

# **DNA, RNA, & Protein Synthesis**

# DNA (Deoxyribonucleic Acid)

- DNA are the instructions for proteins shape.  
(Wrong shape=wrong function)

**Organic molecule (a polymer of nucleotides)=Nucleotide**

- Phosphate Group

- Deoxyribose Sugar

- Nitrogen Base

- The 4 Bases of DNA:

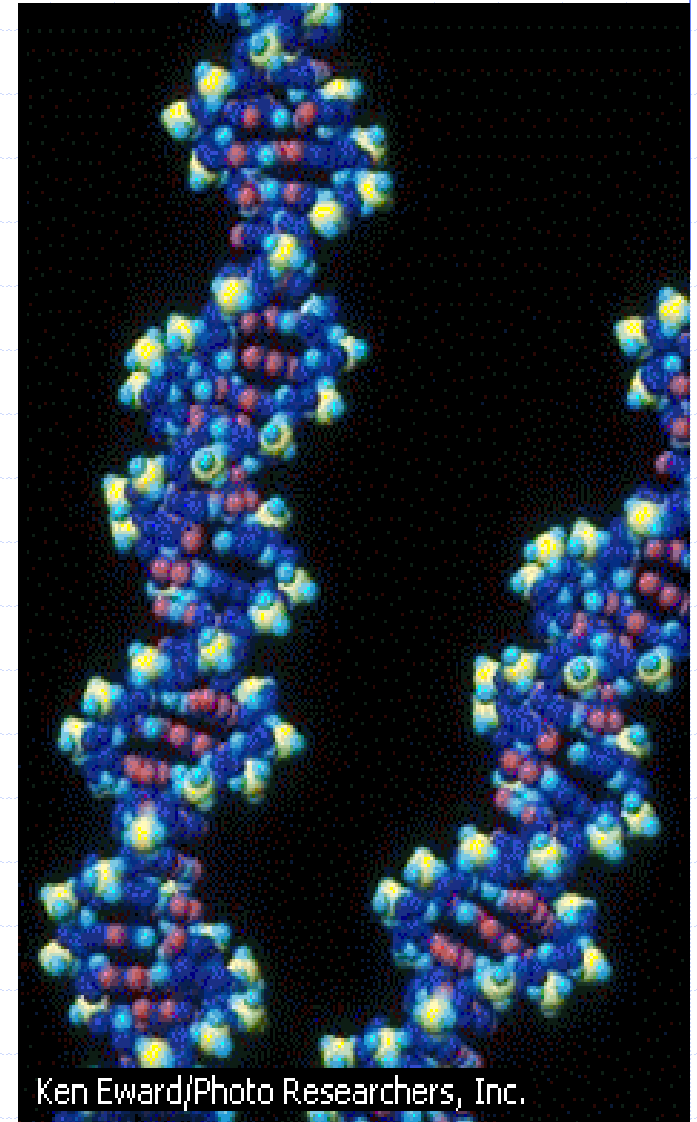
- CYTOSINE (single ring)

- THYMINE (single ring)

- ADENINE (double ring)

- GUANINE (double ring)

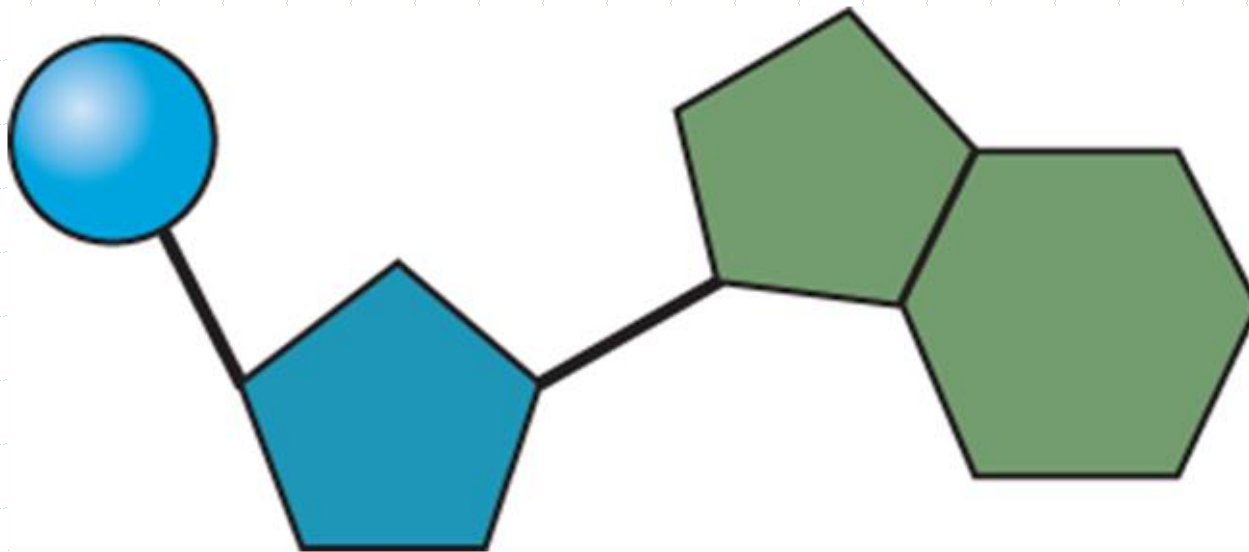
**Located in the chromosomes in the nucleus of cells**



# Nucleotide

phosphate group

nitrogen-containing  
base



deoxyribose (sugar)

## PYRIMIDINES = SINGLE RING

## PURINES = DOUBLE RING

Name of Base

Structural Formula

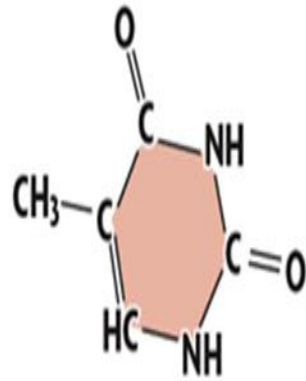
Model

Name of Base

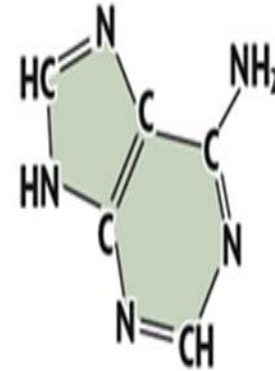
Structural Formula

Model

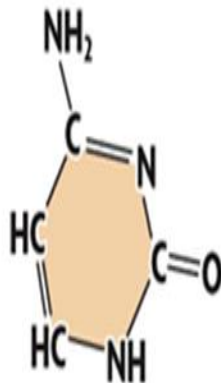
thymine



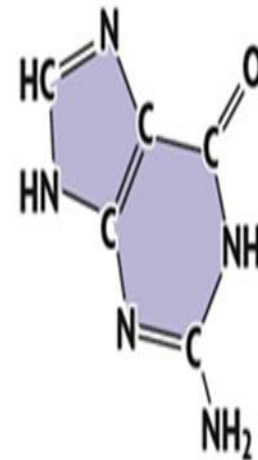
adenine



cytosine



guanine



# Structure of DNA

The same 4 Nitrogenous bases make up the DNA of all organisms. Double ring bases pair with single ring bases to fit like a puzzle:

Adenine-Thymine

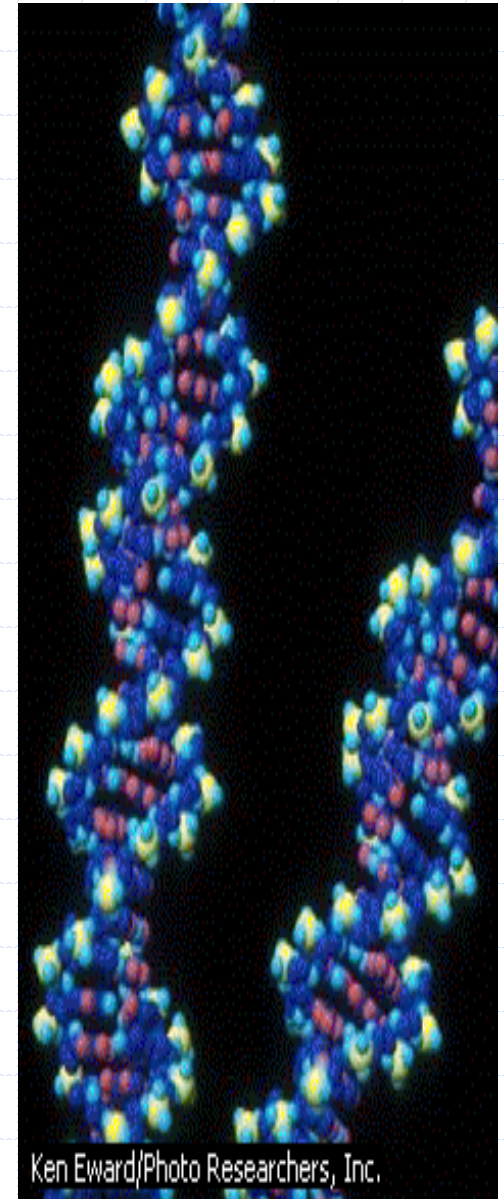
Guanine-Cytosine

The helix has uniform width because a single ring (pyrimidine) pairs with a double ring (purine)

*Ladder Shape, Double strand, helix twist=*  
Double Helix Model (Watson & Crick)  
-Two strands of DNA form a twisted ladder. The strands are complementary of each other.

ex: Strand 1= ACACAC

Strand 2= TGTGTG



# Watson & Crick's Double helix:



Photo Researchers, Inc.

- ◆ Studying protein shape (shape determines function. If protein is not made, that function can't be performed)

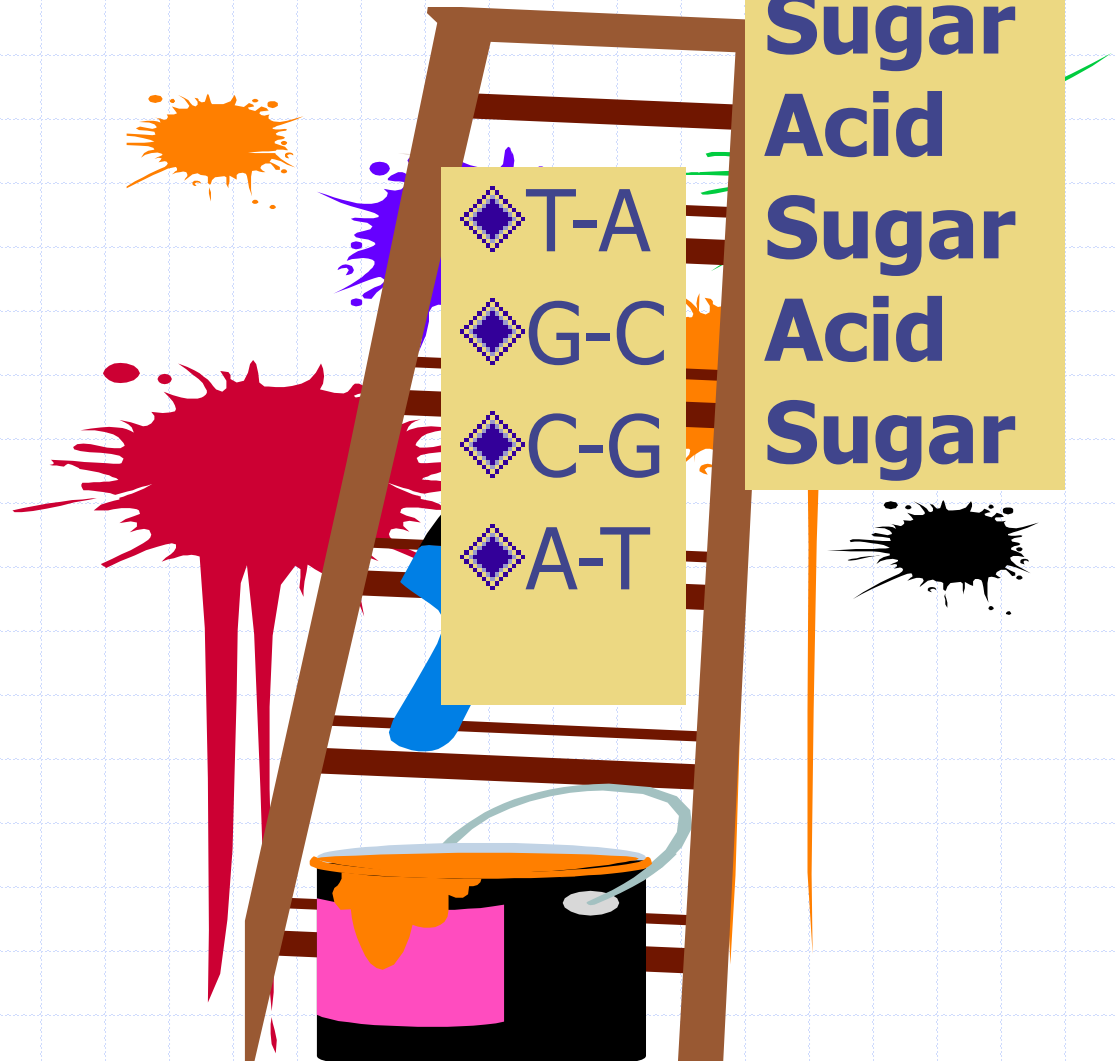
# Ladder Shape (Sides & Rungs)

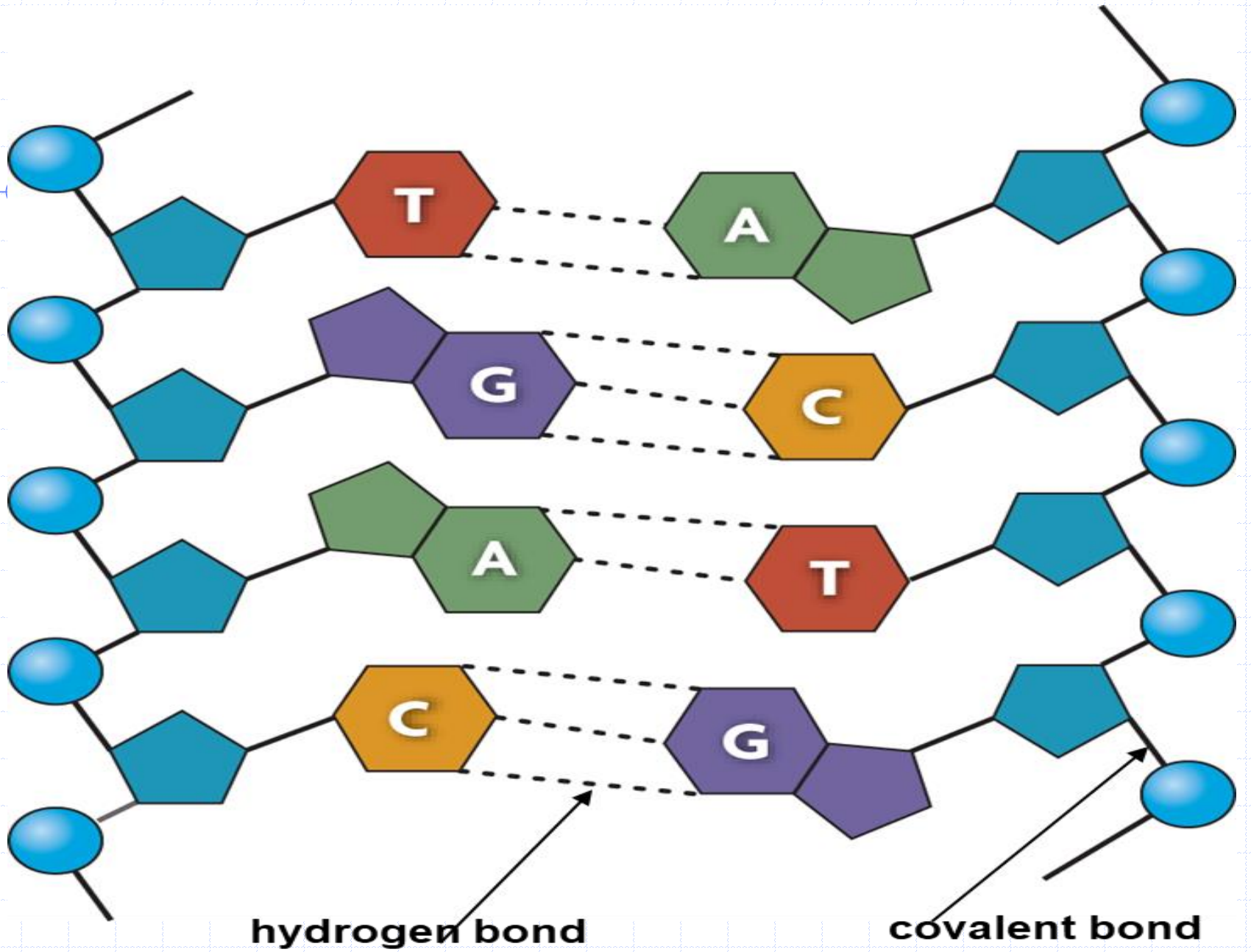
## Sides:

- ◆ Phosphoric Acid
- ◆ Sugar
- ◆ Phosphoric Acid

## Rungs:

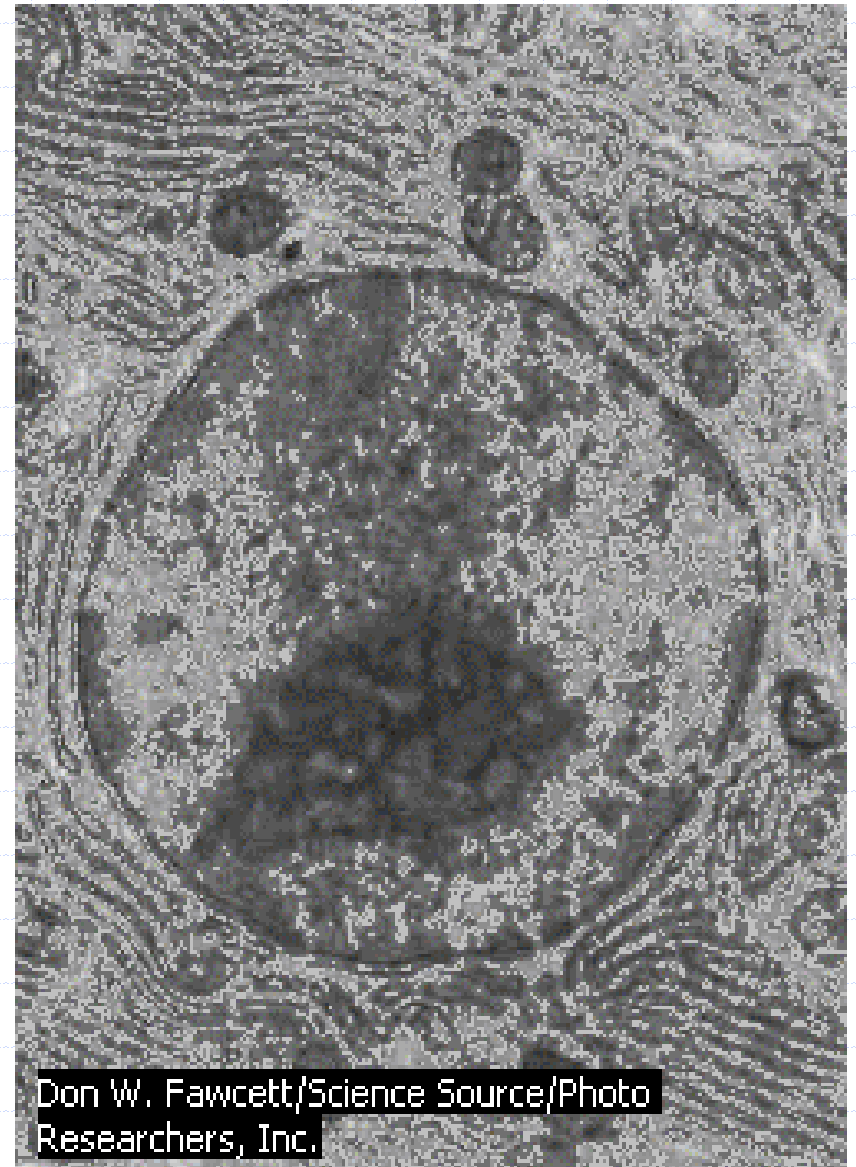
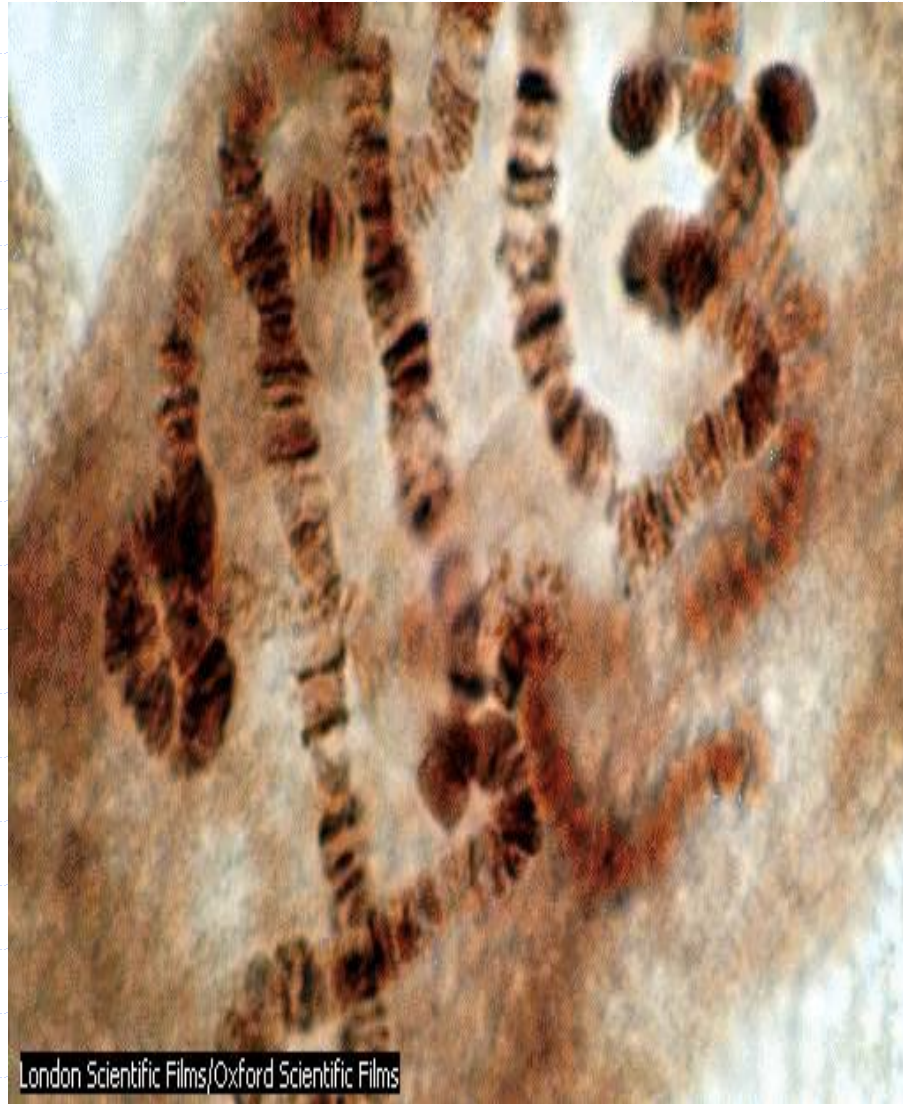
- ◆ A-T
- ◆ T-A
- ◆ G-C
- ◆ C-G



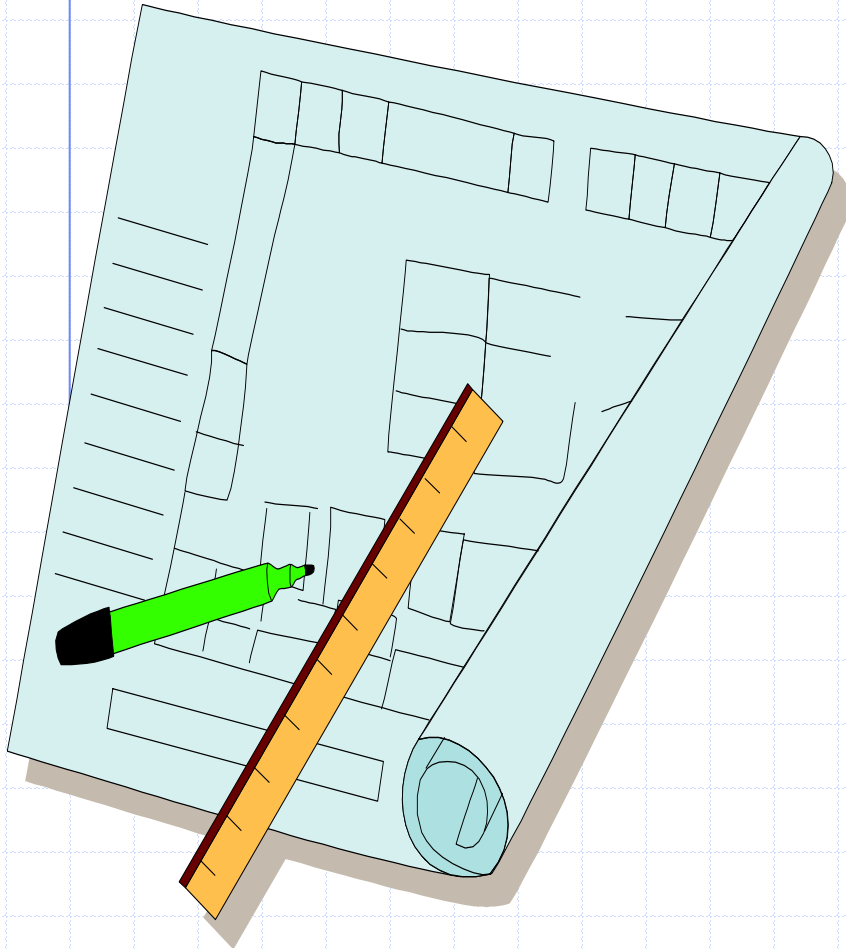




# Chromosomes in Nucleus



# What is DNA's Function?



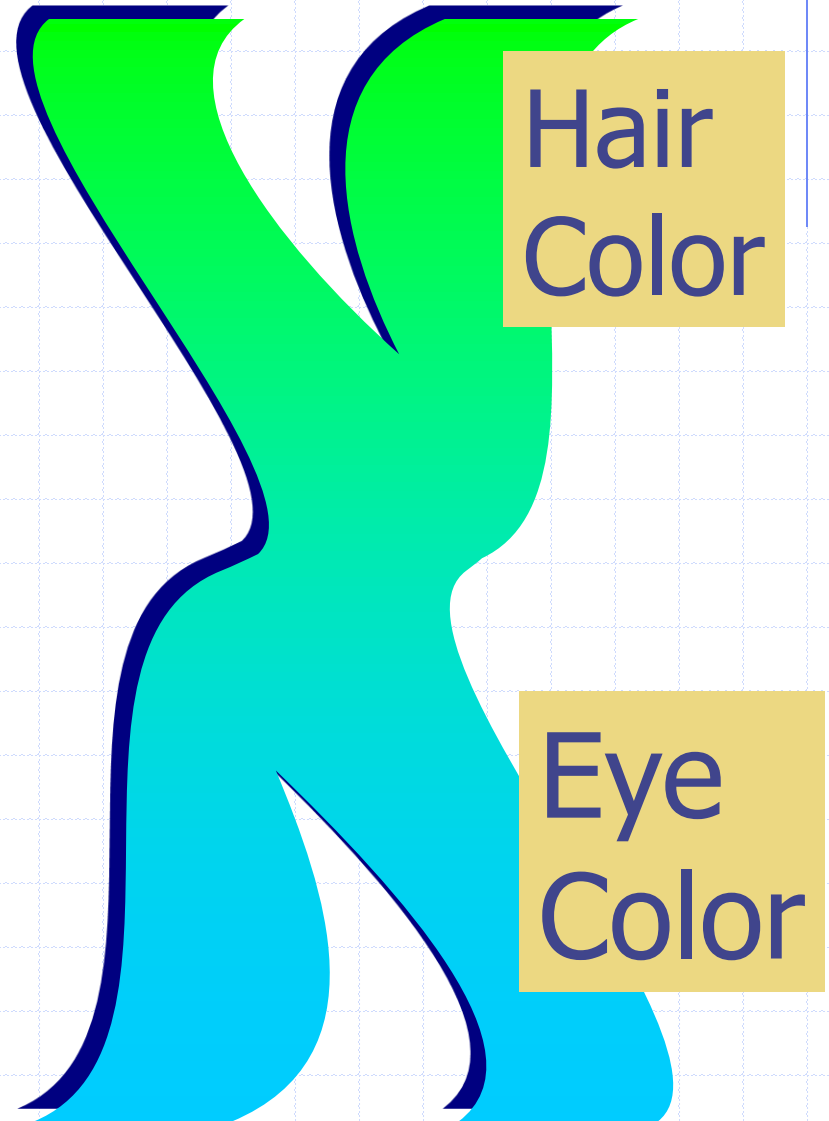
- ◆ **Hereditary Instructions**
- ◆ **Chemical code for every trait**
- ◆ **“Blueprint” for making Proteins**

# Chromosome DNA Code:

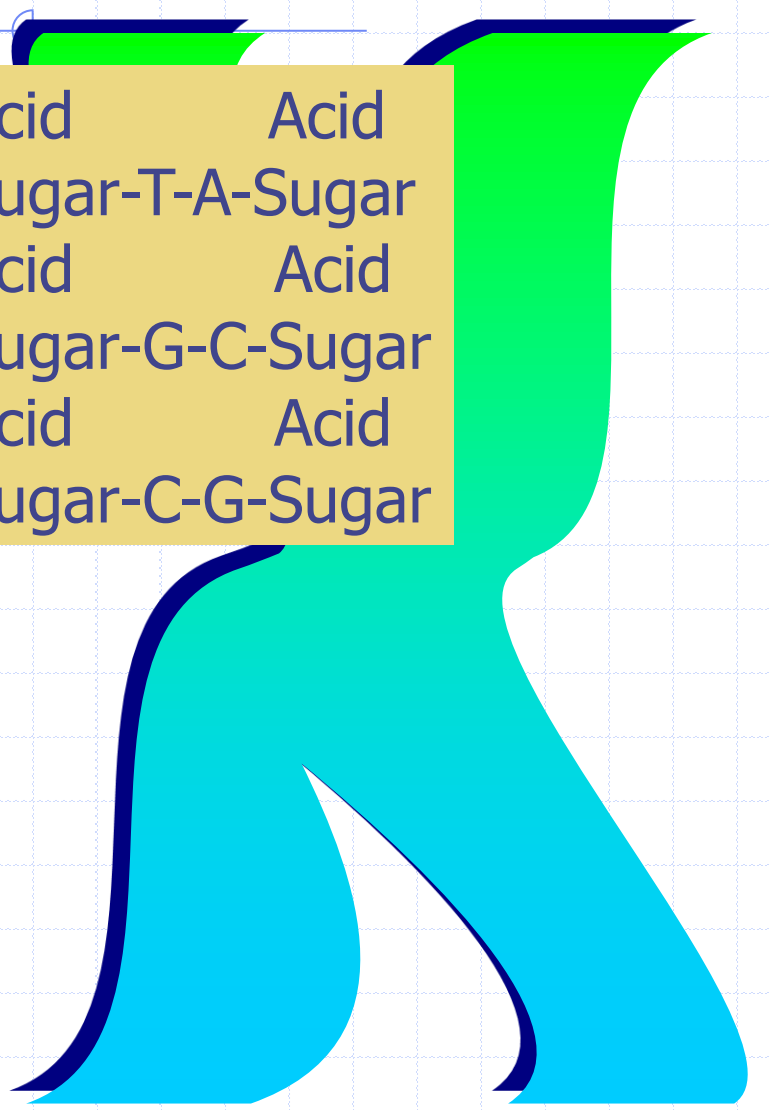
**Genes =**

◆ **Segments  
of DNA**

◆ **Code for  
a trait**



# DNA Chromosome Code:



Acid	Acid
Sugar-T-A-Sugar	
Acid	Acid
Sugar-G-C-Sugar	
Acid	Acid
Sugar-C-G-Sugar	

## Triplets=

- ◆ Sets of 3 Nucleotides
- ◆ Code for Trait (polypeptides/ proteins)

# DNA Chromosome Code:

Like Morse Code:

Hair \*\*\* \*\_ \*\* \*\_\*

A	. _ _
B	_ _ _ _
C	_ _ _ _ .
D	_ _ _
E	.
F	_ _ _ .
G	_ _ _ .
H	_ _ _ .
I	. .
J	. _ _ _ _
K	_ _ . _
L	. _ _ .
M	_ _ _
N	_ .
O	_ _ _ _
P	. _ _ _ .
Q	_ _ _ . _
R	. _ .

S	. . .
T	_ _
U	. . _ _
V	. . . _
W	. _ _ _
X	_ _ _ _
Y	_ . _ _ _
Z	_ _ _ . .
1	. _ _ _ _ _
2	. . _ _ _ _
3	. . . _ _ _
4	. . . . _
5	. . . . .
6	_ _ . . .
7	_ _ _ . . .
8	_ _ _ _ . . .
9	_ _ _ _ _ . .
0	_ _ _ _ _ _

Or DNA  
 A-T  
 A-T  
 G-C  
 C-G  
 T-A  
 C-G

# DNA Replication (copies the genetic information of the cell)

- ◆ Every time a cell divides, DNA must first be copied
- ◆ Replication is preserving the order of the bases in DNA.
- ◆ Chromosomes double in Late Interphase of the Cell Cycle
- ◆ ...DNA stores info, enzymes and proteins make copies of that info

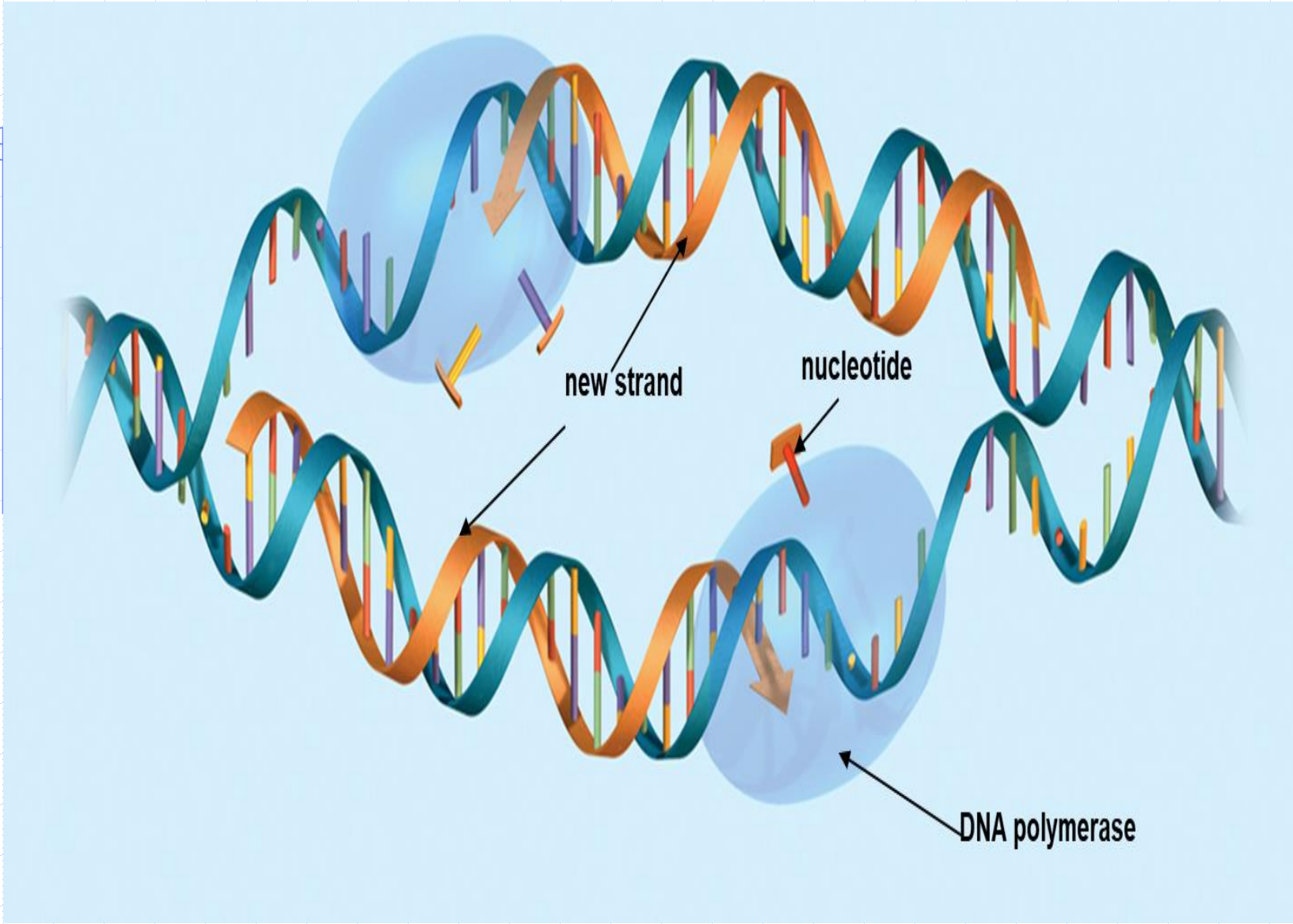
# Steps for DNA Replication:

- 1. DNA untwists**
- 2. DNA unzips (enzyme: DNA Helicase)**
- 3. Exposed bases are paired with Corresponding bases and line up in sets of 3 nucleotides (called triplets or codons)**
- 4. DNA reforms (enzyme: DNA Polymerase)**
- 5. 2 strands twist into helix**

**DNA serves as a template...Enzymes and other proteins do the actual work**

**-Enzymes unzip the helix**

**-Free floating nucleotides form hydrogen bonds with the template strand.**



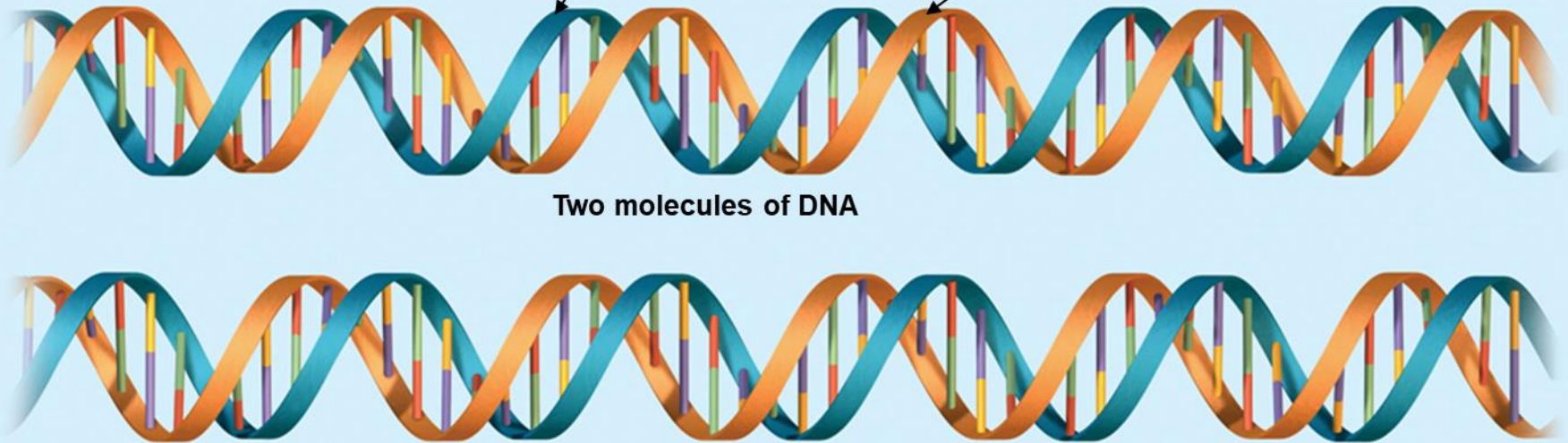


- ◆ Two new molecules of DNA are formed, each with an original strand and a newly formed strand.
- ◆ DNA replication is semiconservative

original strand

new strand

Two molecules of DNA



# RNA

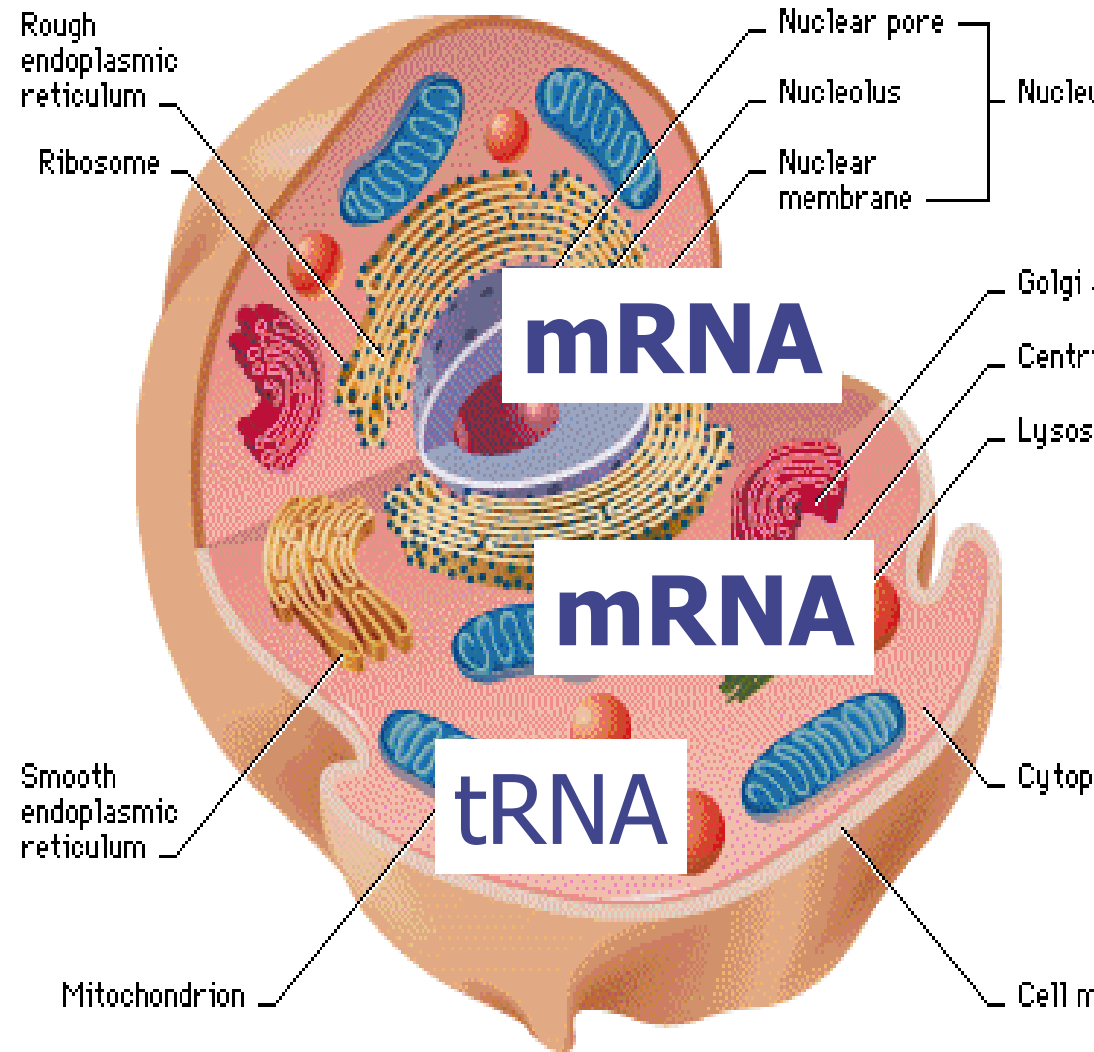
1. Organic Molecule
2. Nucleic Acid
3. *mRNA*=messenger  
*rRNA*=ribosomal  
*tRNA*=transfer

**R**  
**I**  
**B**  
**O**  
**N**  
**U**  
**C**  
**L**  
**E**  
**C**  
**A**  
**C**  
**E**

# B. Where is RNA located?

**1. mRNA in nucleus & cytoplasm**

**2. tRNA only in cytoplasm**



## B. What is RNA's structure?

- ◆ Acid
- ◆ Sugar-Base
- ◆ Acid
- ◆ Sugar-Base
- ◆ Acid
- ◆ Sugar-Base
- ◆ Acid
- ◆ Sugar-Base

### *1. Nucleotides=*

- a. Phosphoric Acid
- b. Ribose sugar
- c. Nitrogenous

**Bases:**

Adenine-Uracil

Guanine-Cytocine

### *2. Single Strand*

### *3. No Twisted helix*

# Comparison of RNA & DNA:

- ◆ Acid
- ◆ Sugar- Uracil
- ◆ Acid
- ◆ Sugar-Base
- ◆ Acid
- ◆ Sugar-Base
- ◆ Acid
- ◆ Ribose -Base

**RNA**

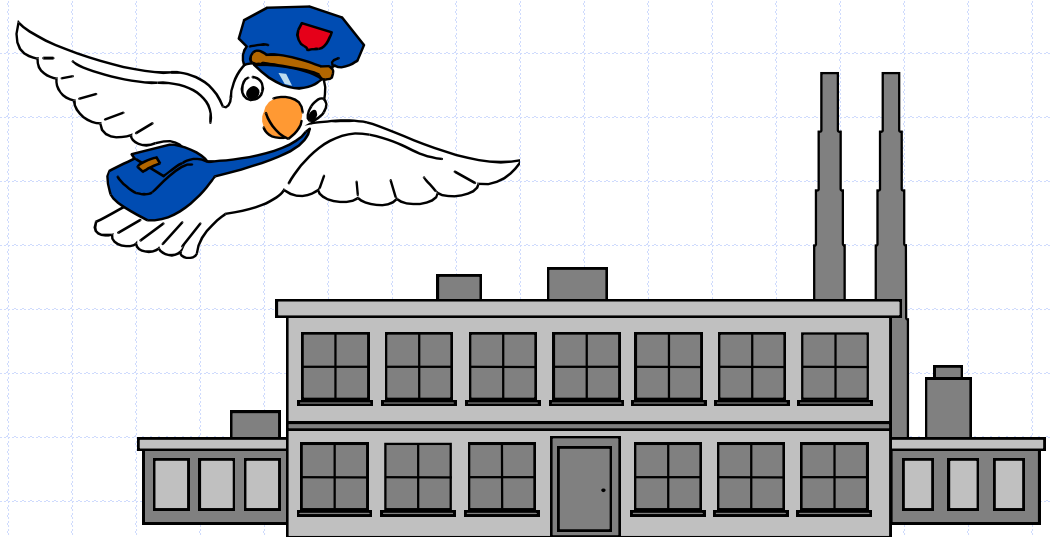
- ◆ Acid Acid
- ◆ Sugar Thymine Sugar
- ◆ Acid Acid
- ◆ Sugar-Base-Sugar
- ◆ Acid Acid
- ◆ Deoxy- -Base-Sugar  
ribose
- ◆ Acid Acid

**DNA Ladder**

# D. What are RNA's functions:

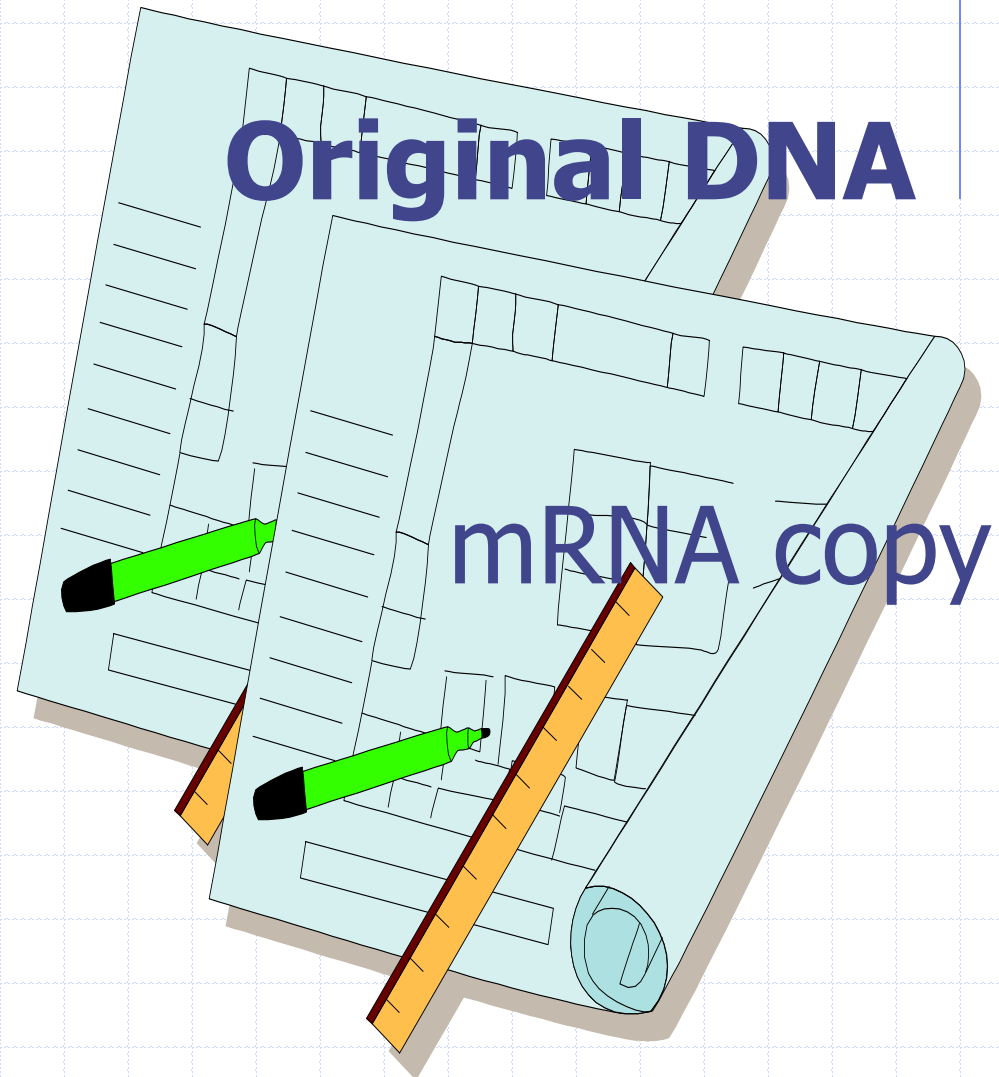
## 1. mRNA=

- ◆ Copies the DNA code
- ◆ Deliveries message to Ribosome
- ◆ Protein Factories



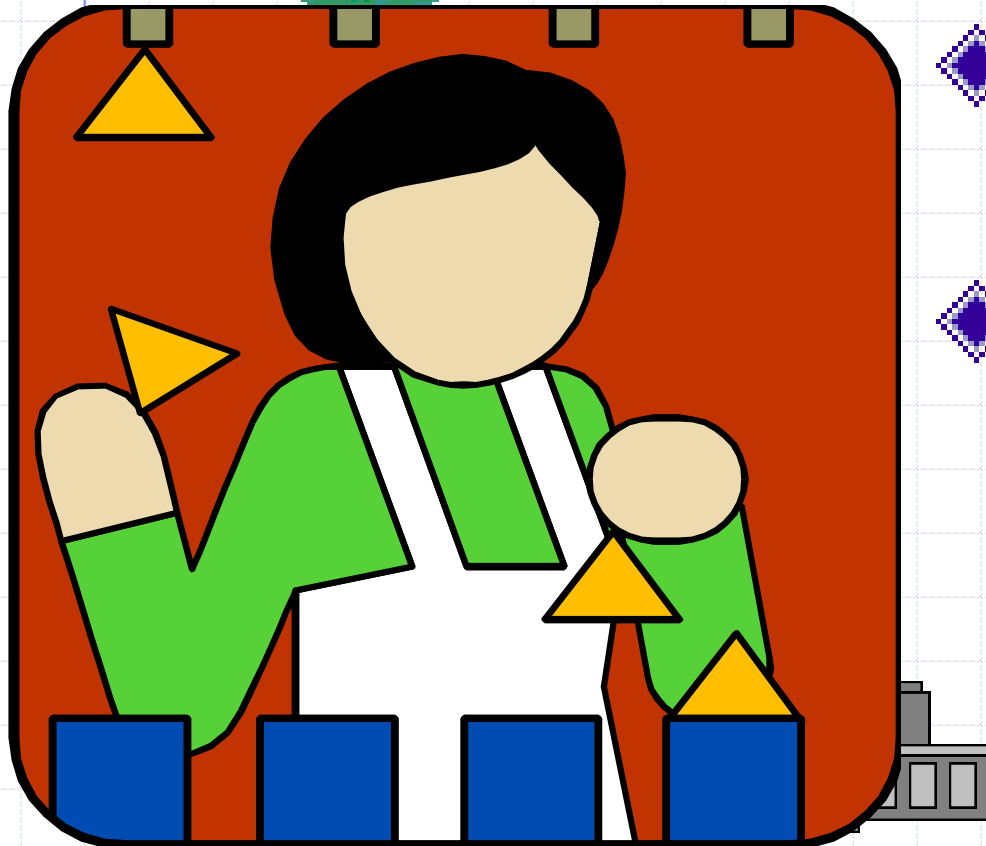
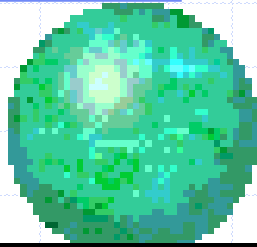
# Why not send the original DNA code out?

- ◆ **DNA might be damaged!**
- ◆ **mRNA components are reused**
- ◆ **To copy more messages**



# RNA function cont.

**Amino  
acid**



## 2. tRNA:

- ◆ **in cytoplasm**
- ◆ **Picks up an amino acid**
- ◆ **“Taxis” the aa to the Ribosome protein factories**





# III. Protein Synthesis

## **Assembling Proteins from the DNA Instructions**

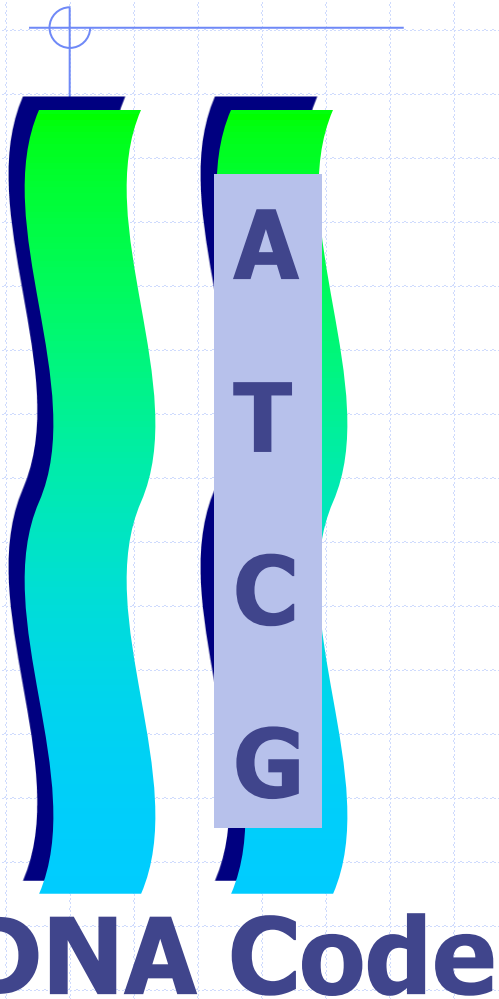


# A. Transcription:

1. mRNA is copied off of DNA
2. In nucleus
3. Steps:
  - ◆ DNA untwists
  - ◆ DNA unzips
  - ◆ RNA codons line up



# Transcription:



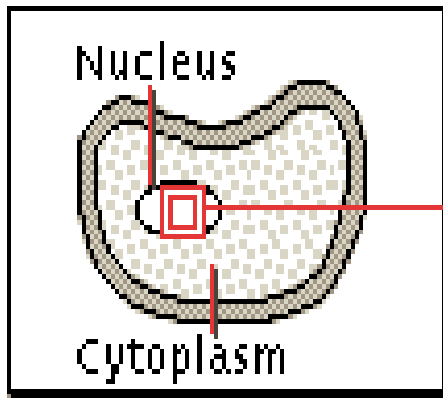
mRNA



mRNA has:

- ◆ Ribose sugar
- ◆ Uracil instead of thymine bases
- ◆ Nuclear membrane allows it to leave!

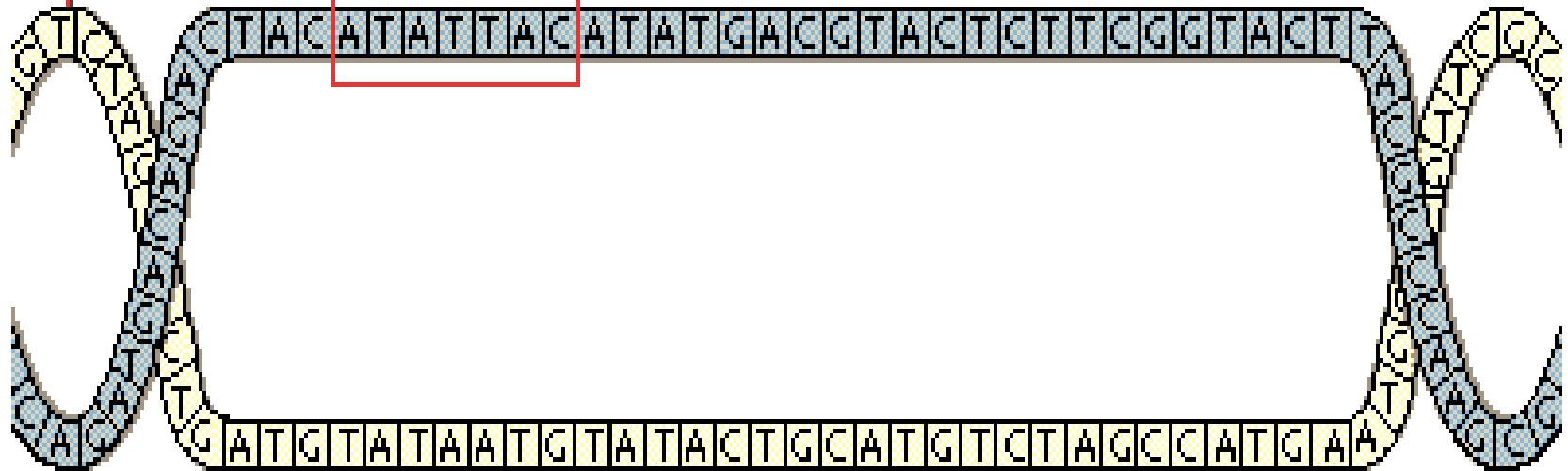
# Transcription in The nucleus



DNA

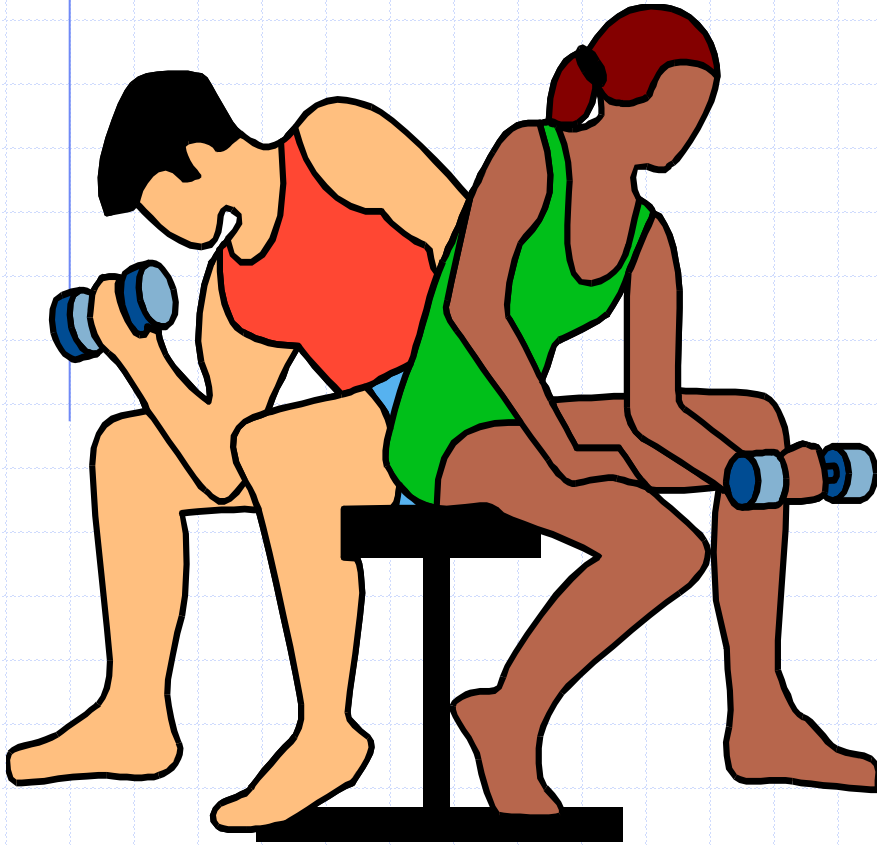
mRNA copy

Promoter



Sense strand

## B. Translation =

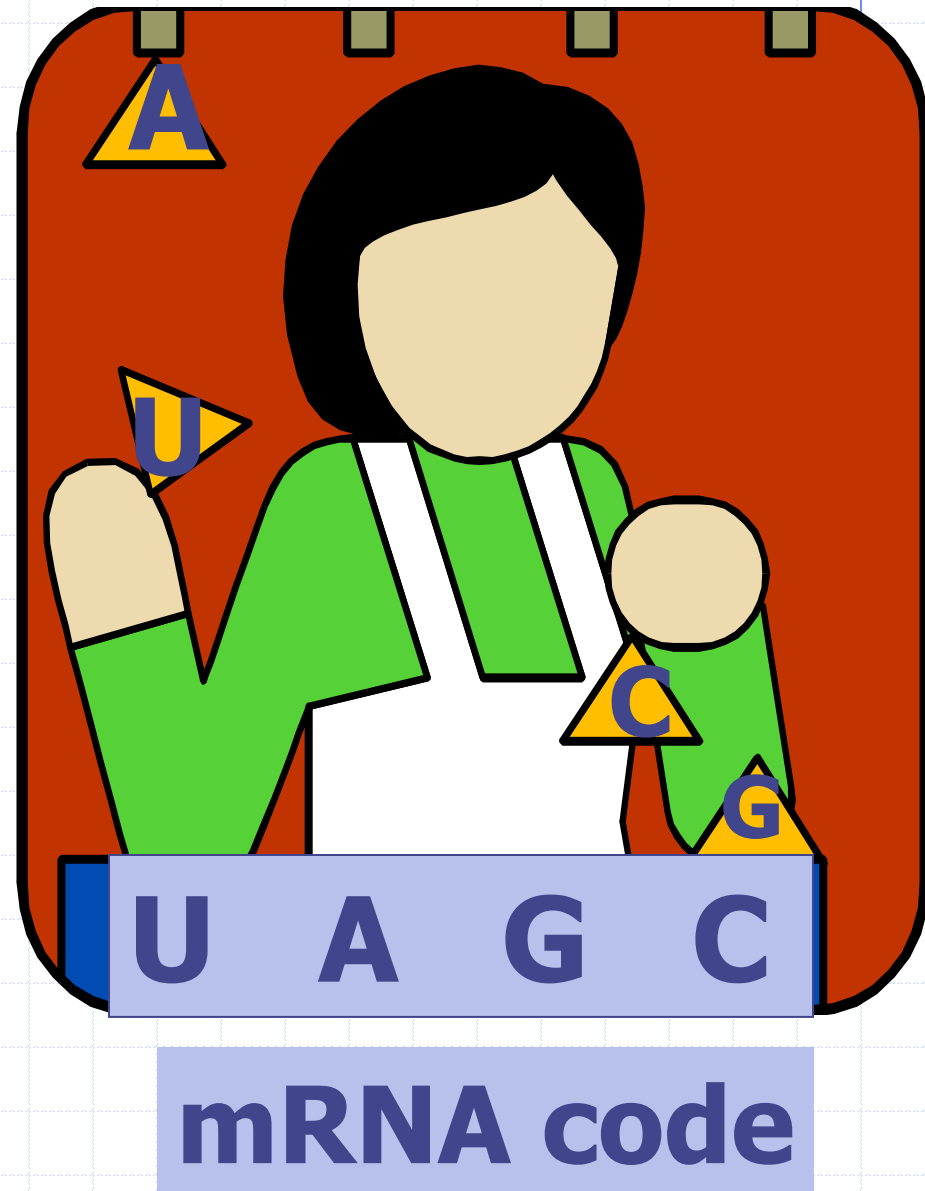


- ◆ **Conversion of the message (mRNA Code)**
- ◆ **Into a protein**
- ◆ **By the ribosome factories**

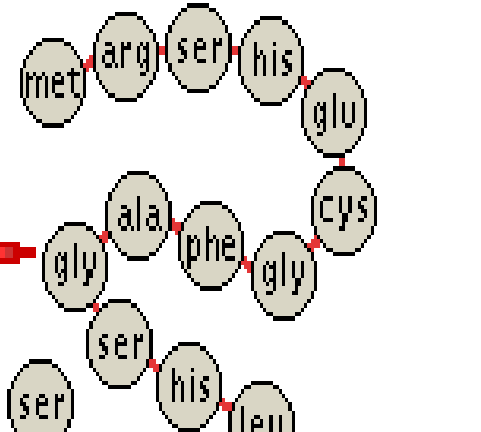
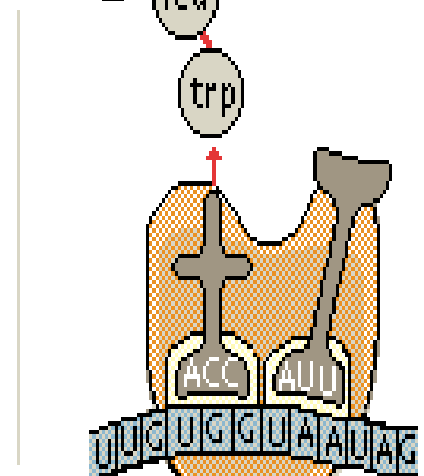
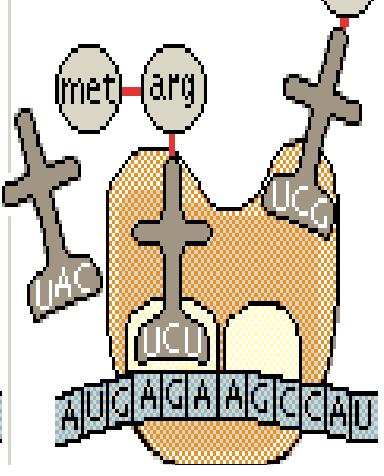
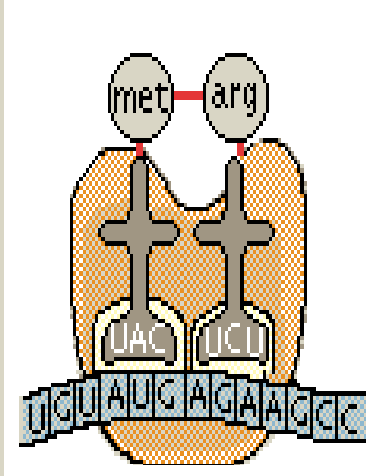
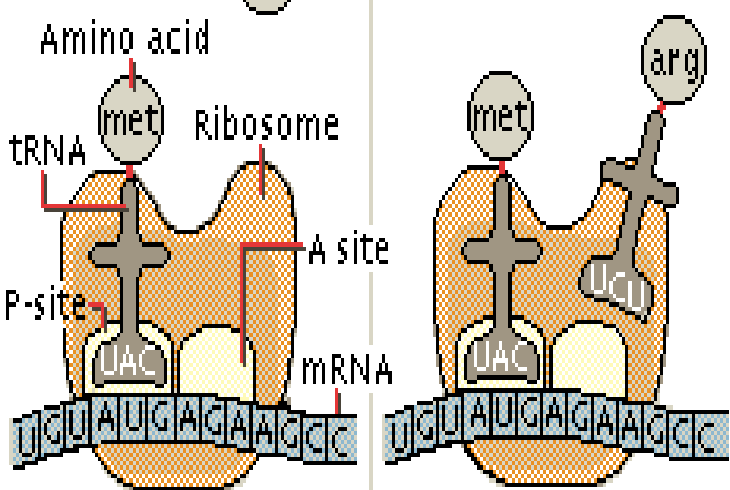
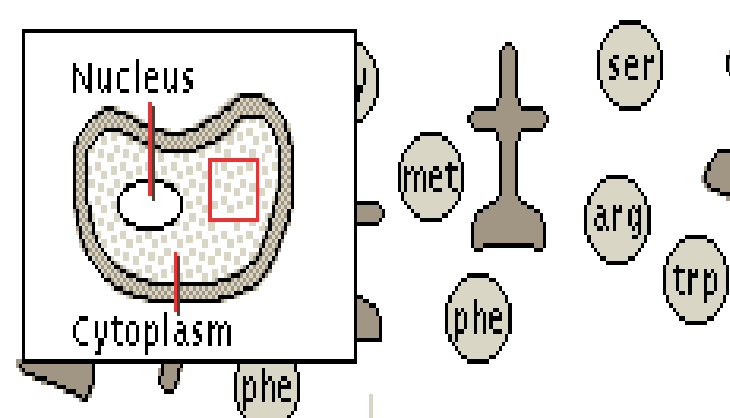
# B. Translation

1. mRNA arrives at the Ribosome
2. tRNA picks up an amino acid
3. tRNA delivers the aa to the ribosome
4. aa are assembled into polypeptide proteins

tRNA taxi



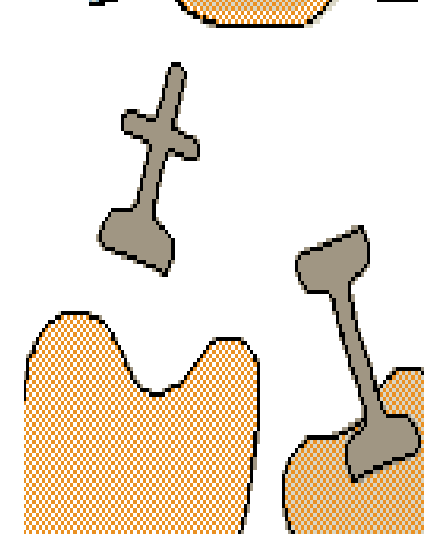
# 4. Polypeptide Chain of amino acids grows



- tRNA delivers amino acid

## 2. Peptide bond forms

## 3. tRNA leaves ribosome



# Summary:

## DNA

### Replication:

- ◆ Make duplicate DNA
- ◆ In nucleus
- ◆ Copy the chromosomes
- ◆ For Mitosis

## Protein Synthesis:

### *1. Transcription:*

- ◆ Make mRNA
- ◆ From DNA

### *2. Translation:*

- ◆ Make protein
- ◆ Off mRNA code
- ◆ Using amino acids