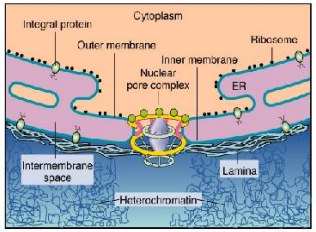
- Nuclear envelope
  - double-thick membrane
  - separates nuclear material from rest of cell
  - pores – channels that allow passage of some molecules
- Chromatin
  - DNA-protein complex
  - Arranged in thread-shaped structures (chromosomes)
- Nucleolus
  - consists of DNA, RNA, proteins and ribosomes in different stages of construction
  - site where components of ribosomes are made
    - Ribosomes – composed of RNA and proteins
      - serves as a “workbench” for making proteins
      - found in cytoplasm or on membranes

The Nuclear Envelope



(a)

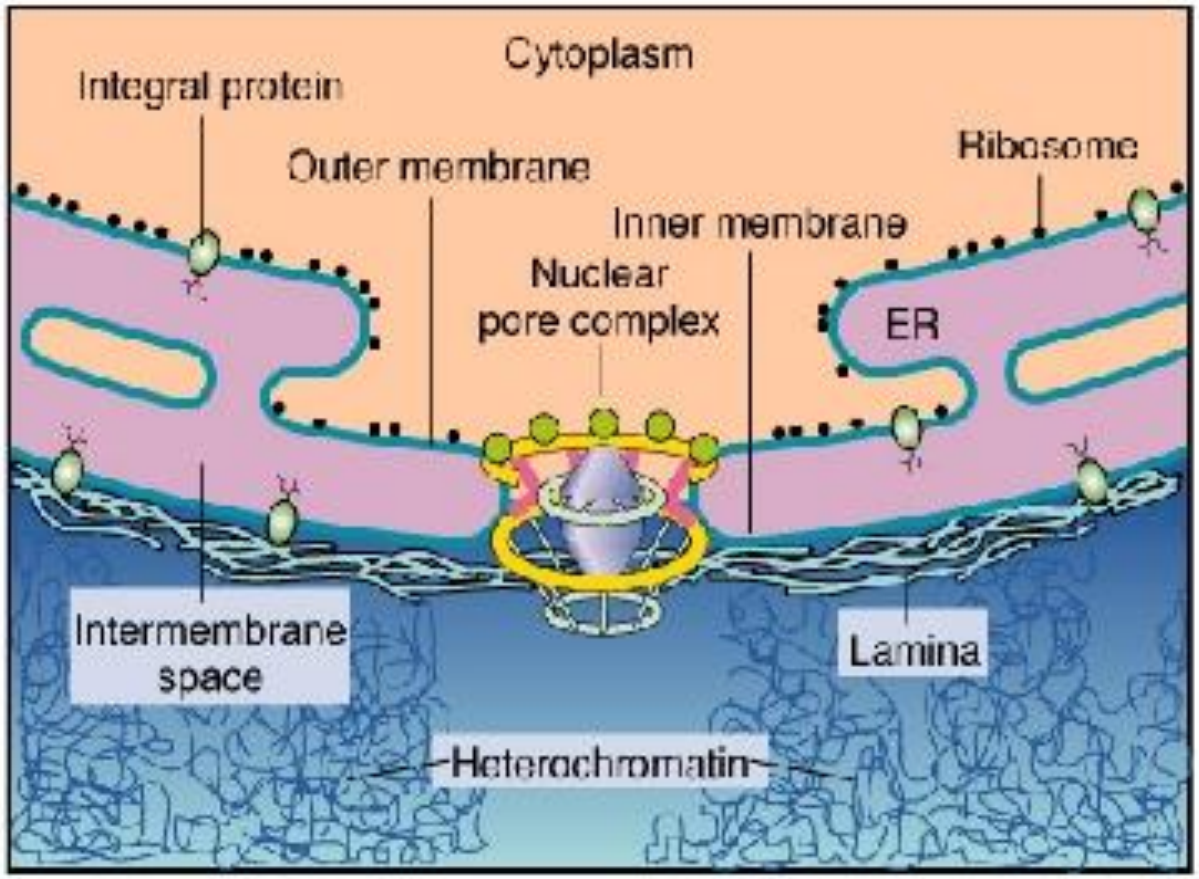
-The core of the nuclear envelope consists of two cellular membranes arranged parallel to one another and separated by an intermembrane space of 10 to 50 nm.

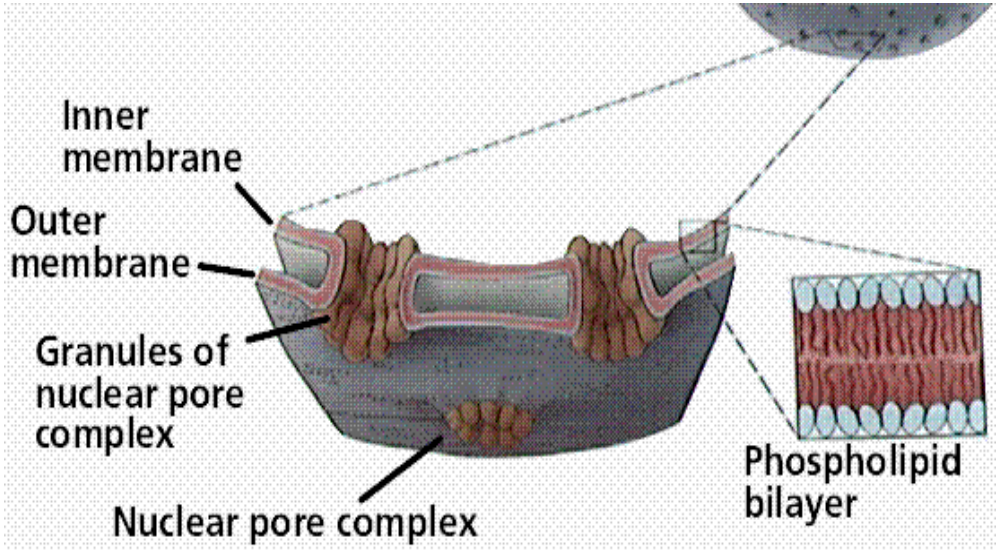
- They serves as barrier for ions, solutes and macromolecules.

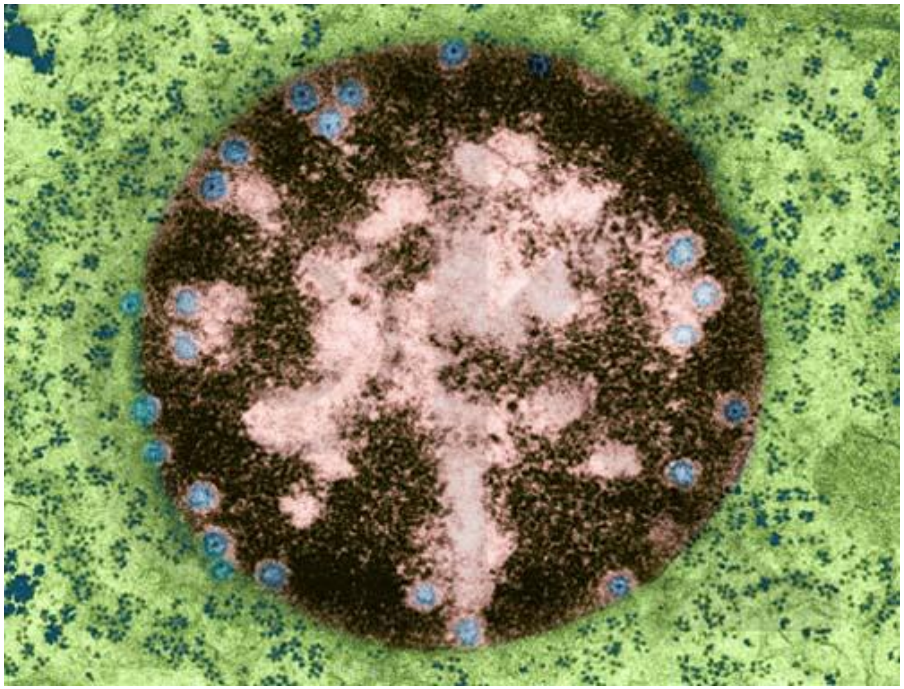
- The two membranes are fused at sites forming circular pores (3,000 per cell aproximately).

- The outer membranes is studded with ribosomes and is sometime continuous with the membrane of the ER.

- The inner membrane is lined by a dense filamentous meshwork called the nuclear lamina (support role and attachment for chromatin).


Cytoplasm
Integral protein
Outer membrane
Ribosome
Inner membrane
Nuclear
pore complex
ER
Intermembrane
space
Lamina
Heterochromatin


Inner membrane
Outer membrane
Granules of nuclear pore complex
Nuclear pore complex
Phospholipid bilayer



The chromatin

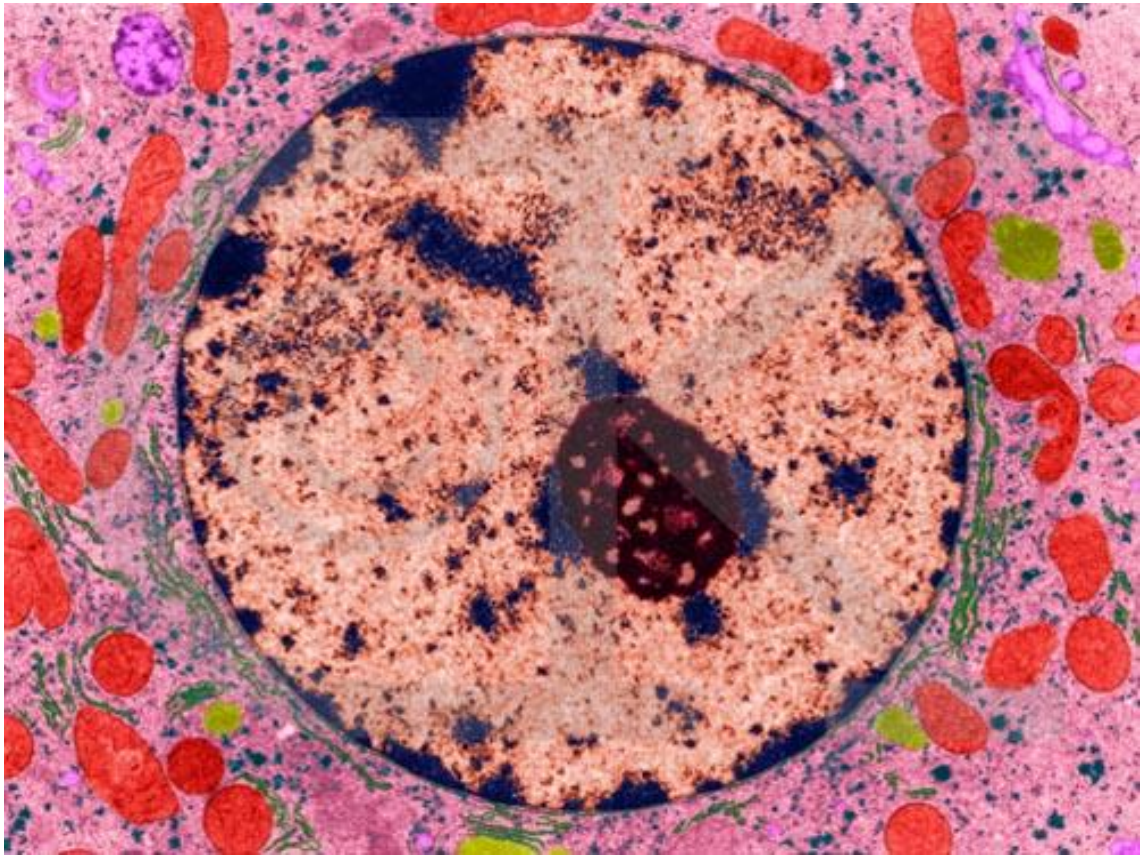
-Chromosomes are composed of DNA and associated proteins.

- Histones are small, well defined basic proteins, whereas nonhistome chromosomal proteins include a large number of diverse proteins.

- Packaging of eukaryotic DNA depends on histones. They are divided into 5 classes (1, 2A, 2B, 3 and 4).

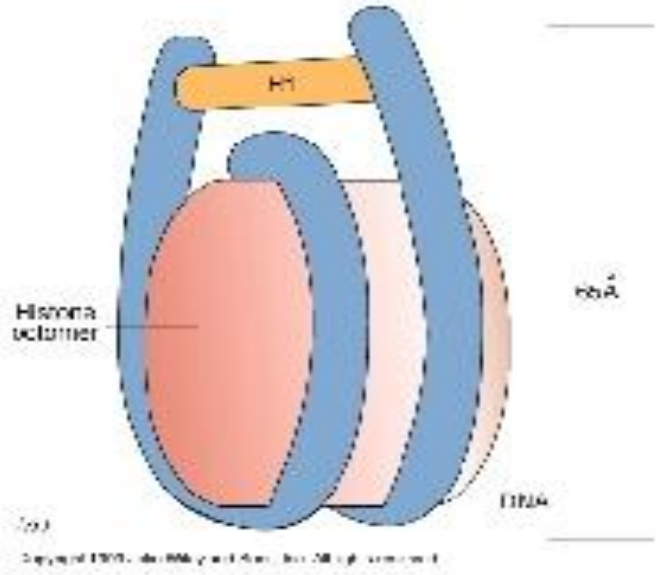
- Chromatin treated with nonspecific nucleases produce 200 bp fragments approximately, while naked DNA produce randomly sized fragments.

Heterochromatin stains more strongly and is a more condensed chromatin. **Euchromatin** stains weakly and is more open (less condensed). Euchromatin remains dispersed (uncondensed) during Interphase, when RNA transcription occurs. Some regions of heterochromatin appear to be structural (as in the heterochromatin near the **centromere region**)

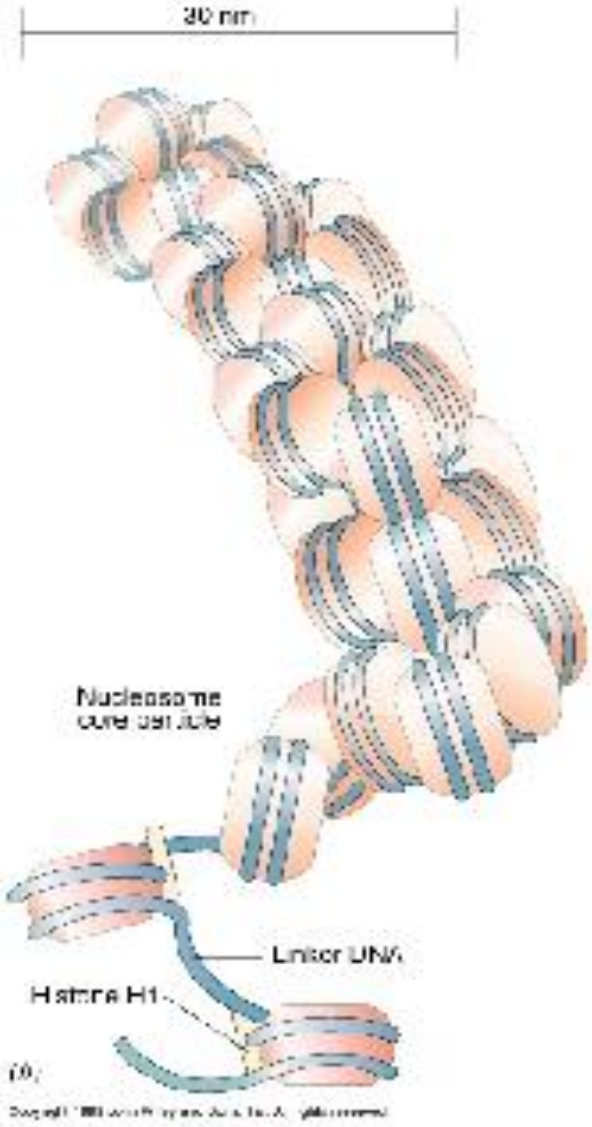


-1974, R. Kornberg proposed that DNA and histones are organized in repeating subunits, called nucleosomes.

- We know now that each nucleosome contains a nucleosome core particle consisting of 146 bp of supercoiled DNA wrapped almost twice around a disc shaped complex of eight histone molecules (2 H2A, 2 H2B, 2 H3, 2 H4)



-The DNA of successive nucleosome core particle is connected by a stretch of linker DNA (around 60 bp).



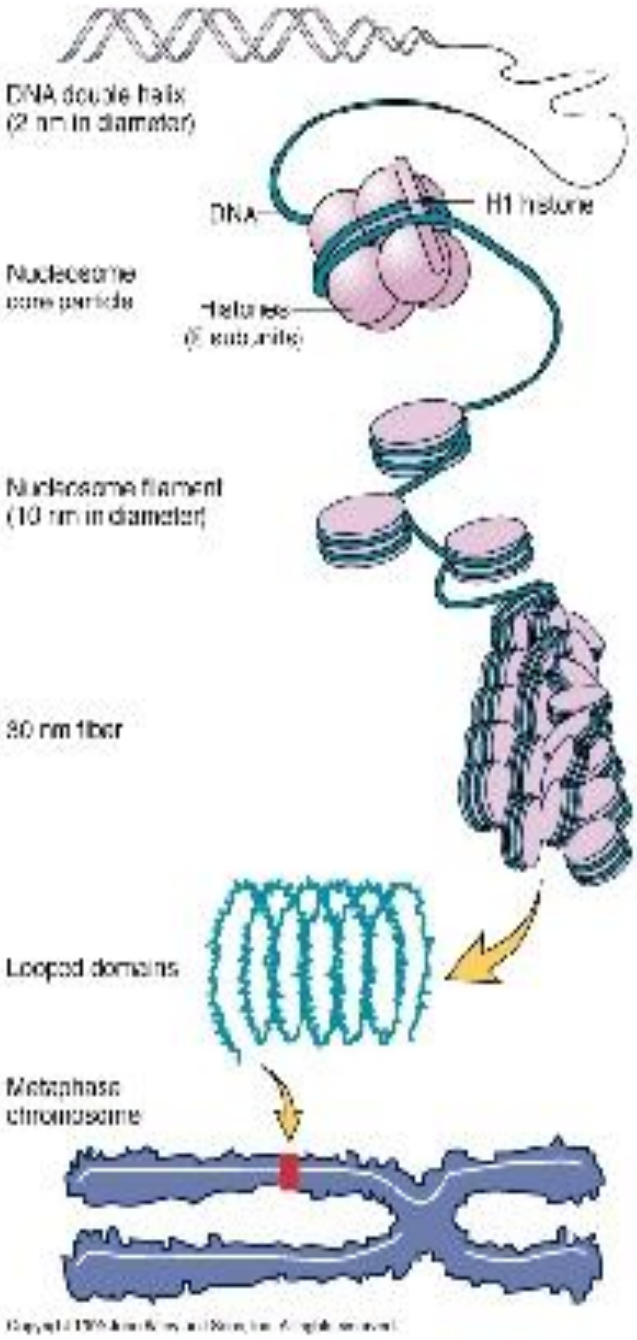
Higher Levels of Chromatin Structure

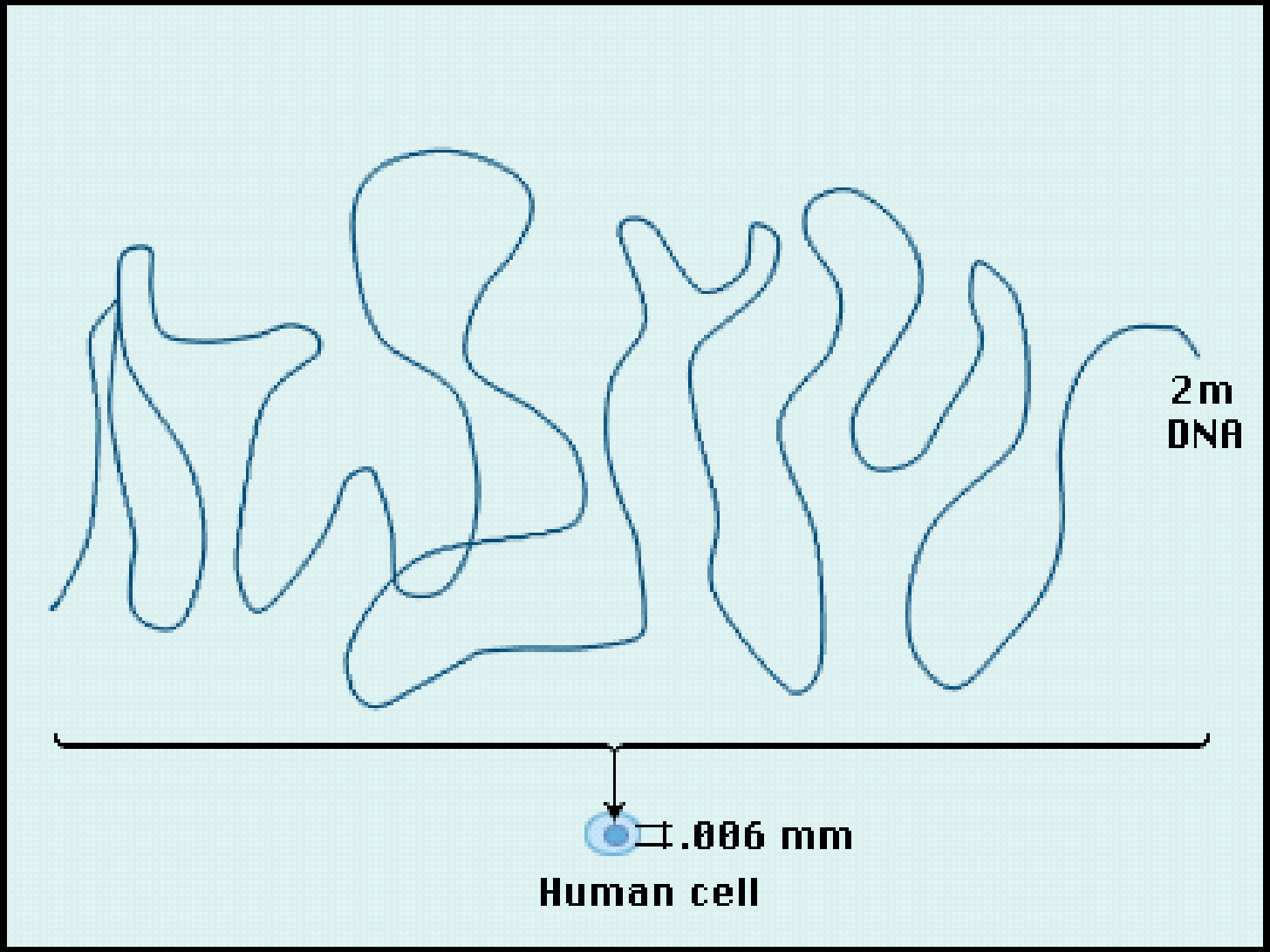
-Electron microscopy of sections through

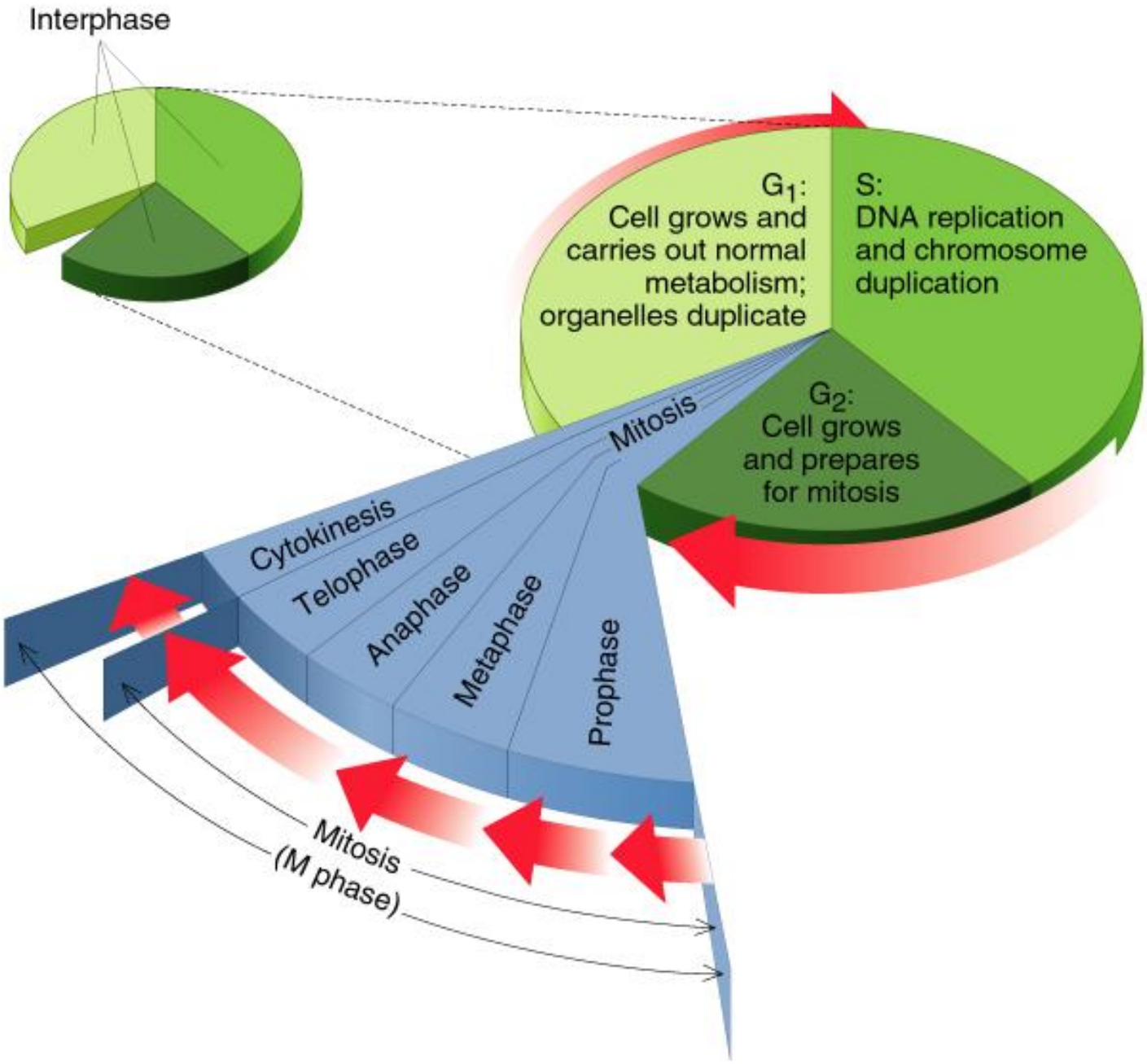
- nuclei reveal large number of tiny dots,

-30 nm in diameter.

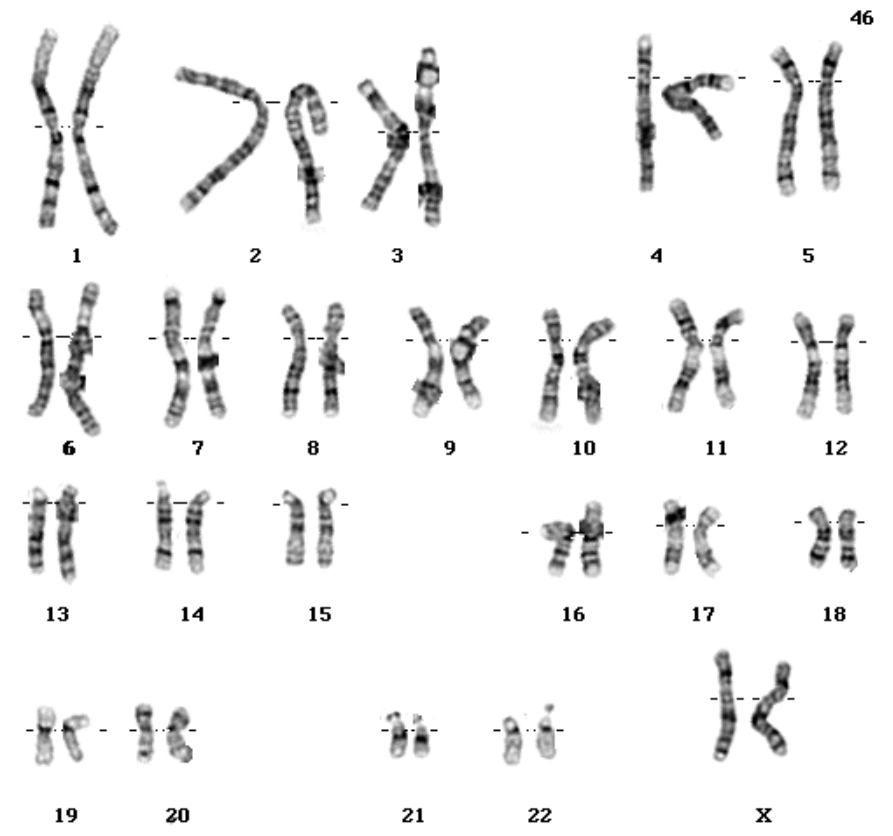
- They are chromatin fibers.

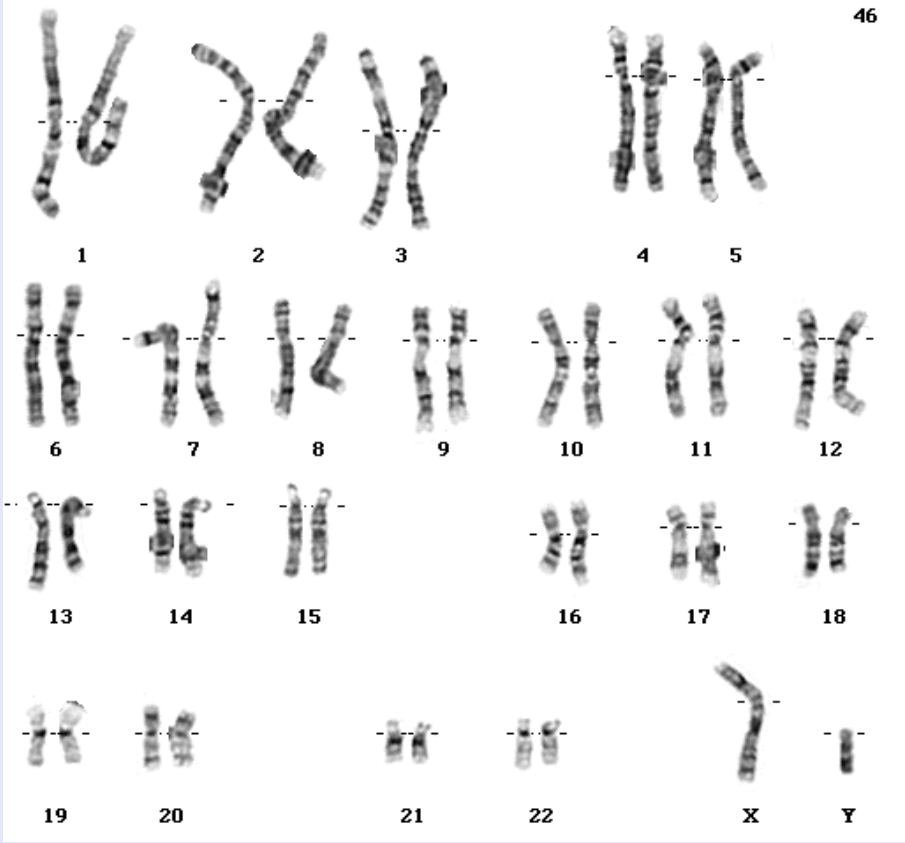

DNA double helix
(2 nm in diameter)
DNA
H1 histone
Nucleosome
core particle
Histones
(8 subunits)
Nucleosome filament
(10 nm in diameter)
30 nm fiber
Looped domains
Metaphase
chromosome


2m
DNA
.006 mm
Human cell

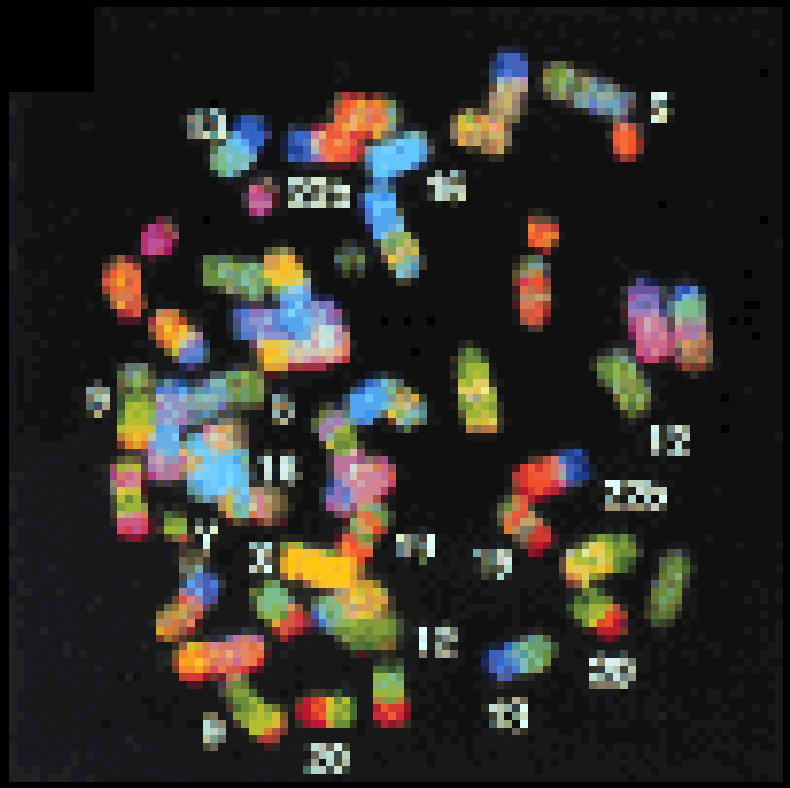

Interphase
G1:
Cell grows and carries out normal metabolism; organelles duplicate
S:
DNA replication and chromosome duplication
G2:
Cell grows and prepares for mitosis
Mitosis
Cytokinesis
Telophase
Anaphase
Metaphase
Prophase
Mitosis
(M phase)

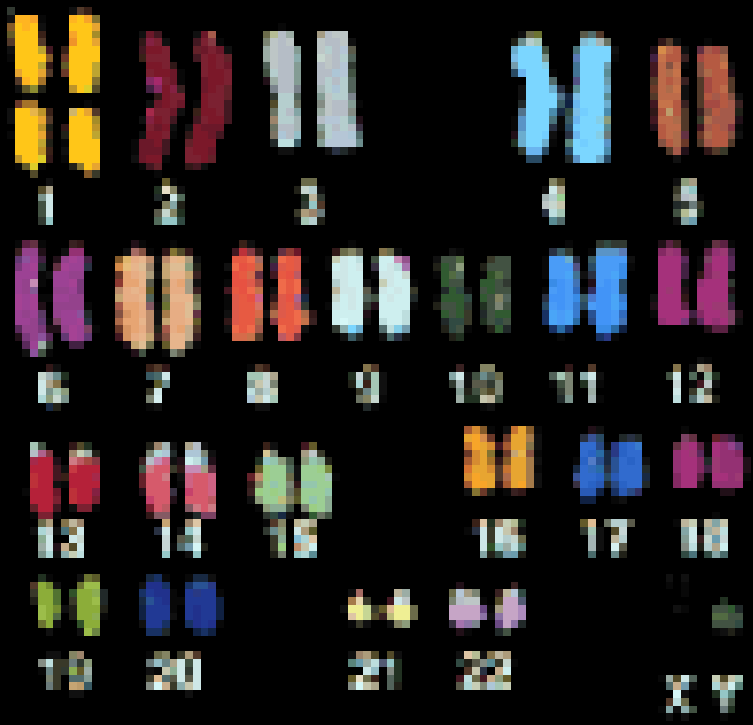
Human chromosomes 2n=46

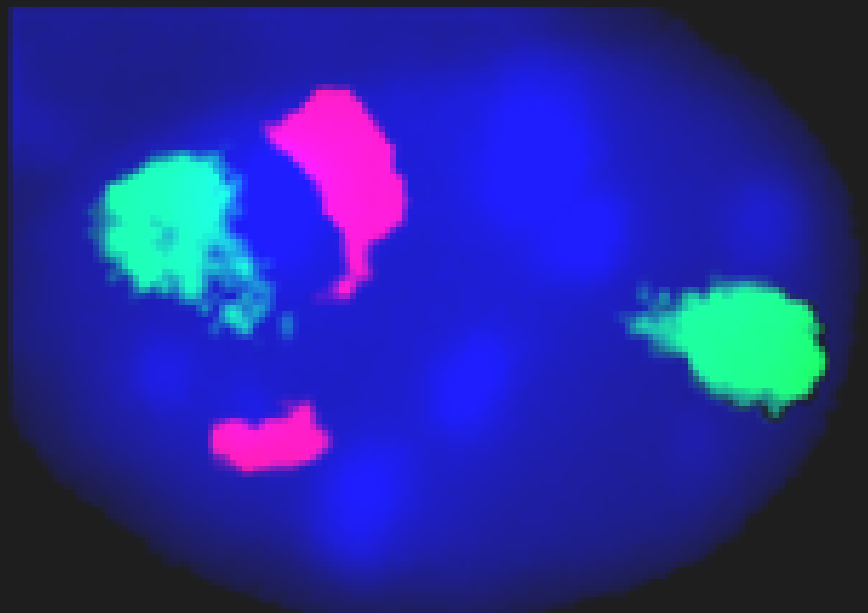




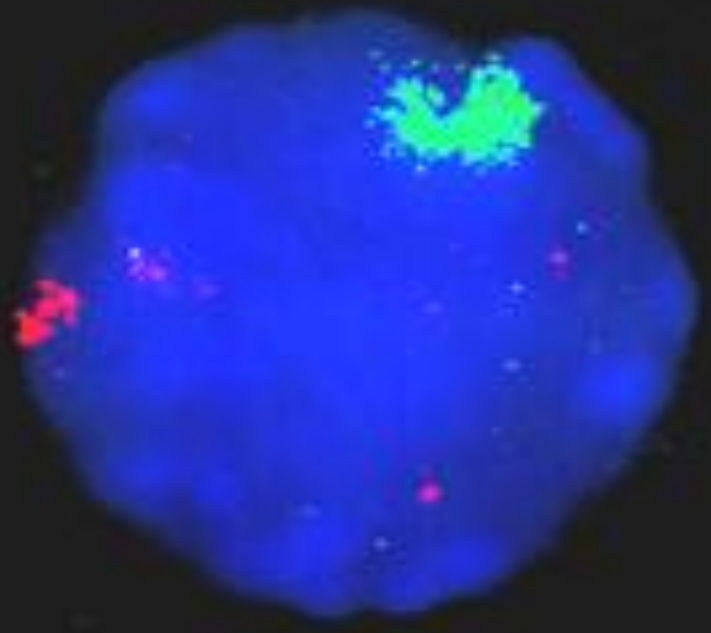
Chromosome painting



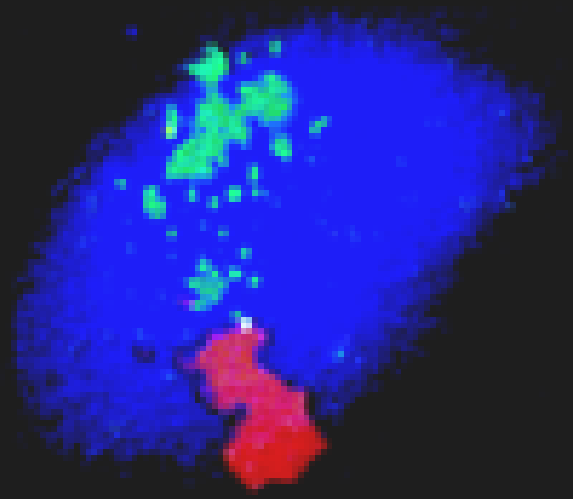




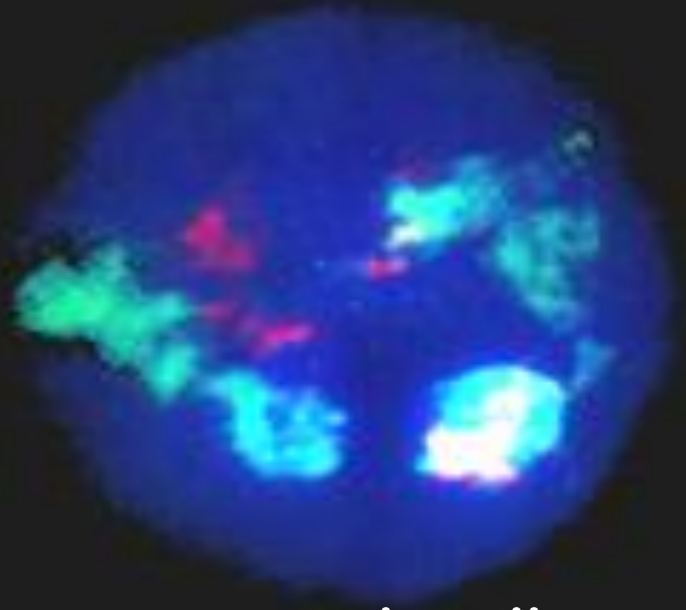
Spermatogonium



Spermatocyte

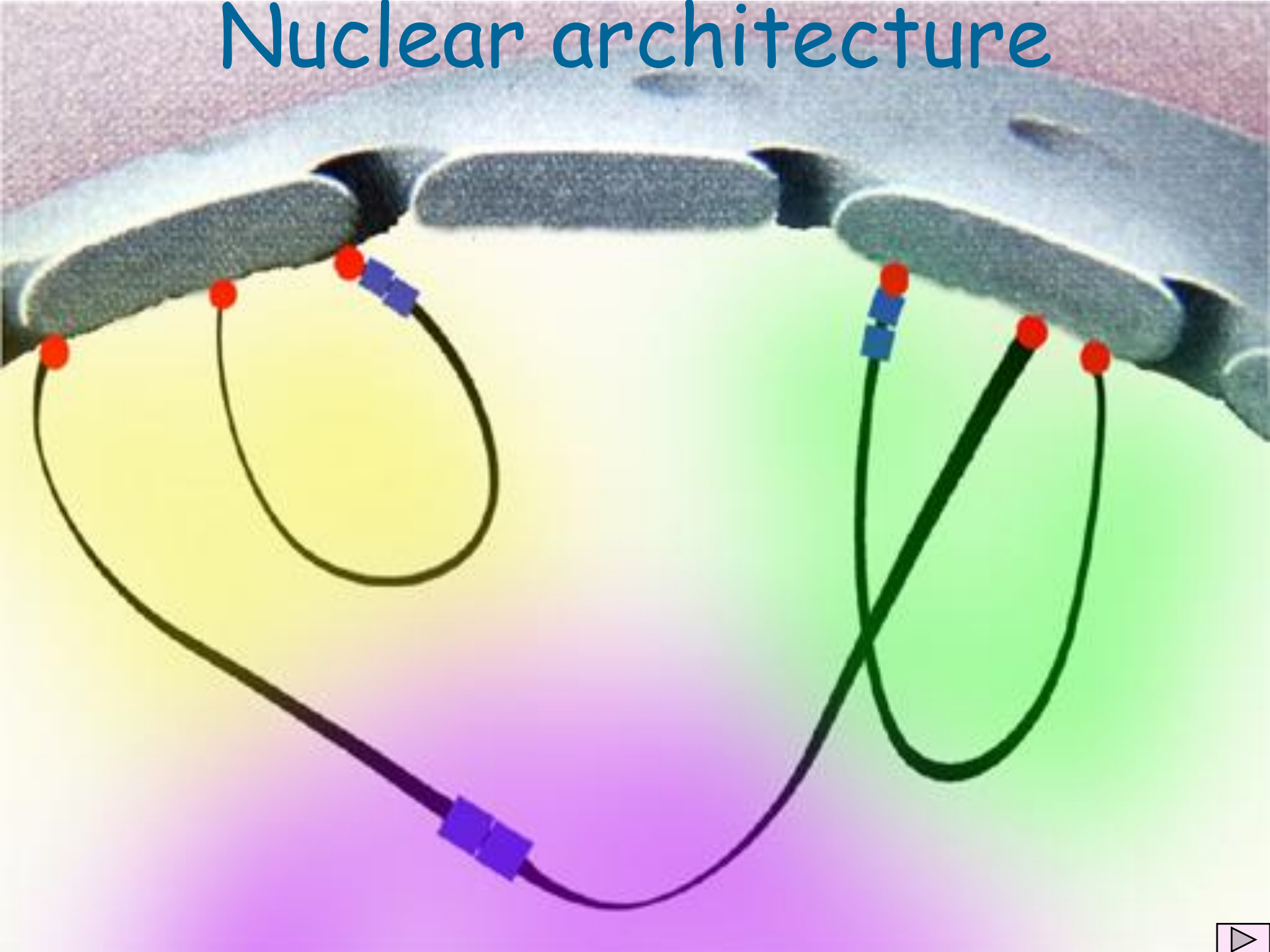


Spermatid



Sertoli cell

Nuclear architecture

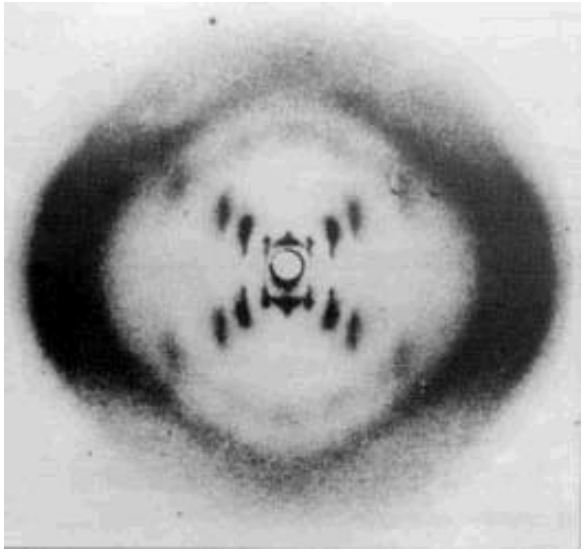


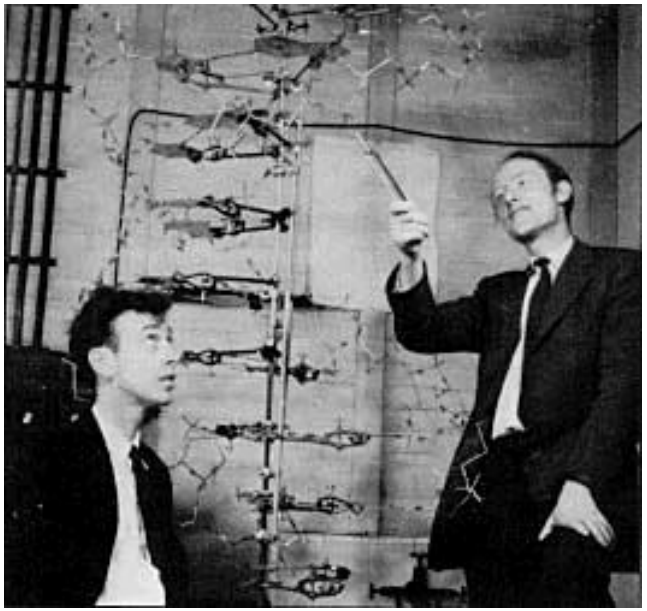
DNA

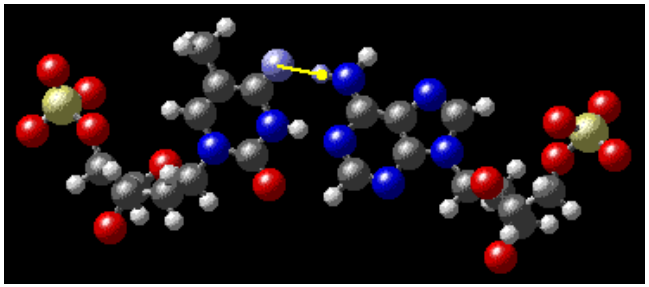
Deoxyribonucleic acid

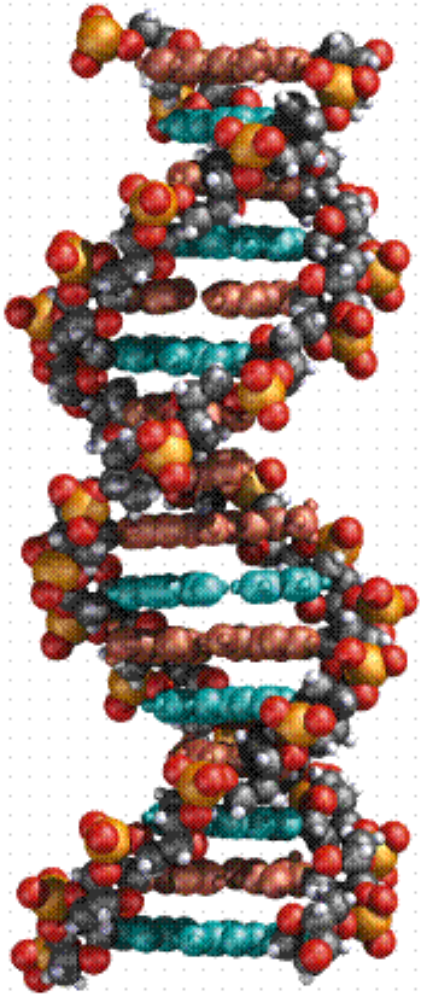
The genetic material in most organisms

Many scientists were interested in deciphering the structure of DNA, among them were Francis Crick, James Watson, Rosalind Franklin, and Maurice Wilkins. Watson and Crick gathered all available data in an attempt to develop a model of DNA structure. Franklin took X-ray diffraction photomicrographs of crystalline DNA extract, the key to the puzzle.







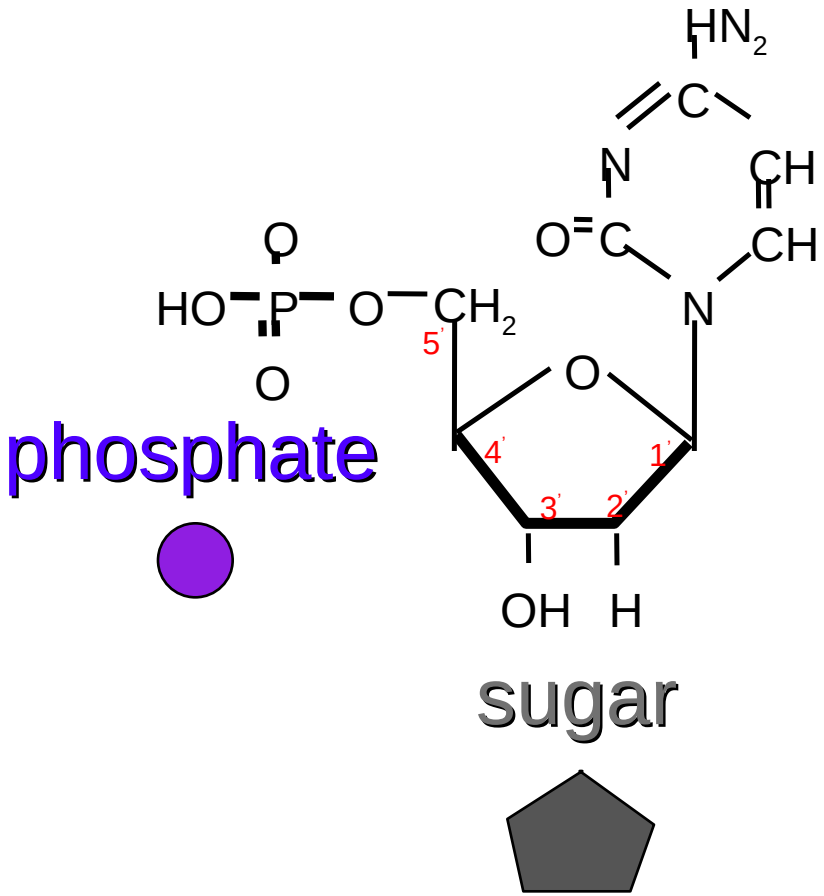


What is DNA?

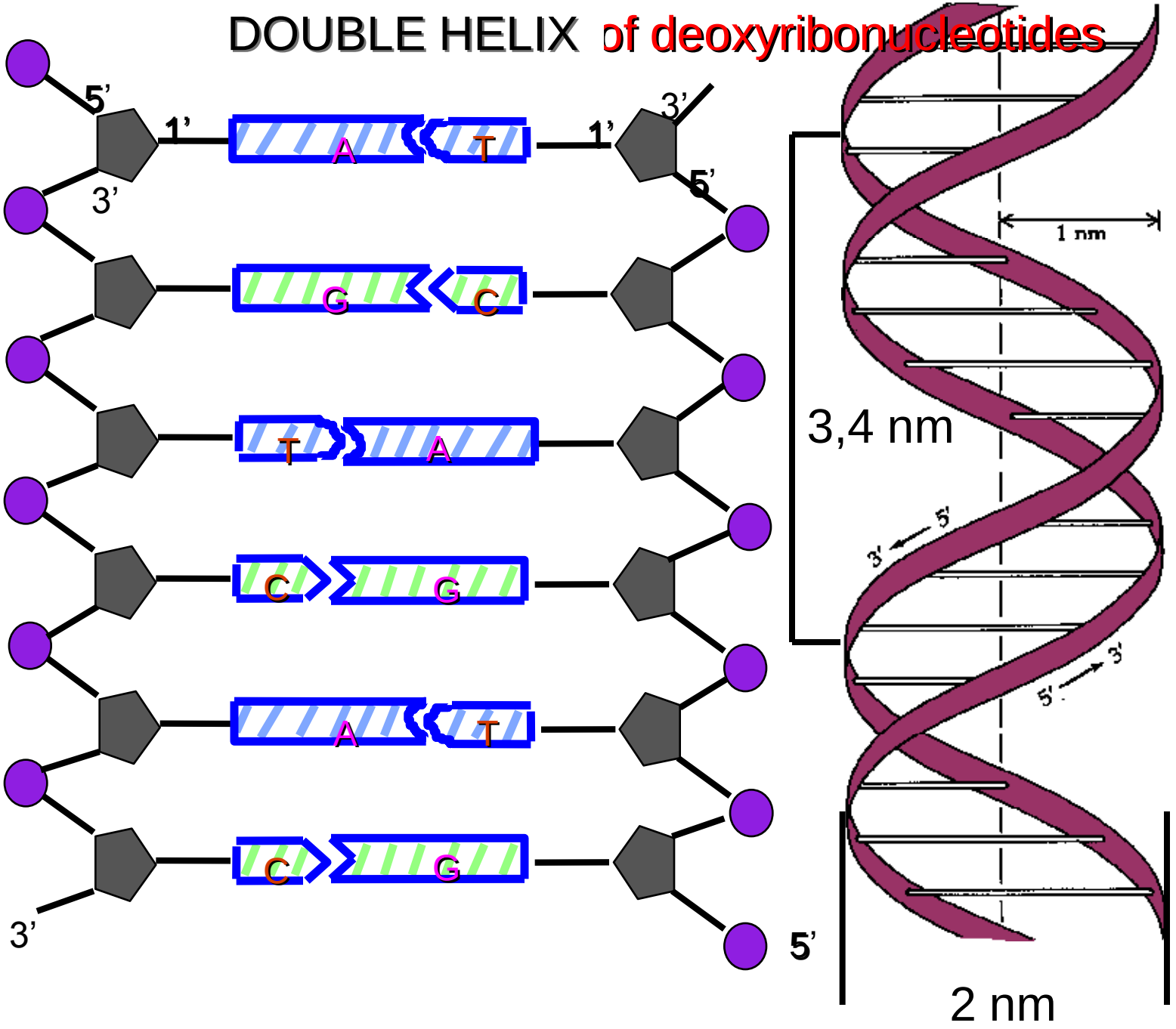
- DNA, or deoxyribonucleic acid, is the genetic instruction set.
- It is composed of a linear sequence of units called nucleotides.
- There are four different kinds of nucleotides (designated by the letters A, G, C, & T; sometimes called "bases").
- An individual DNA strand (or chromosome) may consist of 100,000's of nucleotides.
- The sequence of the nucleotides of a DNA strand determines the genetic code.

GENE

A DNA base sequence that encodes a functional polypeptide (protein) or RNA sequence.

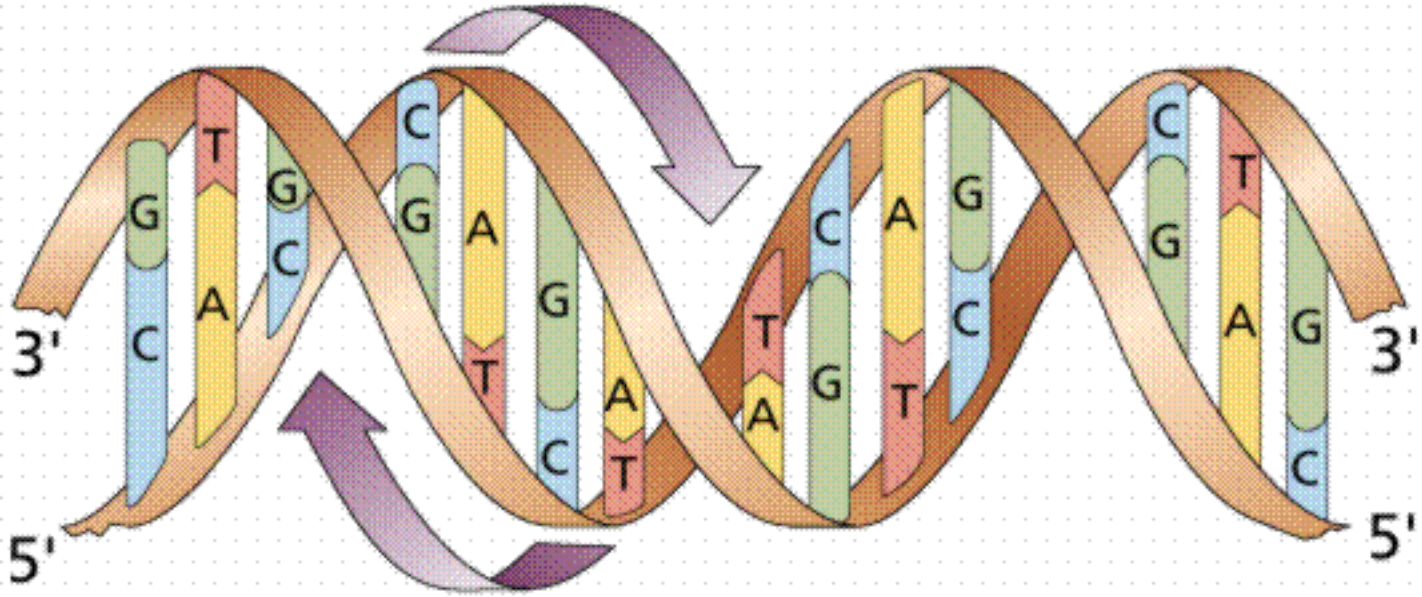

HN2
C
N
CH
O
C
CH
HO
P
O
CH2
5'
N
O
4'
1'
3'
2'
OH
H
phosphate
sugar
base (cytosine)
A
G
T
C
PURINES
PYRIMIDINES

DOUBLE HELIX of deoxyribonucleotides



DNA is a double helix, with bases to the center (like rungs on a ladder) and sugar-phosphate units along the sides of the helix (like the sides of a twisted ladder). The strands are complementary. A pairs with T and C pairs with G, the pairs held together by hydrogen bonds. Notice that a double-ringed purine is always bonded to a single ring pyrimidine. Purines are Adenine (A) and Guanine (G). Pyrimidines are Cytosine (C) and Thymine (T).

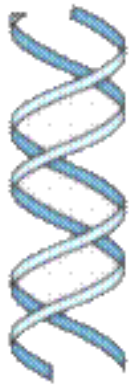
“If we know the base sequence of one strand we know its complement”.



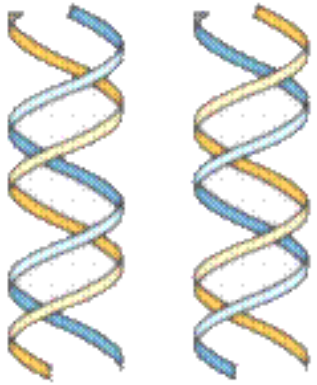
DNA REPLICATION

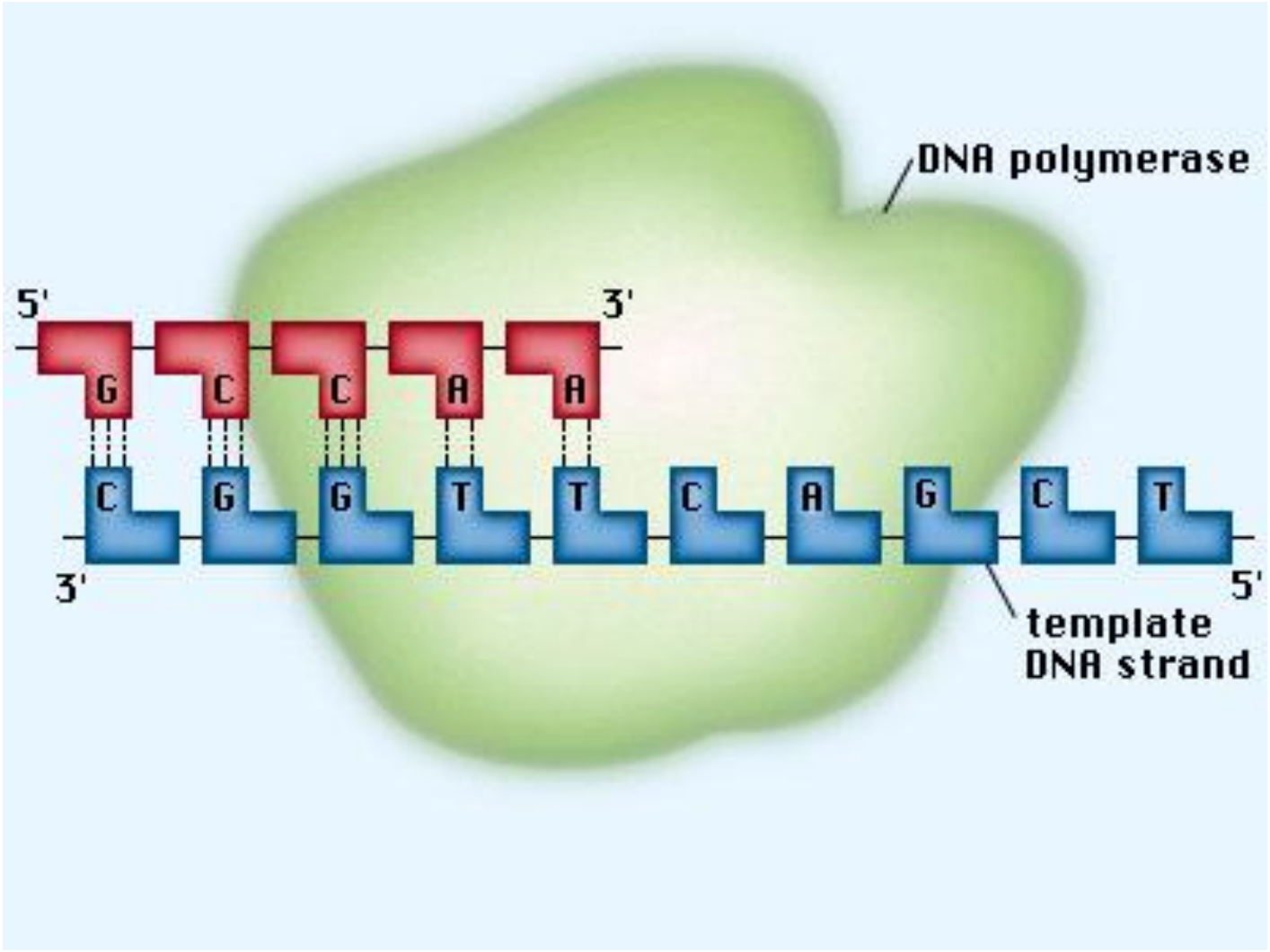
2. Semiconservative replication would produce two DNA molecules, each of which was composed of one-half of the parental DNA along with an entirely new complementary strand

Original DNA Helix

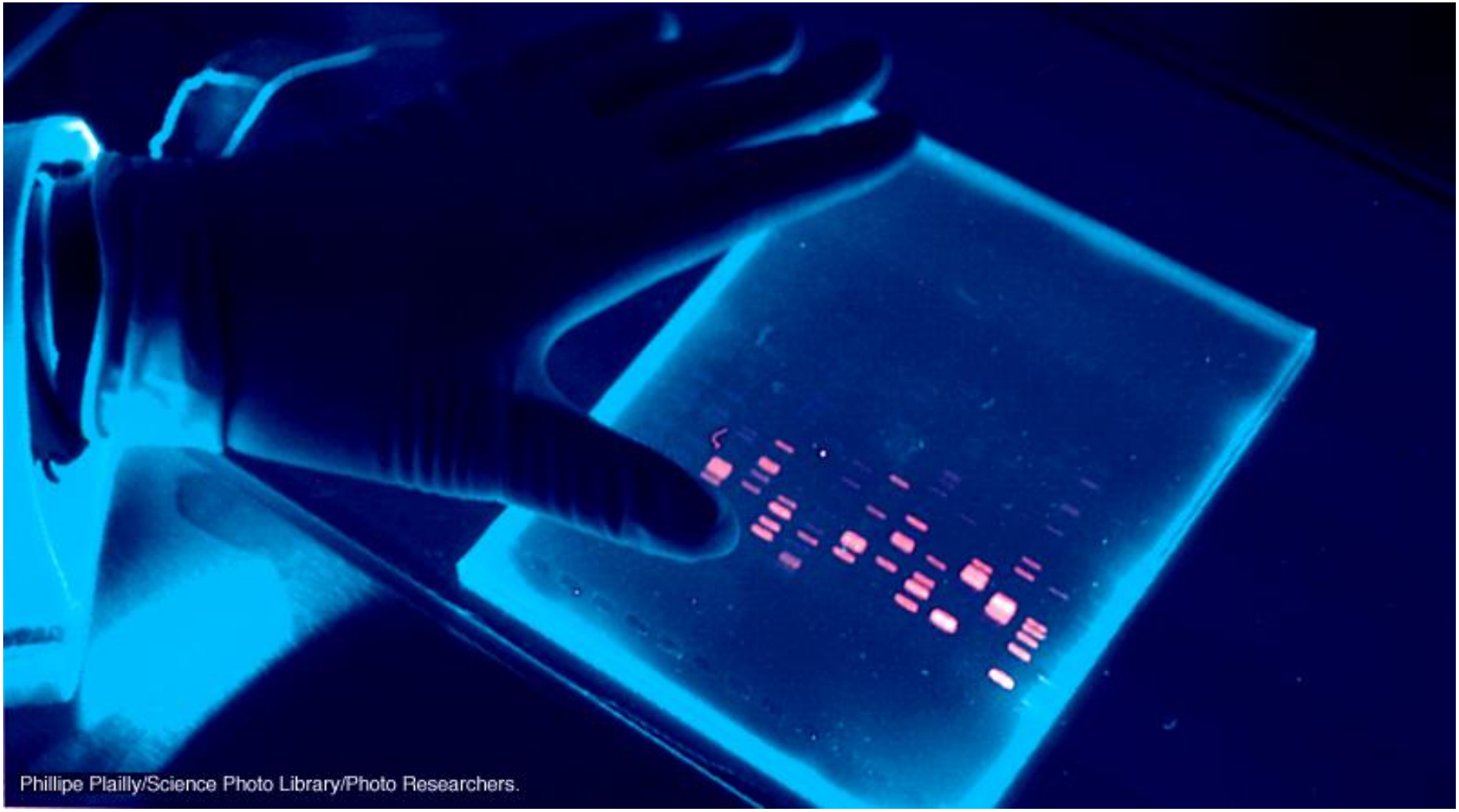


DNA helixes after one round of replication

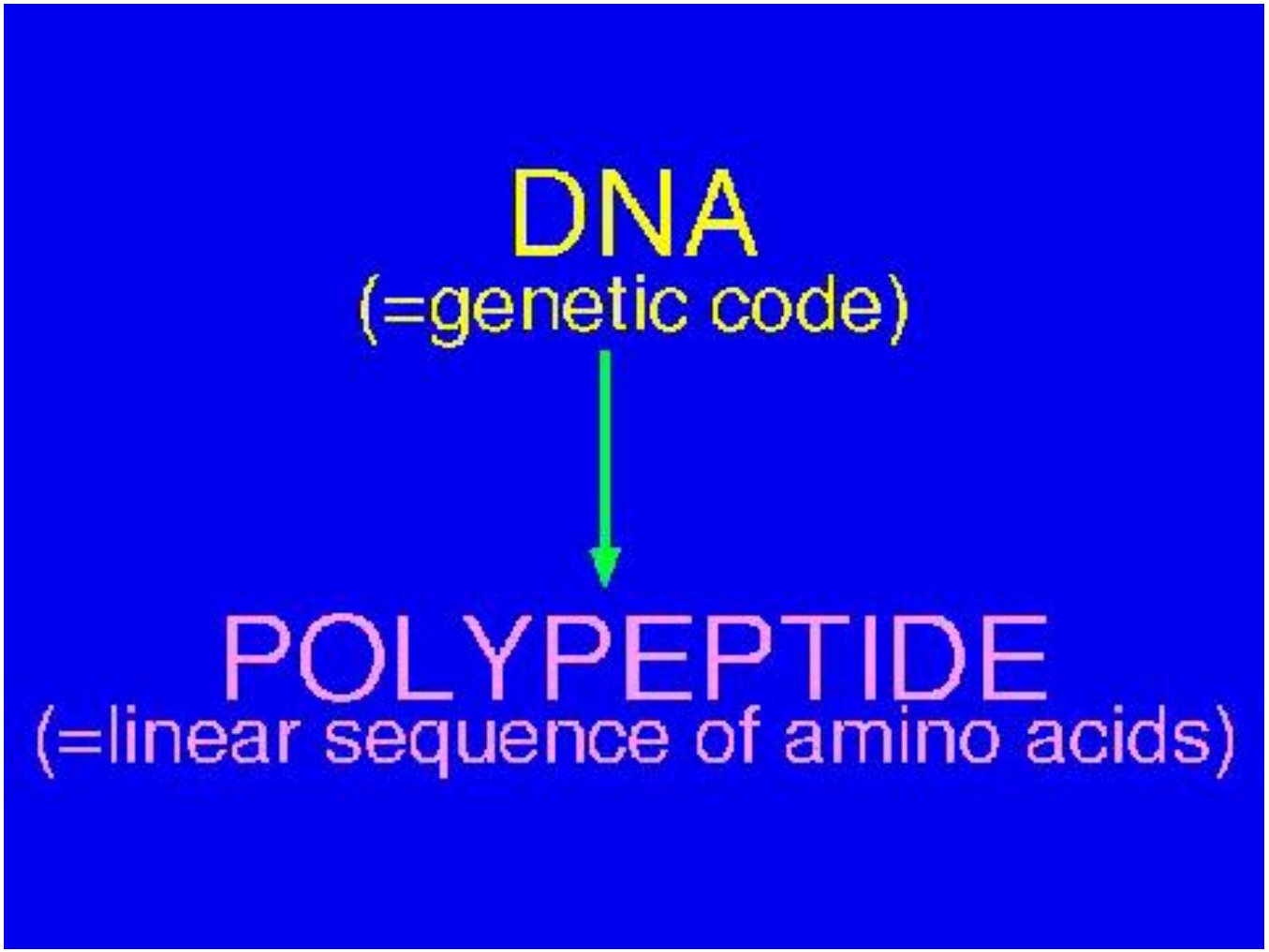



DNA polymerase
5'
3'
G
C
C
A
A
C
G
G
T
T
C
A
G
C
T
3'
5'
template
DNA strand

Polymerase Chain Reaction



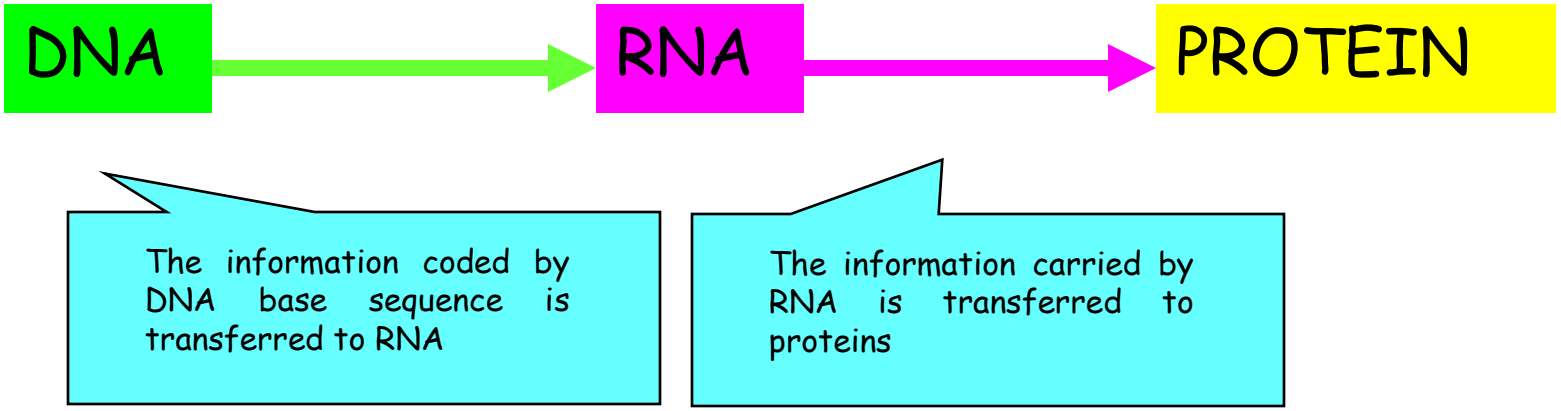
Phillipe Plailly/Science Photo Library/Photo Researchers.

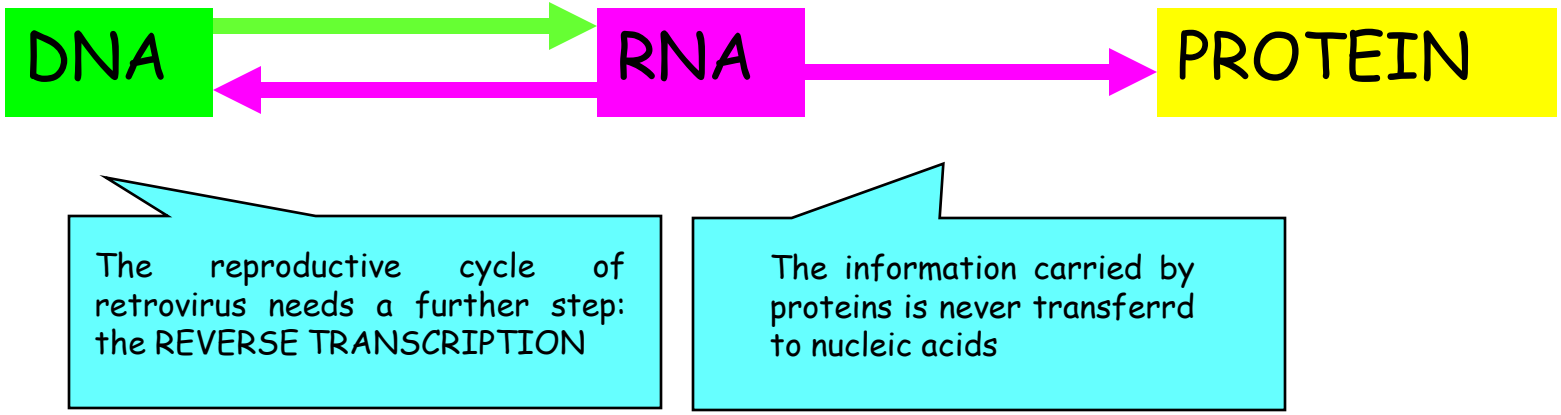


The relationship between a sequence of DNA and the sequence of the corresponding protein is called the genetic code

"The central dogma"

Francis Crick





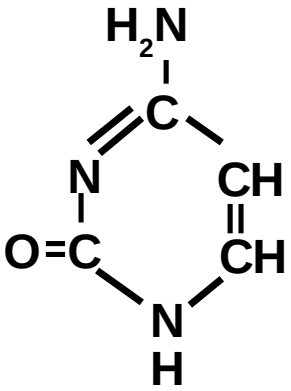
RNA

RibonucleicAcid

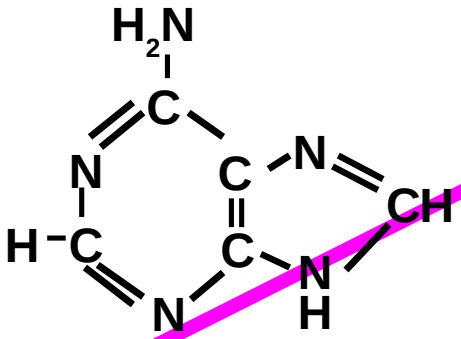
RNA transmits information fr om DNA and has structural and functional roles in pr otein synthesis

Nitrogenous bases found in RNA

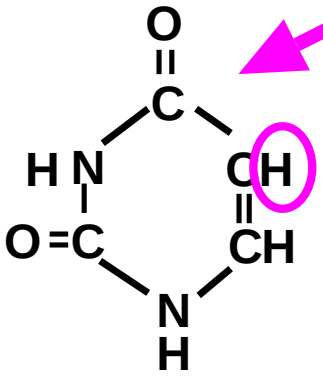
pyrimidines **purines**



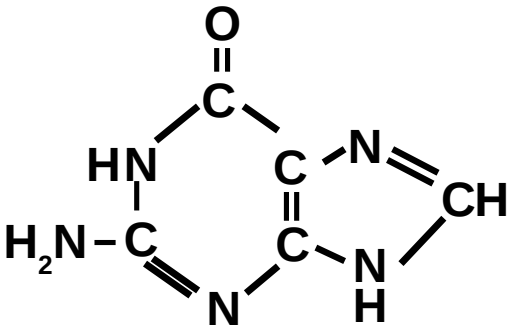
CYTOSINE



ADENINE



URACIL



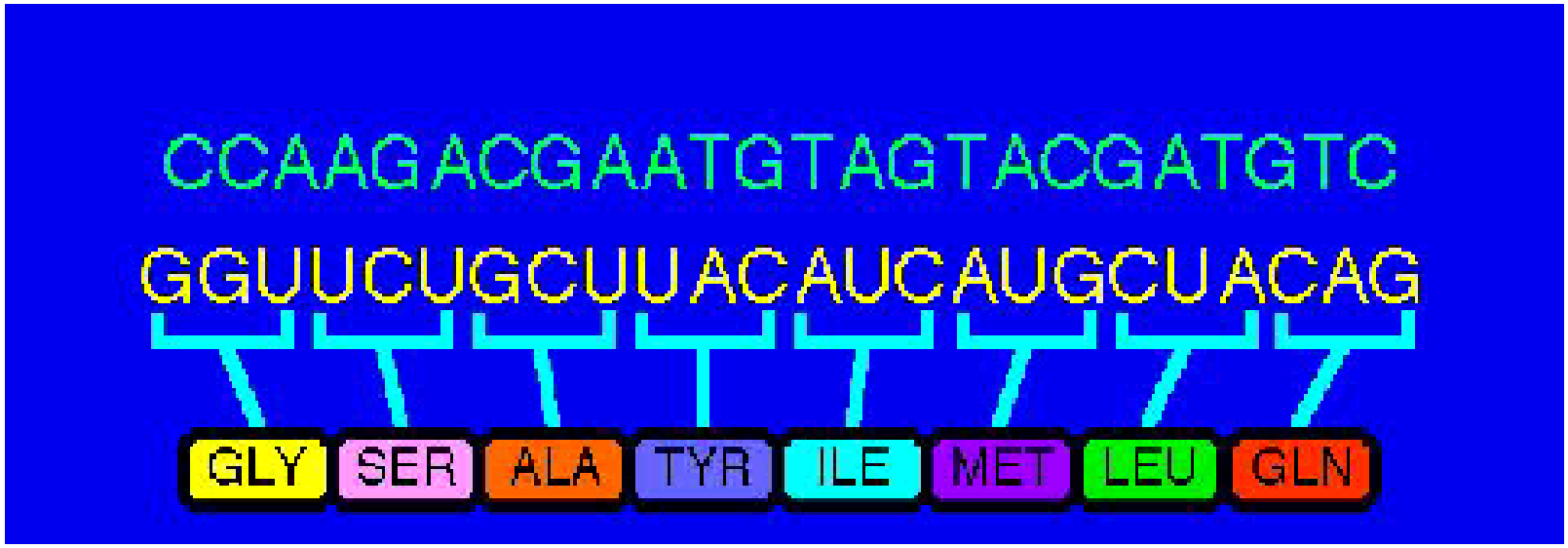
GUANINE

RNA has uracil in place of thymine:

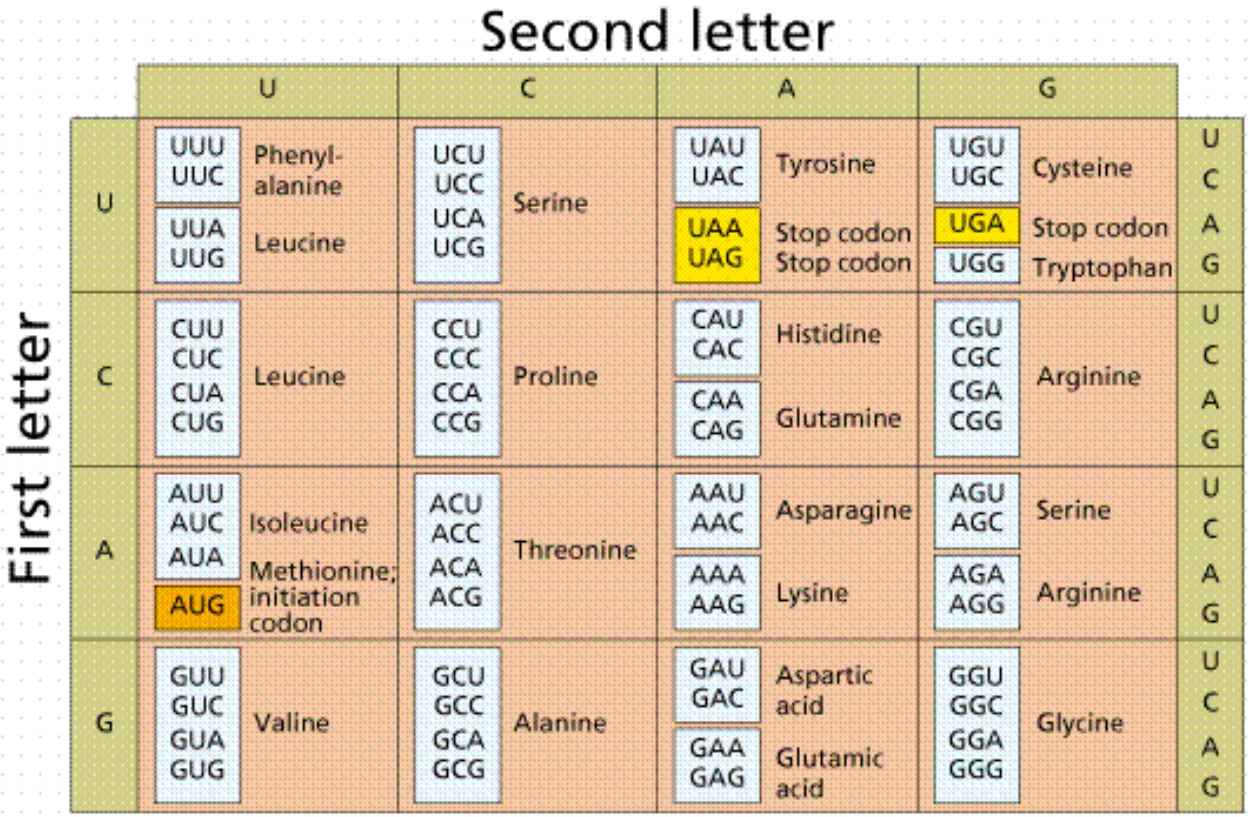
-CH_3 is replaced by -H

Three types of RNA

- **Ribosomal RNA (rRNA)**
  - combines with proteins to form the ribosomes
- **Messenger RNA (mRNA)**
  - contains the instruction for the ordering of amino acids in proteins
- **Transfer RNA (tRNA)**
  - carries specific amino acids to ribosomes



- The genetic code is read in groups of three nucleotids, each group representing one amino acids.
- Each trinucleotides sequence is called a codon.
- A gene includes a series of codons that is read sequencially from a starting point at one end to a termination point at the other end.



Il codice genetico e' universale,
ridondante e degenerato

20 aminoacidi - 64 codoni