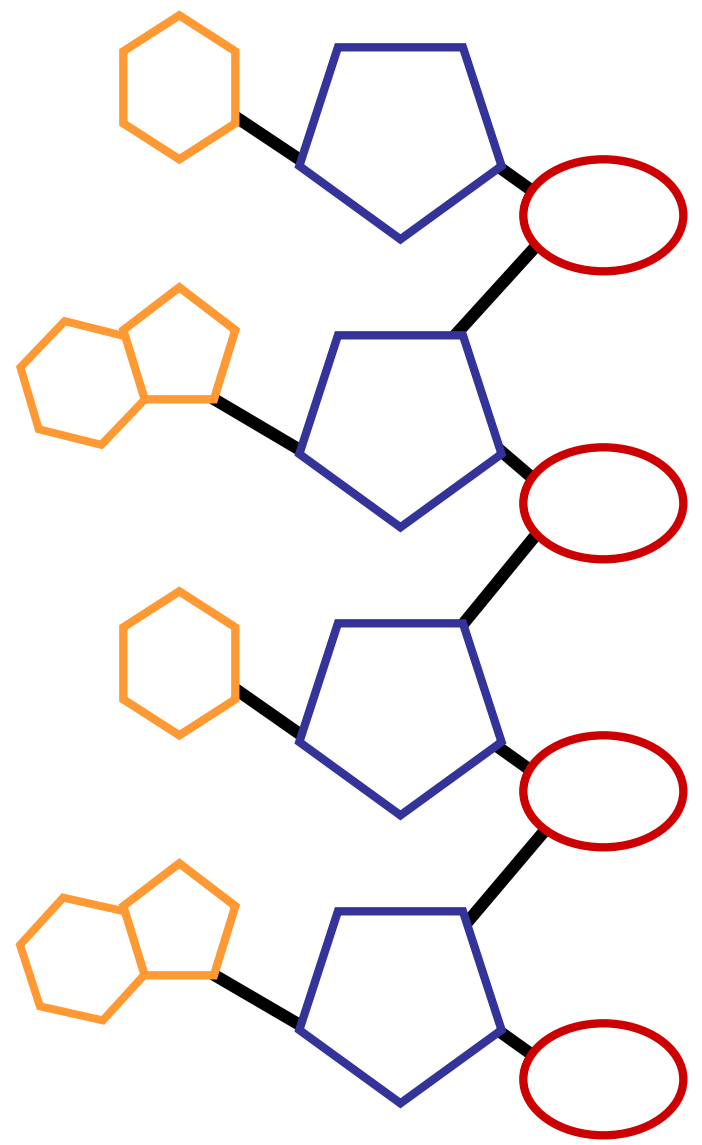
# DNA DOUBLE HELIX MODEL

**POLYNUCLEOTIDE CHAIN**



**FIRST  
POLYNUCLEOTIDE  
CHAIN**

**POLYNUCLEOTIDE CHAIN**



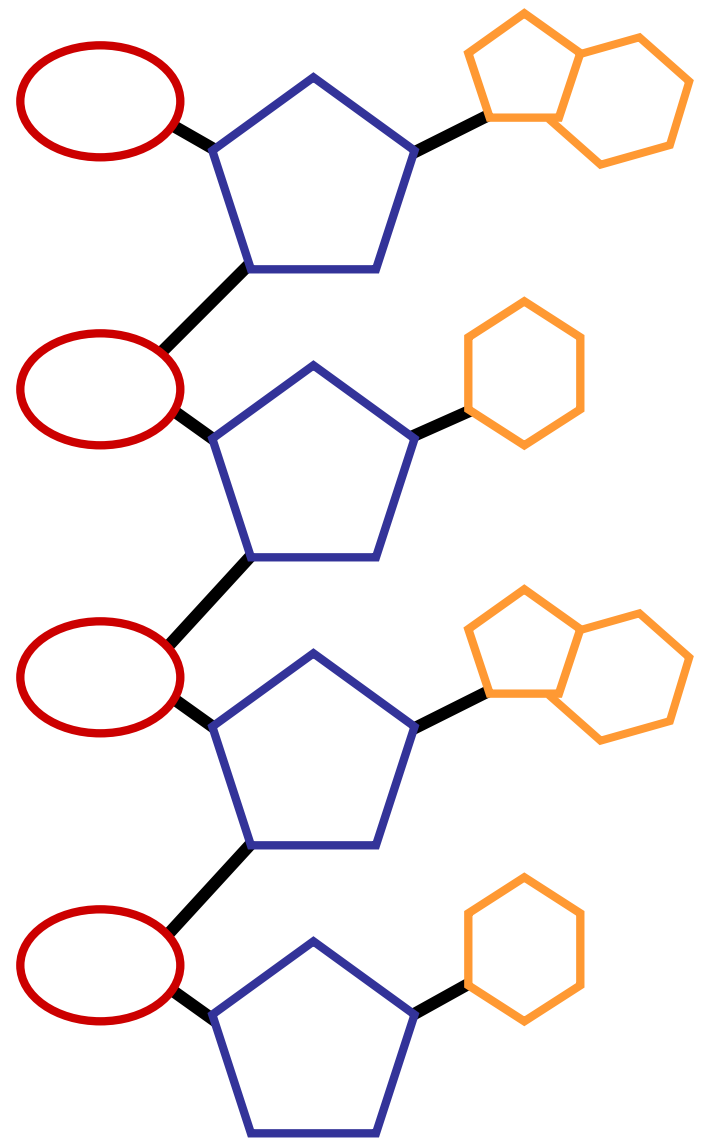
**SECOND  
POLYNUCLEOTIDE  
CHAIN**



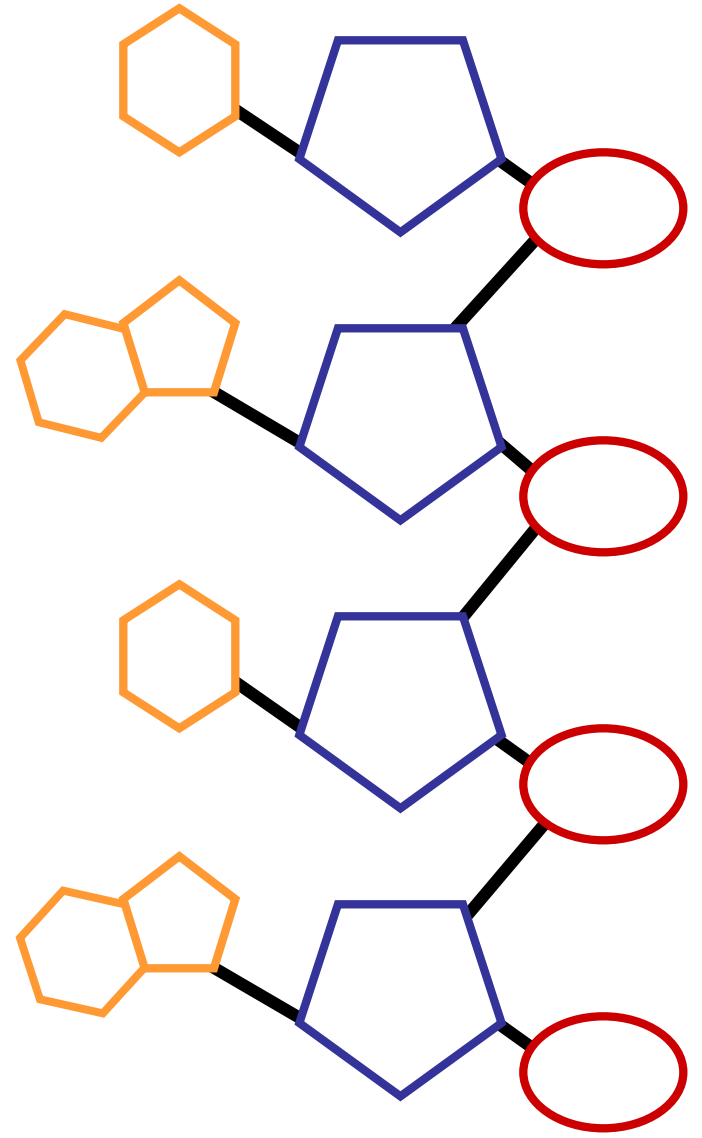
# DNA DOUBLE HELIX MODEL

**B**

**PARALLEL POLYNUCLEOTIDE CHAIN**



**FIRST  
POLYNUCLEOTIDE  
CHAIN**



**SECOND  
POLYNUCLEOTIDE  
CHAIN**

**PARALLEL POLYNUCLEOTIDE CHAIN**

**POLYNUCLEOTIDE  
CHAIN  
BACKBONE**



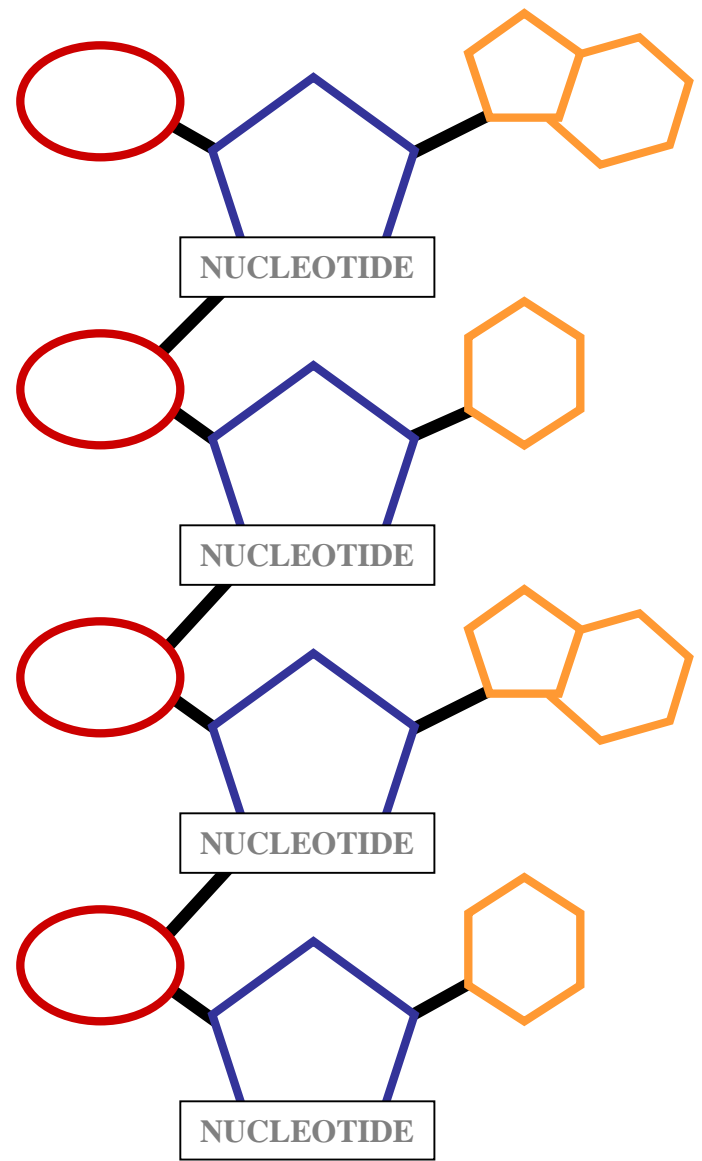
# **POLYNUCLEOTIDE CHAIN BACKBONE**

**BACKBONE CONSISTS  
NUCLEOTIDE  
DEOXYRIBOSE  
PHOSPHATE**

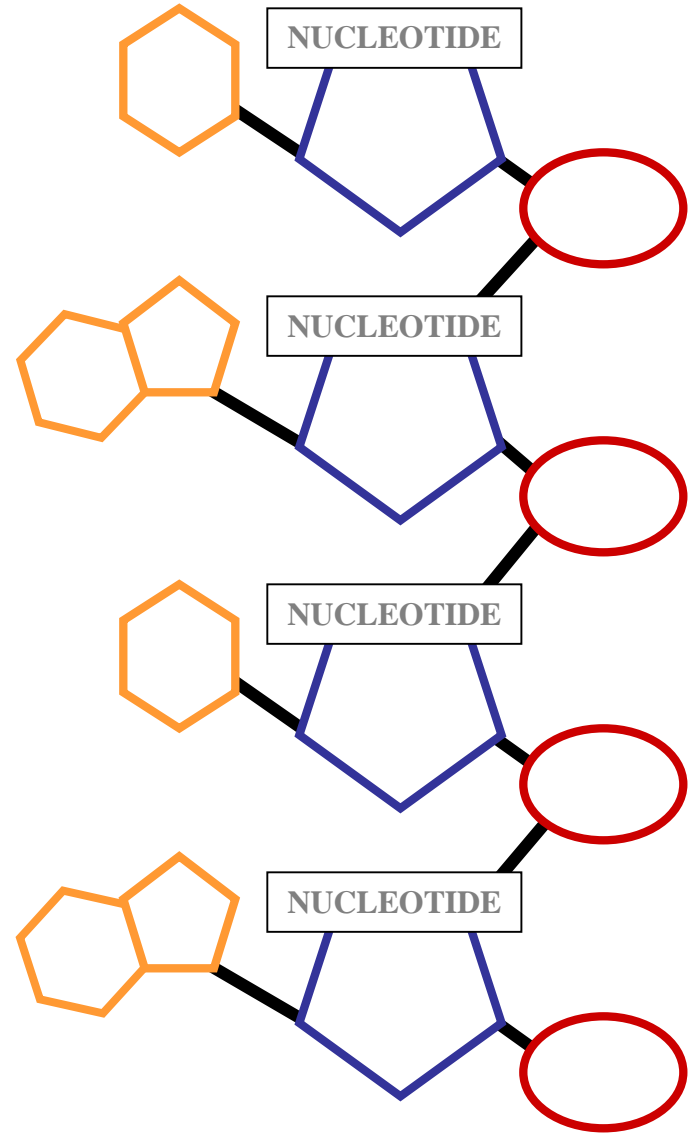
**POLYNUCLEOTIDE CHAIN  
BACKBONE**

# DNA DOUBLE HELIX MODEL

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

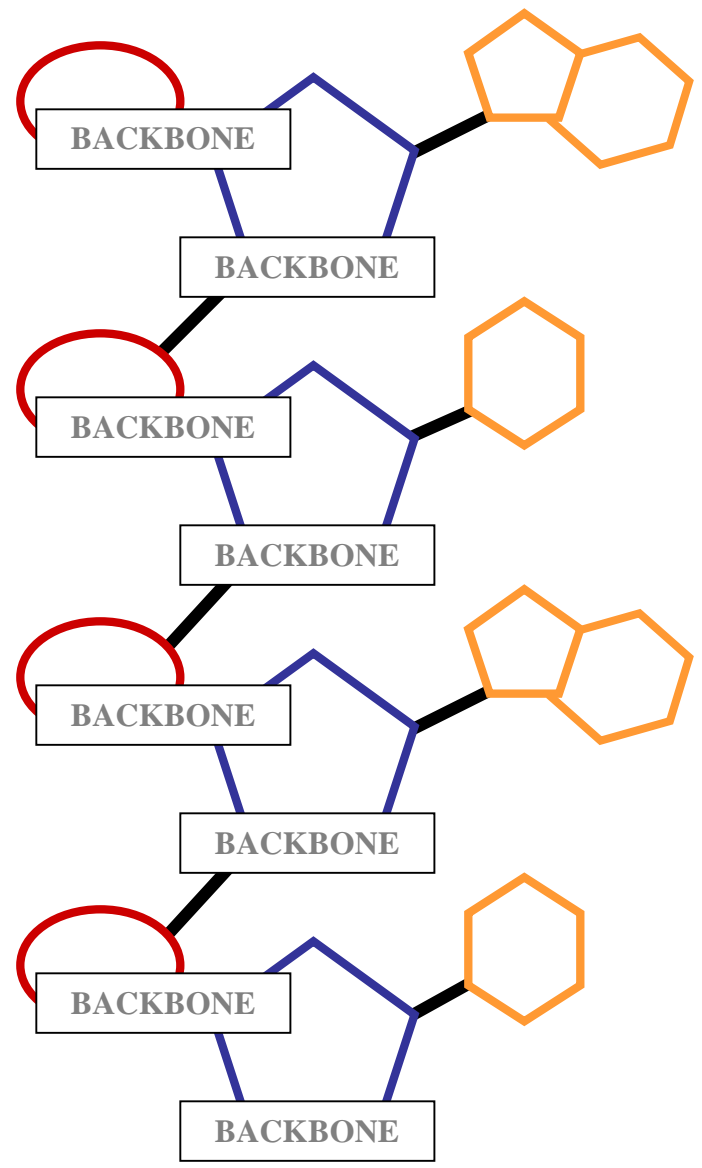


SECOND  
POLYNUCLEOTIDE  
CHAIN

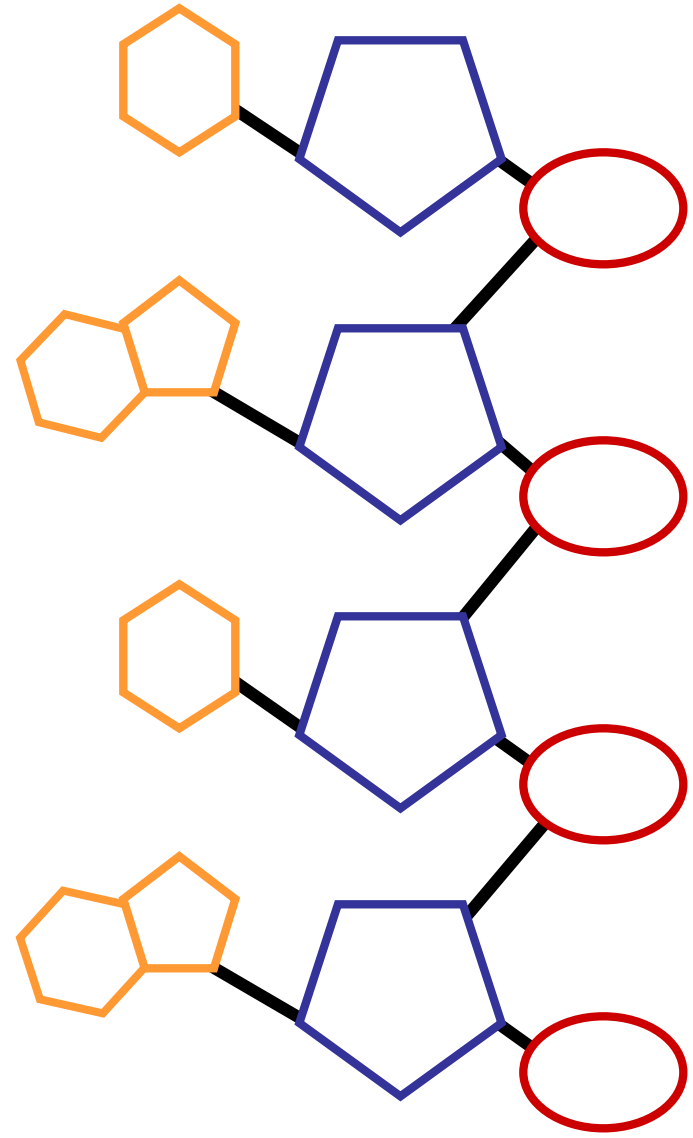
PARALLEL POLYNUCLEOTIDE CHAIN

# DNA DOUBLE HELIX MODEL

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN



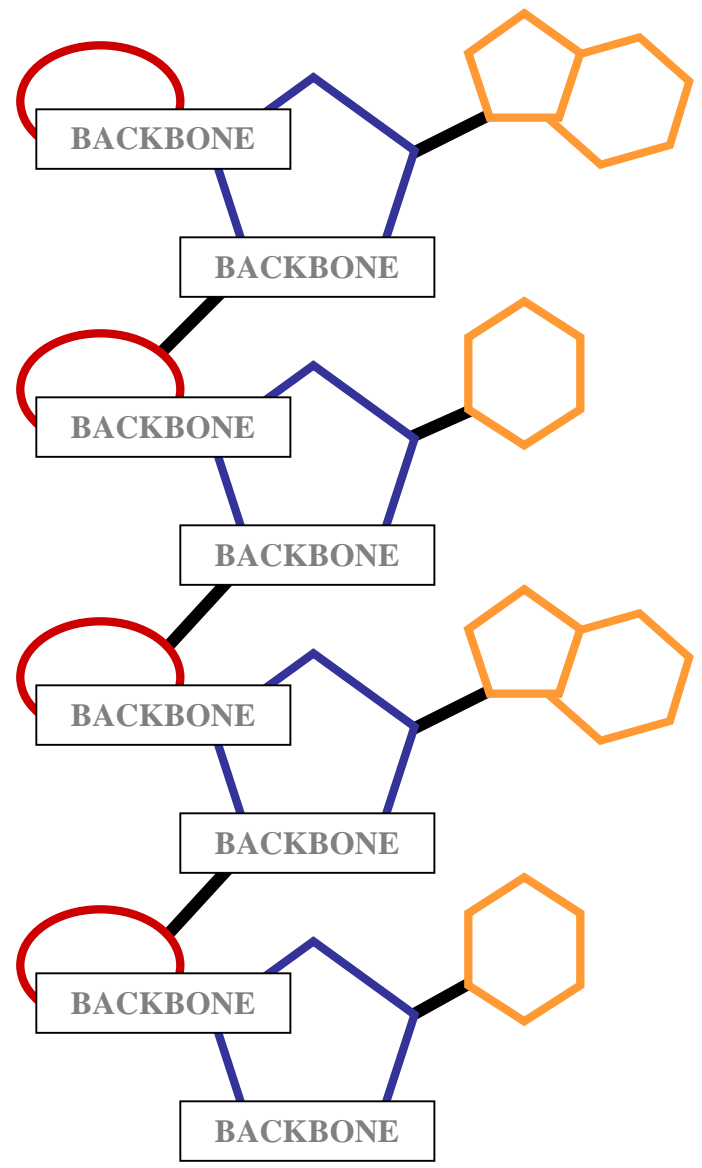
SECOND  
POLYNUCLEOTIDE  
CHAIN

PARALLEL POLYNUCLEOTIDE CHAIN

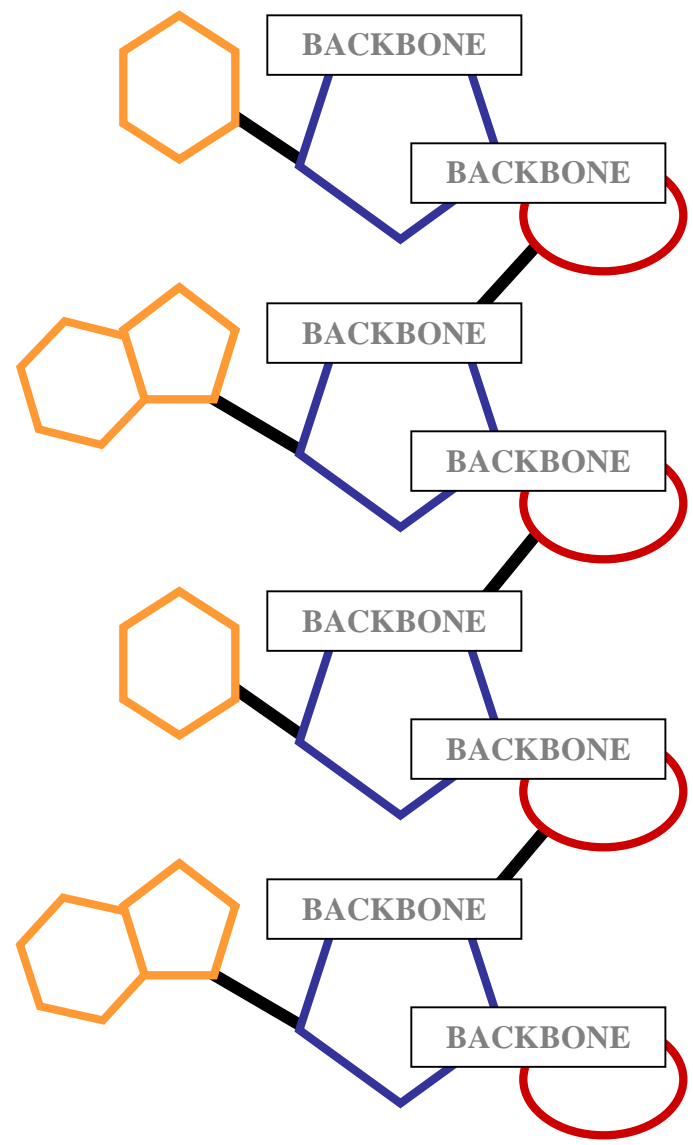
# DNA DOUBLE HELIX MODEL

D

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

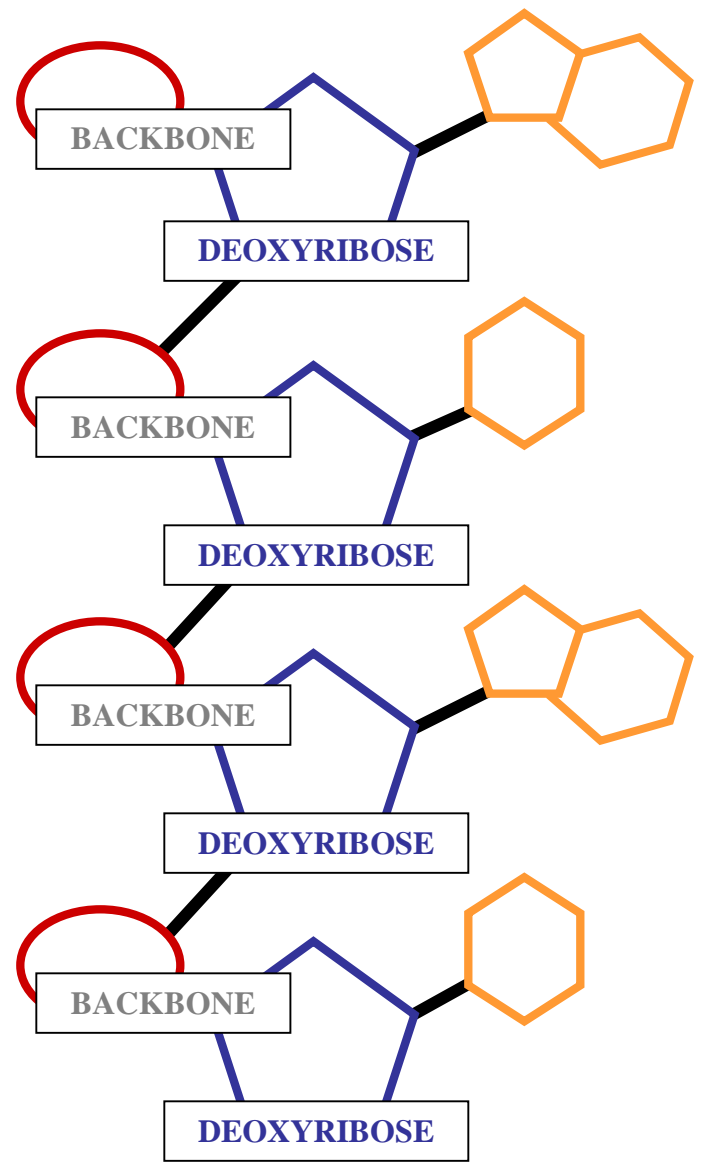


SECOND  
POLYNUCLEOTIDE  
CHAIN

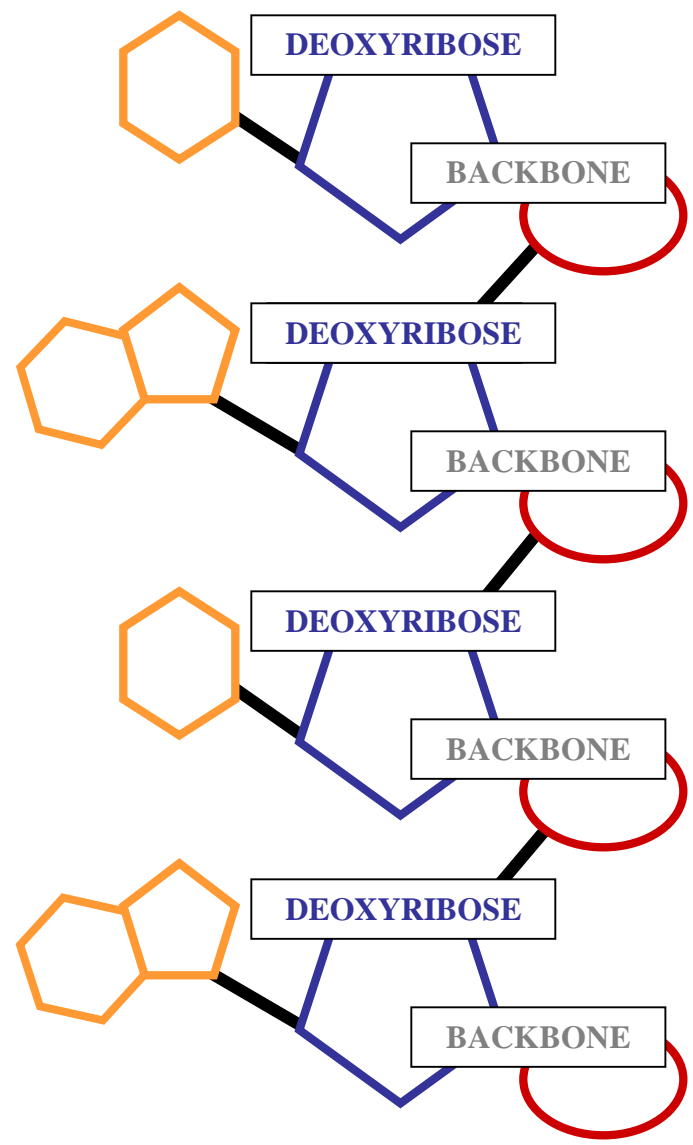
PARALLEL POLYNUCLEOTIDE CHAIN

# DNA DOUBLE HELIX MODEL

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN



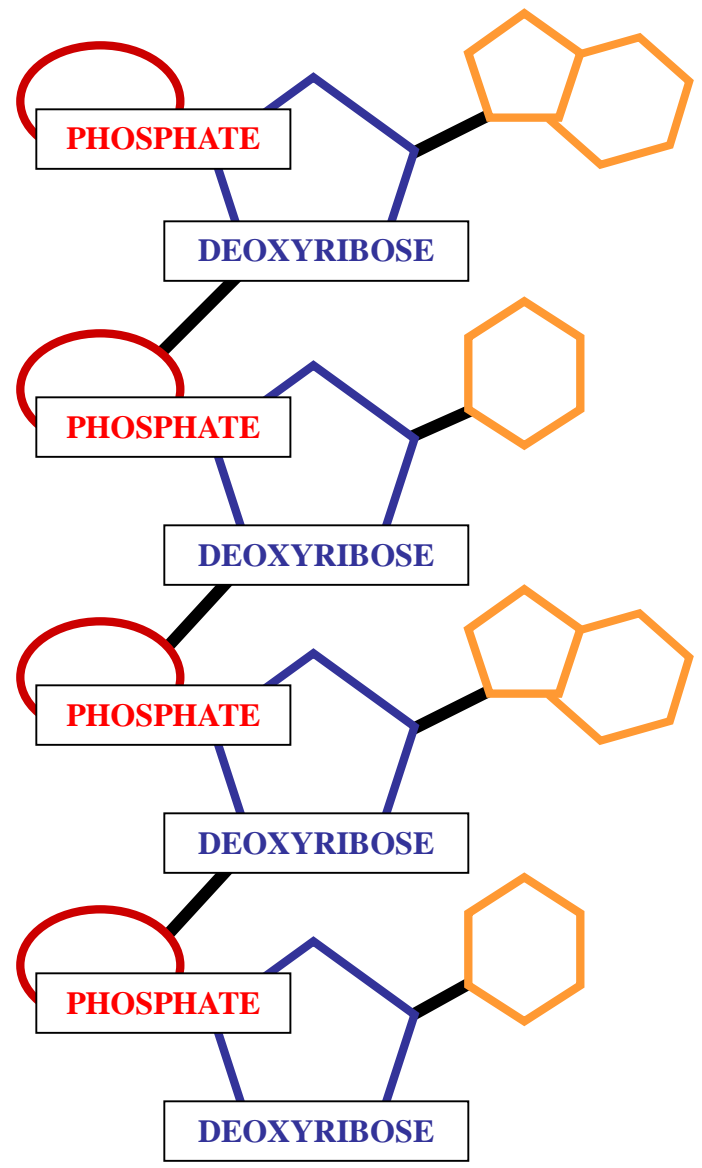
SECOND  
POLYNUCLEOTIDE  
CHAIN

PARALLEL POLYNUCLEOTIDE CHAIN

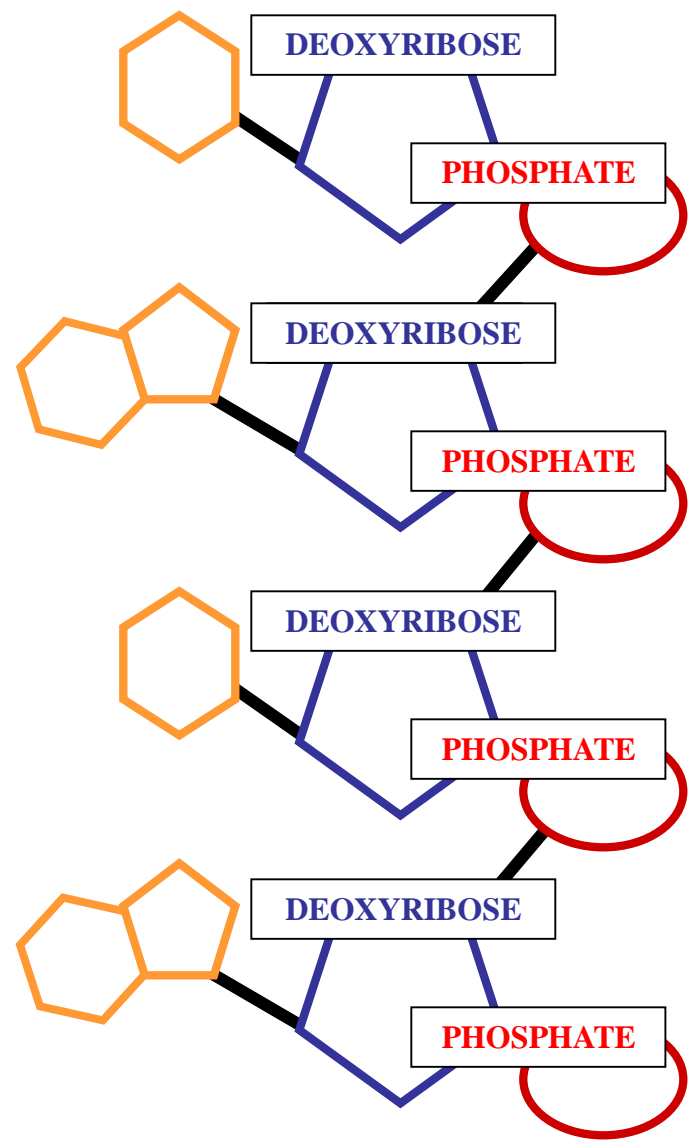
# DNA DOUBLE HELIX MODEL

R

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN



SECOND  
POLYNUCLEOTIDE  
CHAIN

PARALLEL POLYNUCLEOTIDE CHAIN



**POLYNUCLEOTIDE**  
**CHAIN**  
**RUNGS**



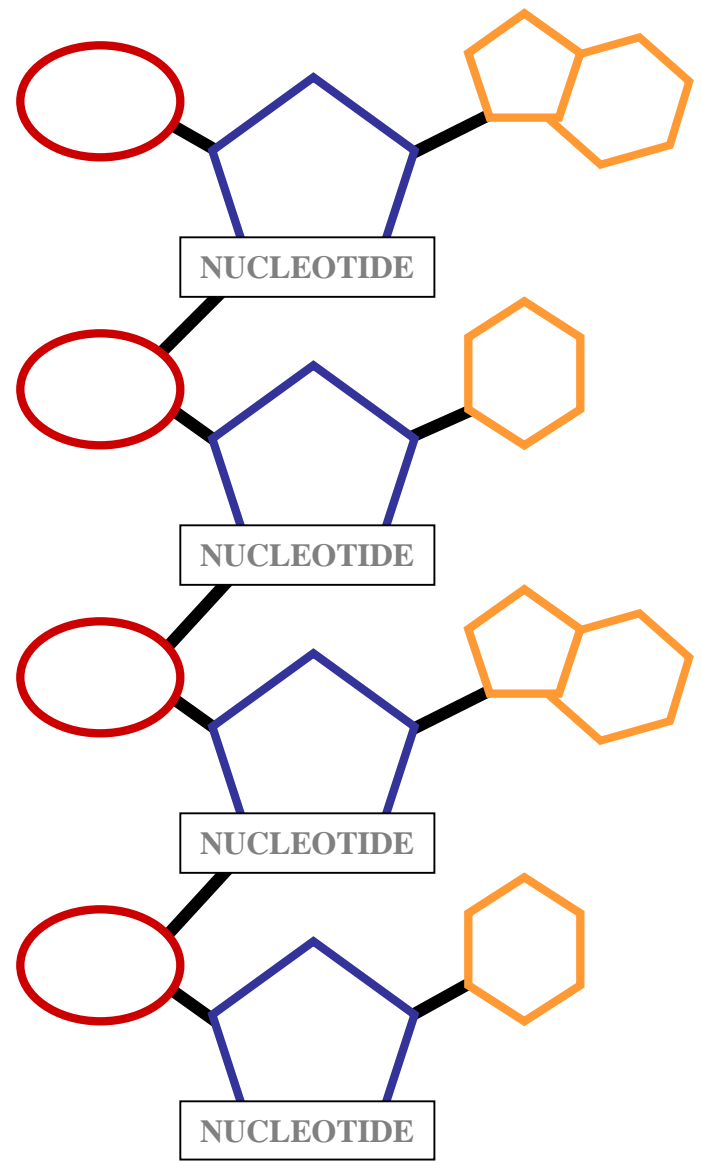
# **POLYNUCLEOTIDE CHAIN RUNGS**

**RUNGS CONSIST  
NUCLEOTIDE  
BASES**

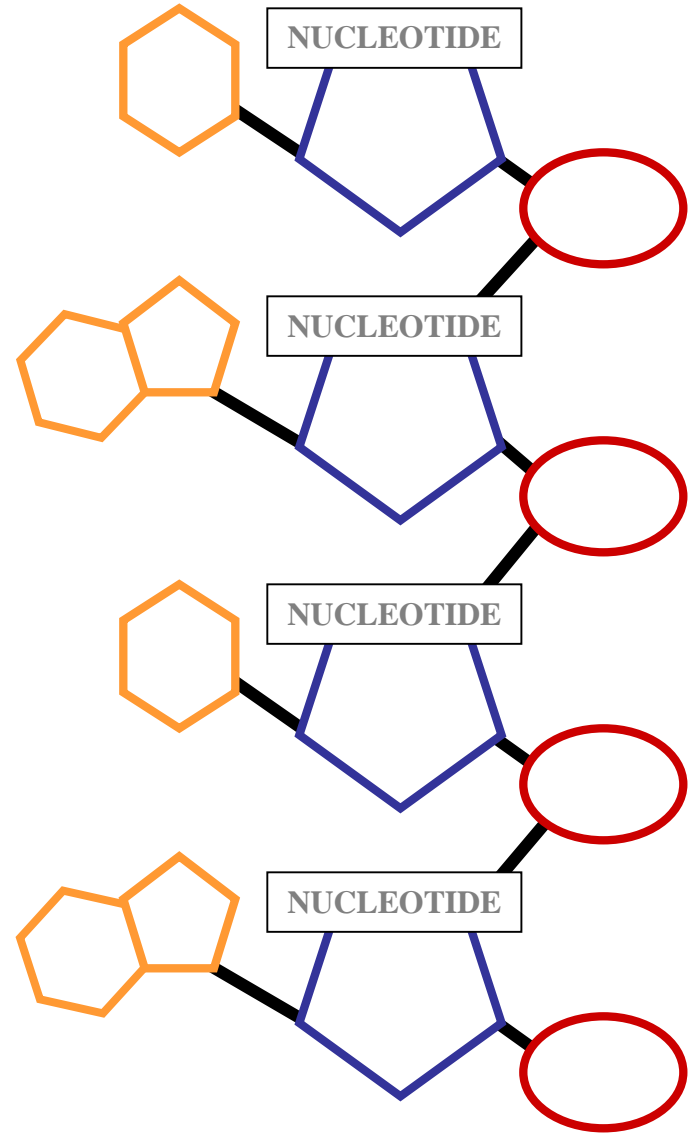
**POLYNUCLEOTIDE CHAIN  
RUNGS**

# DNA DOUBLE HELIX MODEL

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

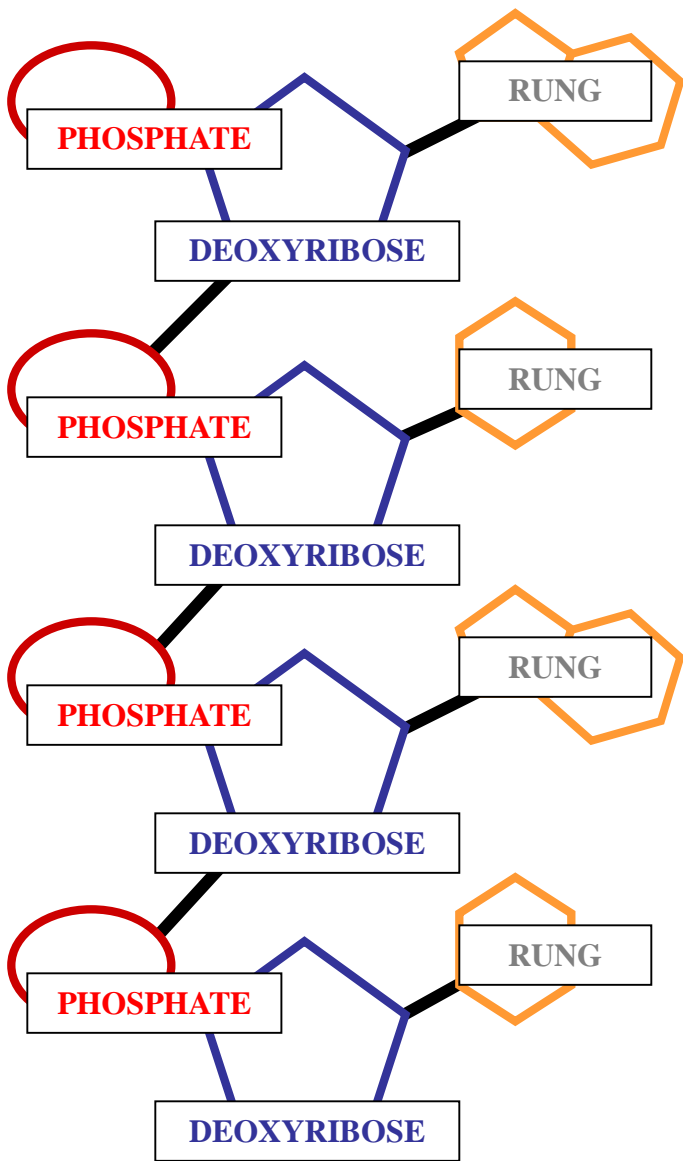


SECOND  
POLYNUCLEOTIDE  
CHAIN

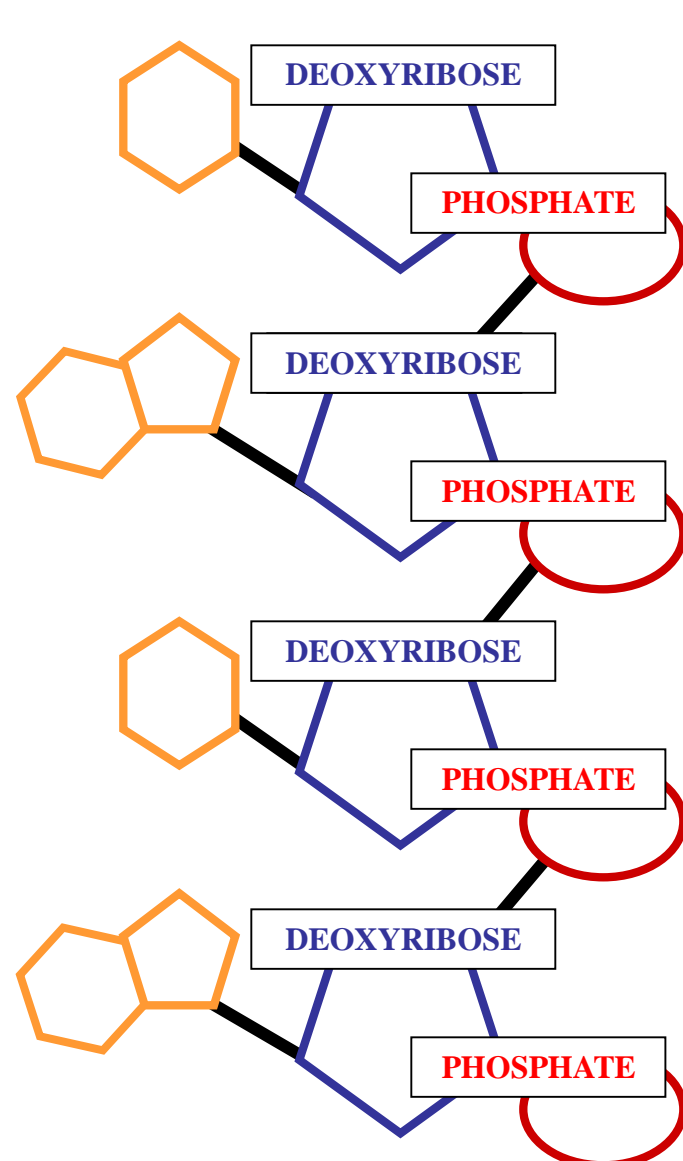
PARALLEL POLYNUCLEOTIDE CHAIN

# DNA DOUBLE HELIX MODEL

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN



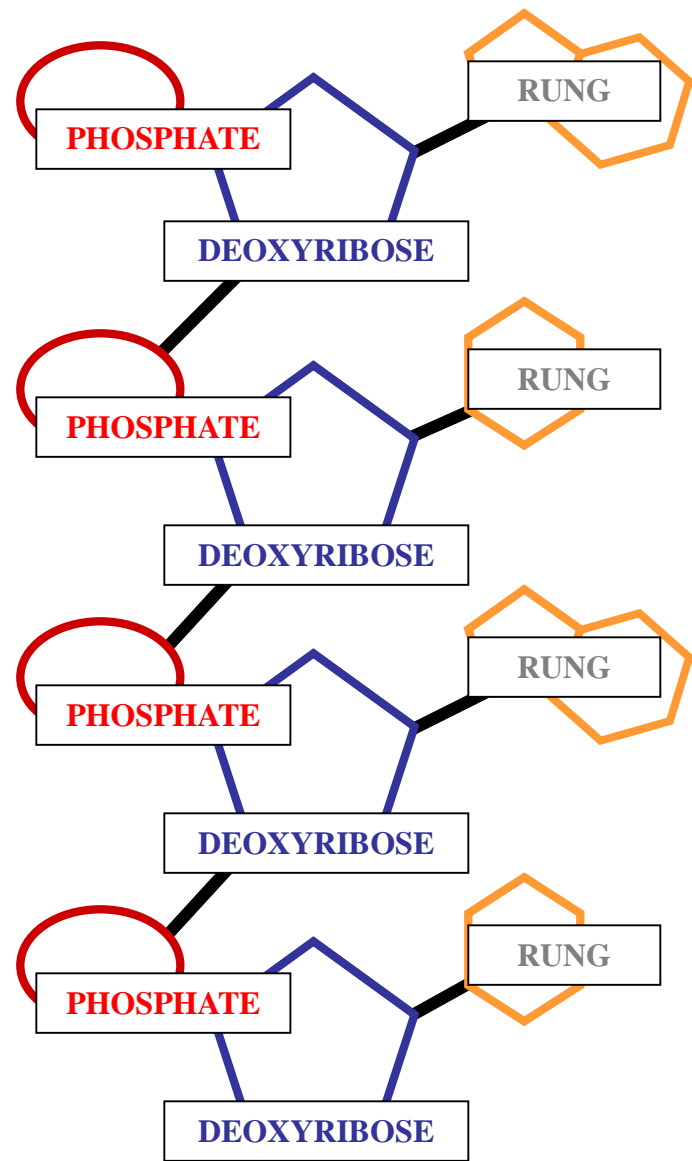
SECOND  
POLYNUCLEOTIDE  
CHAIN

PARALLEL POLYNUCLEOTIDE CHAIN

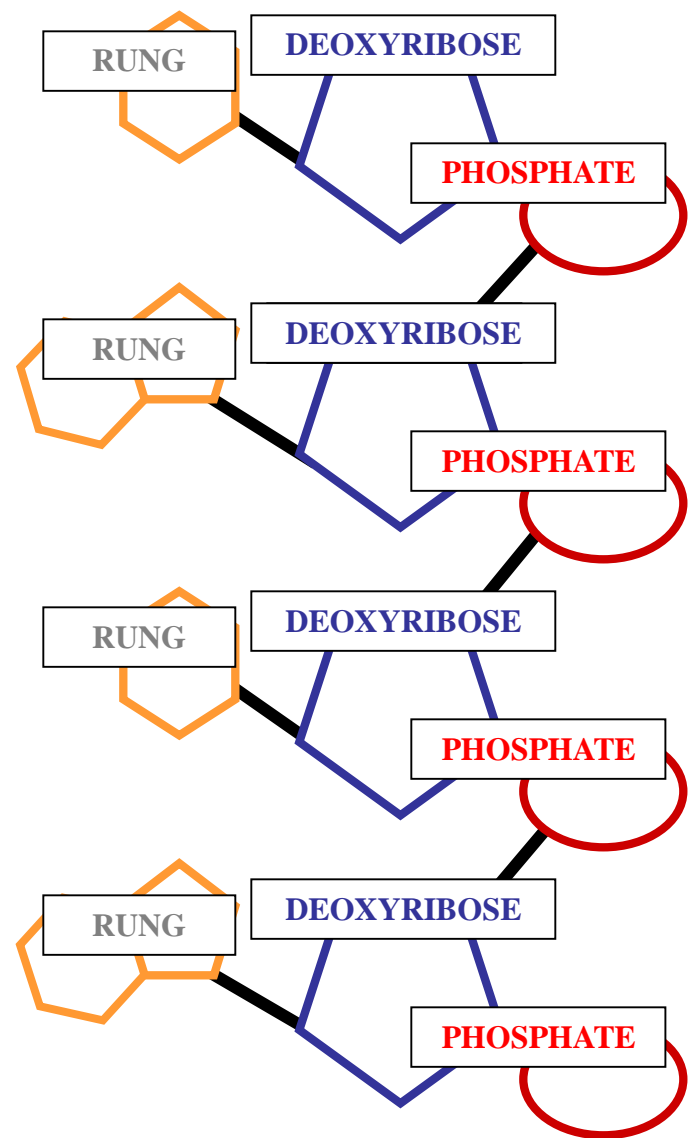
# DNA DOUBLE HELIX MODEL

N

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN



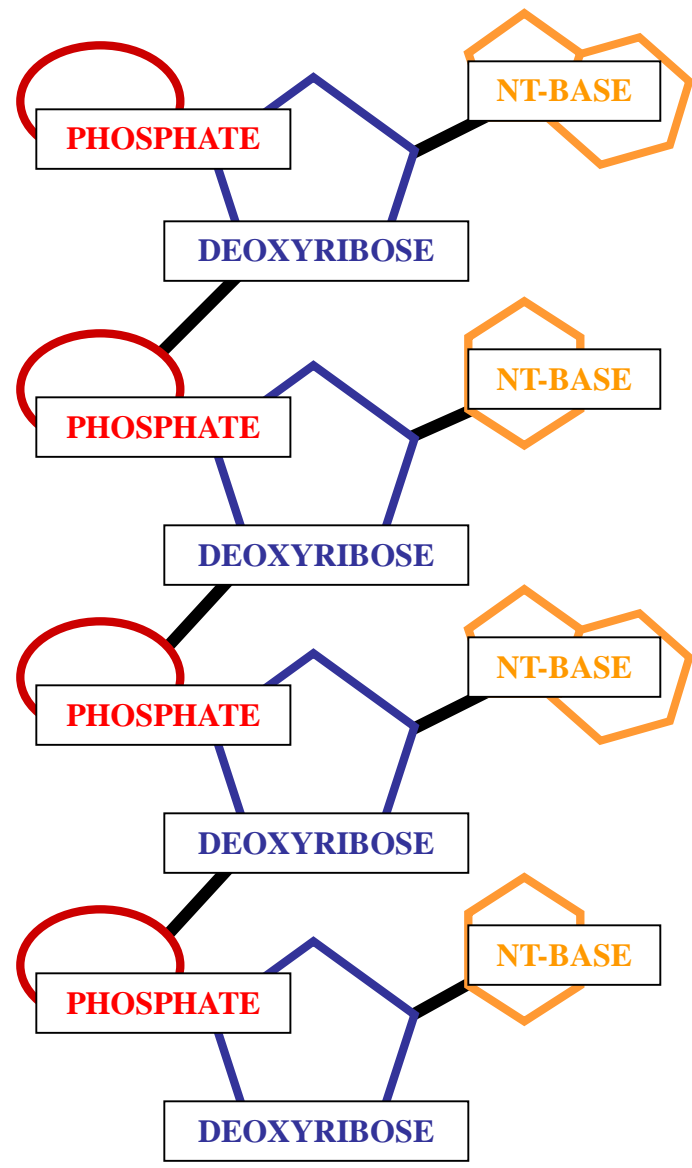
SECOND  
POLYNUCLEOTIDE  
CHAIN

PARALLEL POLYNUCLEOTIDE CHAIN

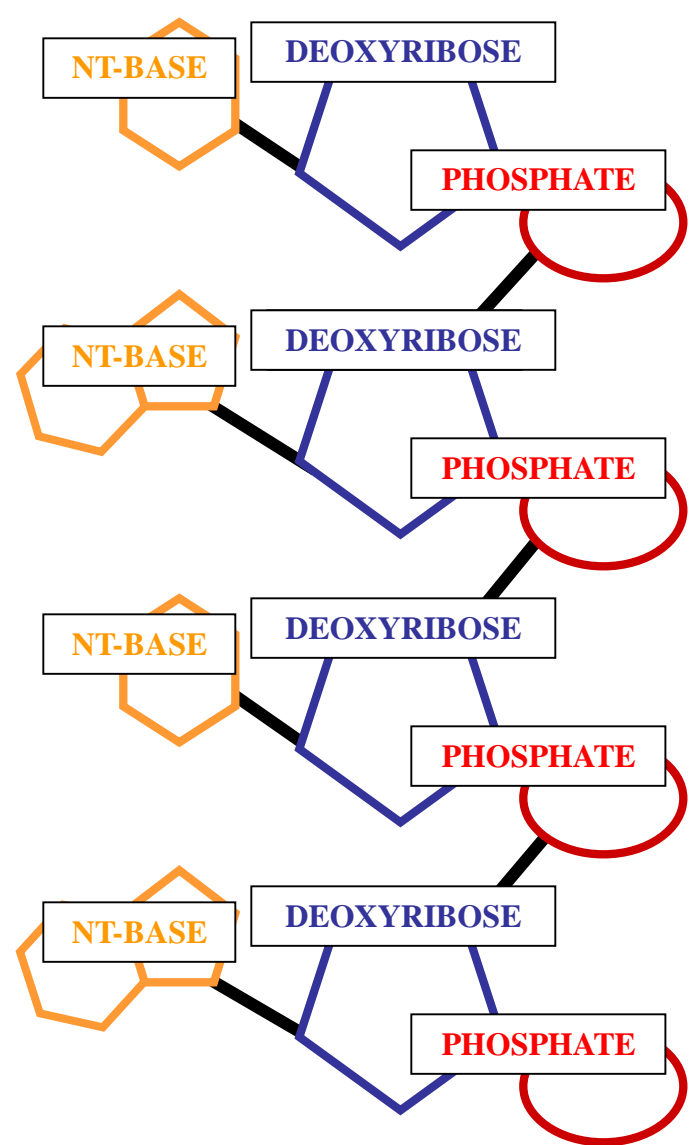
# DNA DOUBLE HELIX MODEL



PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

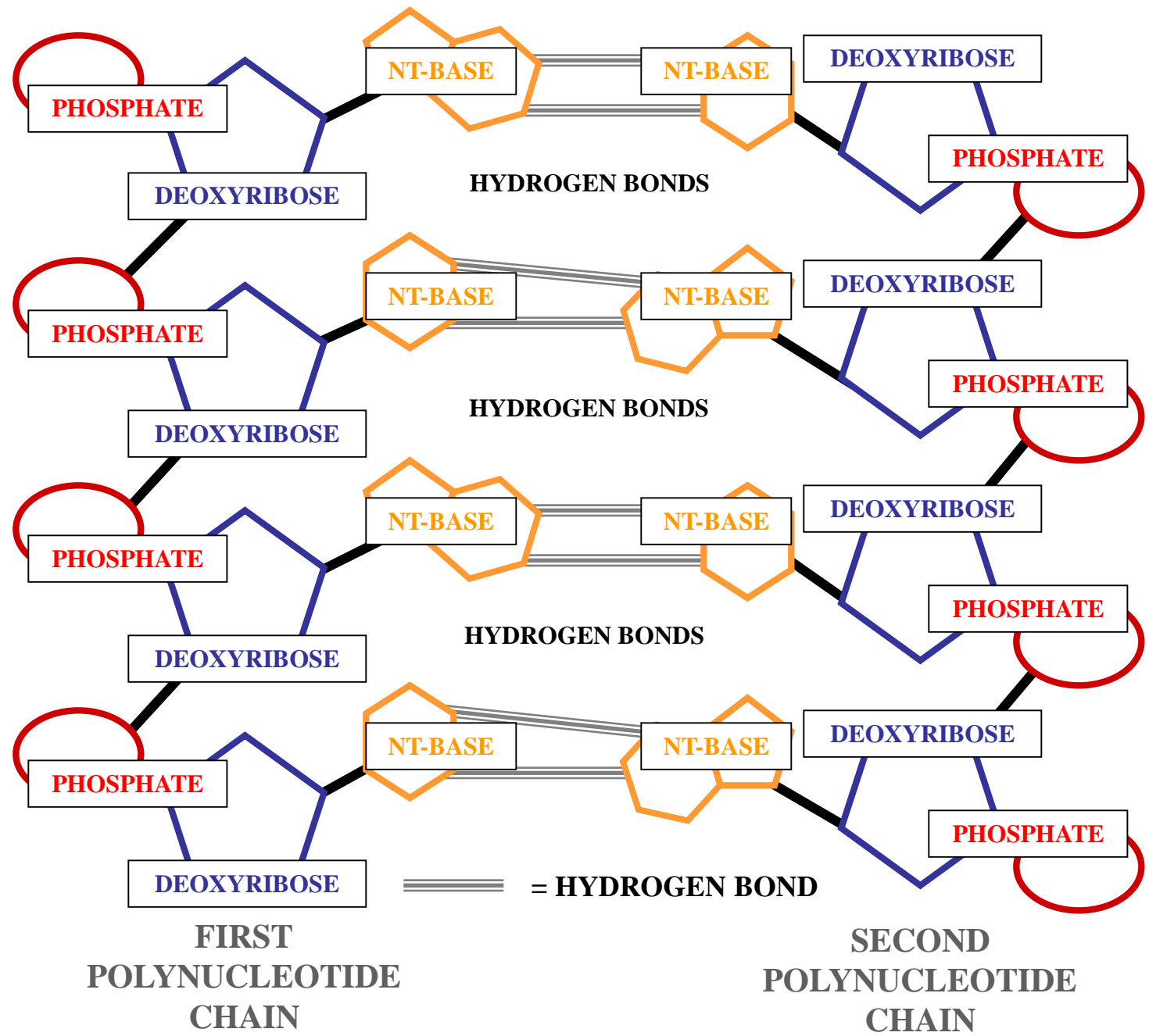


SECOND  
POLYNUCLEOTIDE  
CHAIN

PARALLEL POLYNUCLEOTIDE CHAIN

# DNA DOUBLE HELIX MODEL

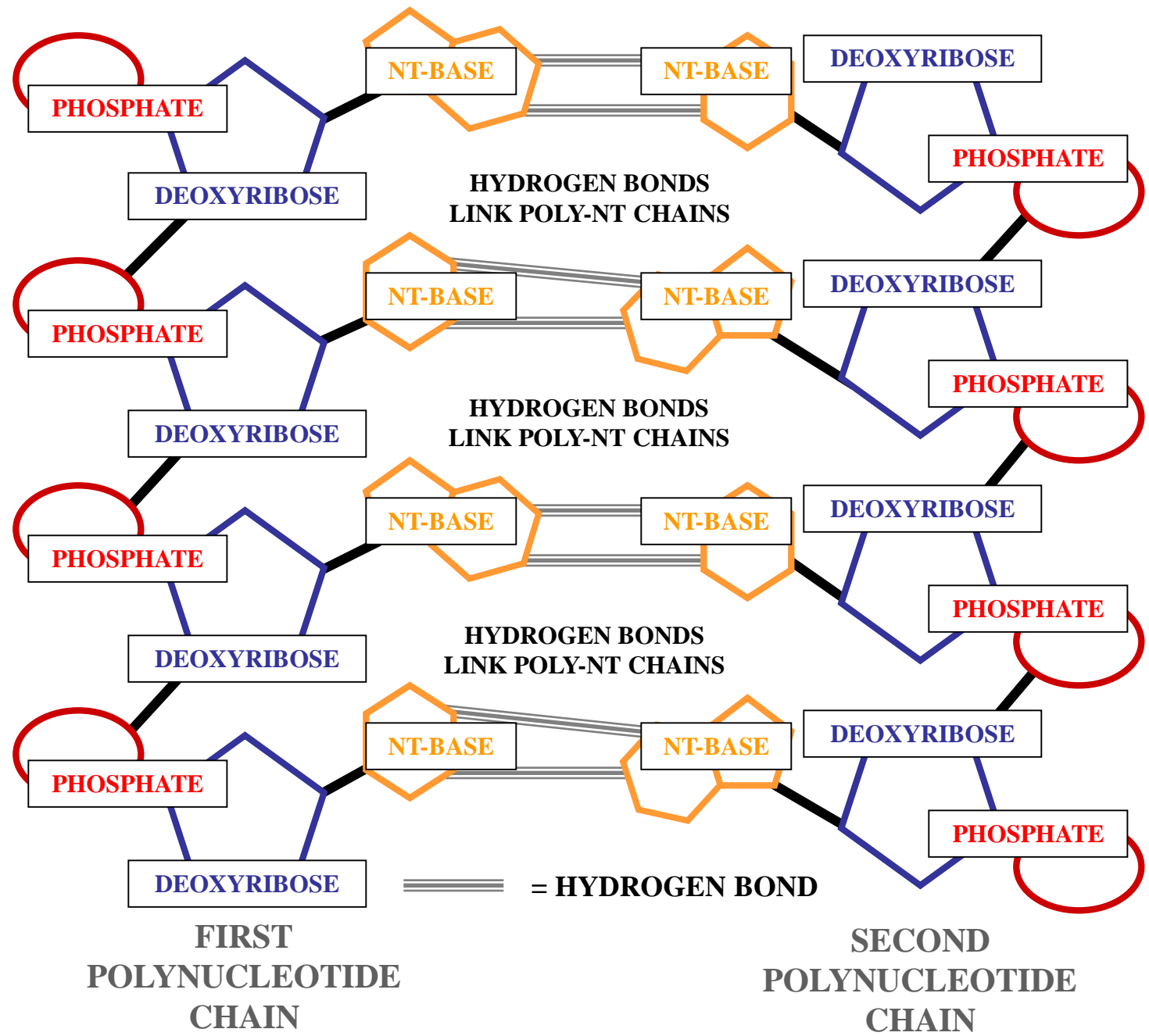
H-BONDS FORM BETWEEN NT-BASES  
PARALLEL POLYNUCLEOTIDE CHAIN



H-BONDS FORM BETWEEN NT-BASES  
PARALLEL POLYNUCLEOTIDE CHAIN

# DNA DOUBLE HELIX MODEL

H-BONDS LINK POLY-NT CHAINS  
PARALLEL POLYNUCLEOTIDE CHAIN

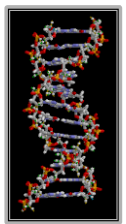
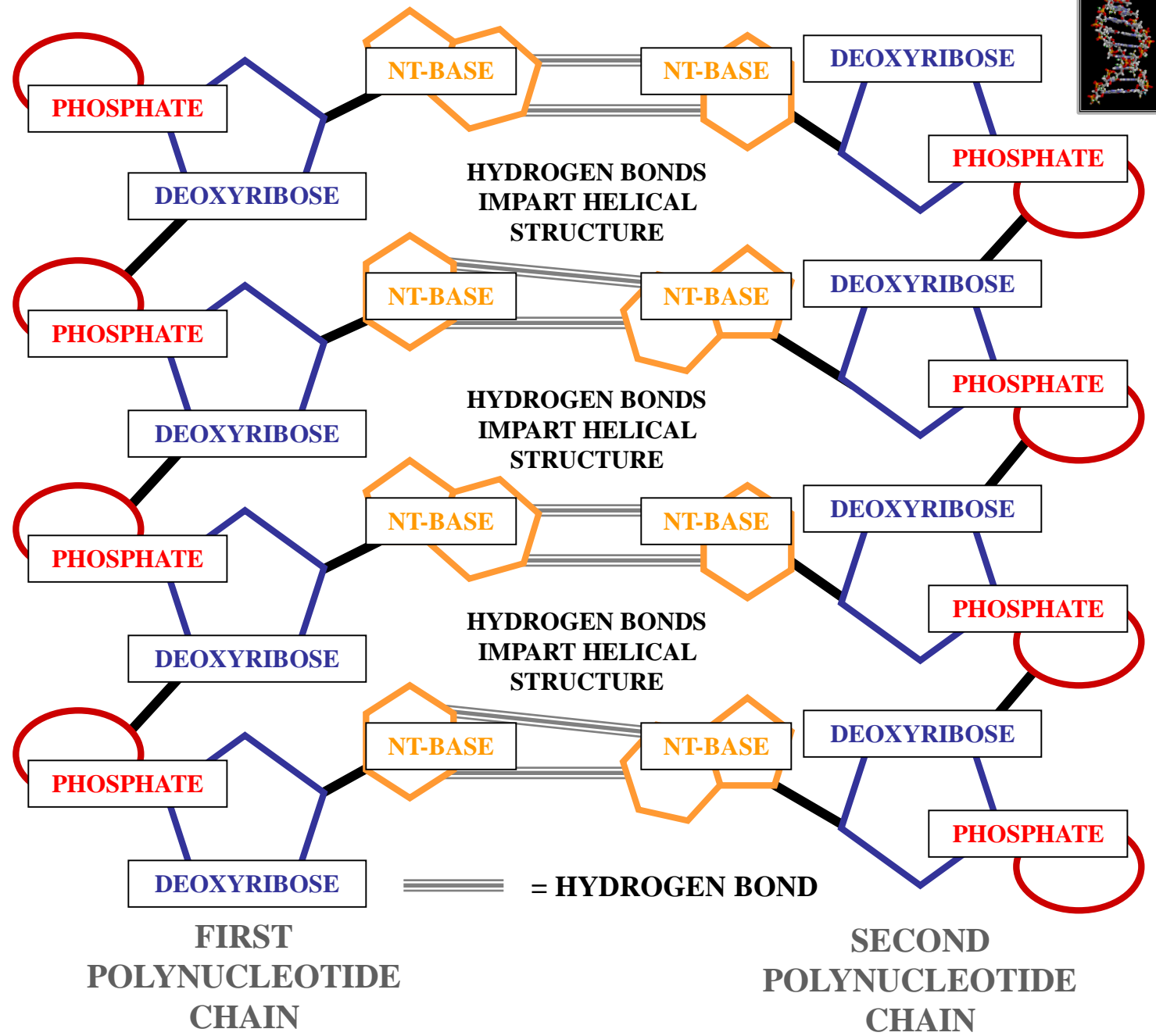


H-BONDS LINK POLY-NT CHAINS  
PARALLEL POLYNUCLEOTIDE CHAIN



# DNA DOUBLE HELIX MODEL

H-BONDS IMPART HELICAL STRUCTURE  
PARALLEL POLYNUCLEOTIDE CHAIN



H-BONDS IMPART HELICAL STRUCTURE  
PARALLEL POLYNUCLEOTIDE CHAIN

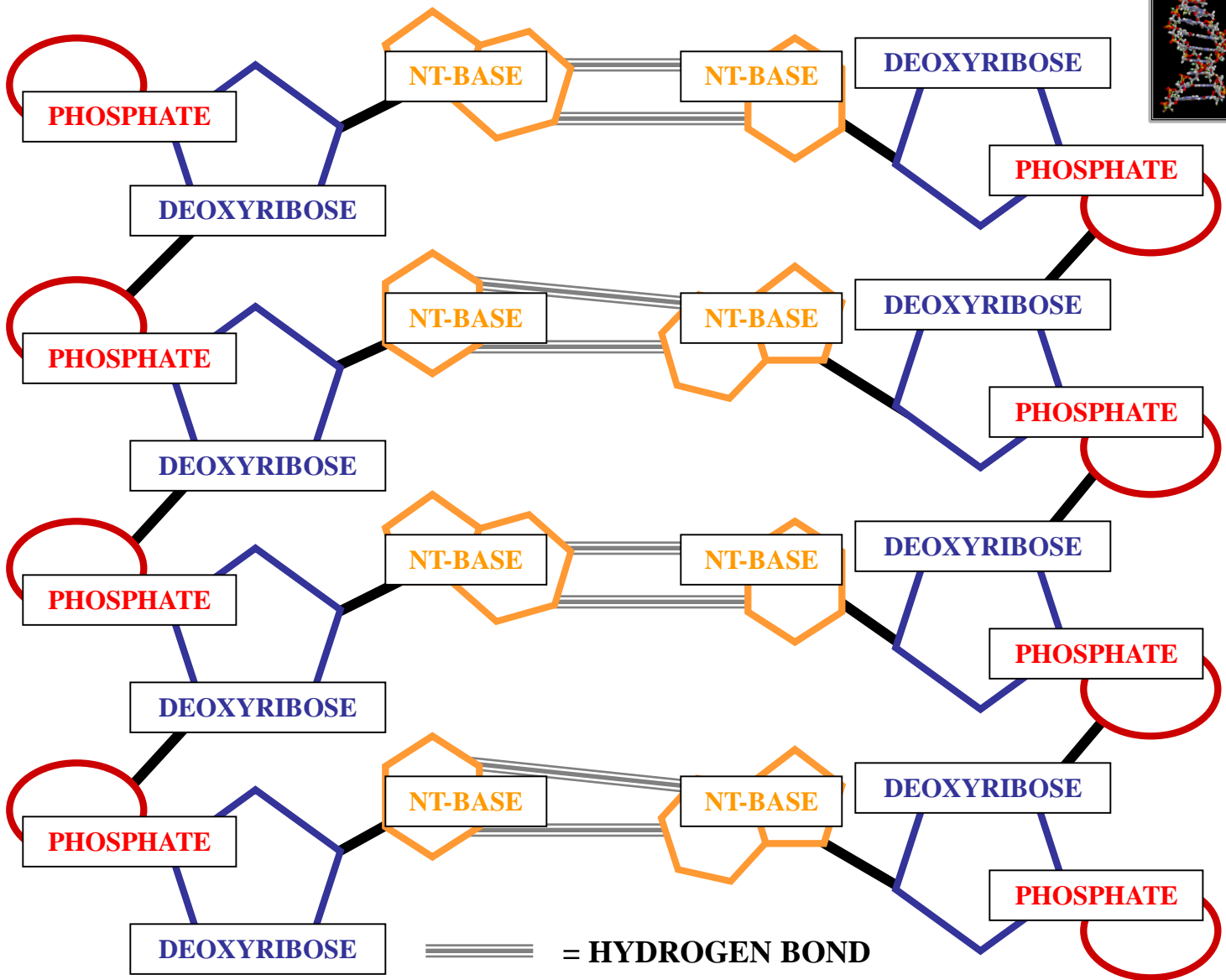




**DNA**  
**POLYNUCLEOTIDE**  
**CHAINS**  
**NUCLEOTIDE**  
**BASE PAIRS**

# DNA DOUBLE HELIX MODEL

NUCLEOTIDE BASE PAIRS  
PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

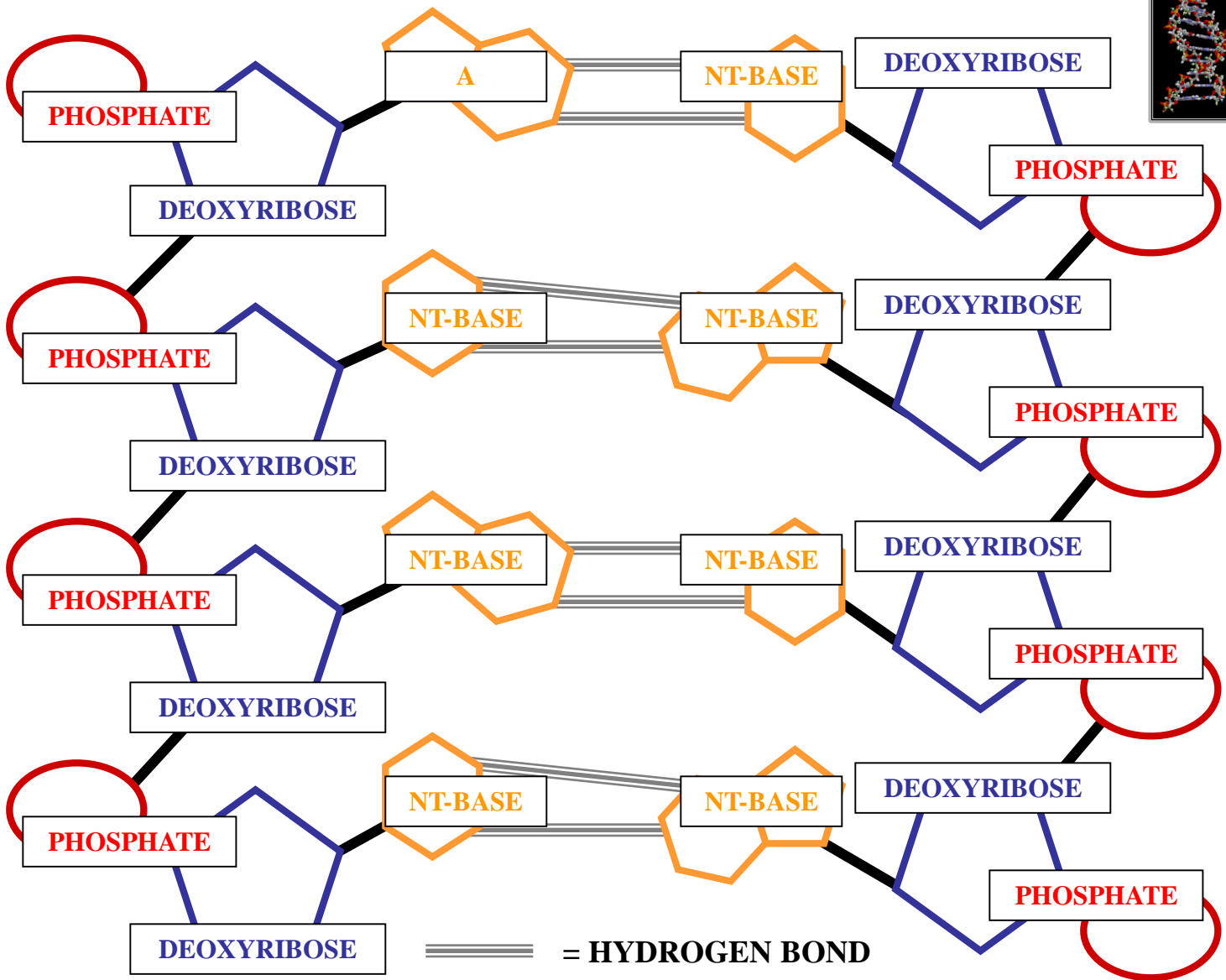
SECOND  
POLYNUCLEOTIDE  
CHAIN

NUCLEOTIDE BASE PAIRS  
PARALLEL POLYNUCLEOTIDE CHAIN

A

# DNA DOUBLE HELIX MODEL

NUCLEOTIDE BASE PAIRS  
PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

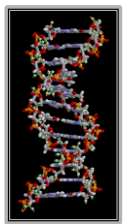
SECOND  
POLYNUCLEOTIDE  
CHAIN

== = HYDROGEN BOND

NUCLEOTIDE BASE PAIRS  
PARALLEL POLYNUCLEOTIDE CHAIN

T

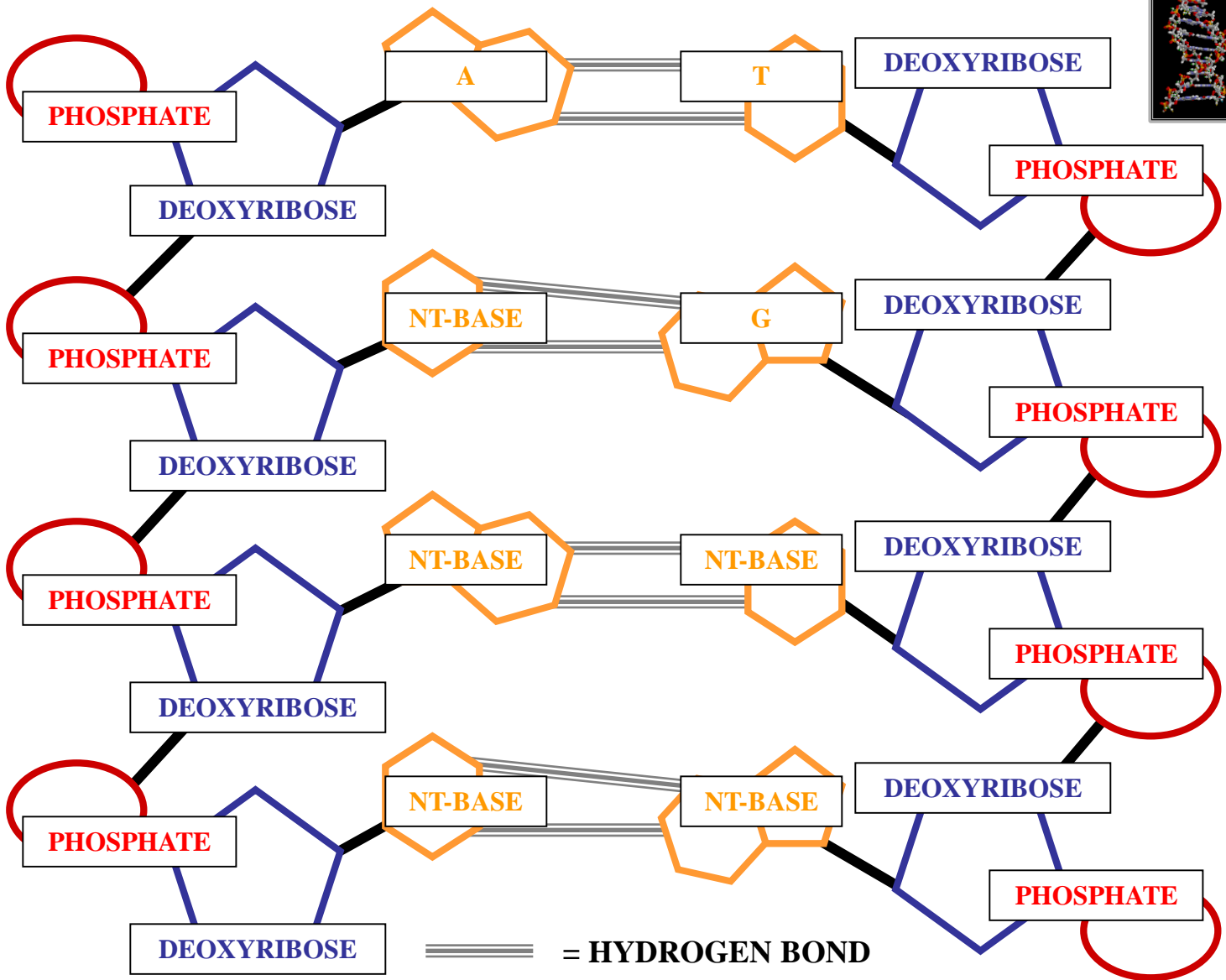
PARALLEL POLYNUCLEOTIDE CHAIN





# DNA DOUBLE HELIX MODEL

NUCLEOTIDE BASE PAIRS  
PARALLEL POLYNUCLEOTIDE CHAIN



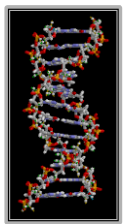
FIRST  
POLYNUCLEOTIDE  
CHAIN

SECOND  
POLYNUCLEOTIDE  
CHAIN

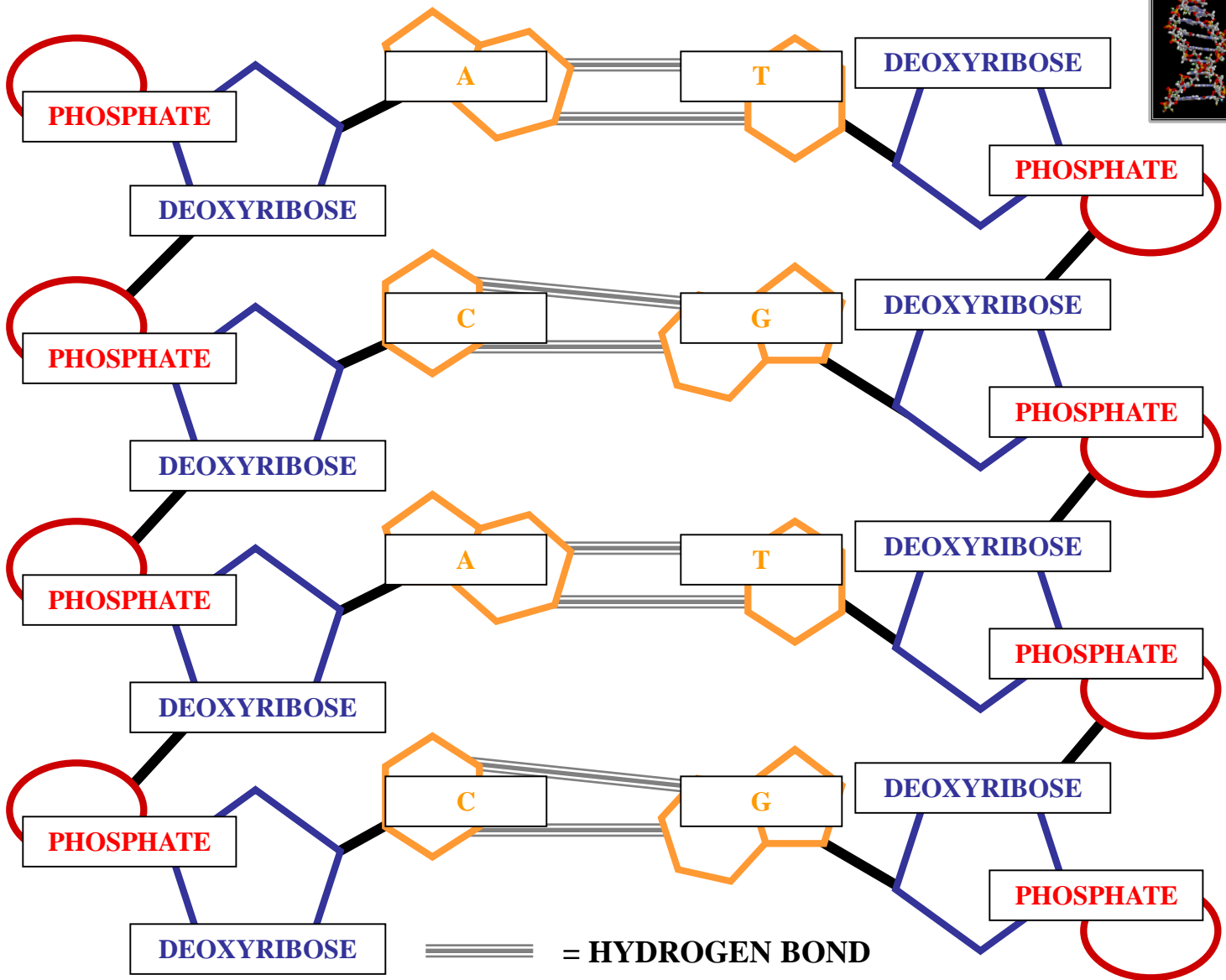
== = HYDROGEN BOND

NUCLEOTIDE BASE PAIRS  
PARALLEL POLYNUCLEOTIDE CHAIN

# DNA DOUBLE HELIX MODEL



NUCLEOTIDE BASE PAIRS  
PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

SECOND  
POLYNUCLEOTIDE  
CHAIN

== = HYDROGEN BOND

NUCLEOTIDE BASE PAIRS  
PARALLEL POLYNUCLEOTIDE CHAIN



NUCLEOTIDE BASE PAIRS  
PARALLEL POLYNUCLEOTIDE CHAIN



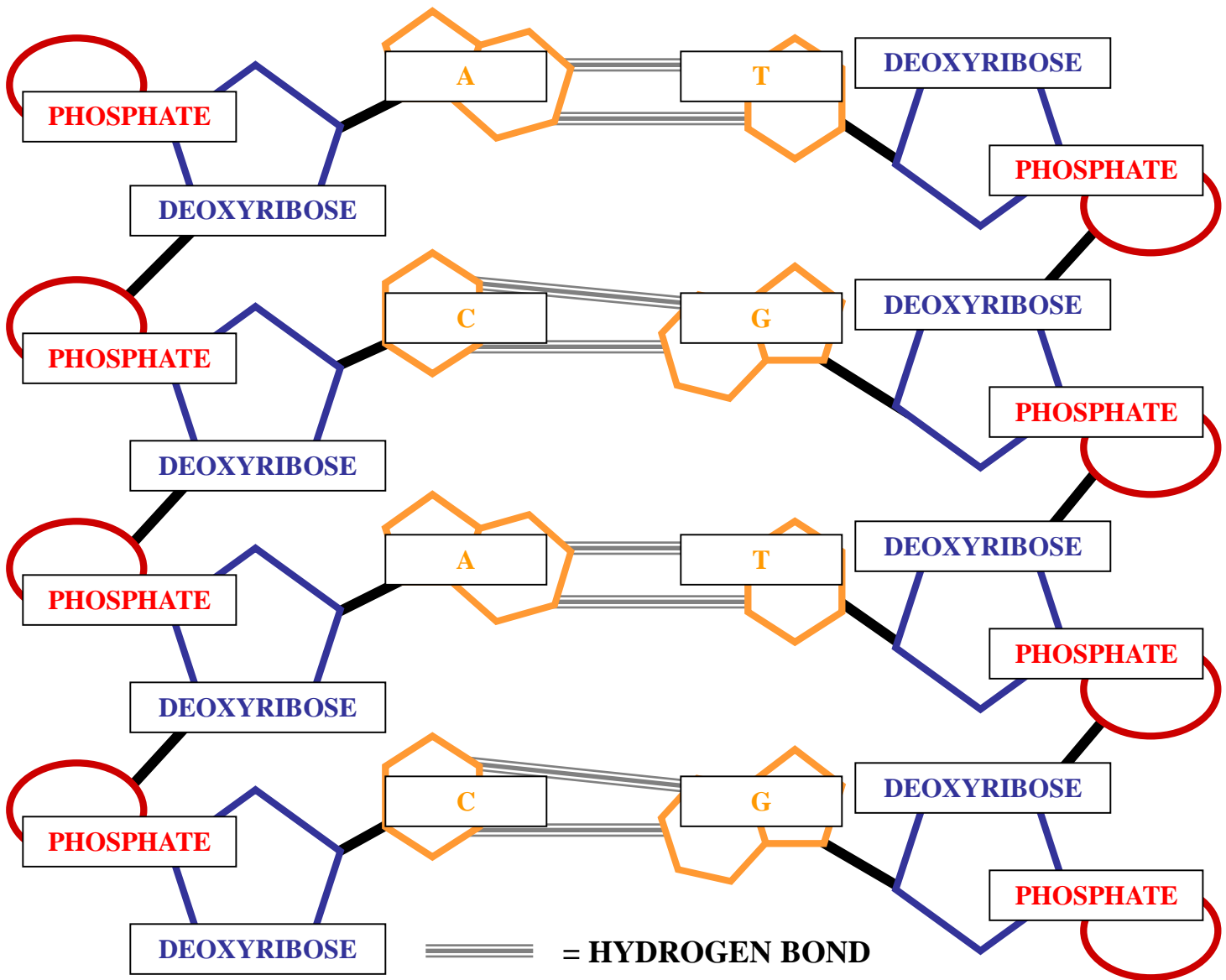
**DNA**  
**POLYNUCLEOTIDE**  
**CHAINS**  
**ANTIPARALLEL**  
**ALIGNMENT**



# DNA DOUBLE HELIX MODEL

ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN

ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

SECOND  
POLYNUCLEOTIDE  
CHAIN

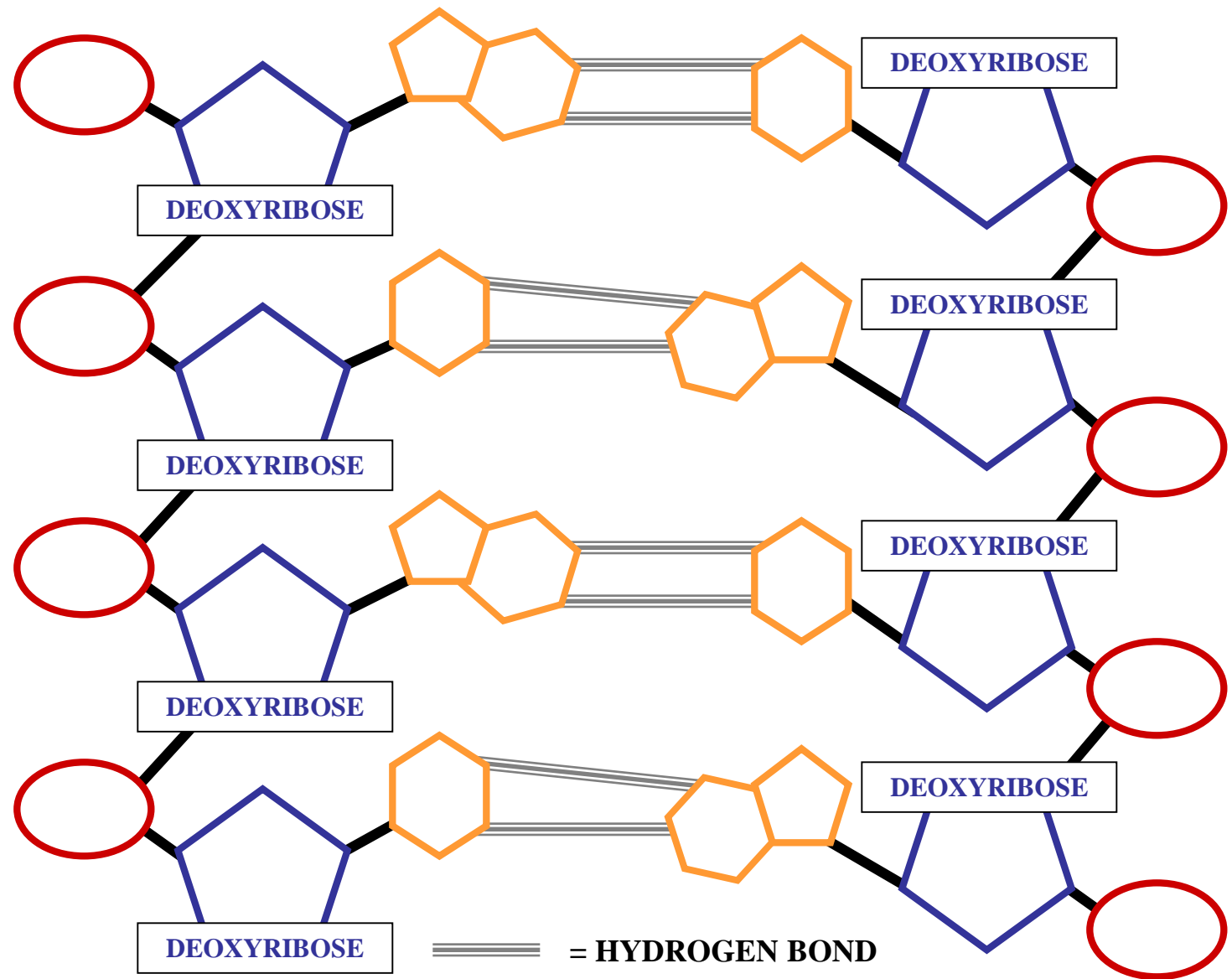
== = HYDROGEN BOND

# DNA DOUBLE HELIX MODEL



**ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN**

**ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN**

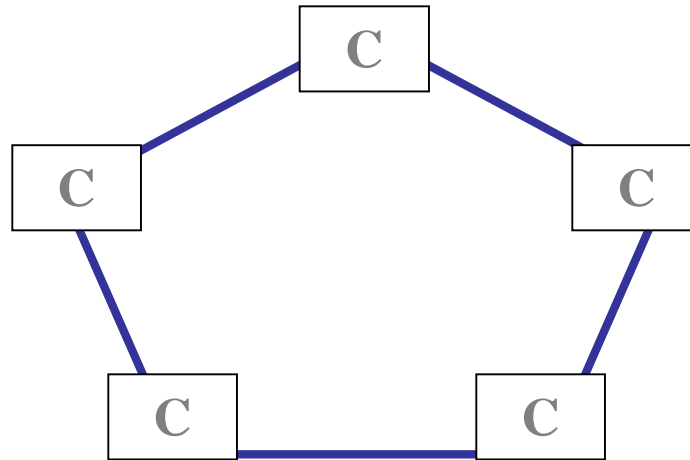


**FIRST  
POLYNUCLEOTIDE  
CHAIN**

**SECOND  
POLYNUCLEOTIDE  
CHAIN**

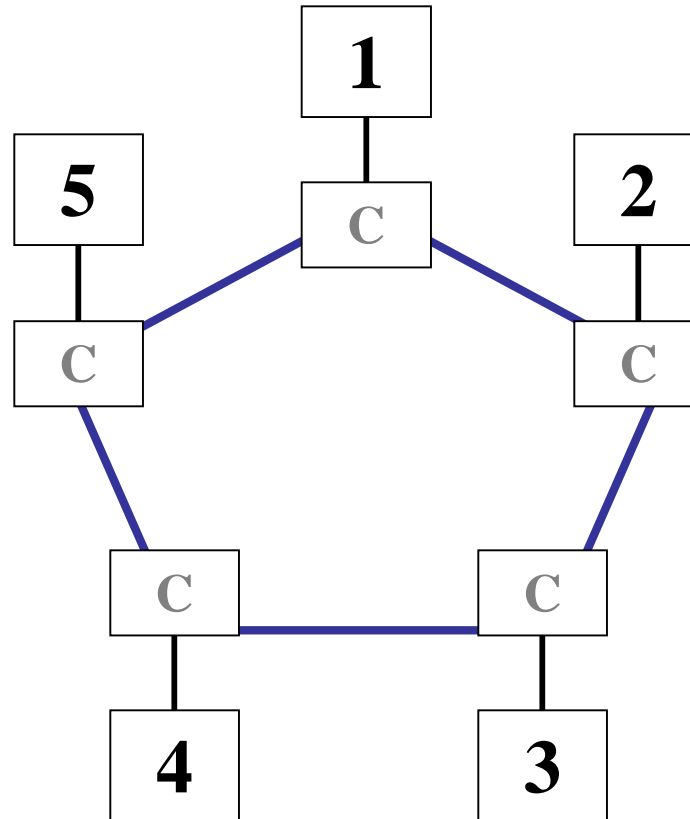
== = HYDROGEN BOND

# DEOXYRIBOSE PENTOSE SUGAR



**C** = CARBON ATOM

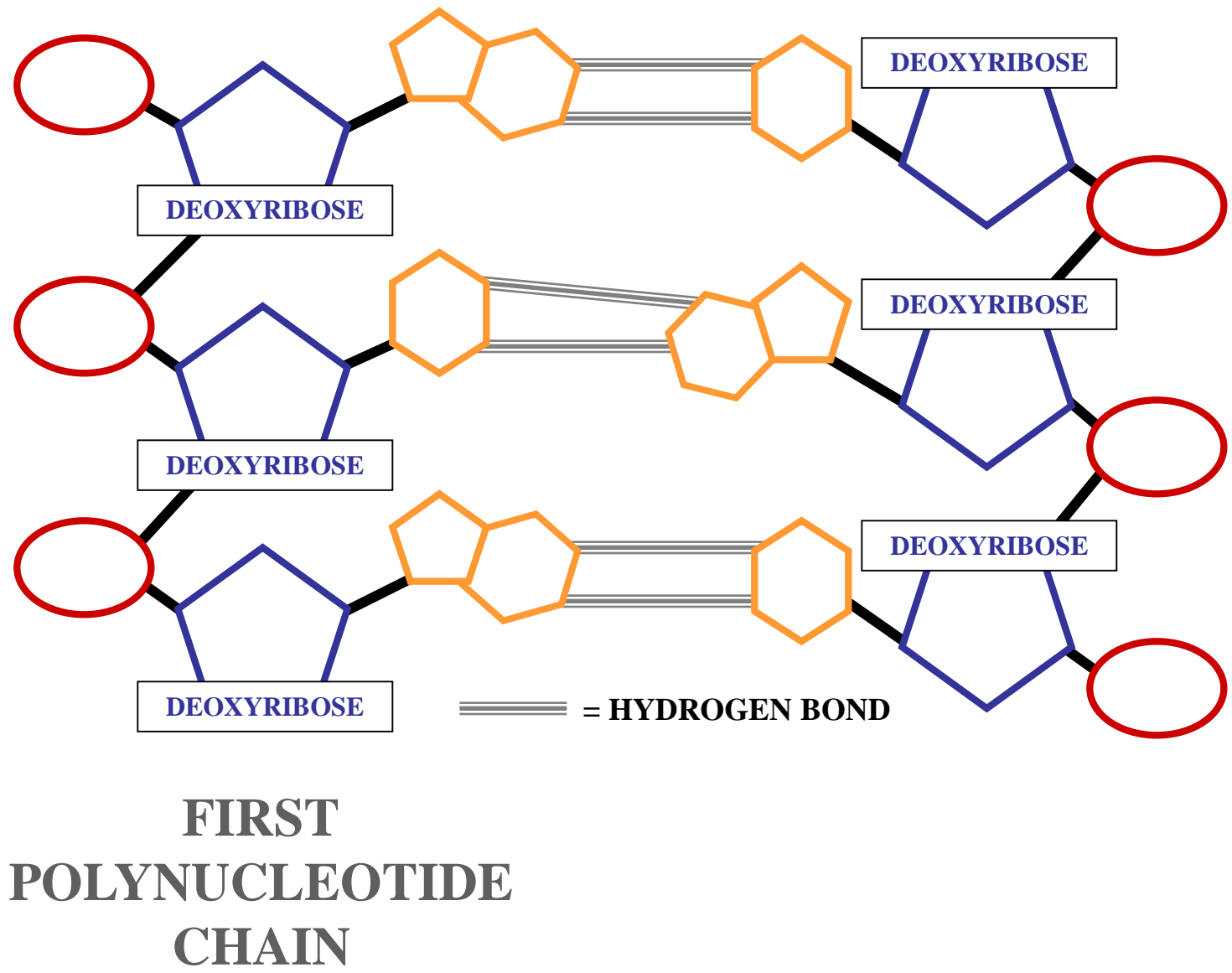
# DEOXYRIBOSE PENTOSE SUGAR



**C** = CARBON ATOM

# DNA DOUBLE HELIX MODEL

ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN

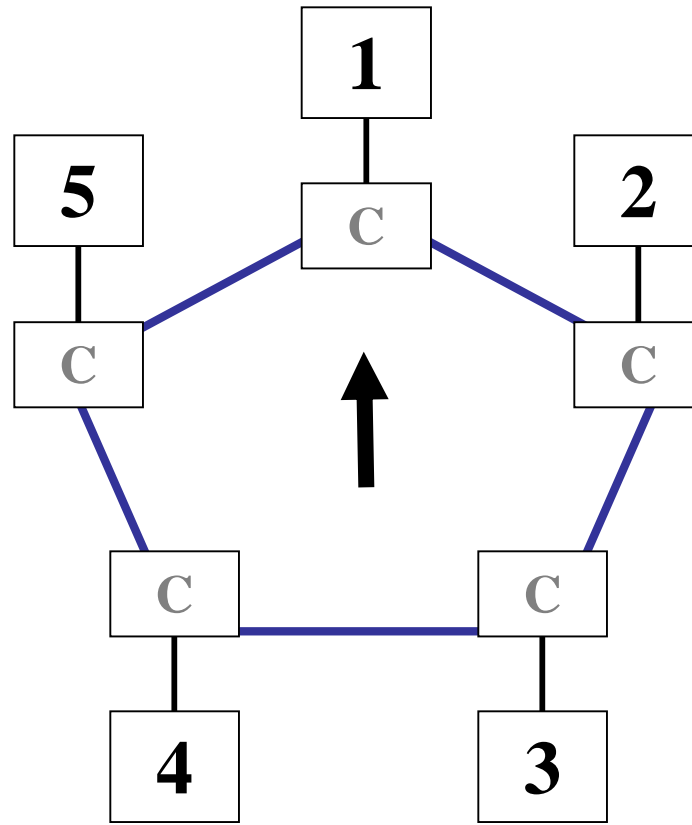


ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN





# DEOXYRIBOSE PENTOSE SUGAR



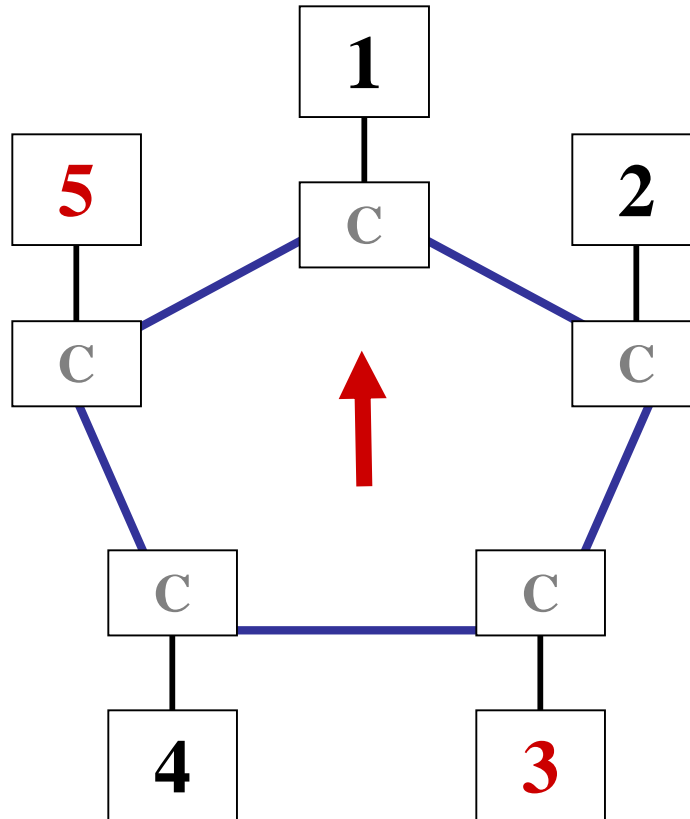
FIRST  
POLYNUCLEOTIDE  
CHAIN

**C** = CARBON ATOM

# DEOXYRIBOSE PENTOSE SUGAR

1

3



FIRST  
POLYNUCLEOTIDE  
CHAIN  
DEOXYRIBOSE  
~3~5 C ALIGNMENT

**C** = CARBON ATOM



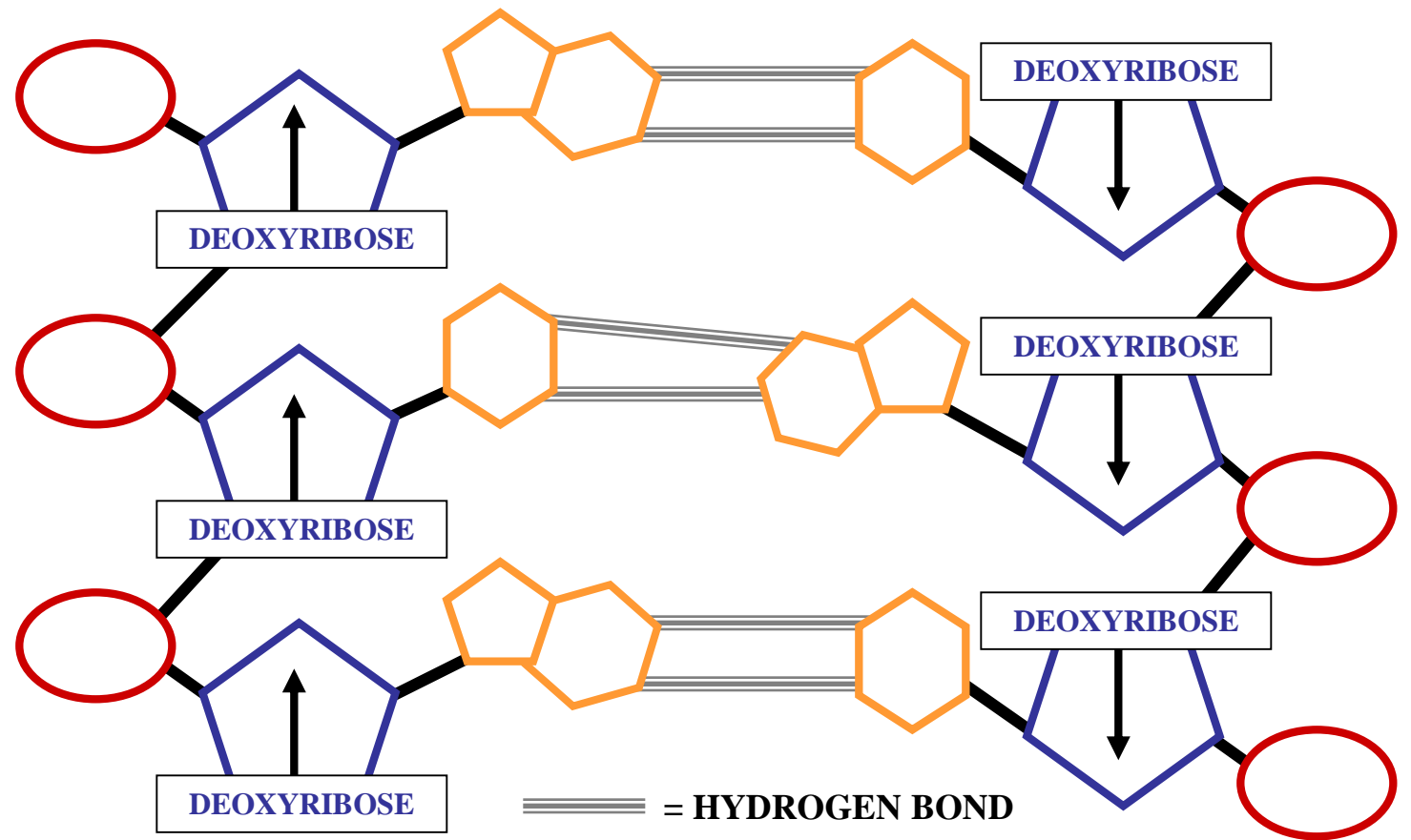






# DNA DOUBLE HELIX MODEL

ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN

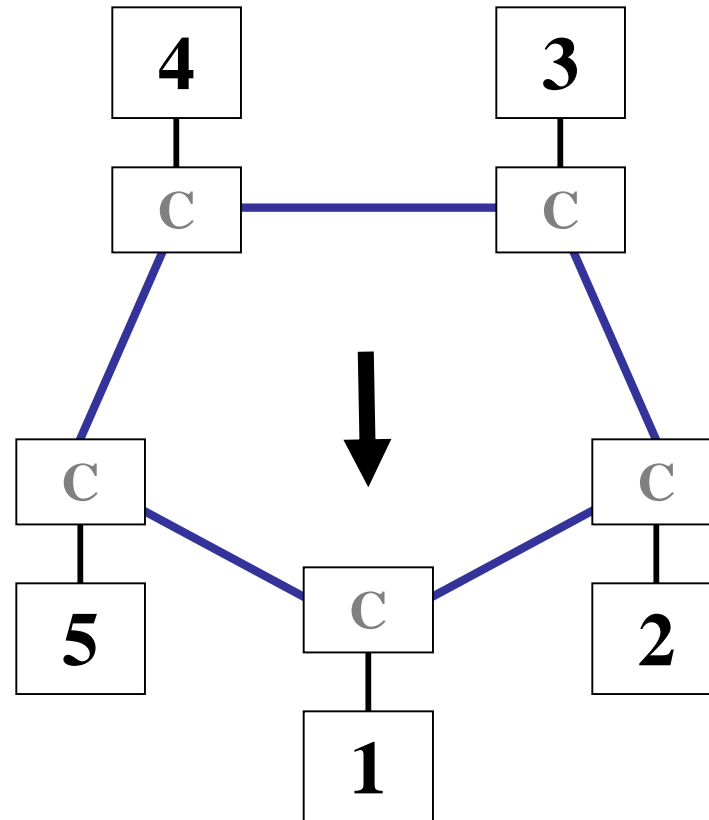


FIRST  
POLYNUCLEOTIDE  
CHAIN  
DEOXYRIBOSE  
~3~5 C ALIGNMENT

SECOND  
POLYNUCLEOTIDE  
CHAIN

ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN

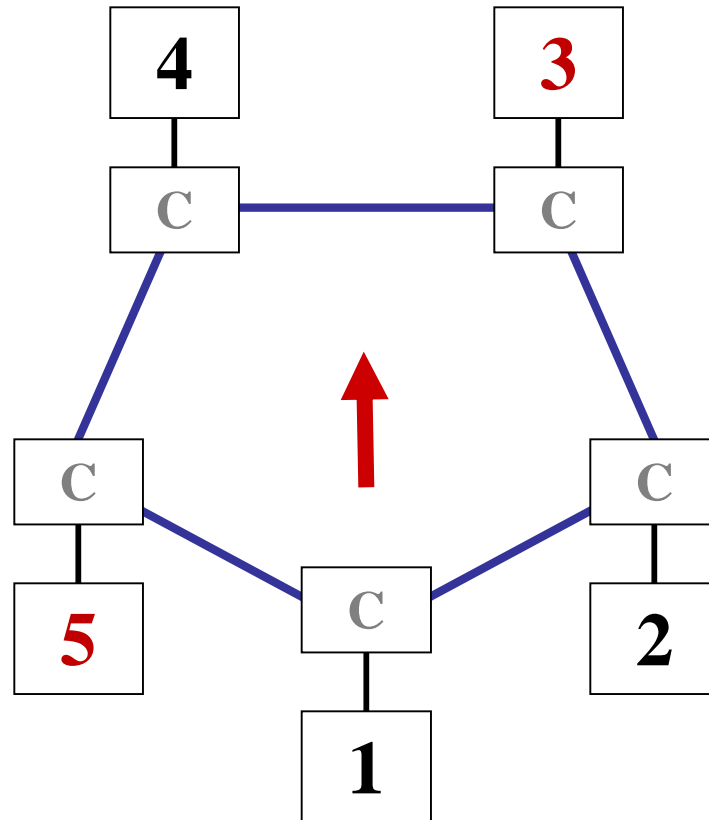
# DEOXYRIBOSE PENTOSE SUGAR



SECOND  
POLYNUCLEOTIDE  
CHAIN

**C** = CARBON ATOM

# DEOXYRIBOSE PENTOSE SUGAR



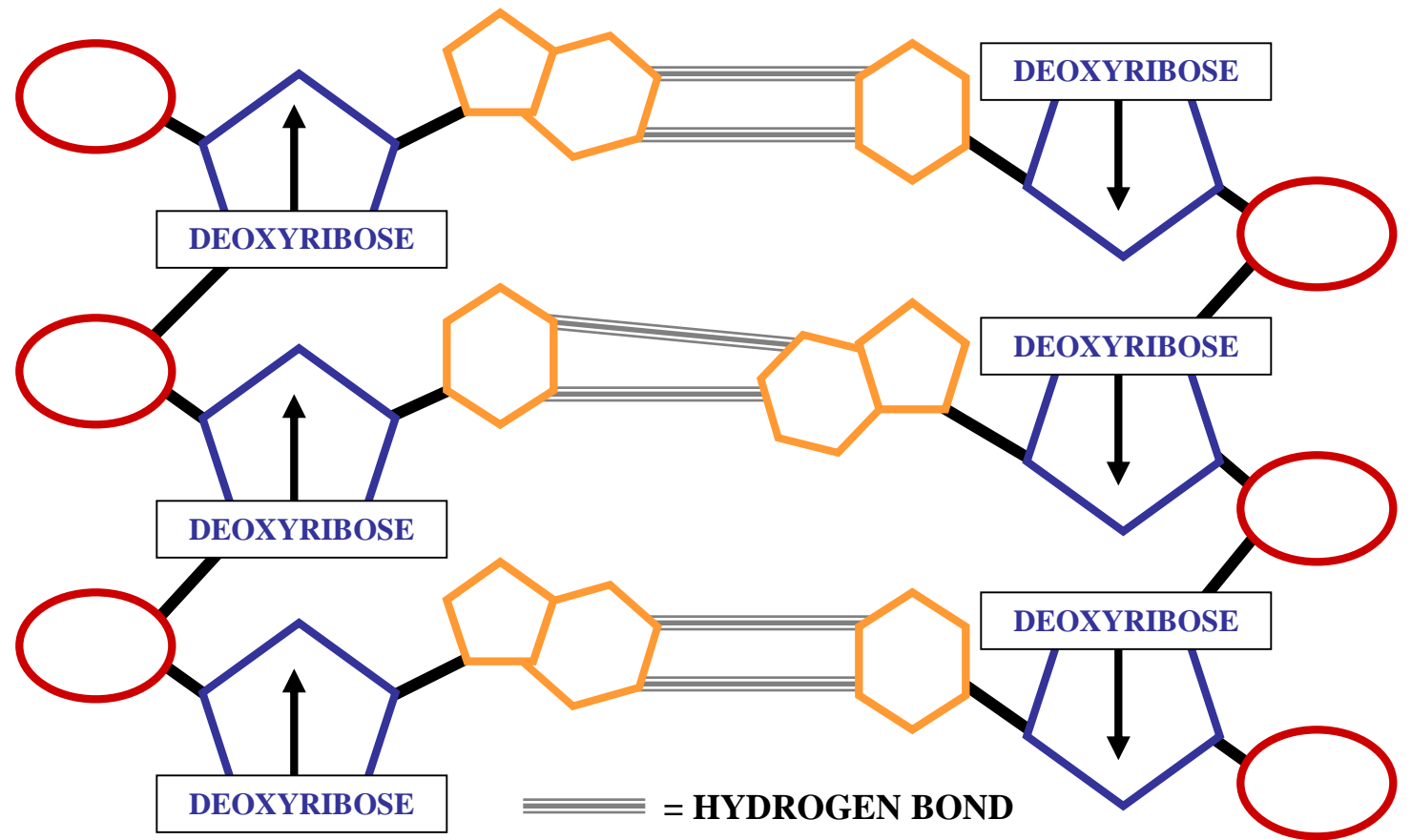
SECOND  
POLYNUCLEOTIDE  
CHAIN  
DEOXYRIBOSE  
~5~3 C ALIGNMENT

**C** = CARBON ATOM

# DNA DOUBLE HELIX MODEL

ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN

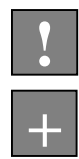
ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN  
DEOXYRIBOSE  
~3~5 C ALIGNMENT

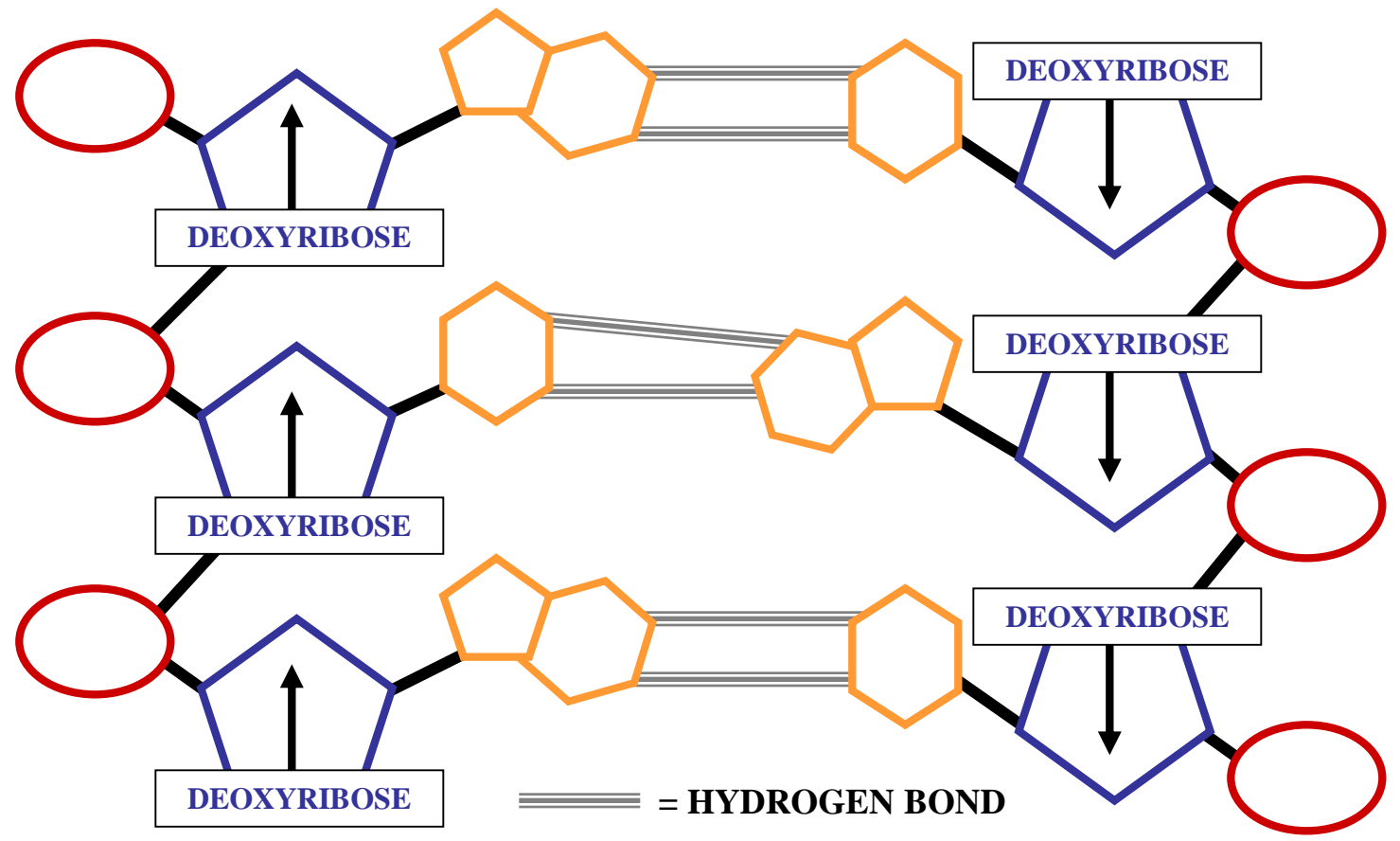
SECOND  
POLYNUCLEOTIDE  
CHAIN

# DNA DOUBLE HELIX MODEL

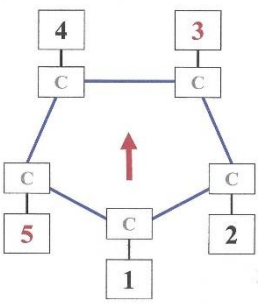


ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN

ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN  
DEOXYRIBOSE  
~3~5 C ALIGNMENT



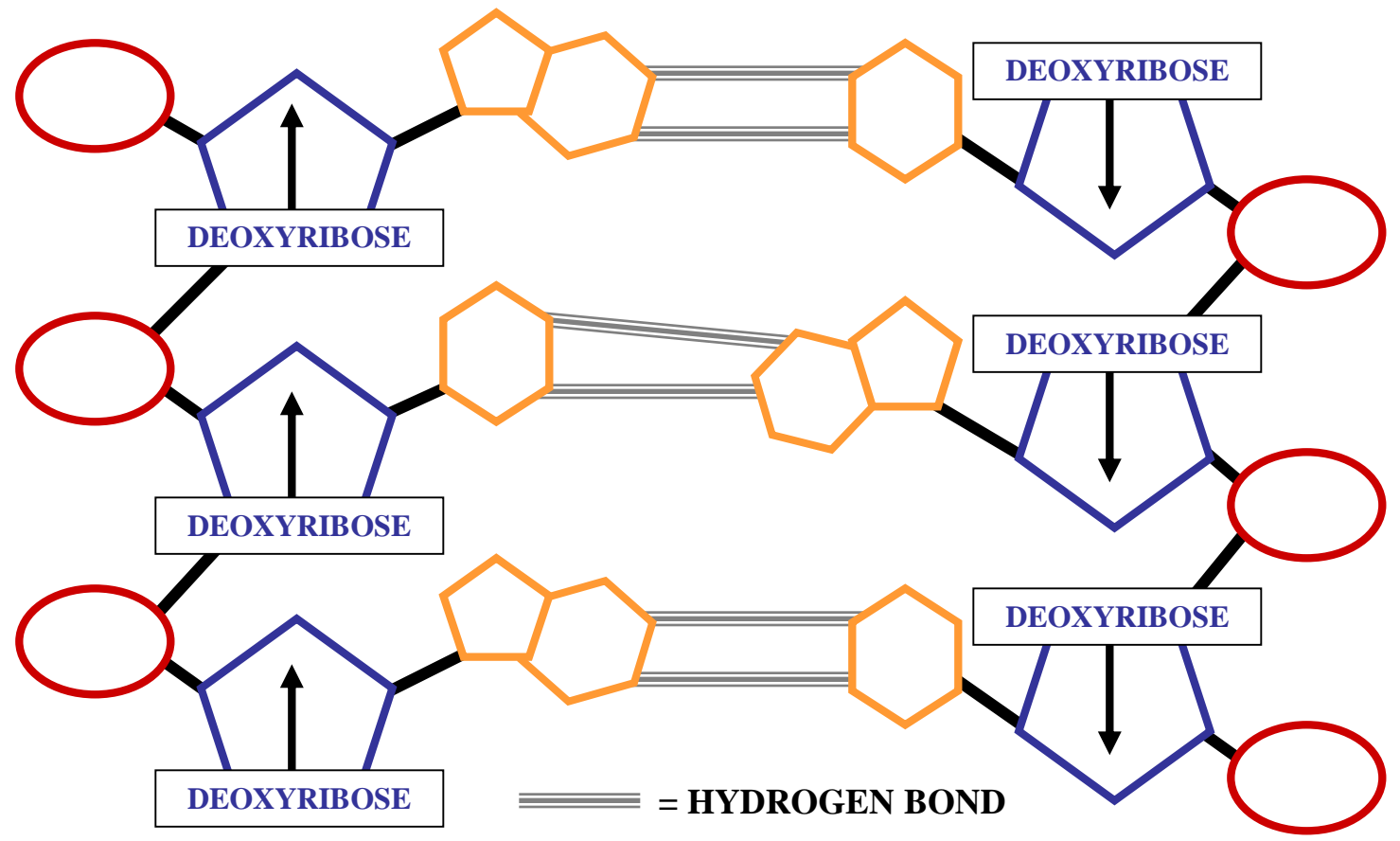
SECOND  
POLYNUCLEOTIDE  
CHAIN  
DEOXYRIBOSE  
~5~3 C ALIGNMENT



# DNA DOUBLE HELIX MODEL

ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN

ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN  
DEOXYRIBOSE  
~3~5 C ALIGNMENT

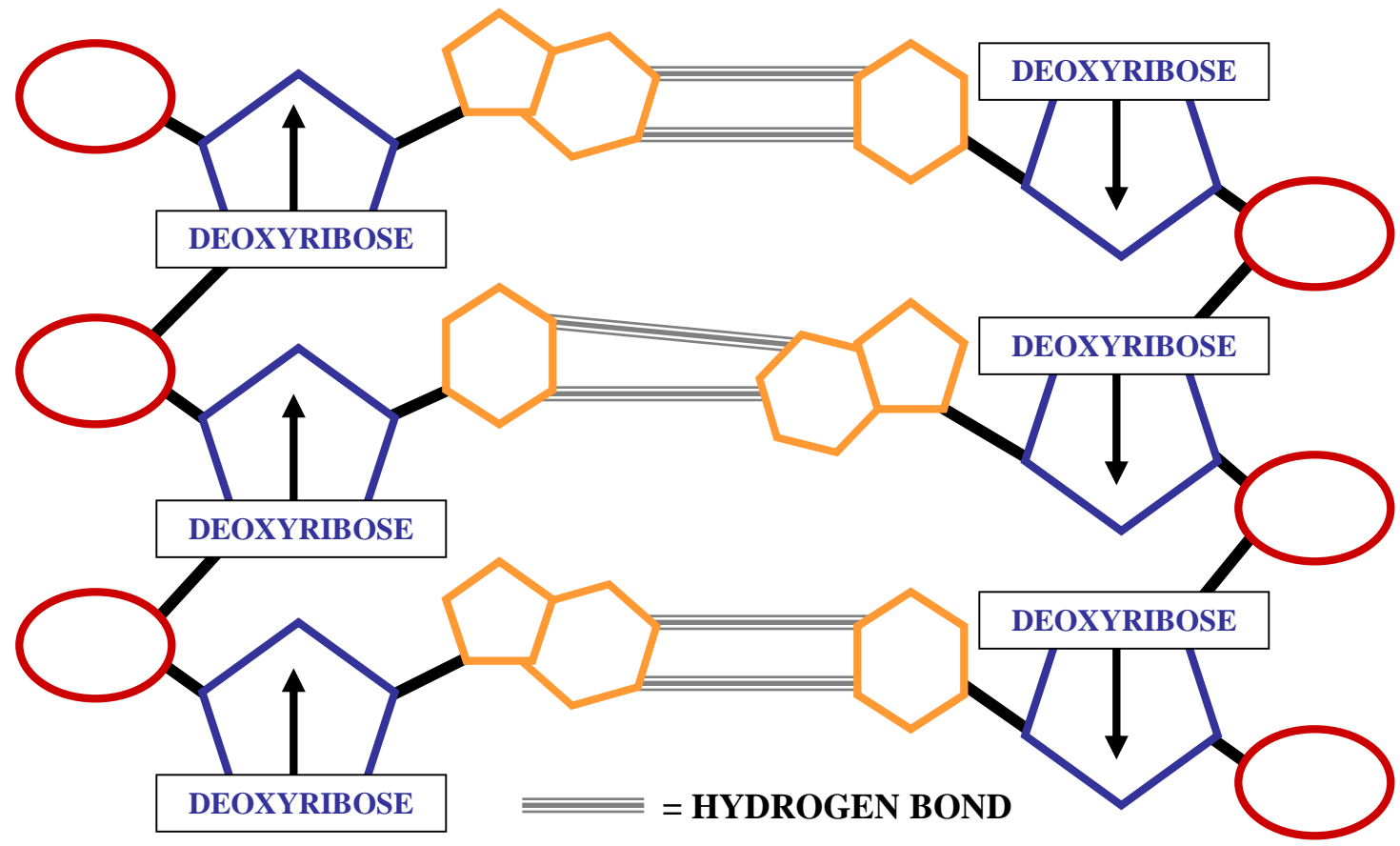
SECOND  
POLYNUCLEOTIDE  
CHAIN  
DEOXYRIBOSE  
~5~3 C ALIGNMENT



# DNA DOUBLE HELIX MODEL



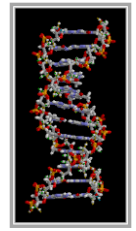
ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN



ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN

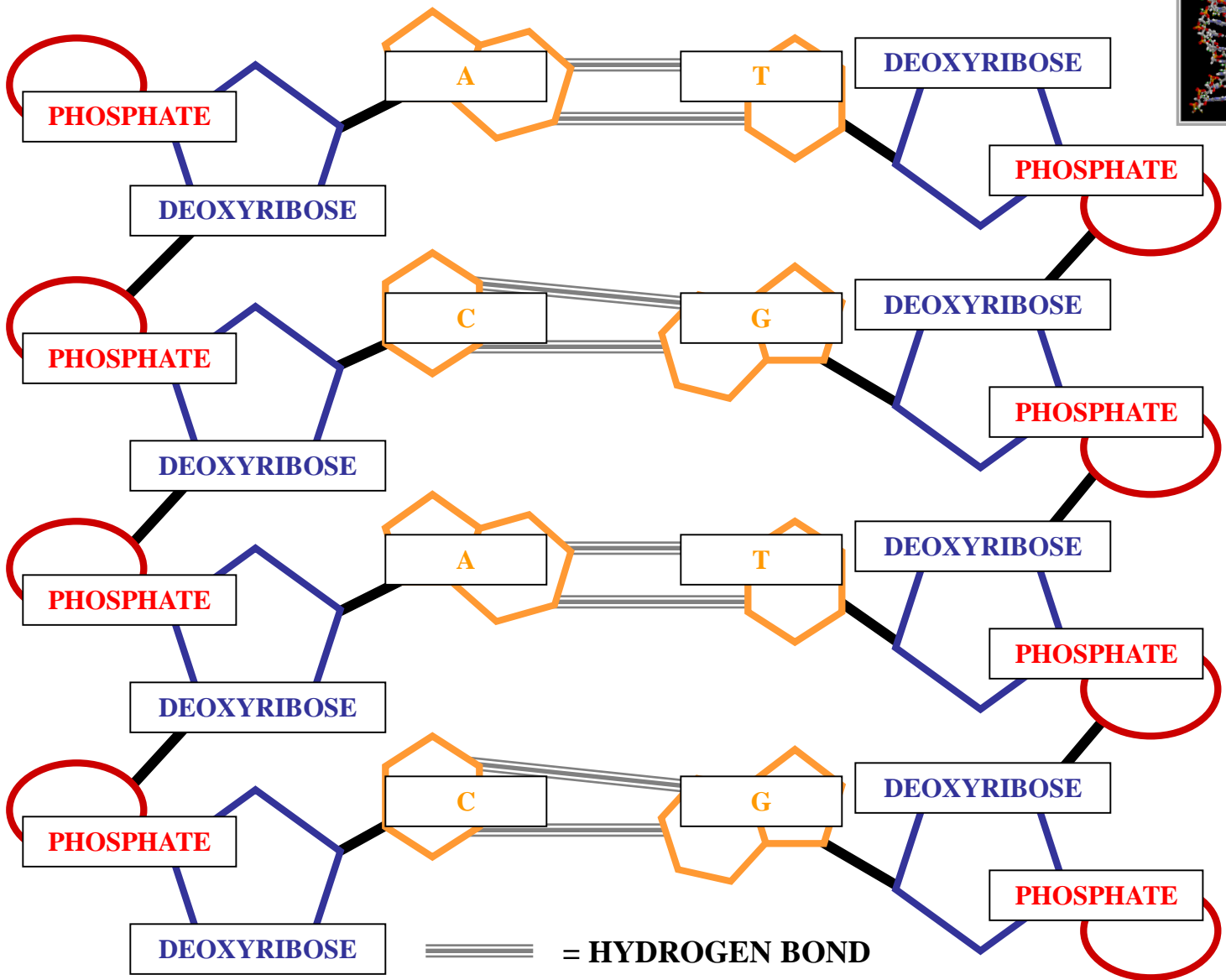
**POLYNUCLEOTIDE CHAINS  
ANTIPARALLEL**

# DNA DOUBLE HELIX MODEL



ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN

ANTIPARALLEL  
POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

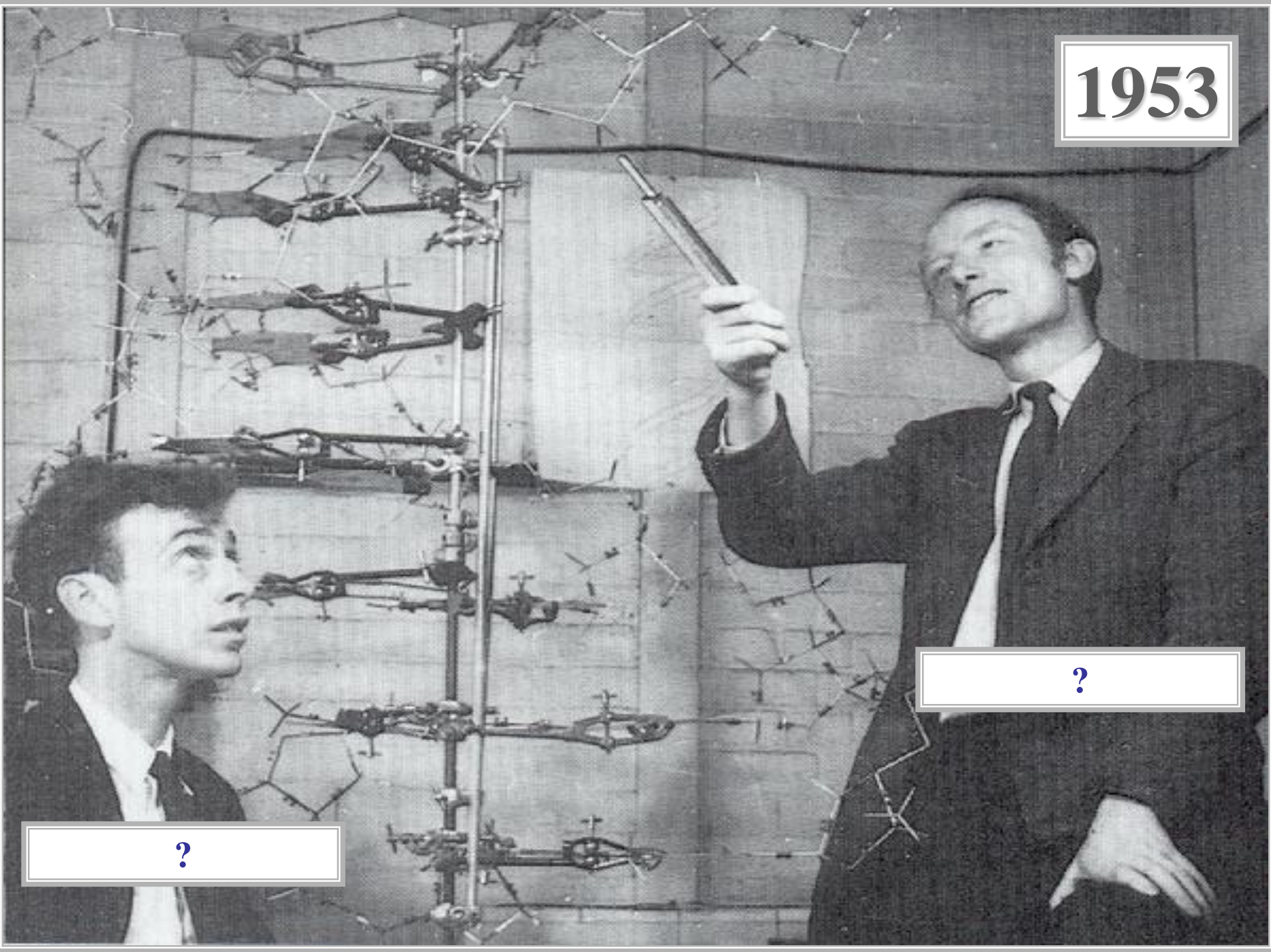
SECOND  
POLYNUCLEOTIDE  
CHAIN

== = HYDROGEN BOND



**DNA**  
**DOUBLE HELIX**  
**MODEL**  
**SUMMARY**

1953



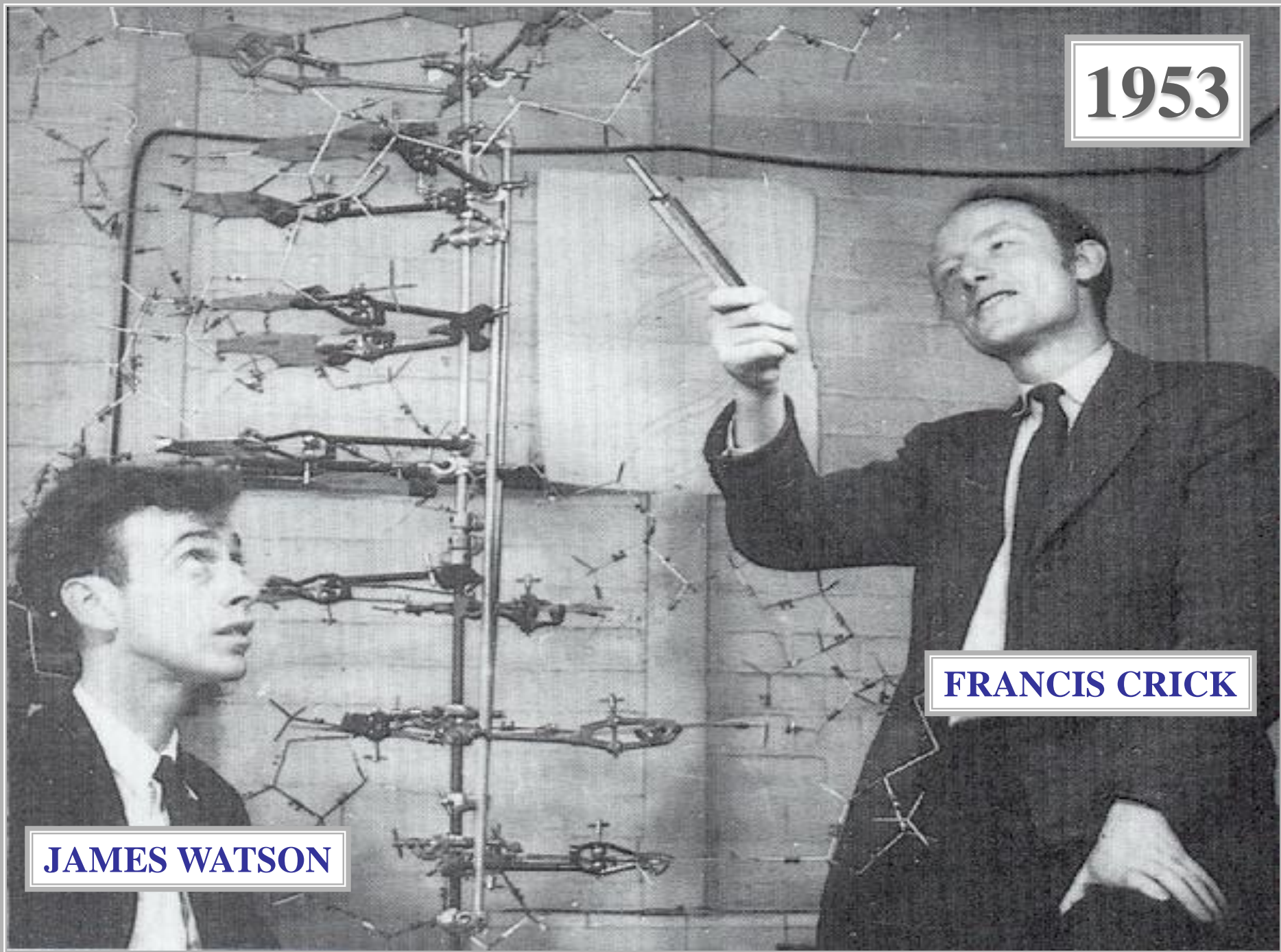
?

?

**1953**

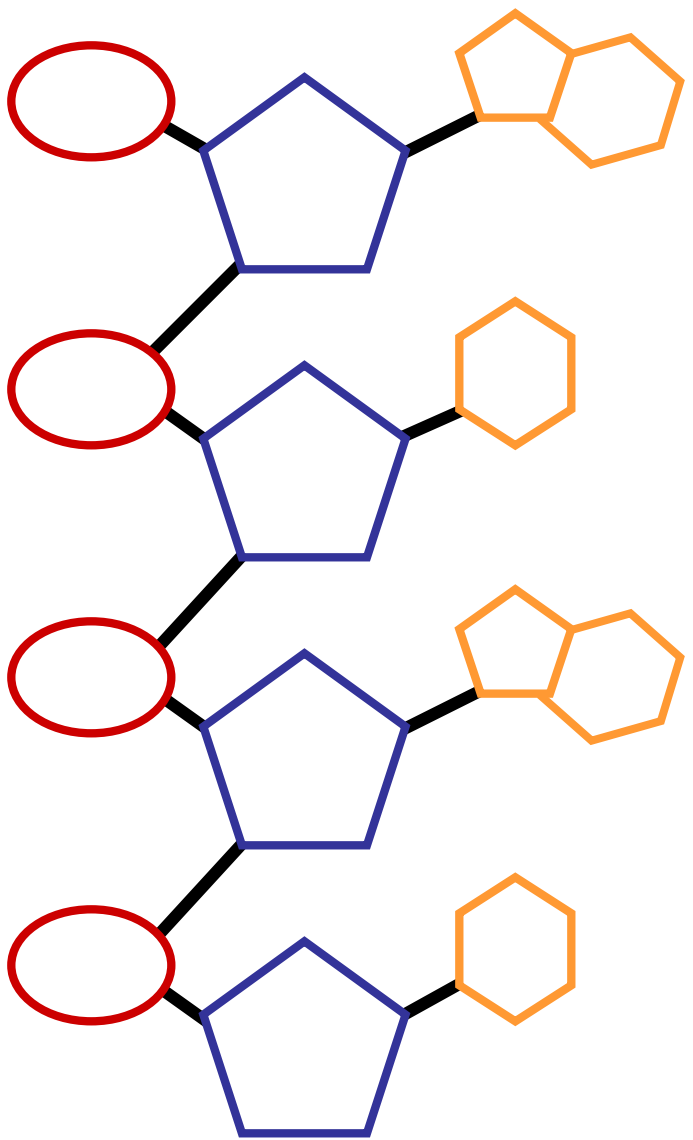
**FRANCIS CRICK**

**JAMES WATSON**



# DNA DOUBLE HELIX MODEL

POLYNUCLEOTIDE CHAIN

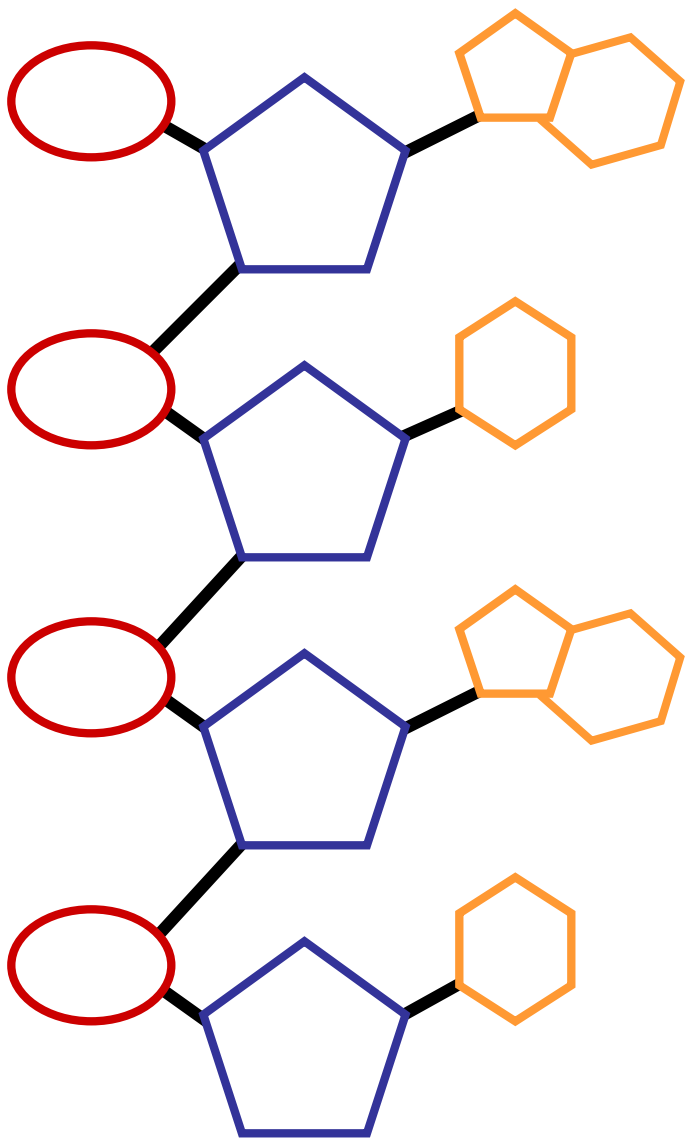


FIRST  
POLYNUCLEOTIDE  
CHAIN



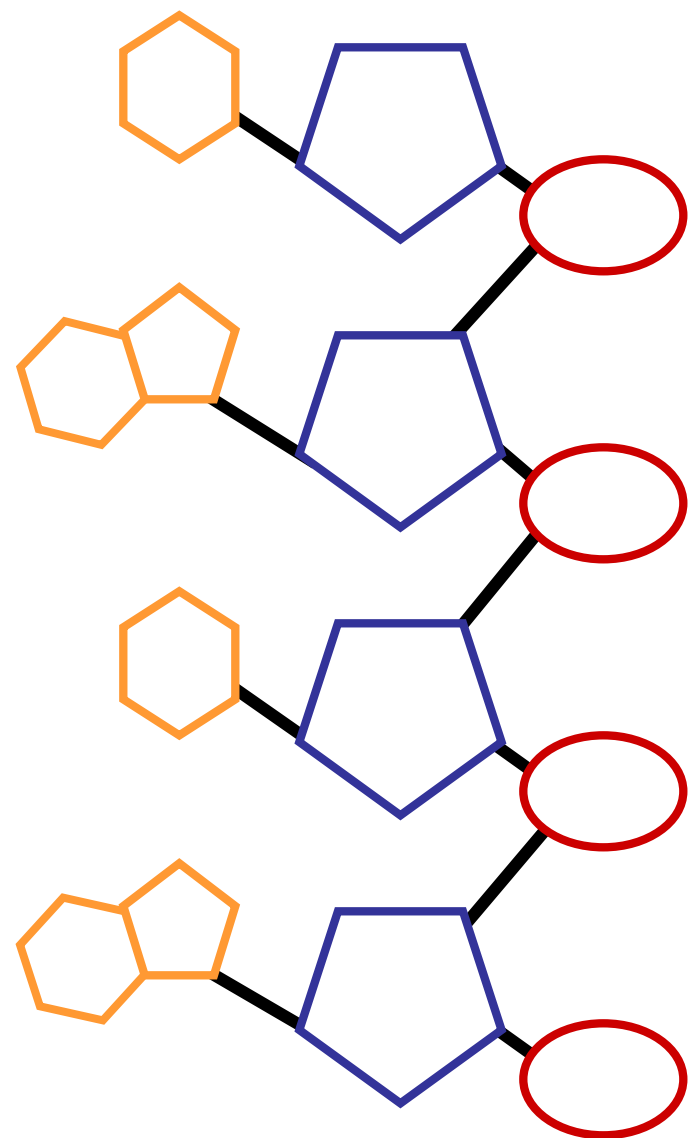
# DNA DOUBLE HELIX MODEL

POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

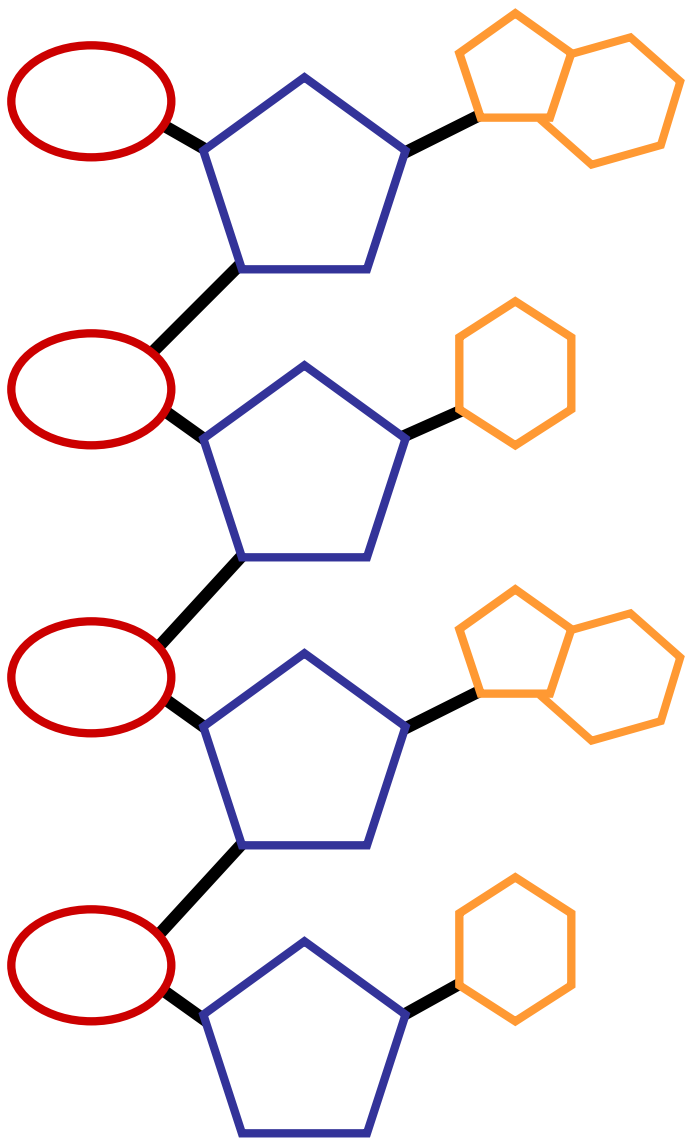
POLYNUCLEOTIDE CHAIN



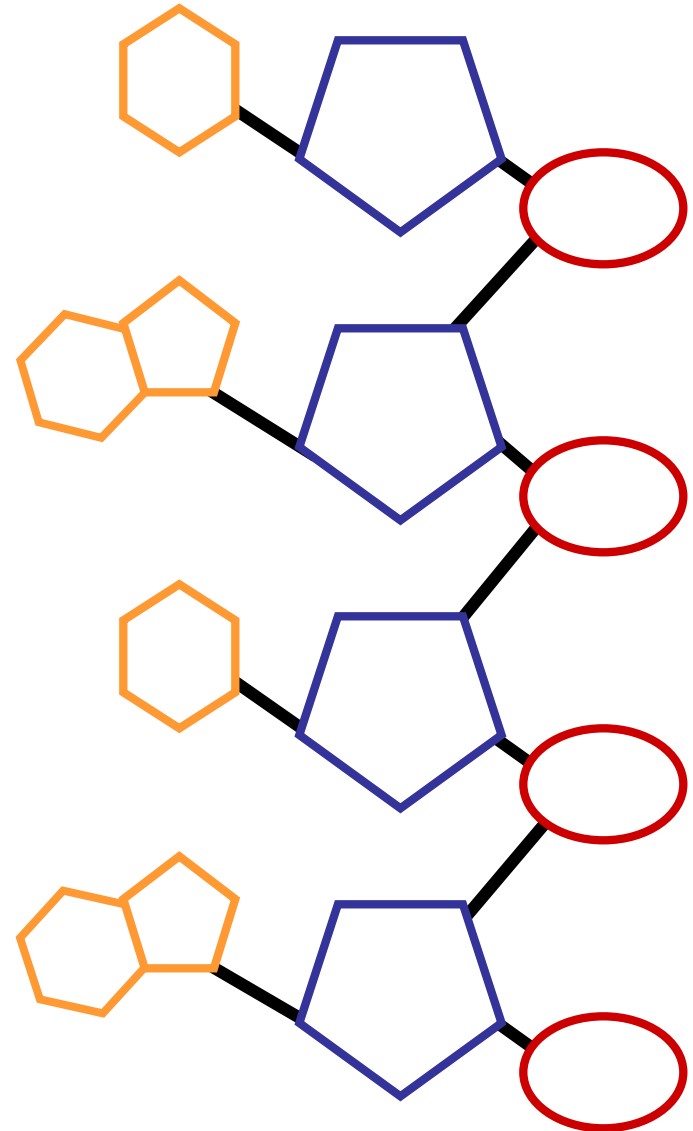
SECOND  
POLYNUCLEOTIDE  
CHAIN

# DNA DOUBLE HELIX MODEL

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

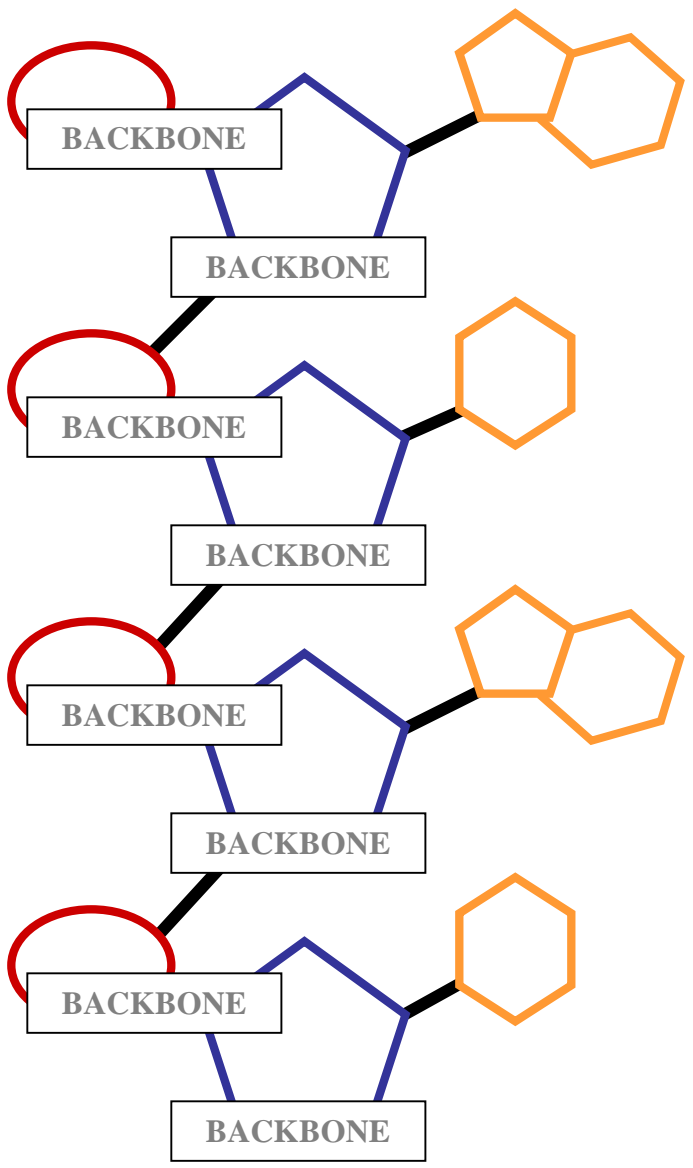


SECOND  
POLYNUCLEOTIDE  
CHAIN

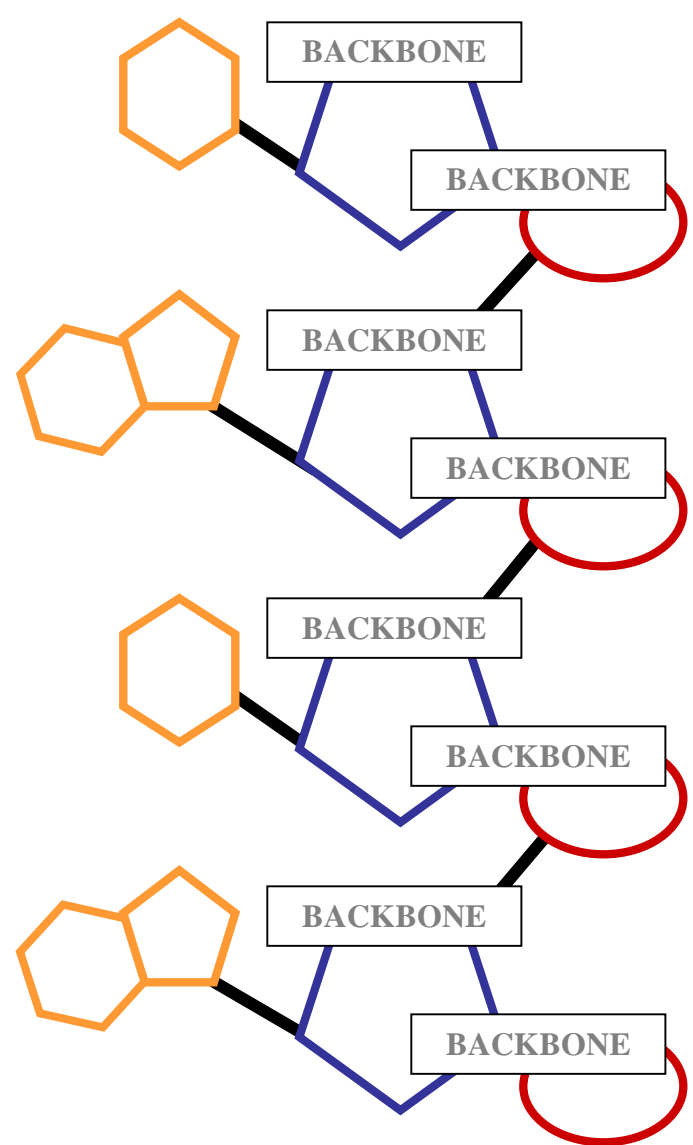
PARALLEL POLYNUCLEOTIDE CHAIN

# DNA DOUBLE HELIX MODEL

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN

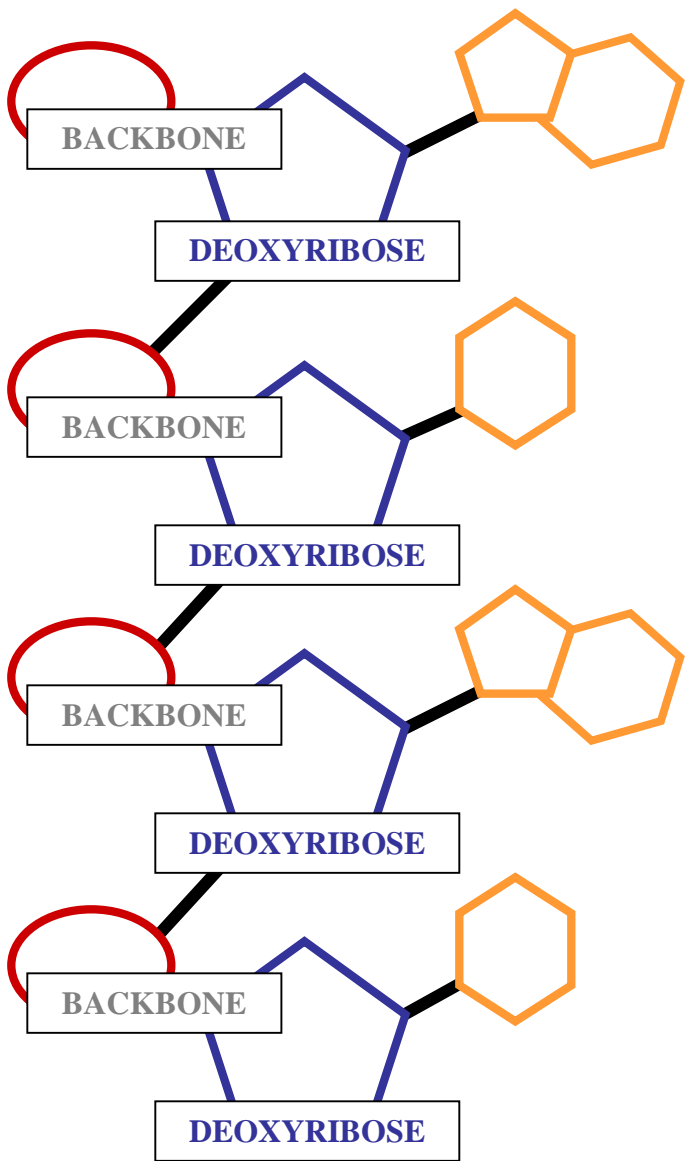


SECOND  
POLYNUCLEOTIDE  
CHAIN

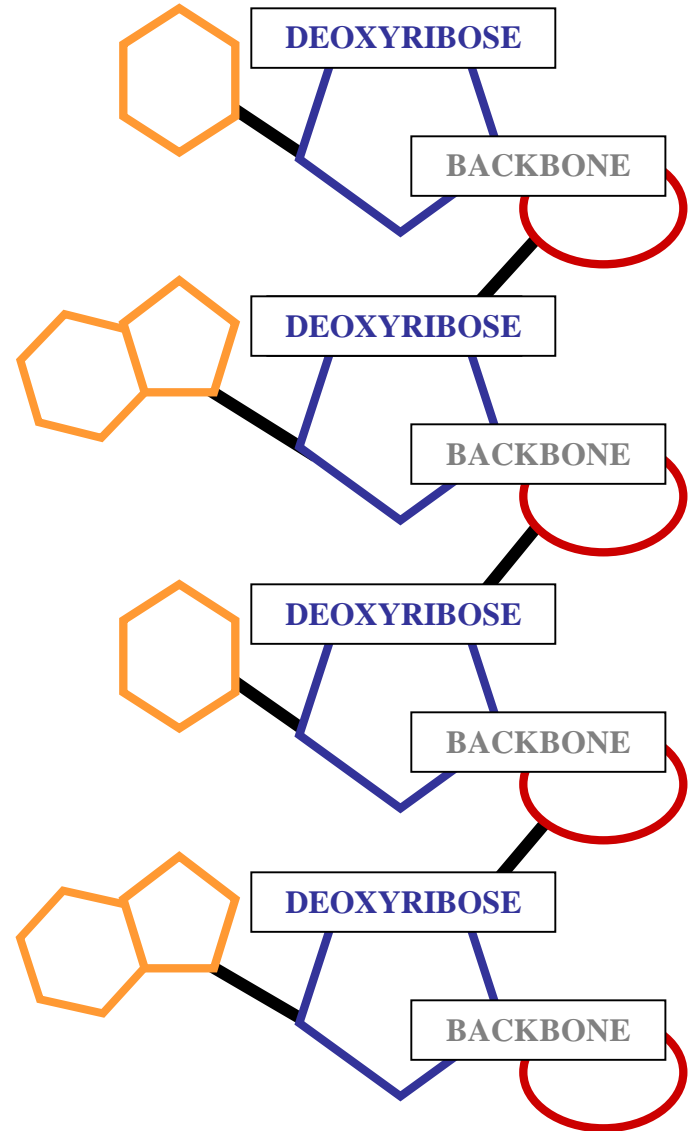
PARALLEL POLYNUCLEOTIDE CHAIN

# DNA DOUBLE HELIX MODEL

PARALLEL POLYNUCLEOTIDE CHAIN



FIRST  
POLYNUCLEOTIDE  
CHAIN



SECOND  
POLYNUCLEOTIDE  
CHAIN

PARALLEL POLYNUCLEOTIDE CHAIN