Welcome to 3.091

Lecture 32

December 2, 2009

Biochemistry: Lipids, Nucleic Acids, & DNA

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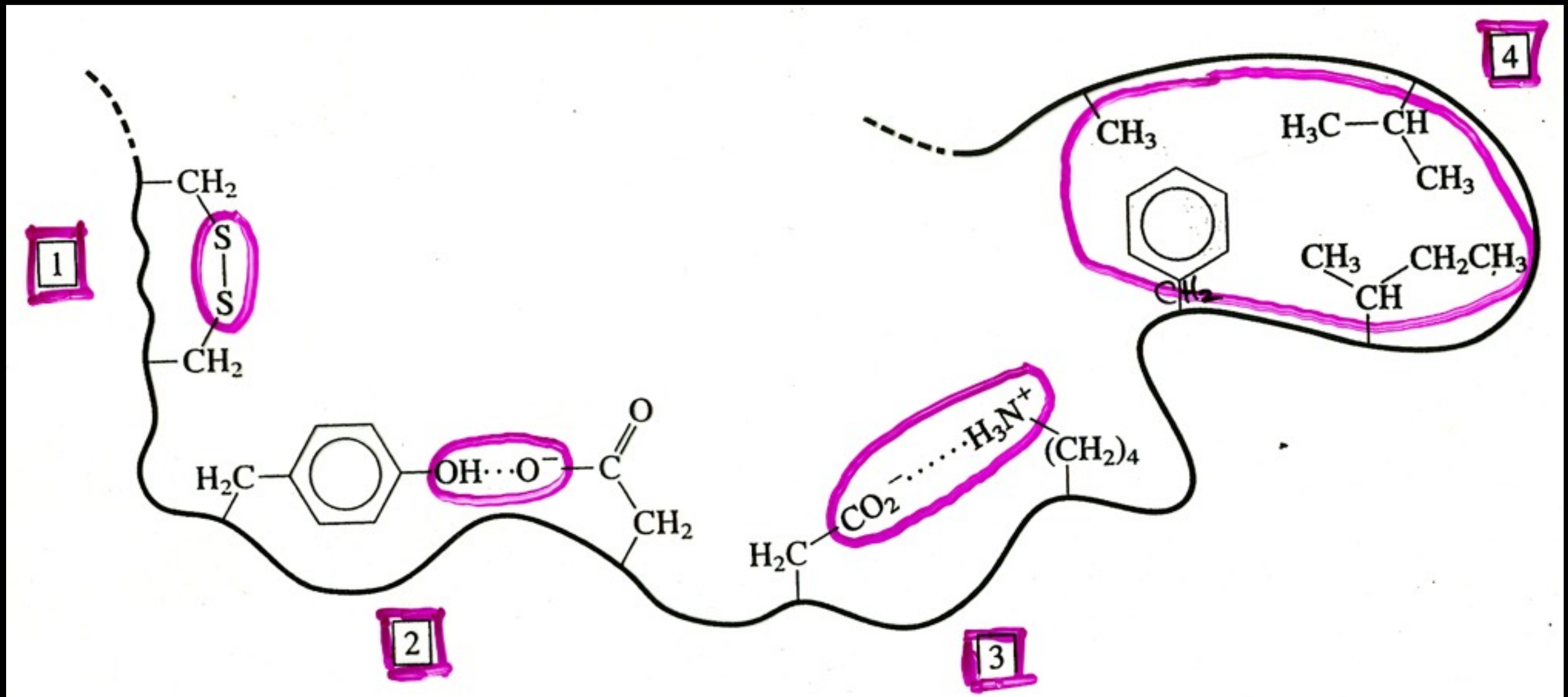
from Silk Stockings (1957)
Cyd Charisse as Ninotchka Yoschenko
Fred Astaire as Steve Canfield

tertiary structure of proteins



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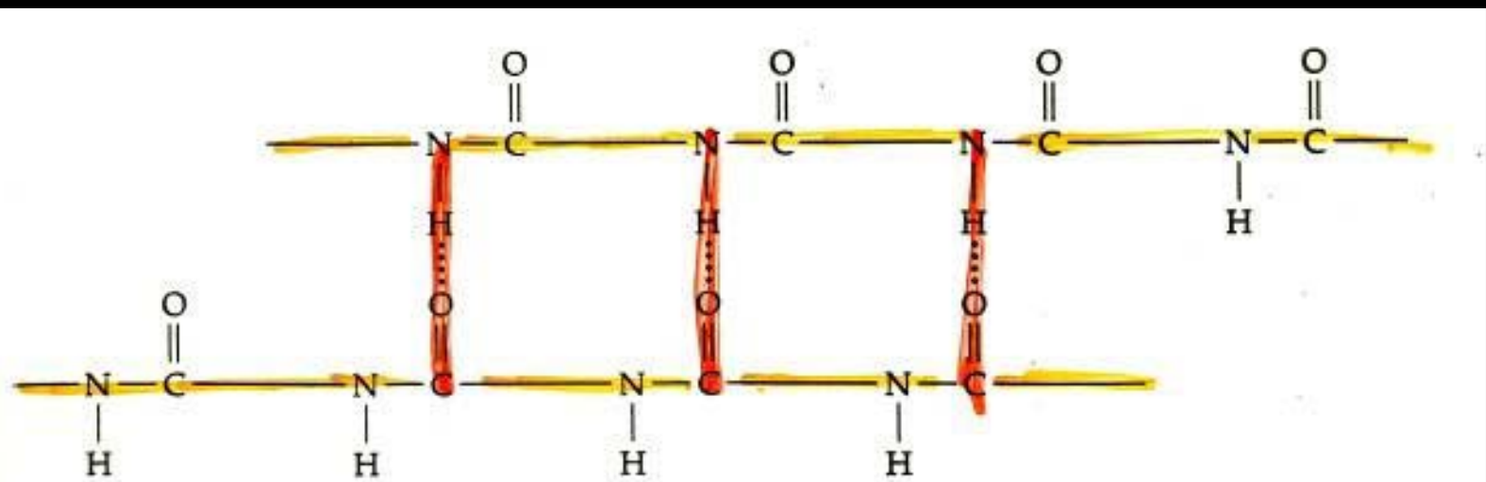
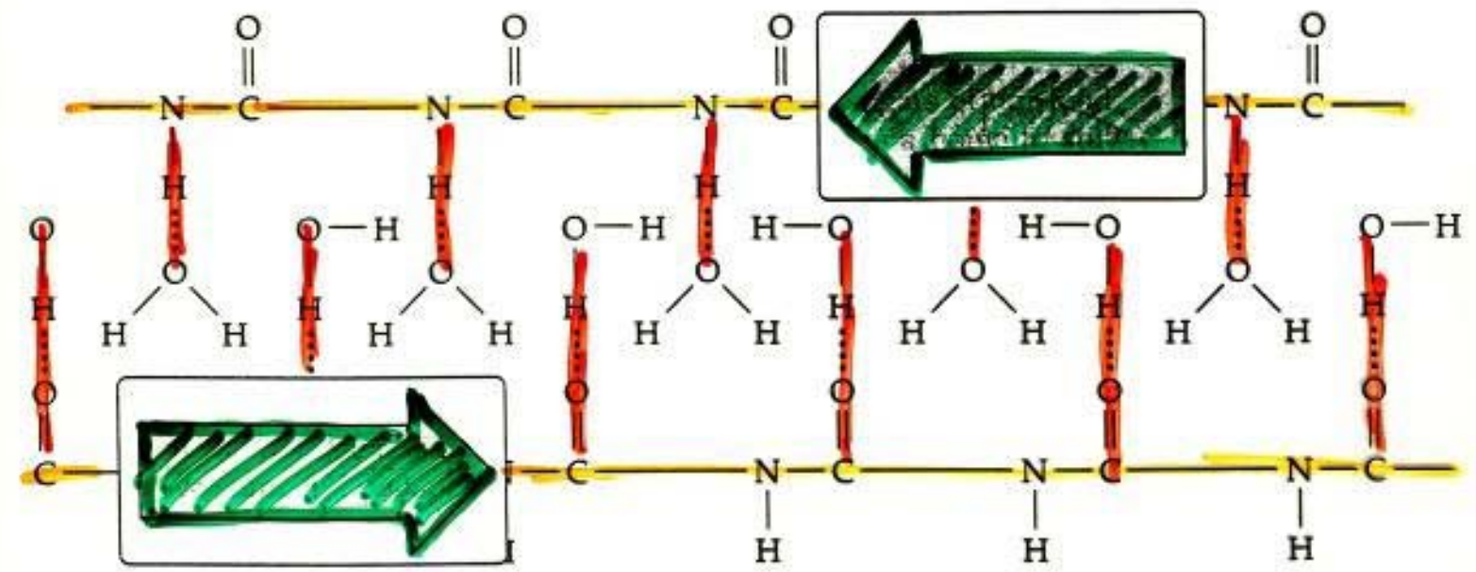
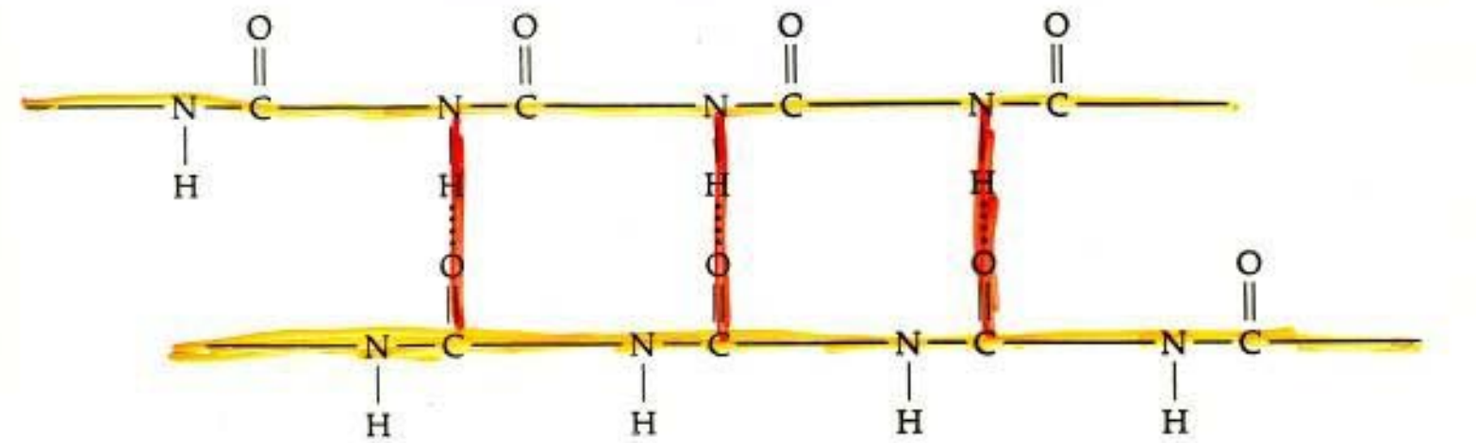


Adjacent protein strands of dry hair are held in place partly by hydrogen bonds.



Hydrogen bonding with water allows protein polymers to slide past each other when hair is wet.



Drying hair removes water and fixes a new orientation of strands.

Water as plasticizer

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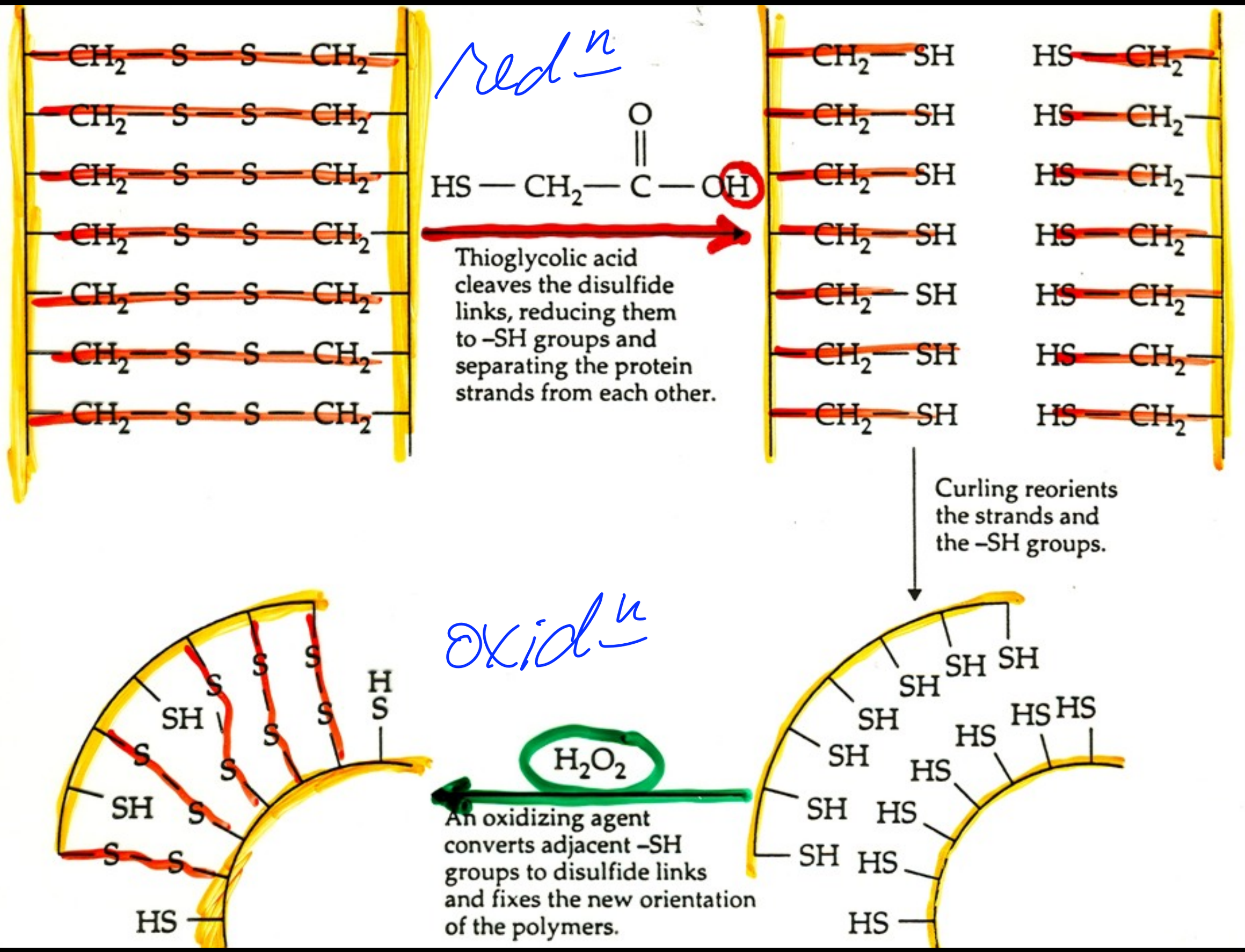

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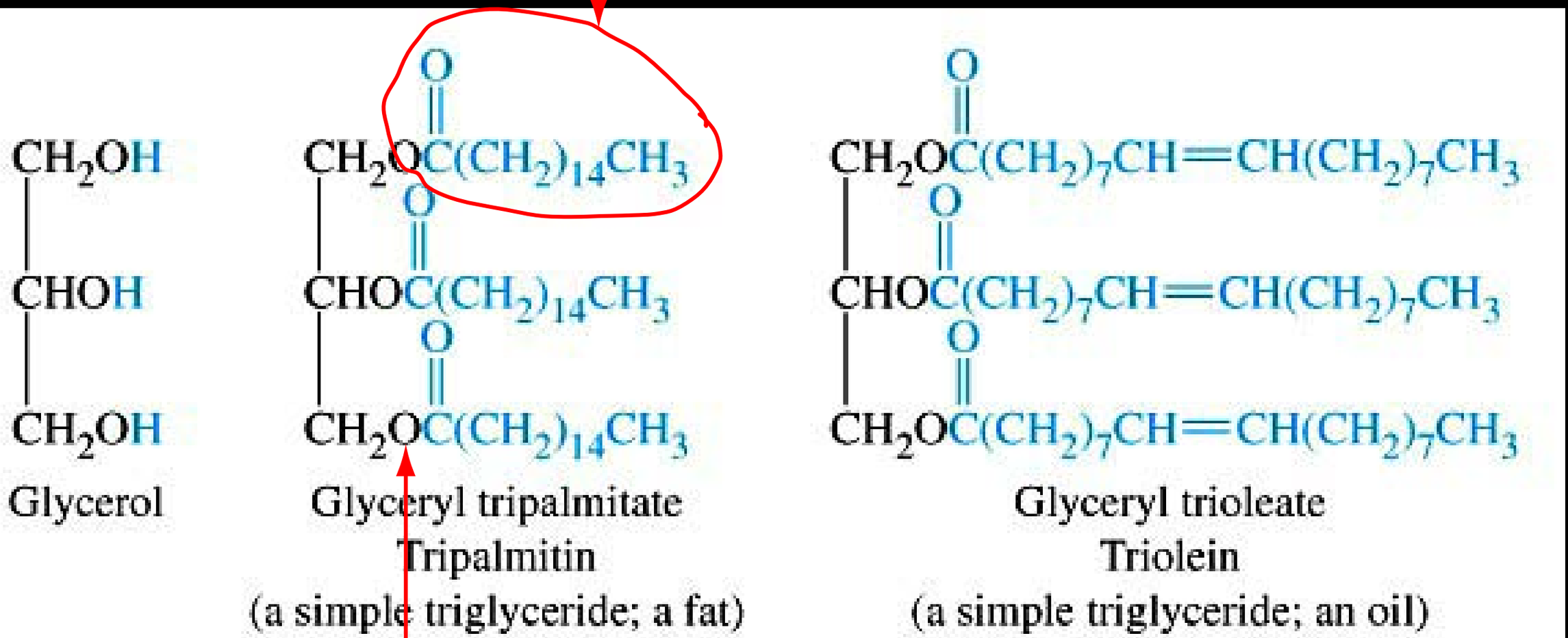
Palmitic acid



- O - bridge ester

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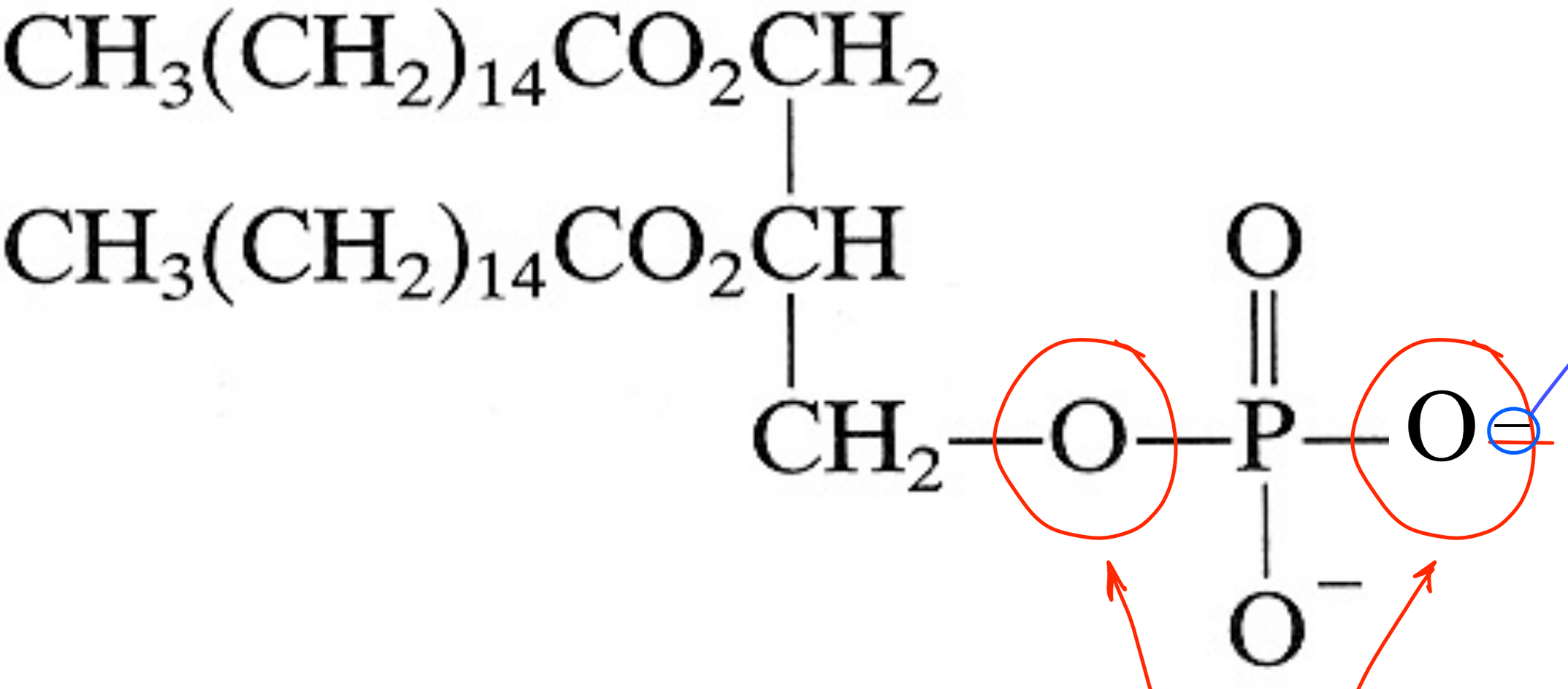
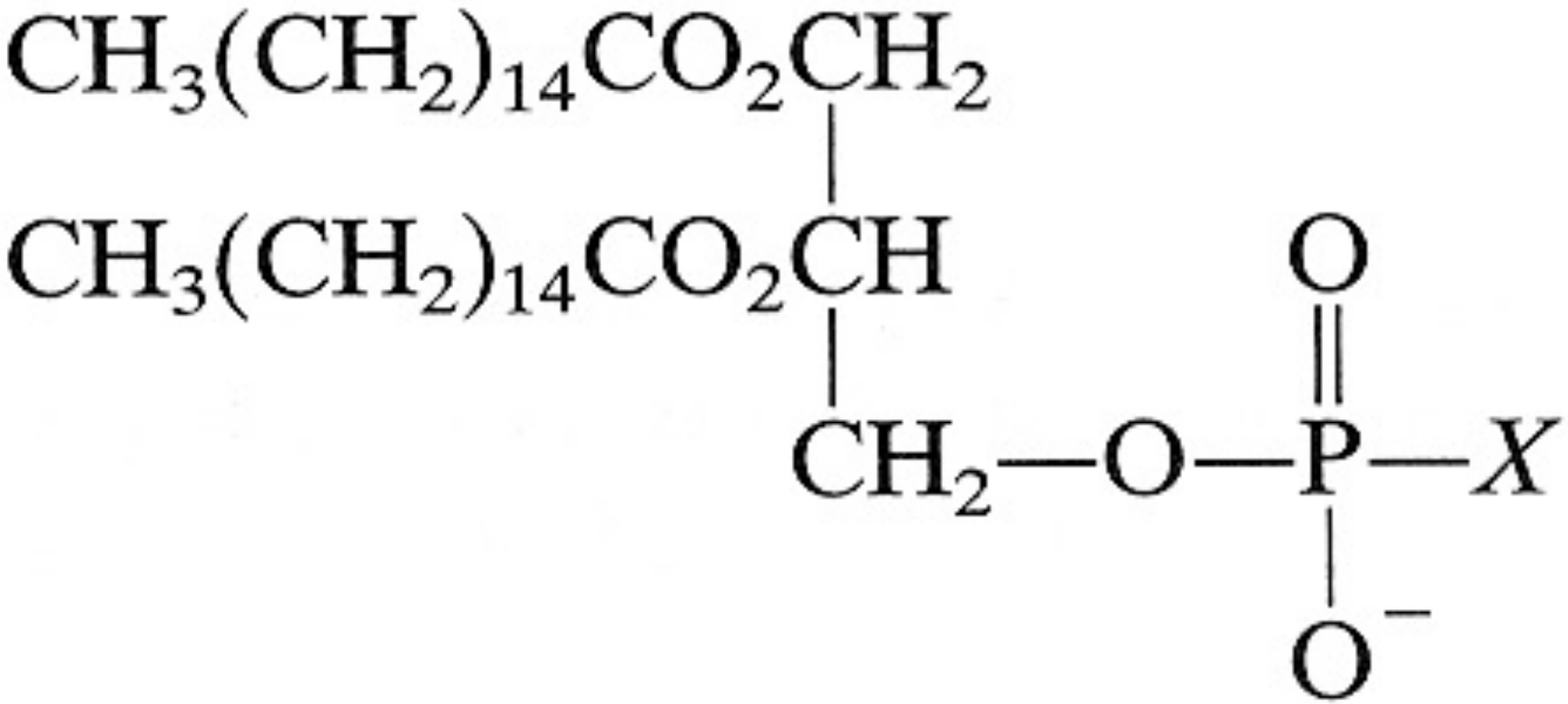
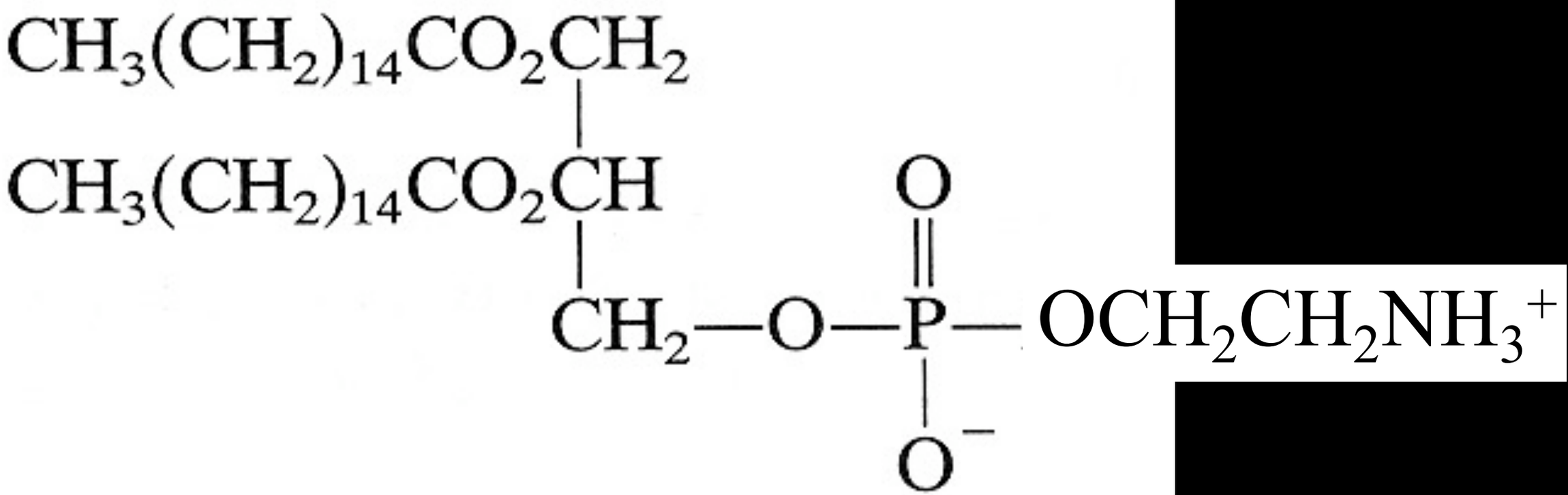


phospholipid



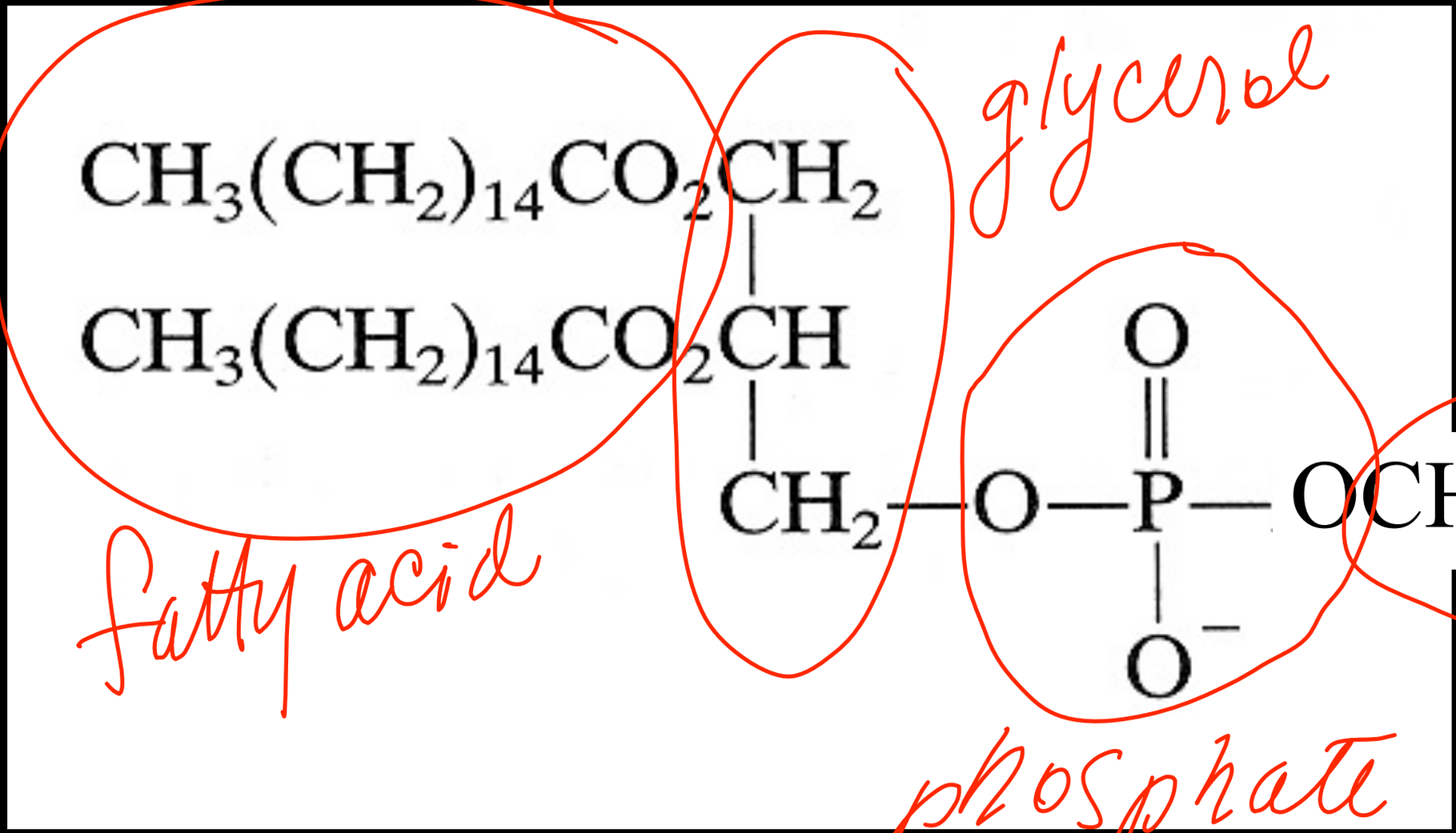
phospholipid



phosphatide

phosphatidylethanolamine

twin hydrophobic tails



glycerol

hydrophilic head

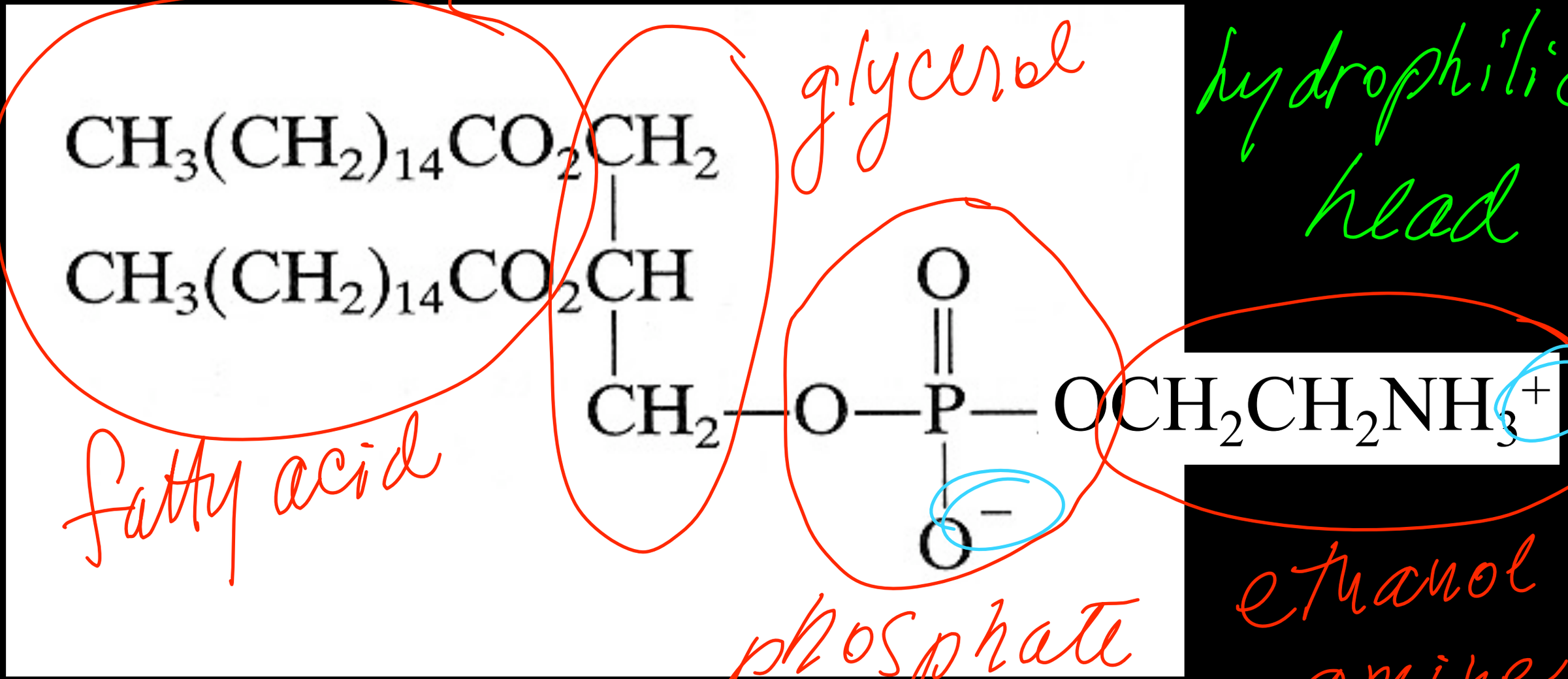
fatty acid

phosphate bridge

ethanol amine

phosphatidylethanolamine

twin hydrophobic tails



glycerol

hydrophilic head

fatty acid

phosphate

ethanol amine

zwitterionic

phosphatidylethanolamine

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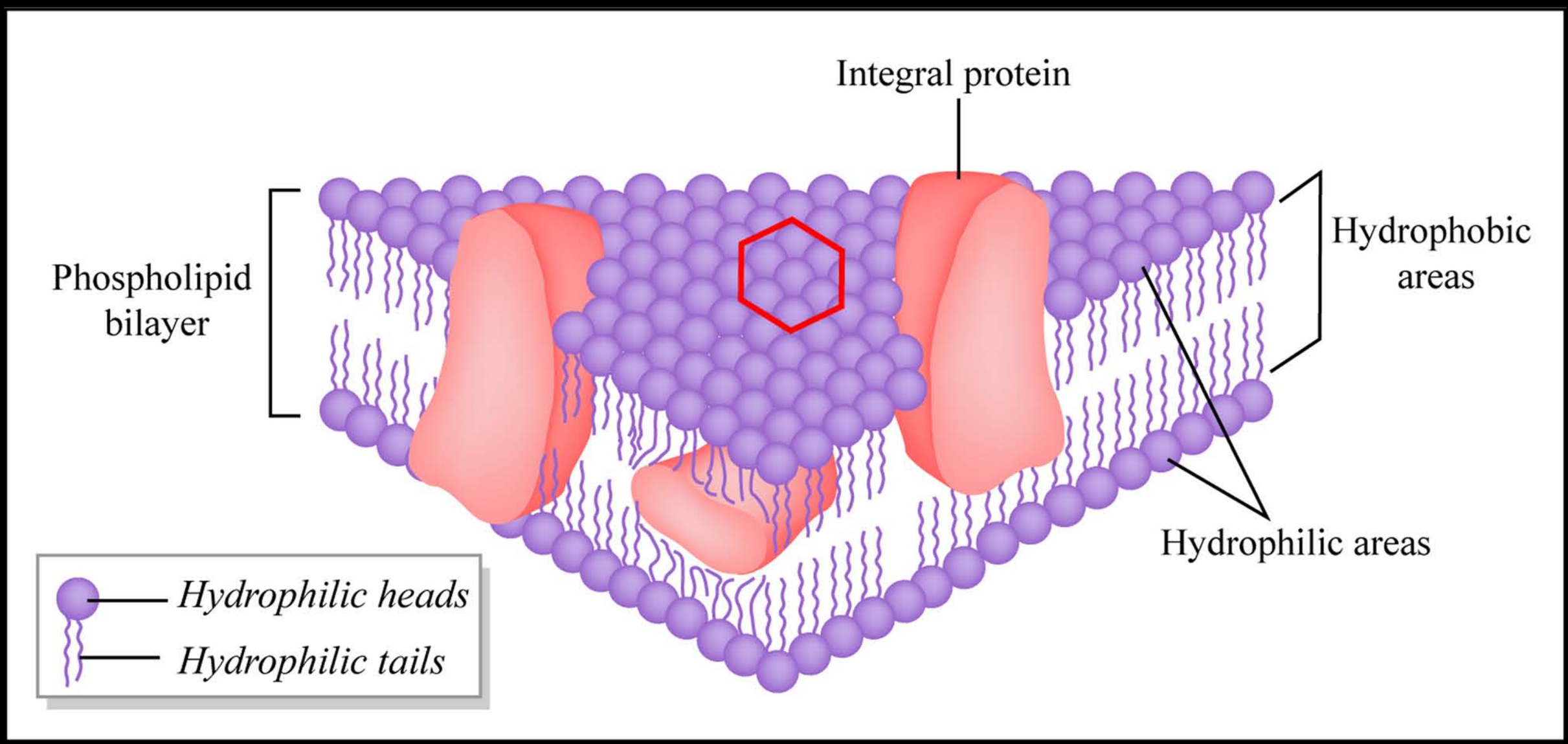

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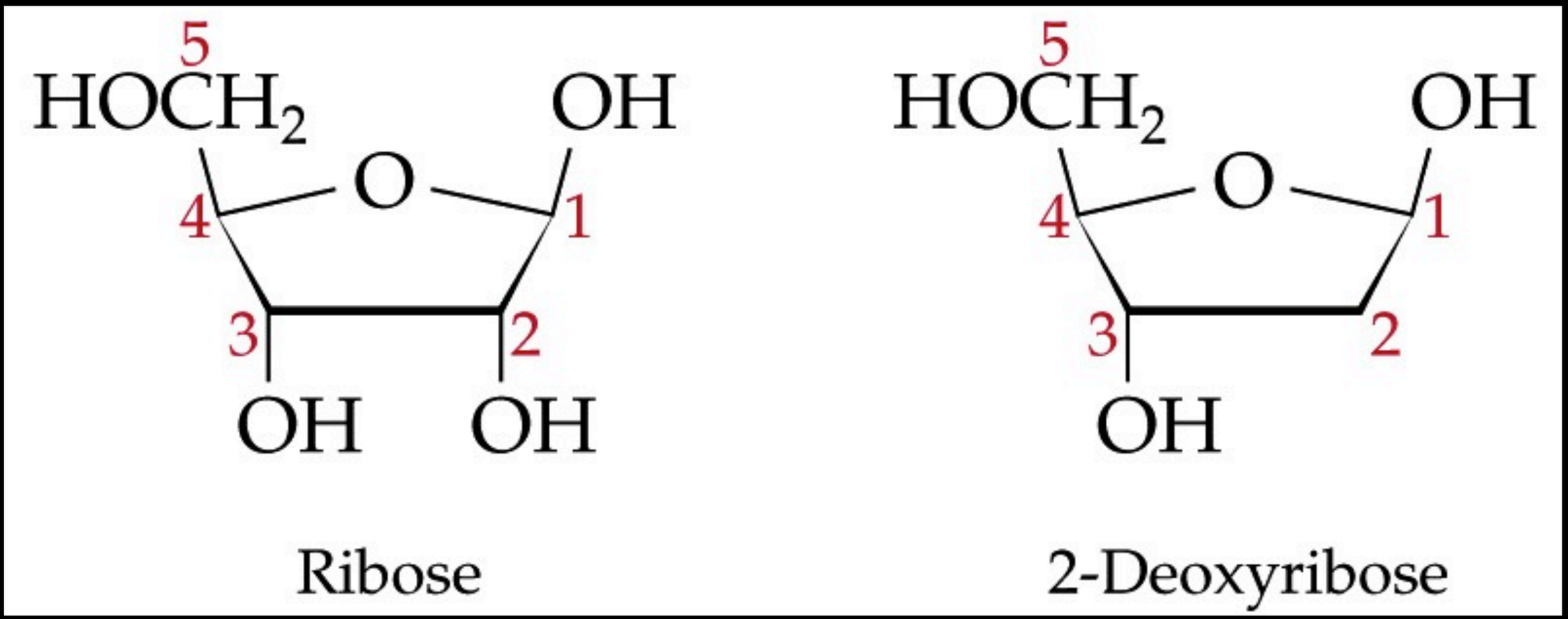
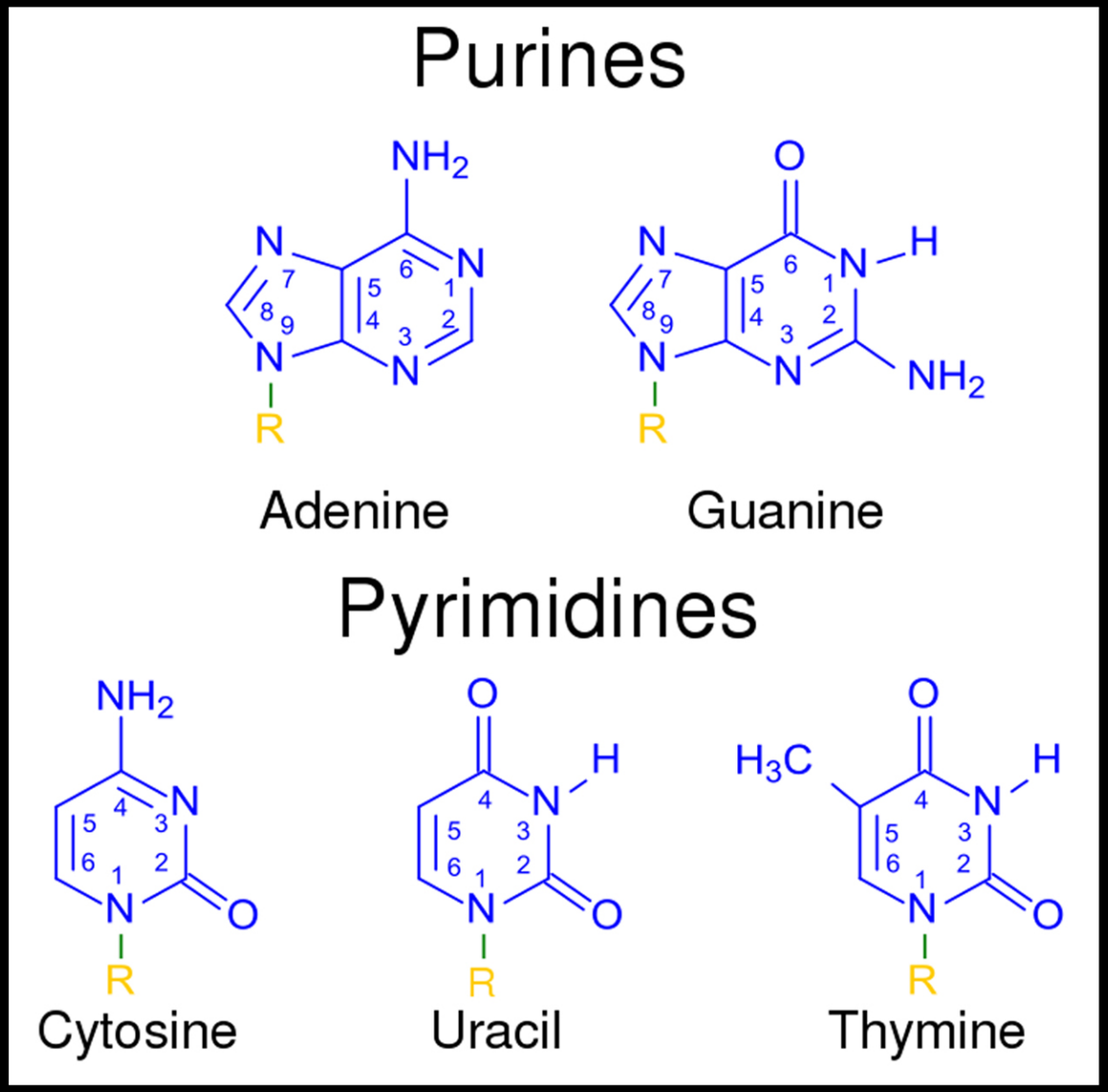


sugars found in nucleic acids



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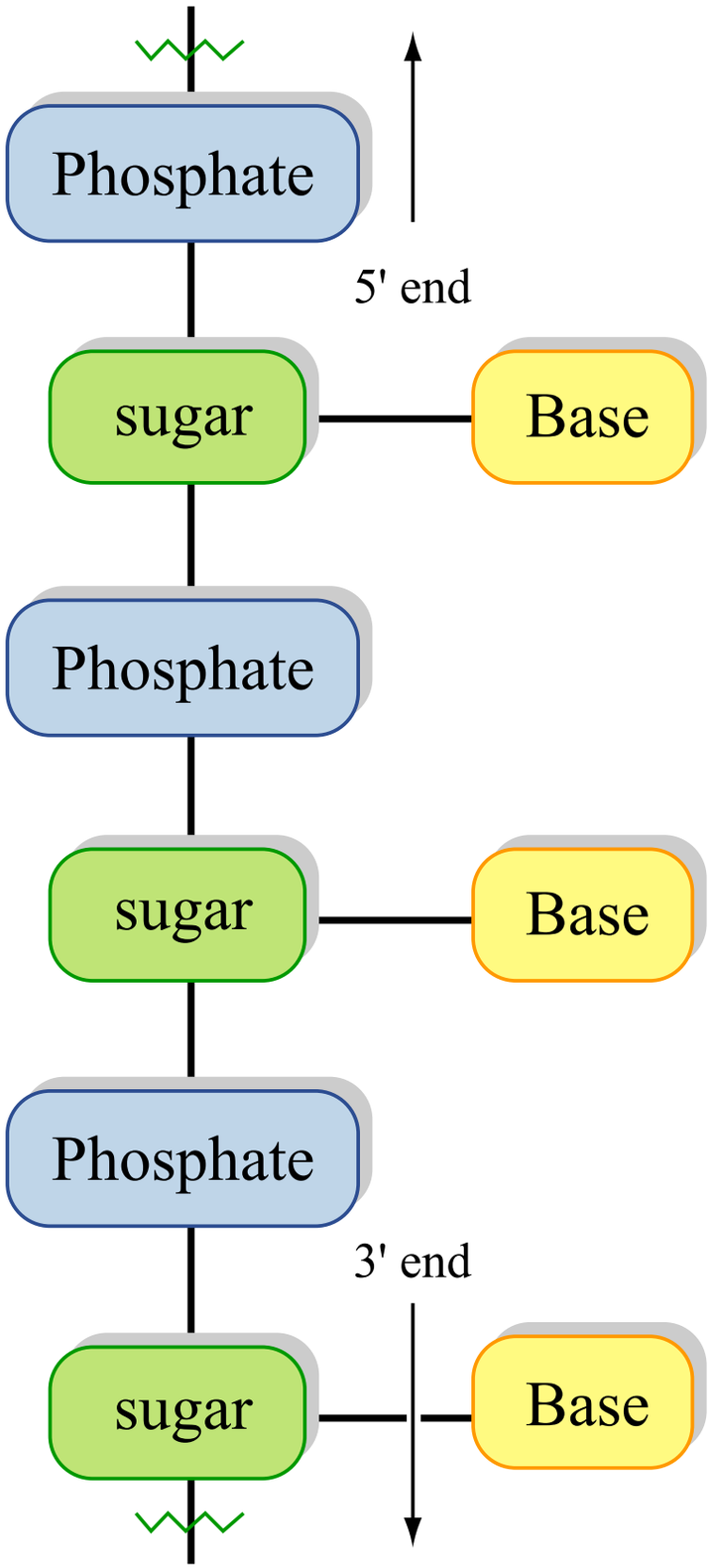
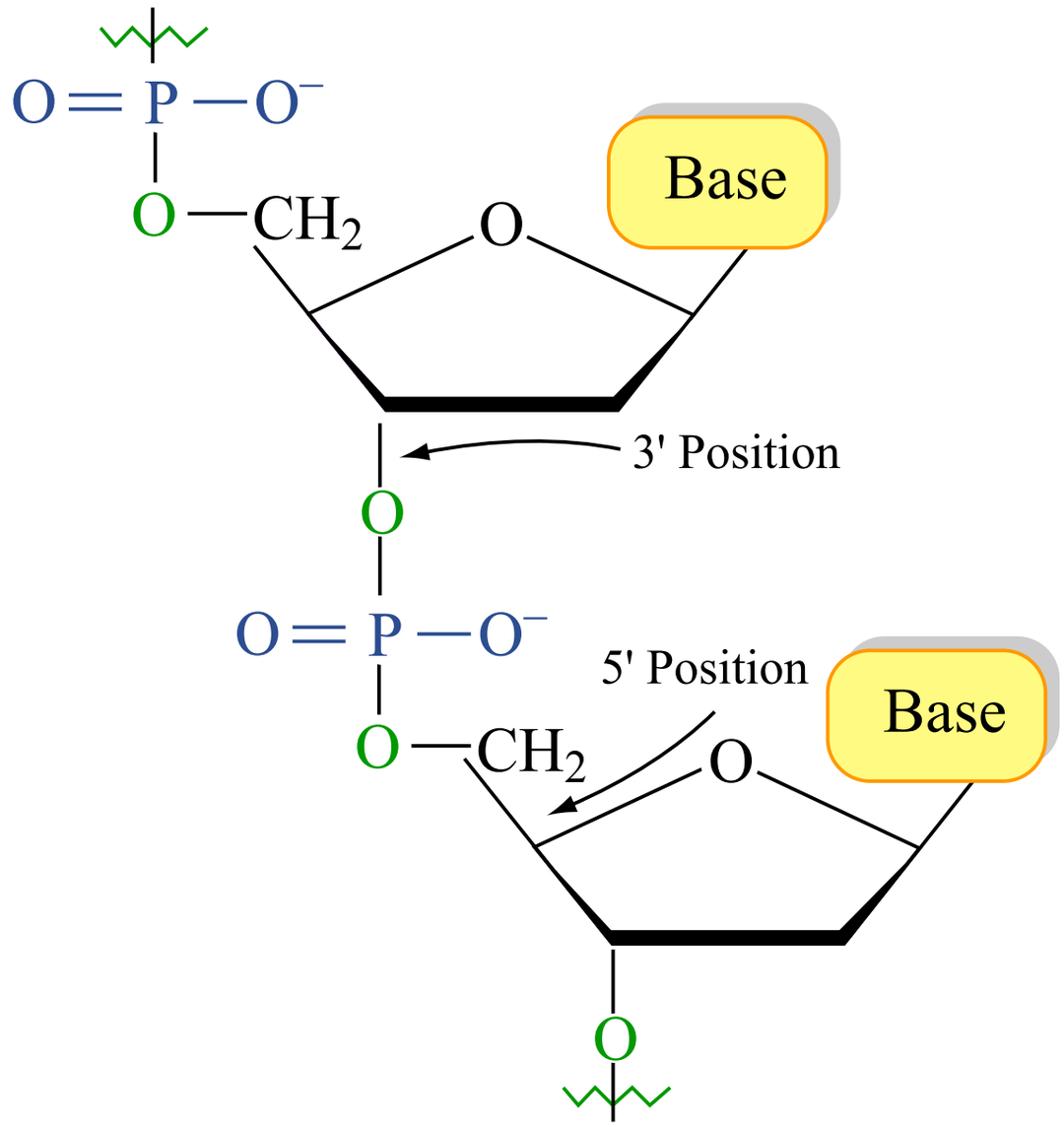
amines found in nucleic acids

Generalized Structure of Nucleic Acid





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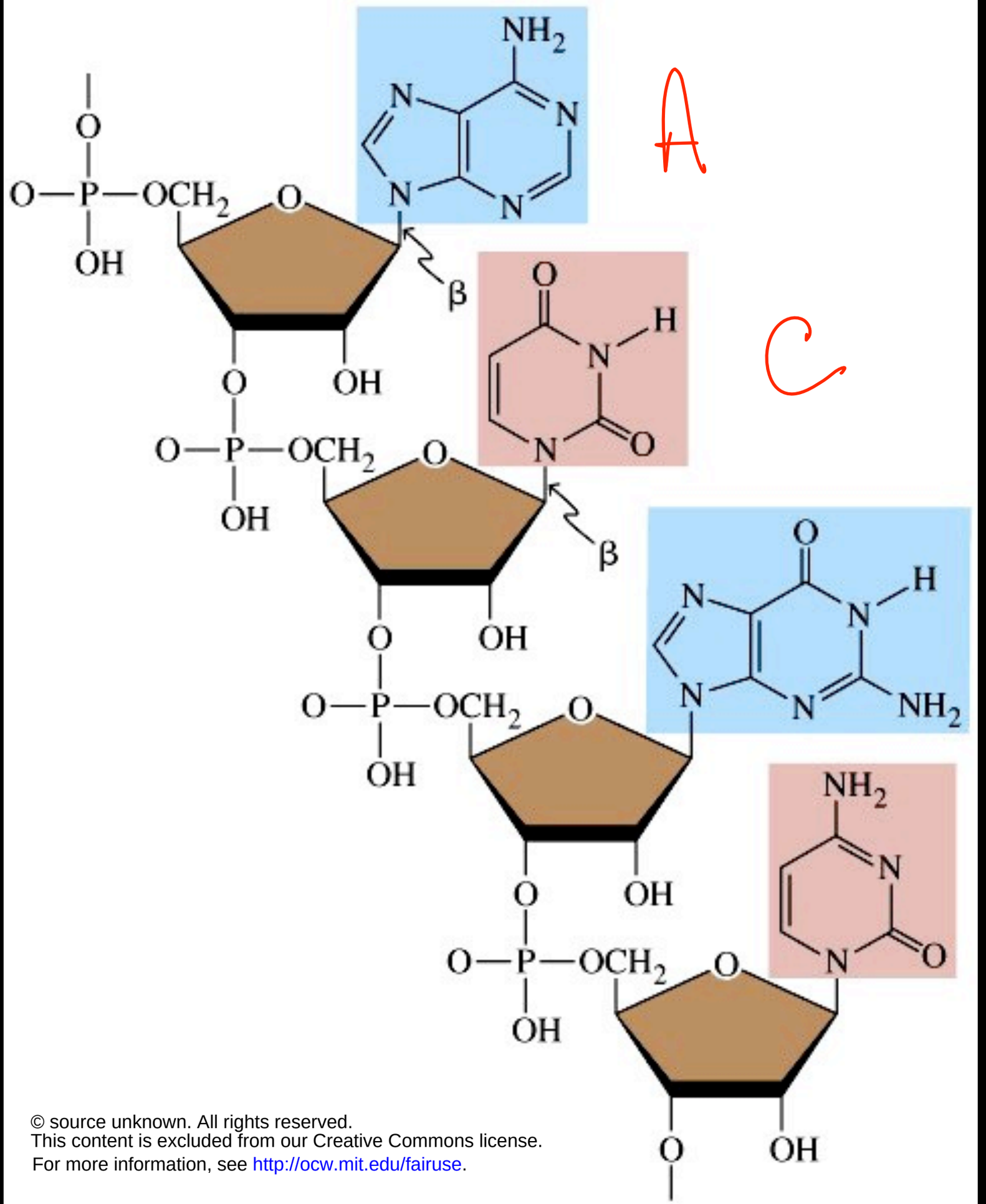

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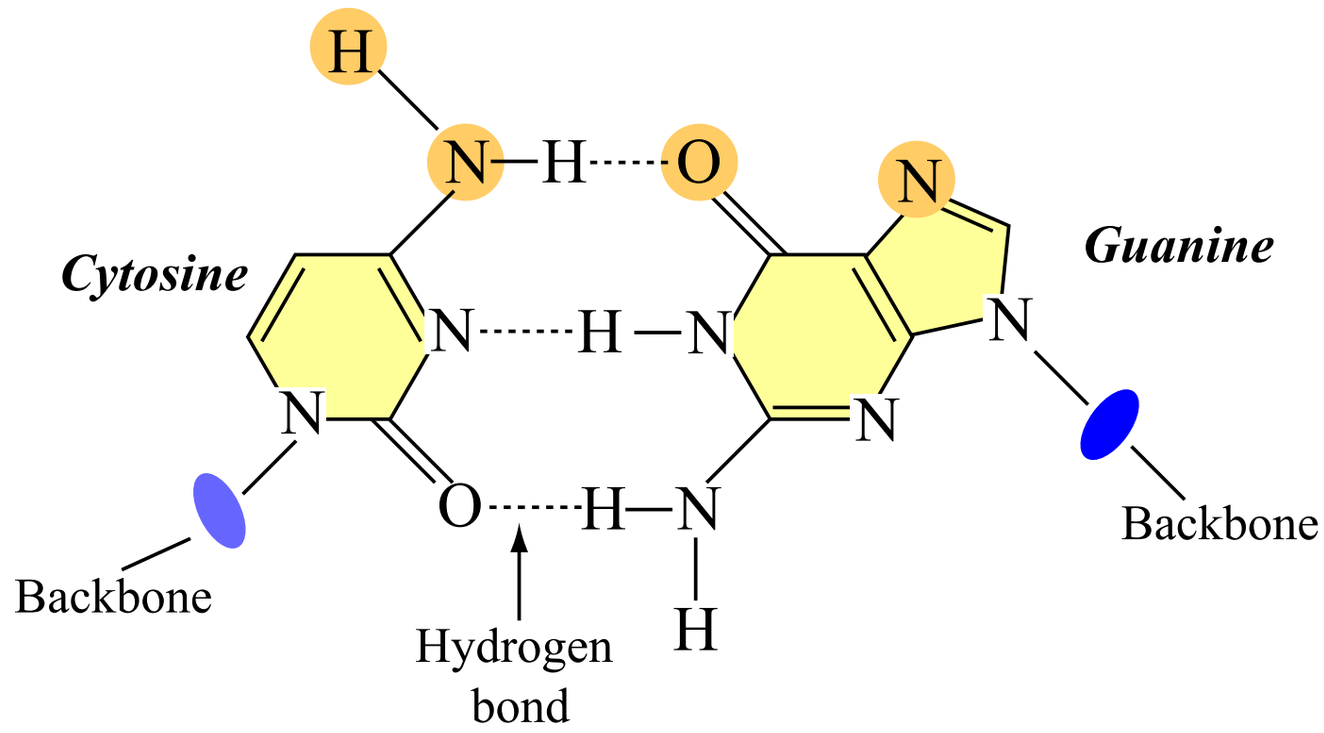

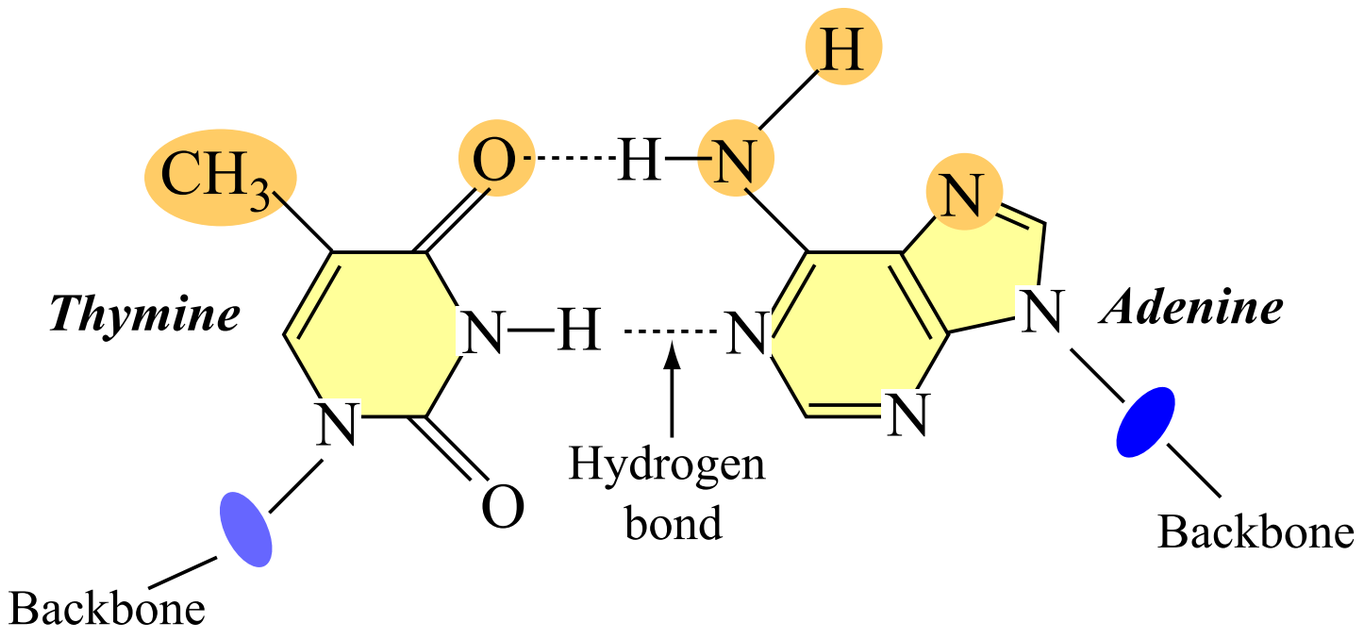

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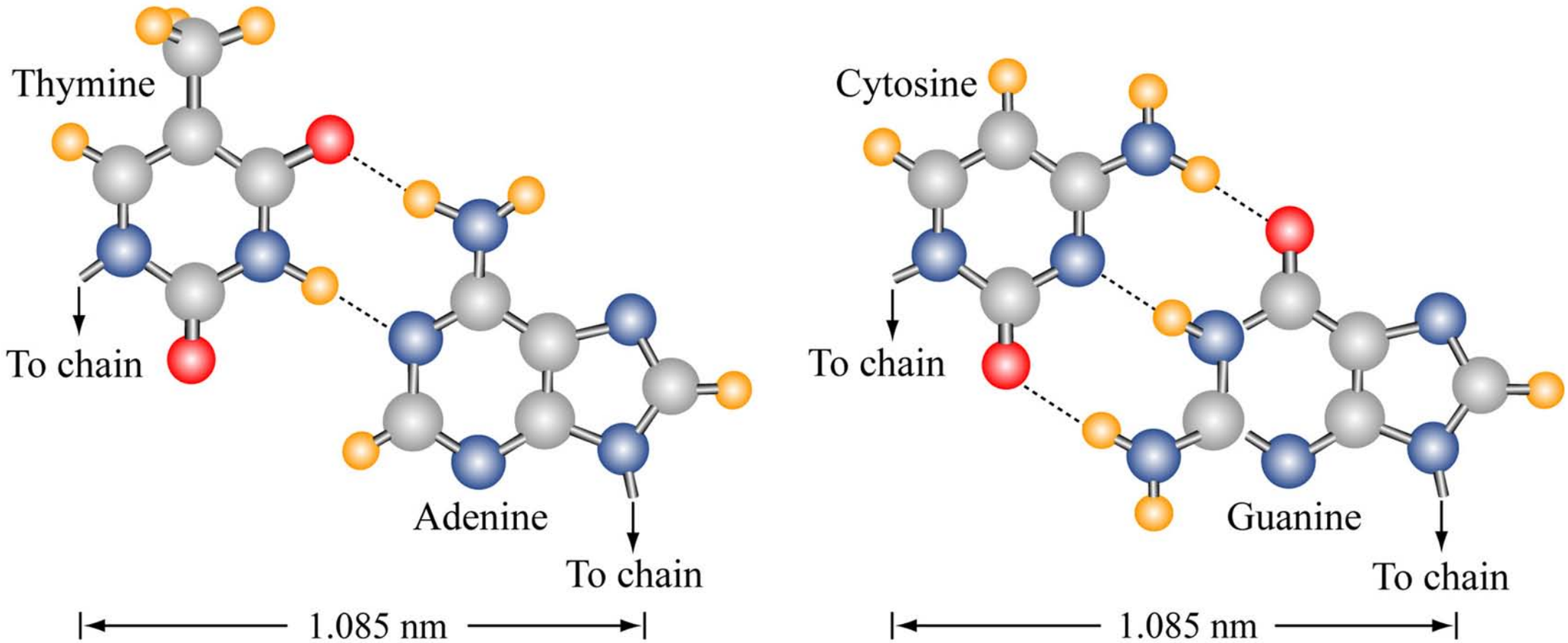

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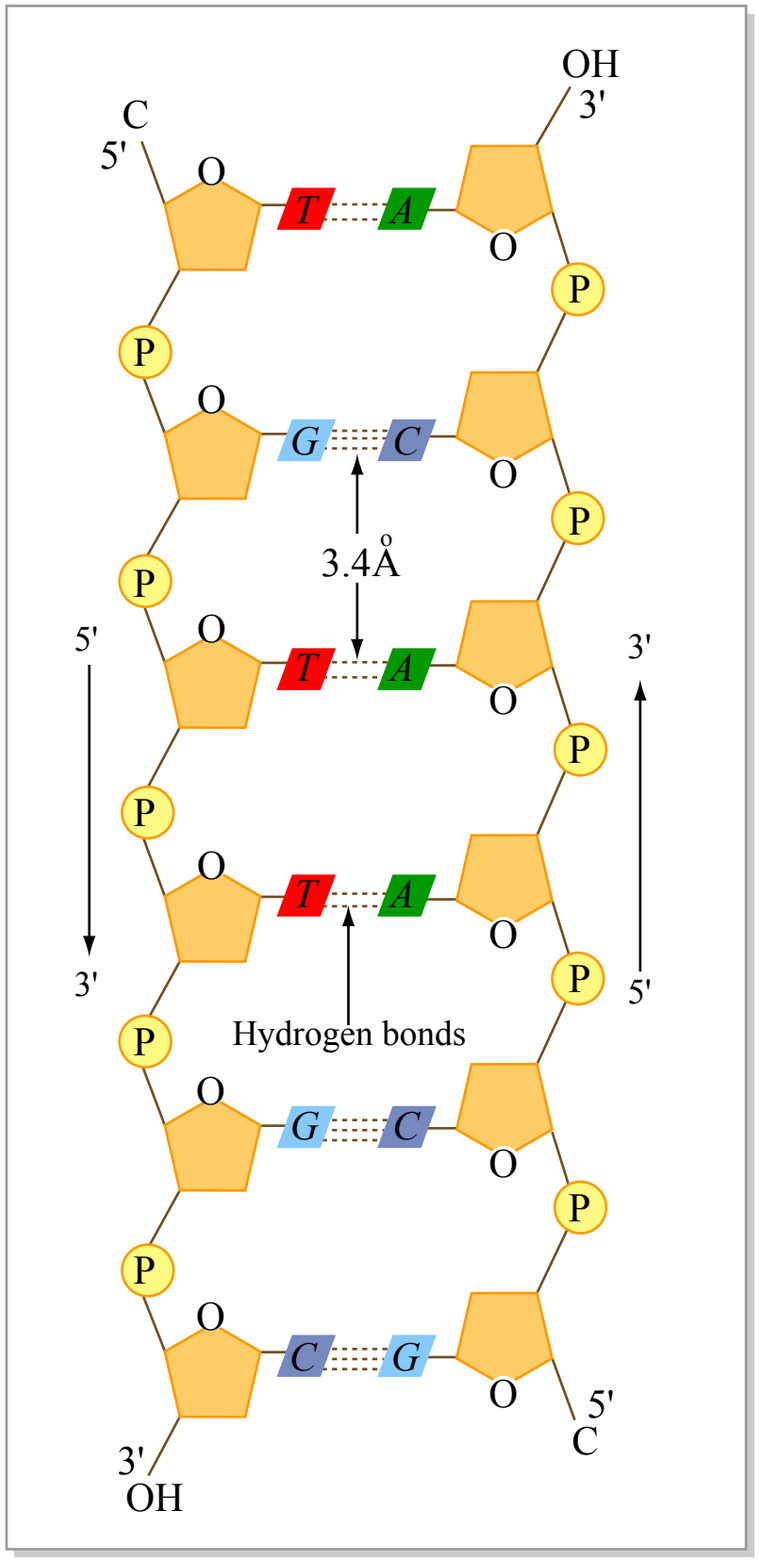
Sugar - Phosphate Backbone in DNA



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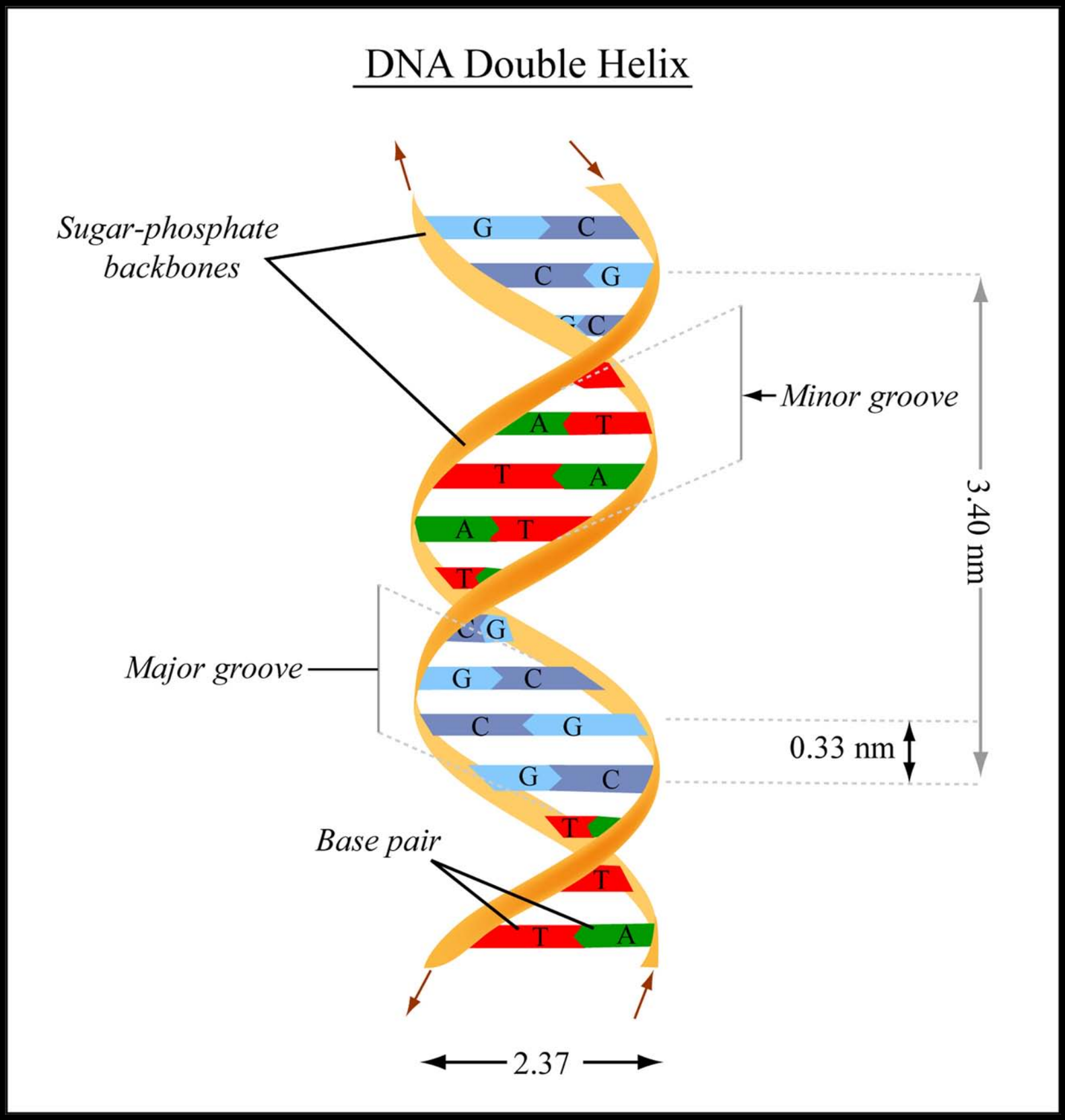

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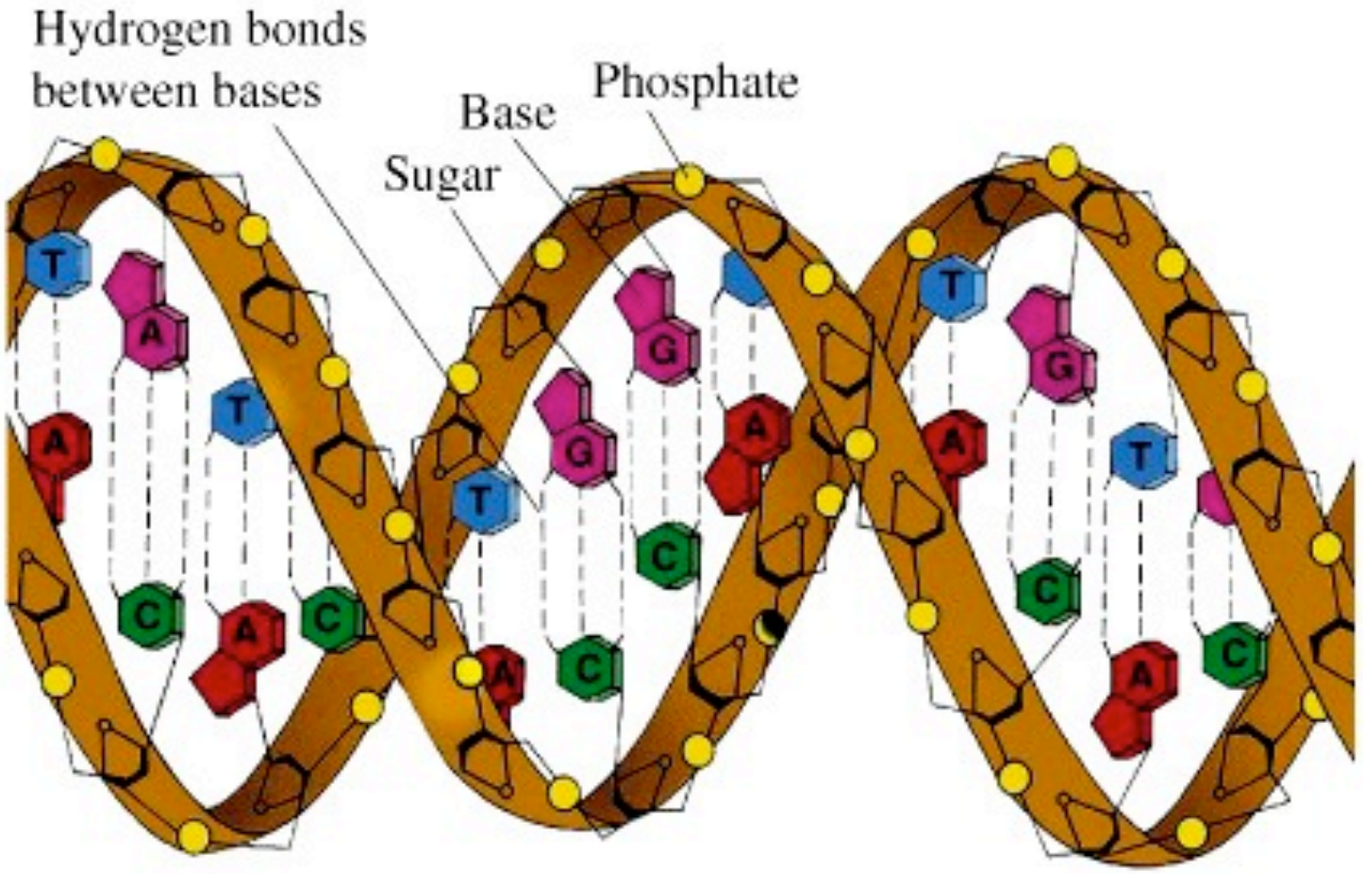
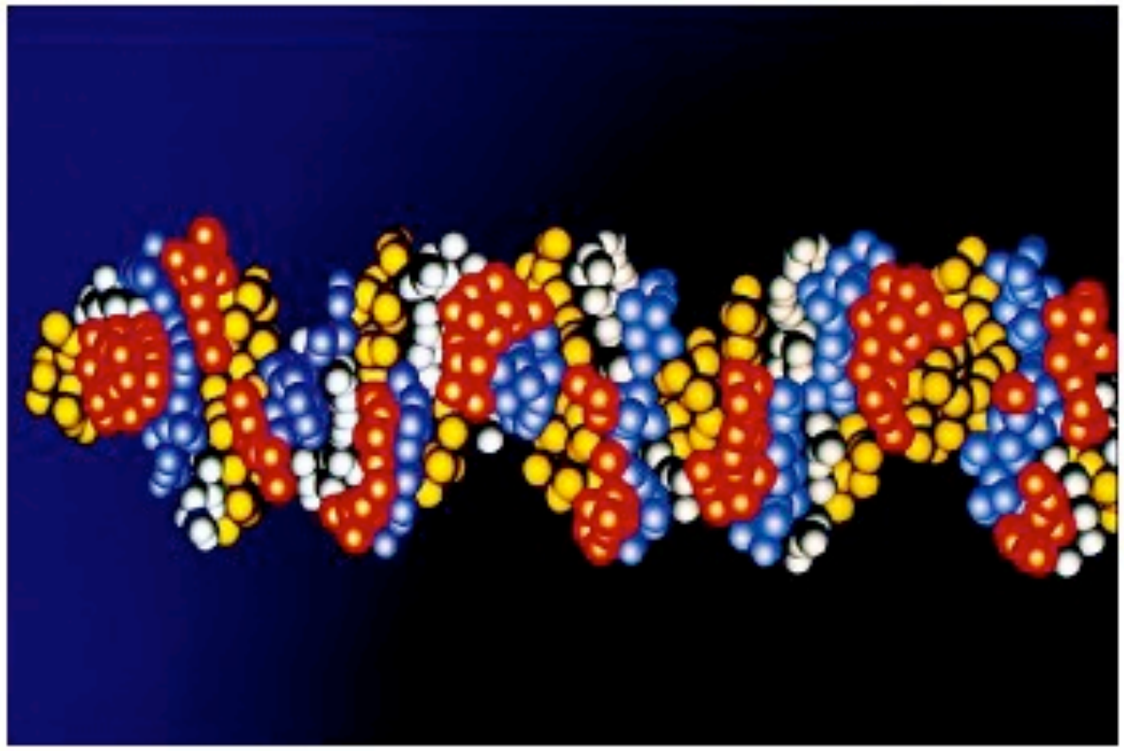


(a)



(b)

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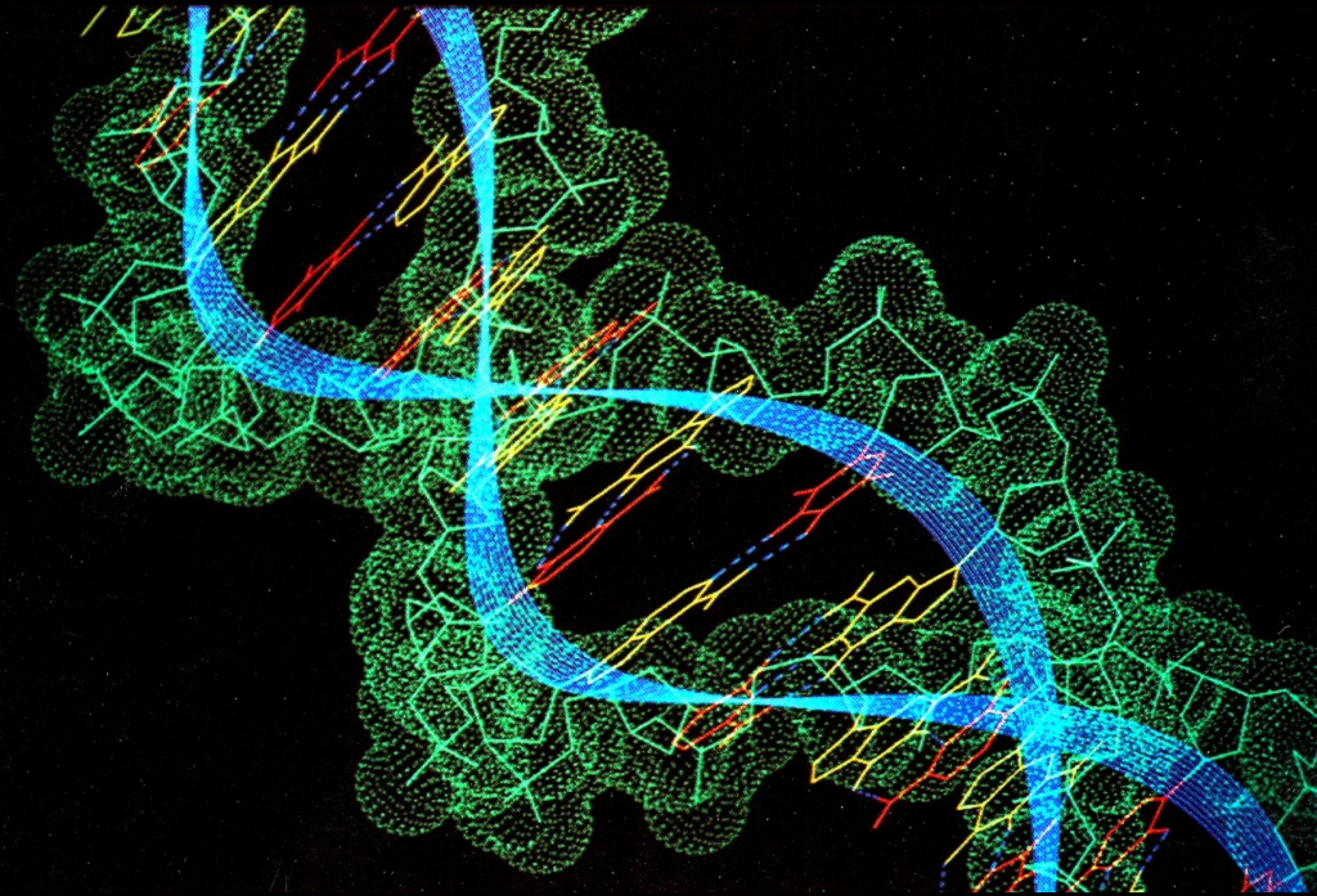

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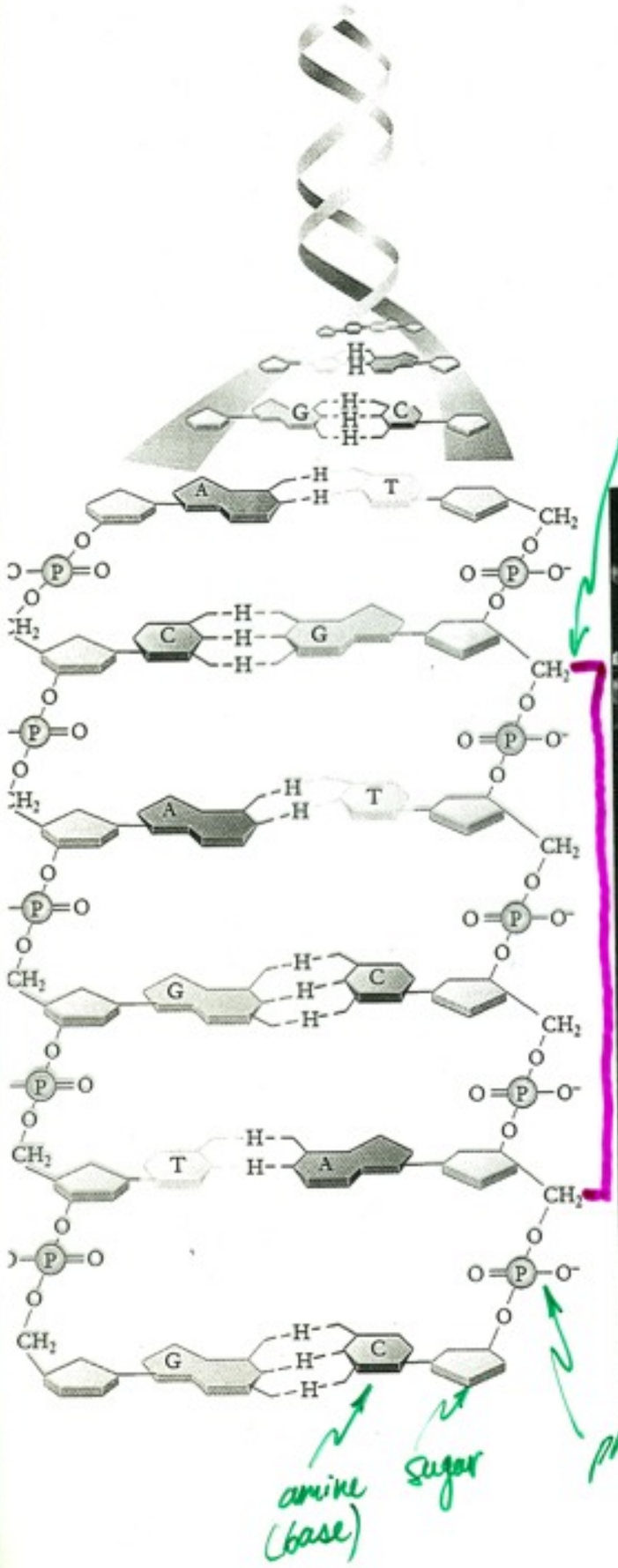
FIGURE 25.18 The double-helix structure of DNA. *(Right, Copyright Kenneth Edward/Biografx/Photo Researchers, Inc.)*



codon = 3 bases ⇒ amino acid

amine (base)

sugar

phosphate

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Oswald Avery

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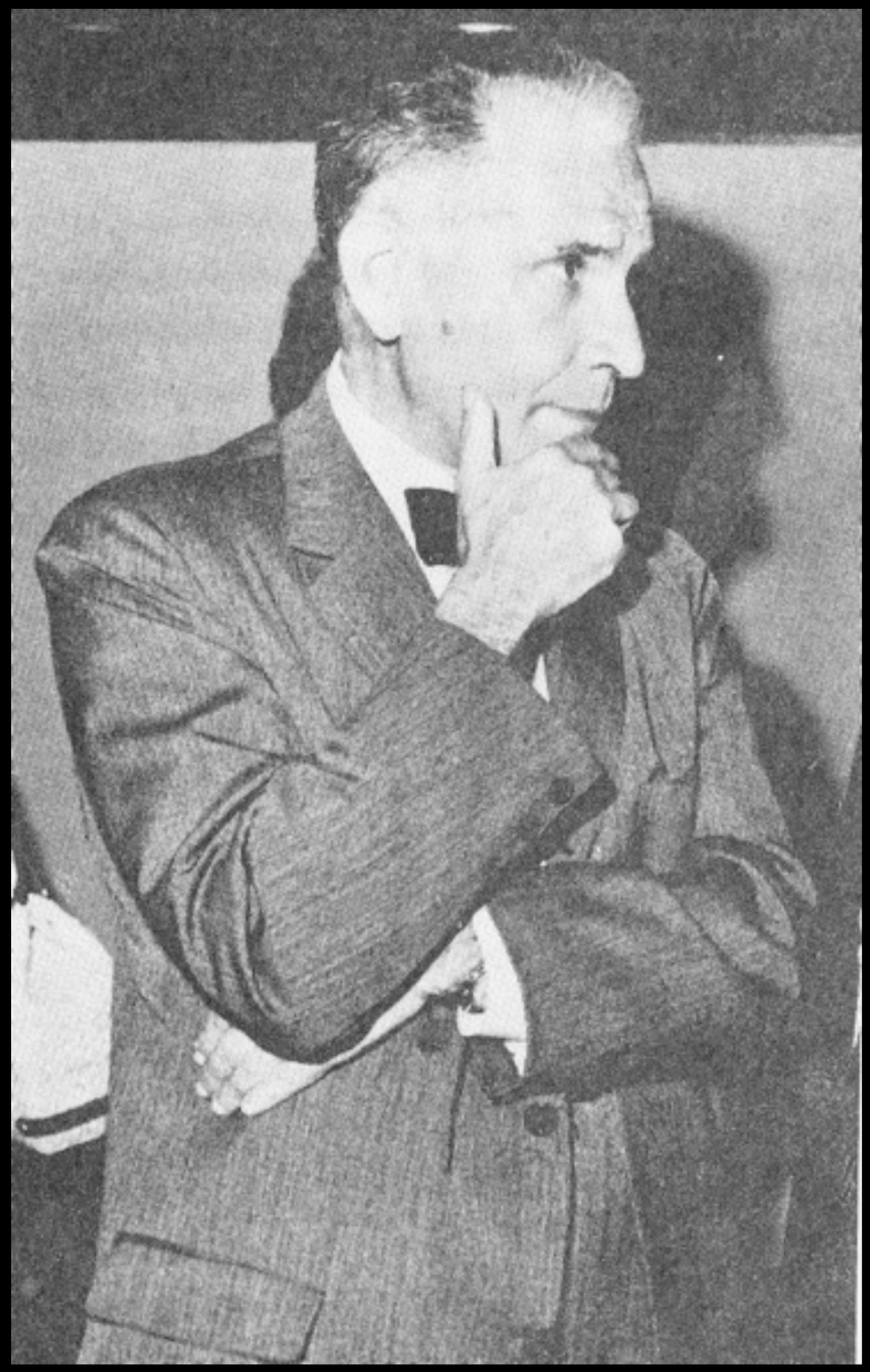
Oswald Avery

nucleic acids store and transmit genetic information (1944)



Erwin Chargaff

Chargaff's Rules (1949):

① [A] = [T]

② [C] = [G]

③ [A] + [G] = [C] + [T]

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DNA Base Compositions for Various Species				
Species	**Adenine**	**Thymine**	**Guanine**	**Cytosine**
Homo sapiens (human)	31.0	31.5	19.1	18.4
Drosophila melanogaster (fruit fly)	27.3	27.6	22.5	22.5
Zea mays (corn)	25.6	25.3	24.5	24.6
Neurospora crassa (mold)	23.0	23.3	27.1	26.6
Escherichia coli (bacterium)	24.6	24.3	25.5	25.6
Bacillus subtilis (bacterium)	28.4	29.0	21.0	21.6

Note that the percentages of adenine and thymine, and of cytosine and guanine, are consistently similar.

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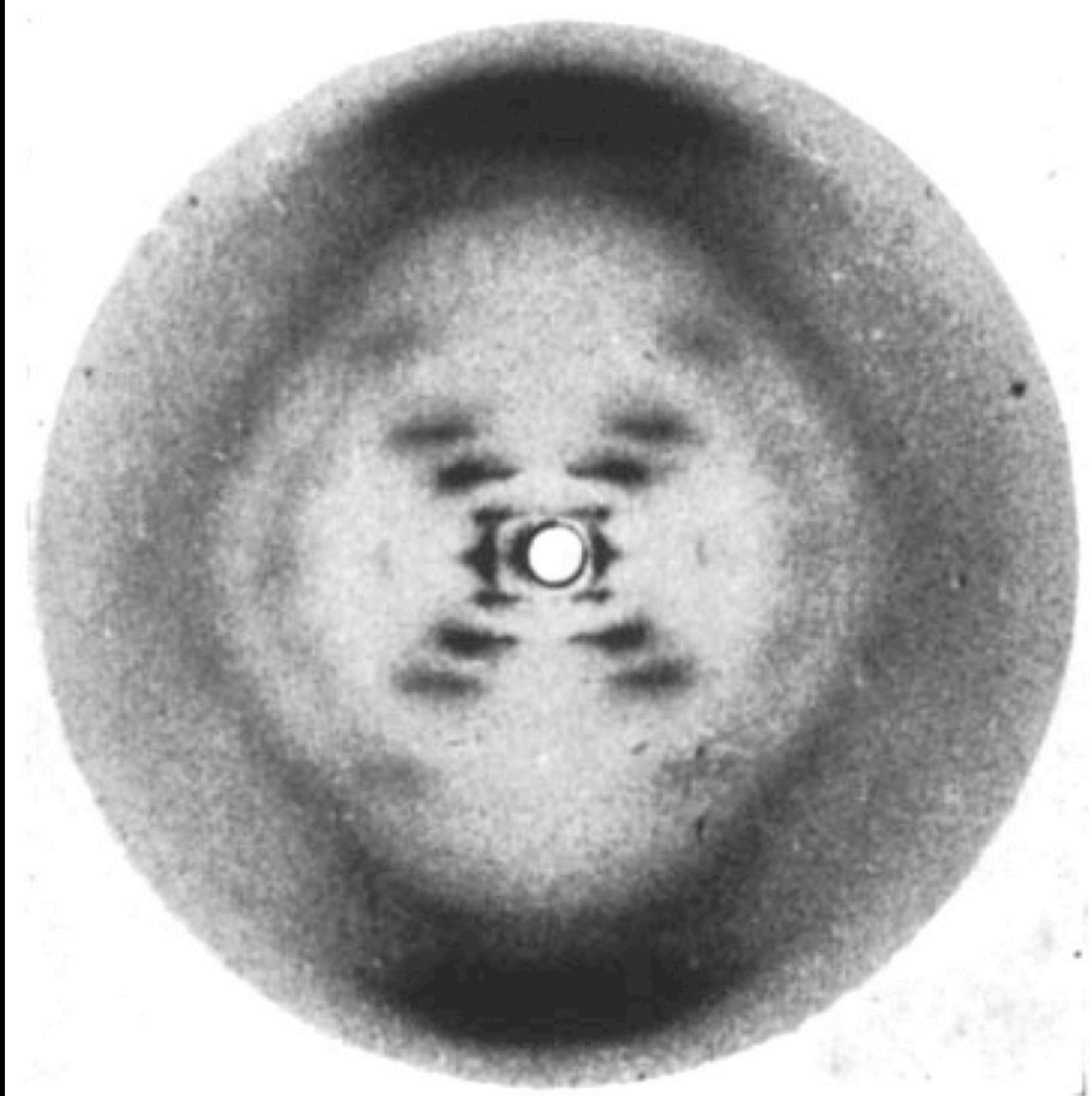
Rosalind Franklin
Pattern No. 51
May, 1952



Sodium deoxyribose nucleate from calf thymus. Structure *B*

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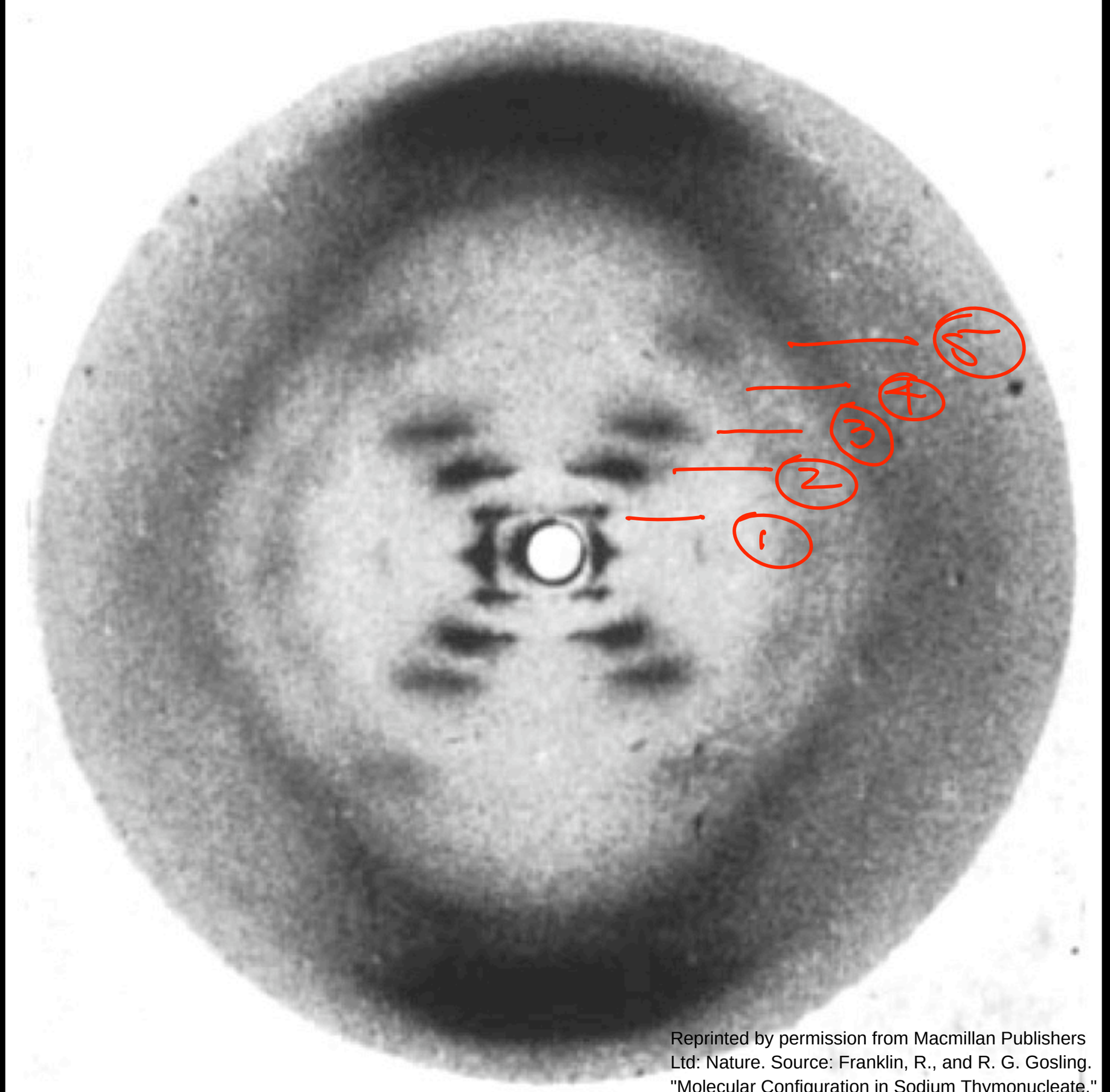

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Sodium deoxyribose nucleate from calf thymus. Structure *B*

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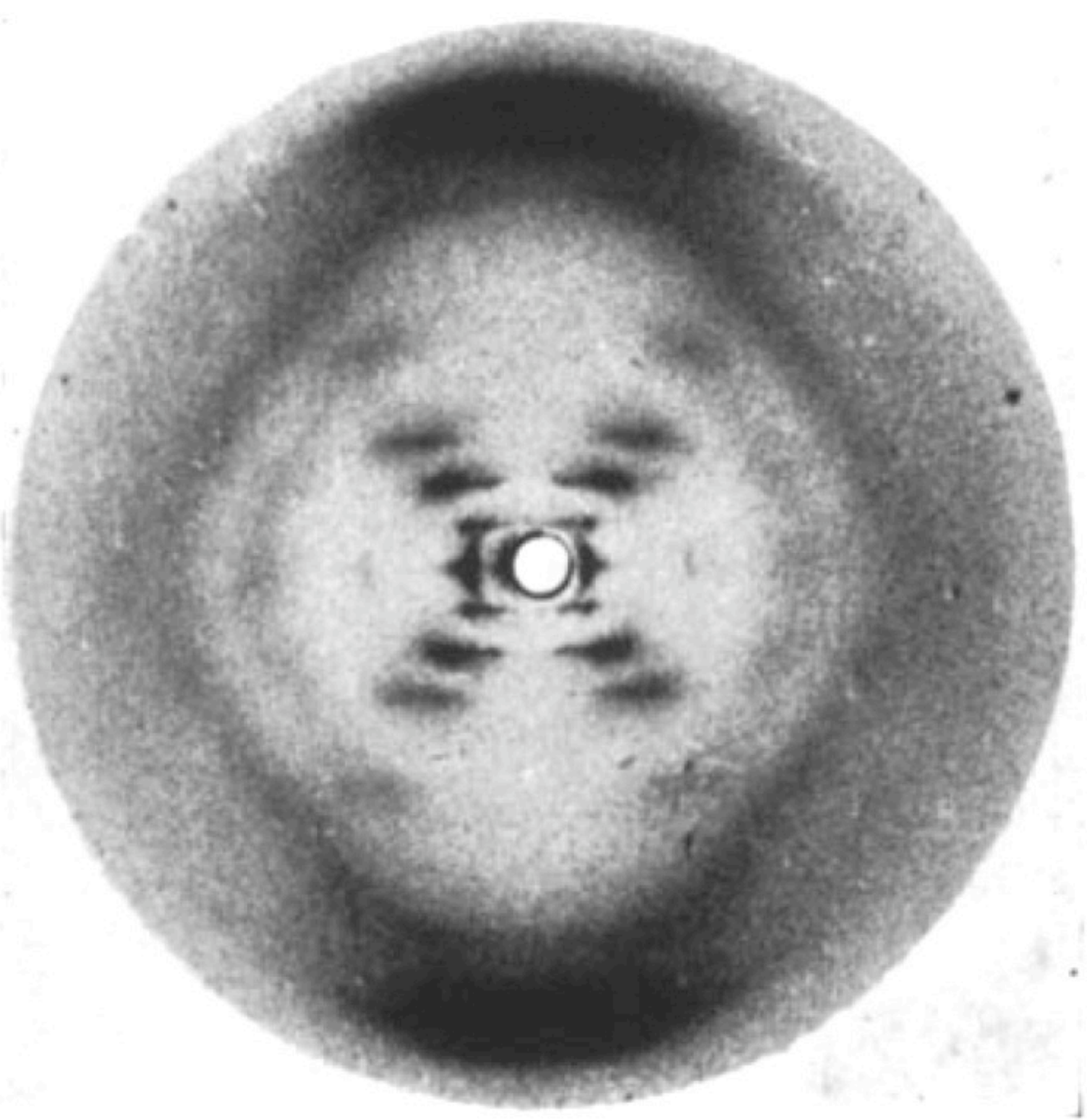
May, 1952



Sodium deoxyribose nucleate from calf thymus. Structure *B*

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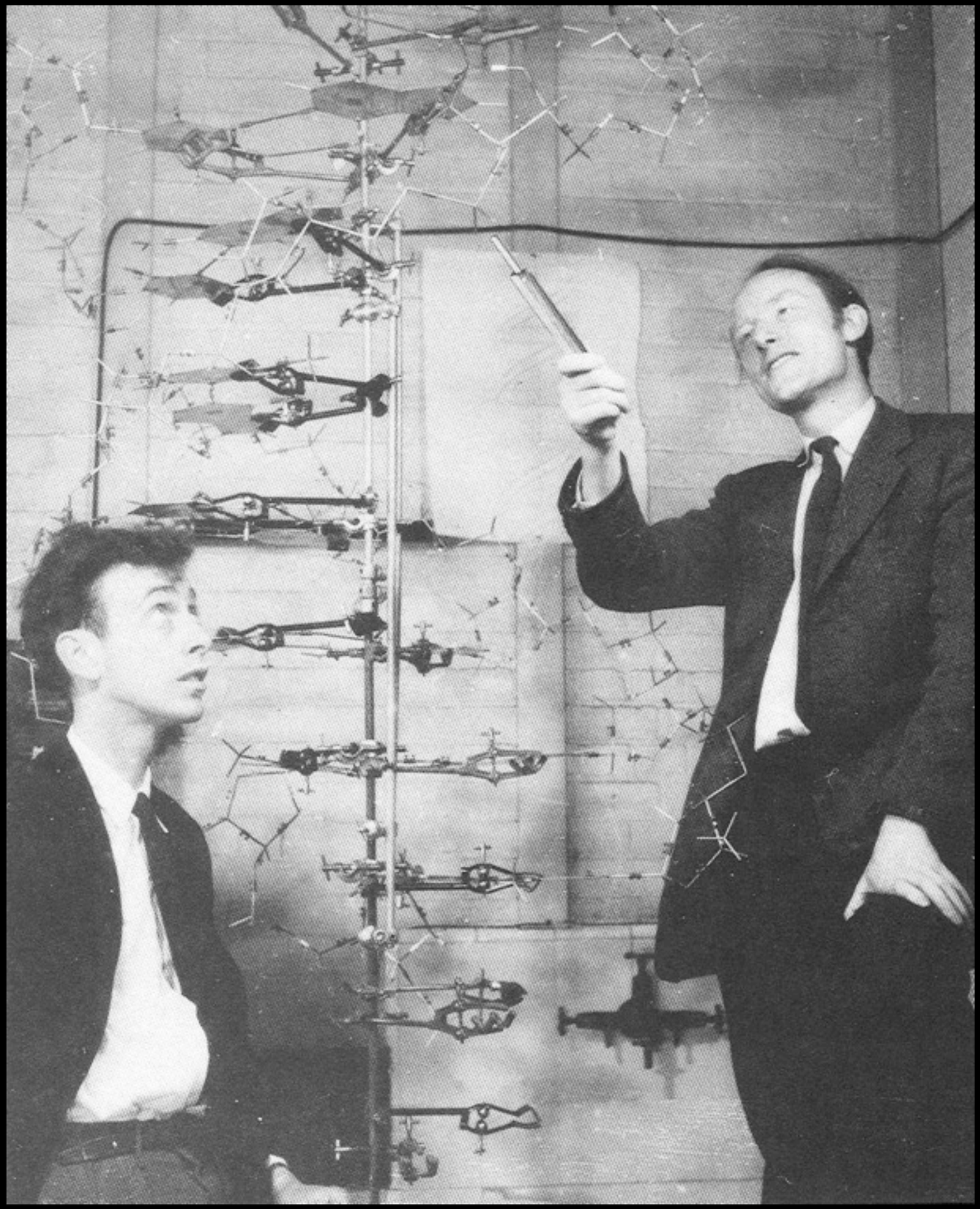
See Judson, Horace Freeland. *The Eighth Day of Creation: Makers of the Revolution in Biology*. 25th anniversary edition. Woodbury, NY: Cold Spring Harbor Laboratory Press, 1996. ISBN: 9780879694784.



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A Structure for Deoxyribose Nucleic Acid

WE wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological interest.

A structure for nucleic acid has already been proposed by Pauling and Corey[1]. They kindly made their manuscript available to us in advance of publication. Their model consists of three inter-twined chains, with the phosphates near the fibre axis, and the bases on the outside. In our opinion, this structure is unsatisfactory for two reasons: (1) We believe that the material which gives the X-ray diagrams is the salt, not the free acid. Without the acidic hydrogen atoms it is not clear what forces would hold the structure together, especially as the negatively charged phosphates near the axis will repel each other. (2) Some of the van der Waals distances appear to be too small.

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The previously published X-ray data[5,6] on deoxyribose nucleic acid are insufficient for a rigorous test of our structure. So far as we can tell, it is roughly compatible with the experimental data, but it must be regarded as unproved until it has been checked against more exact results. Some of these are given in the following communications. We were not aware of the details of the results presented there when we devised our structure, which rests mainly though not entirely on published experimental data and stereochemical arguments.

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We are much indebted to Dr. Jerry Donohue for constant advice and criticism, especially on interatomic distances. We have also been stimulated by a knowledge of the general nature of the unpublished experimental results and ideas of Dr. M. H. F. Wilkins, Dr. R. E. Franklin and their co-workers at King's College, London. One of us (J. D. W.) has been aided by a fellowship from the National Foundation for Infantile Paralysis.

J. D. Watson
F. H. C. Crick

Medical Research Council Unit for the
Study of the Molecular Structure of
Biological Systems,
Cavendish Laboratory, Cambridge.
April 2.

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The Sequence of the Human Genome

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Alexander Levitsky,[1] Mark Lewis,[1] Xiangjun Liu,[1] John Lopez,[1] Daniel Ma,[1] William Majoros,[1]
Joe McDaniel,[1] Sean Murphy,[1] Matthew Newman,[1] Trung Nguyen,[1] Ngoc Nguyen,[1] Marc Nodell,[1]
Sue Pan,[1] Jim Peck,[1] Marshall Peterson,[1] William Rowe,[1] Robert Sanders,[1] John Scott,[1]
Michael Simpson,[1] Thomas Smith,[1] Arlan Sprague,[1] Timothy Stockwell,[1] Russell Turner,[1] Eli Venter,[1]
Mei Wang,[1] Meiyuan Wen,[1] David Wu,[1] Mitchell Wu,[1] Ashley Xia,[1] Ali Zandieh,[1] Xiaohong Zhu[1]

It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material.

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Stockholm, December 10, 1962

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New York, NY: HarperCollins, 2002. ISBN: 9780060184070.

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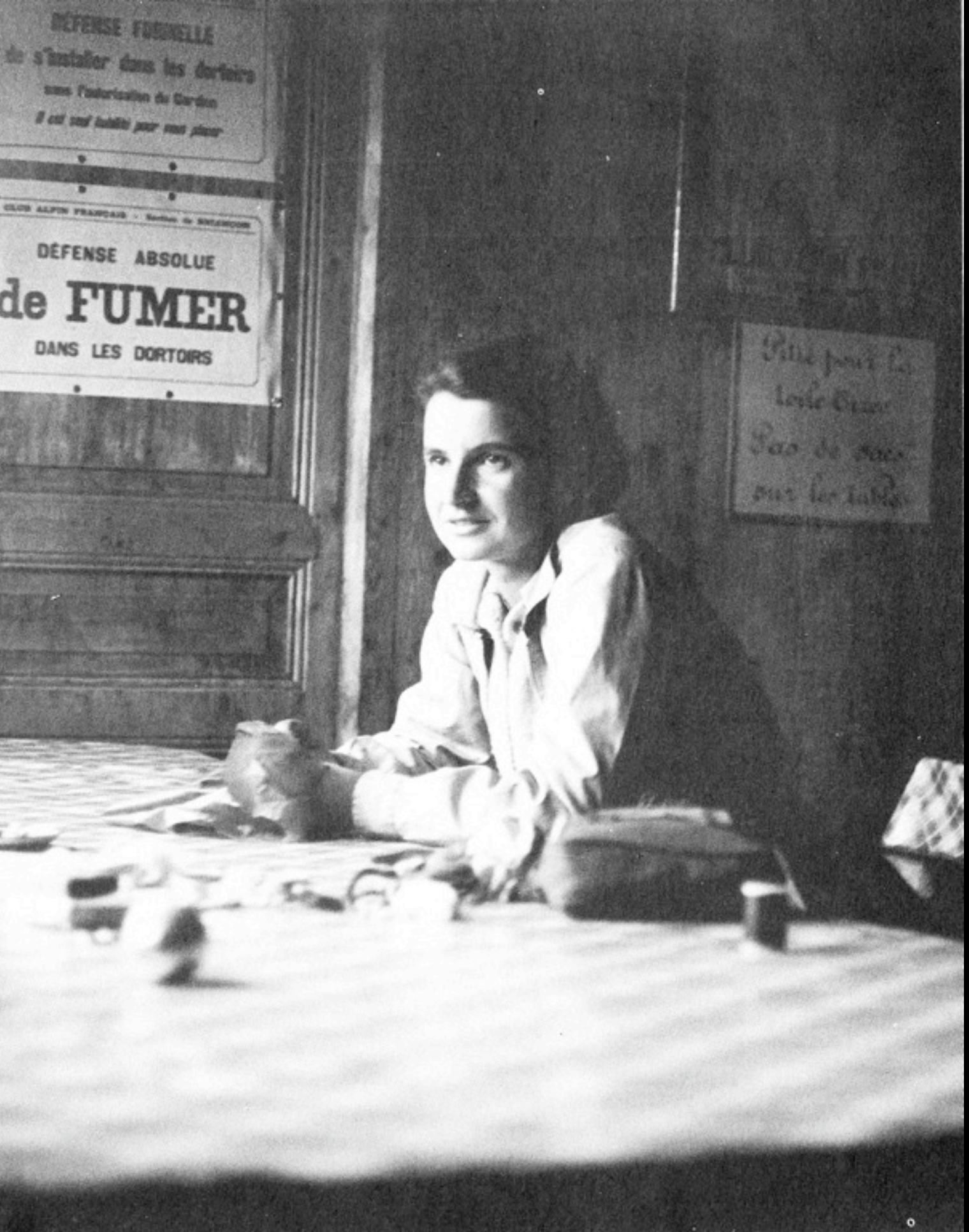

image:
Rosalind Franklin
on vacation in France

music:
“The Twist”
Hank Ballard

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3.091SC Introduction to Solid State Chemistry

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