

# Ch 12 DNA and RNA

12-1 DNA

12-2 Chromosomes and DNA Replication

12-3 RNA and Protein Synthesis

12-4 Mutations

12-5 Gene Regulation

# 12-1 DNA

- All diversity in cells comes from **Deoxyribonucleic Acid (DNA)**
  - Function is to store and transmit genetic information that informs cells when to make proteins and which proteins to make
- DNA is a chain of Nucleotides composed of a Sugar (deoxyribose), a phosphate group, and a Nitrogen base
- The Nitrogen base is where the DNA differentiates into 4 different characteristics
  - These groups are Adenine (A), Guanine (G), Cytosine (C), and Thymine (T)

# 12-1 DNA

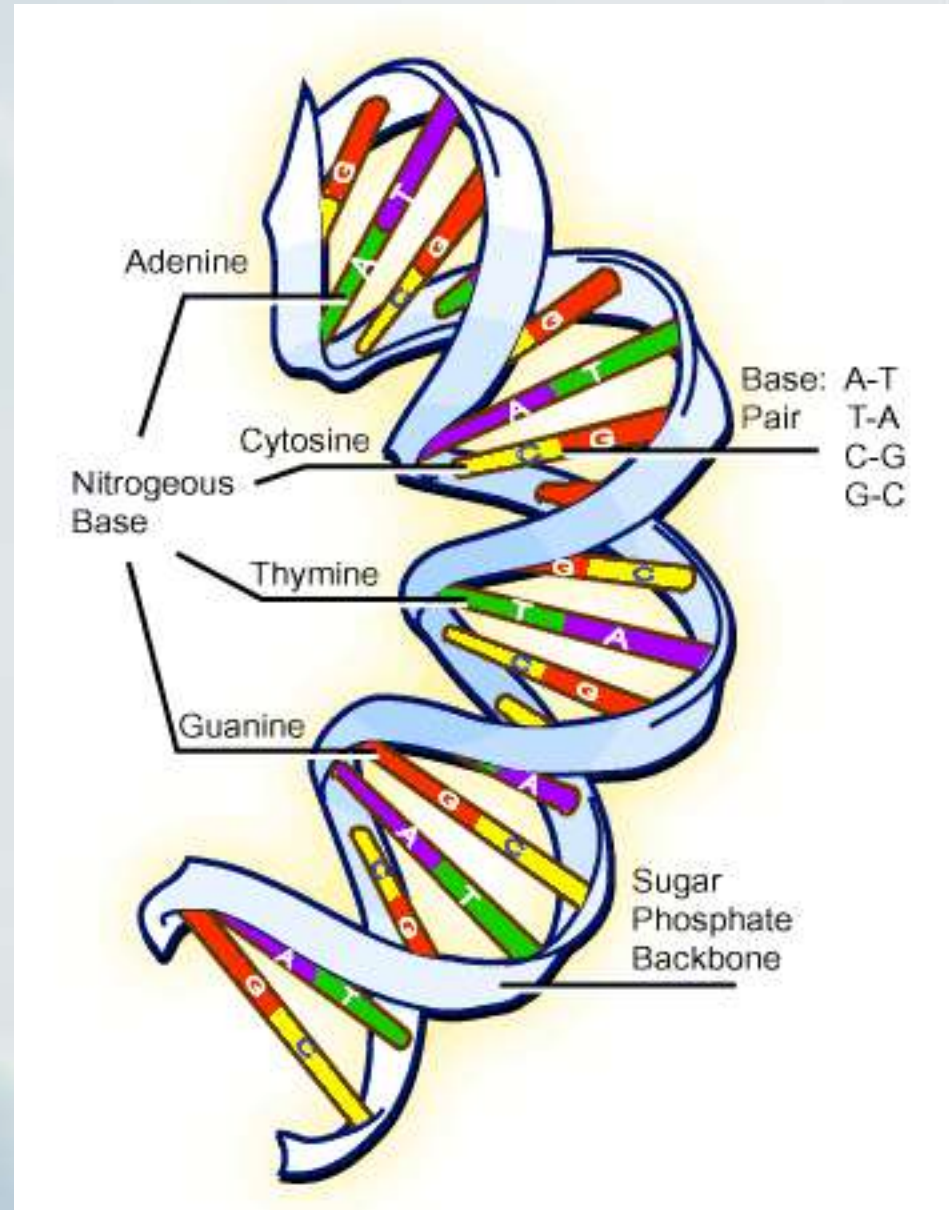
- The DNA is grouped as following
  - Cytosine pairs with Guanine (CG)
  - Adenine Groups with Thymine (AT)
- They are connected and create a double helix shape with alteration of Deoxyribose sugar and Phosphate create the backbone
- This pairing of the nitrogen bases and the backbone are vital in the reproductions of DNA

# 12-1 DNA

## Look don't

### write

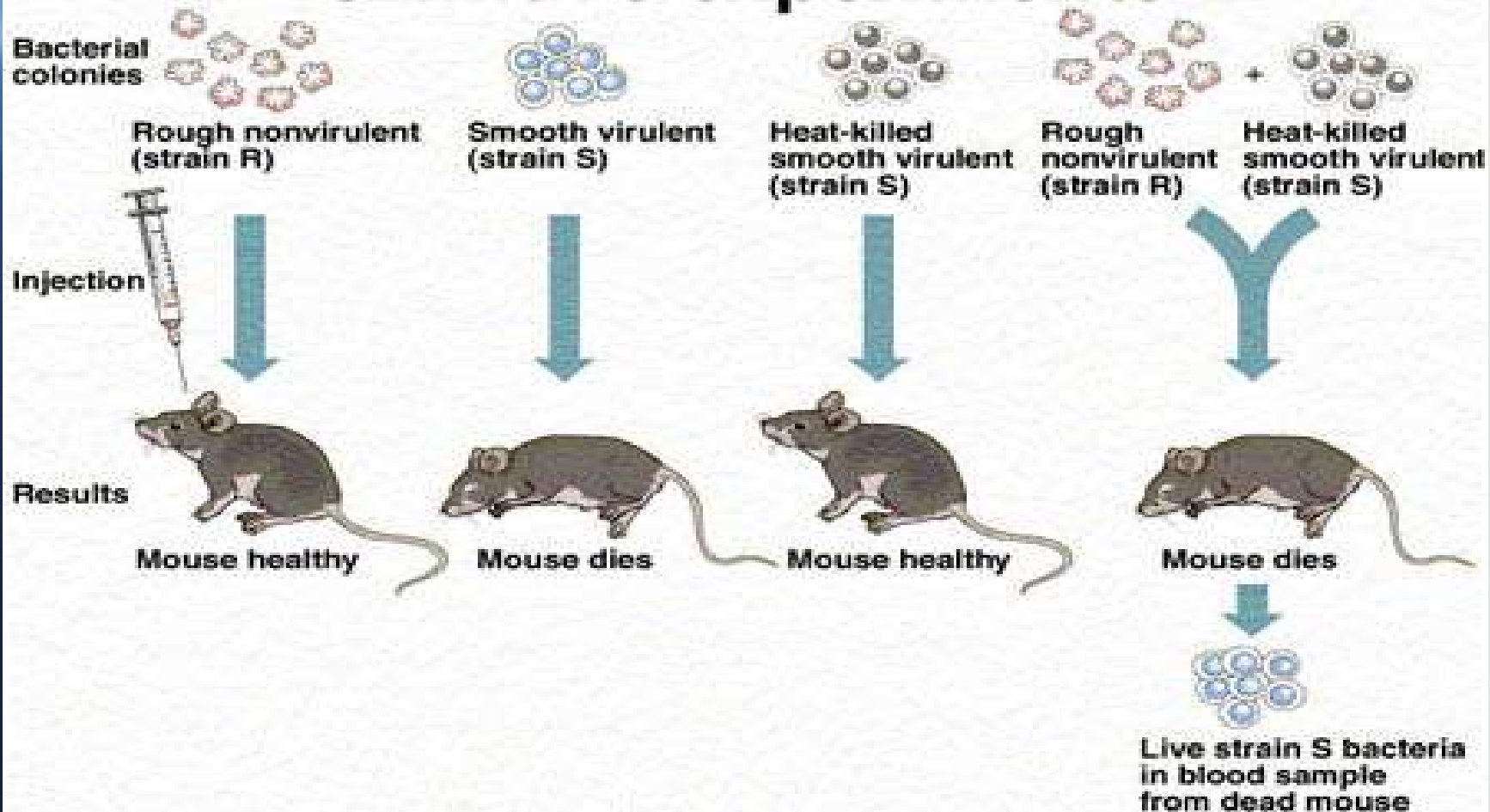
- Notice how the Nitrogen bases are paired A-T and C-G
- The Sugar and Phosphate create and guide the double helix



# How did DNA get discovered?

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## Griffith's experiments

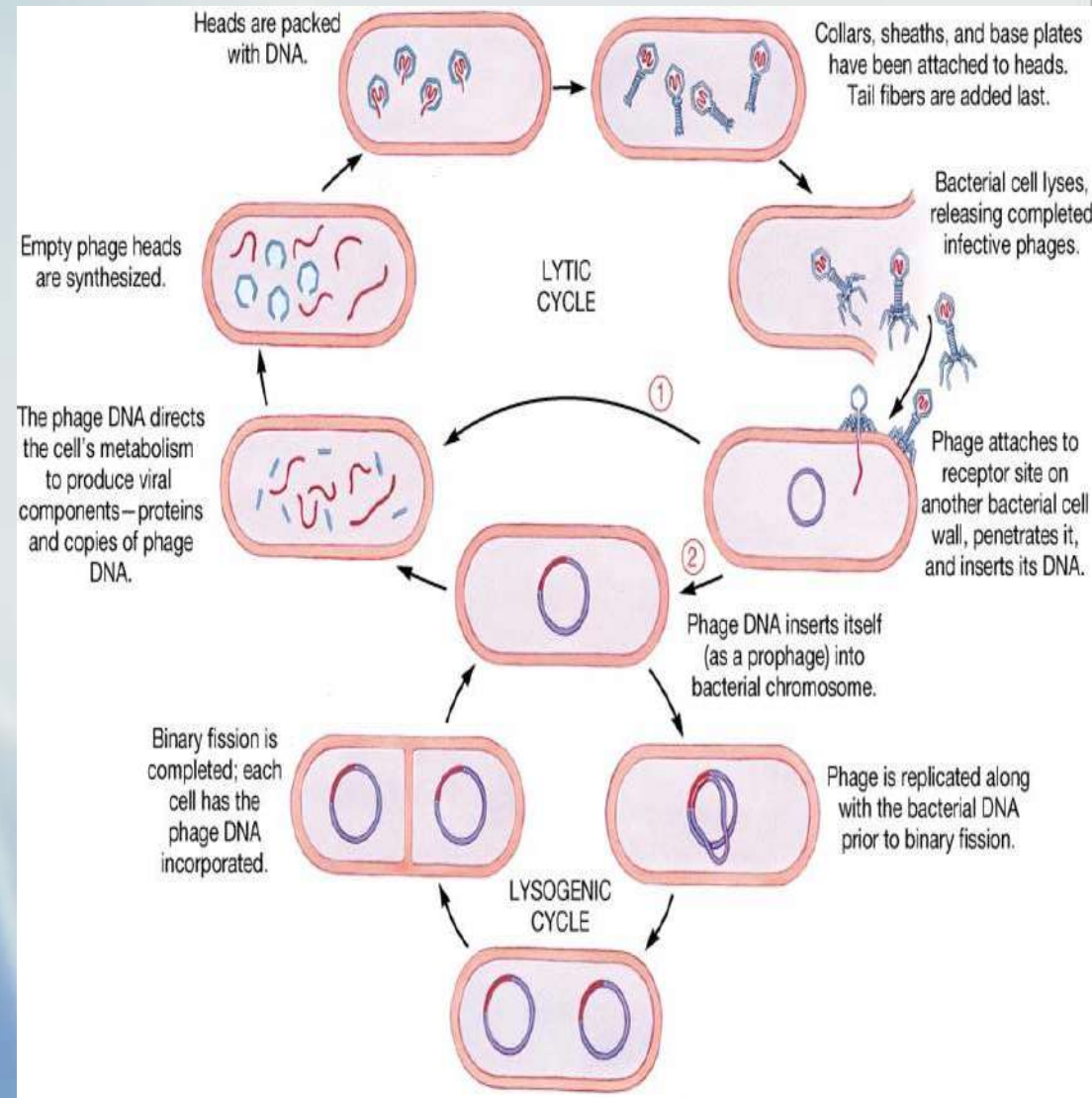


# 12-1 DNA

- Griffith called this process Transformation because one strain of bacteria had apparently been changed permanently into another
- Griffith's experiment led to others which led to the conclusion- DNA stores and transmits the genetic information from one generation of an organism to the next

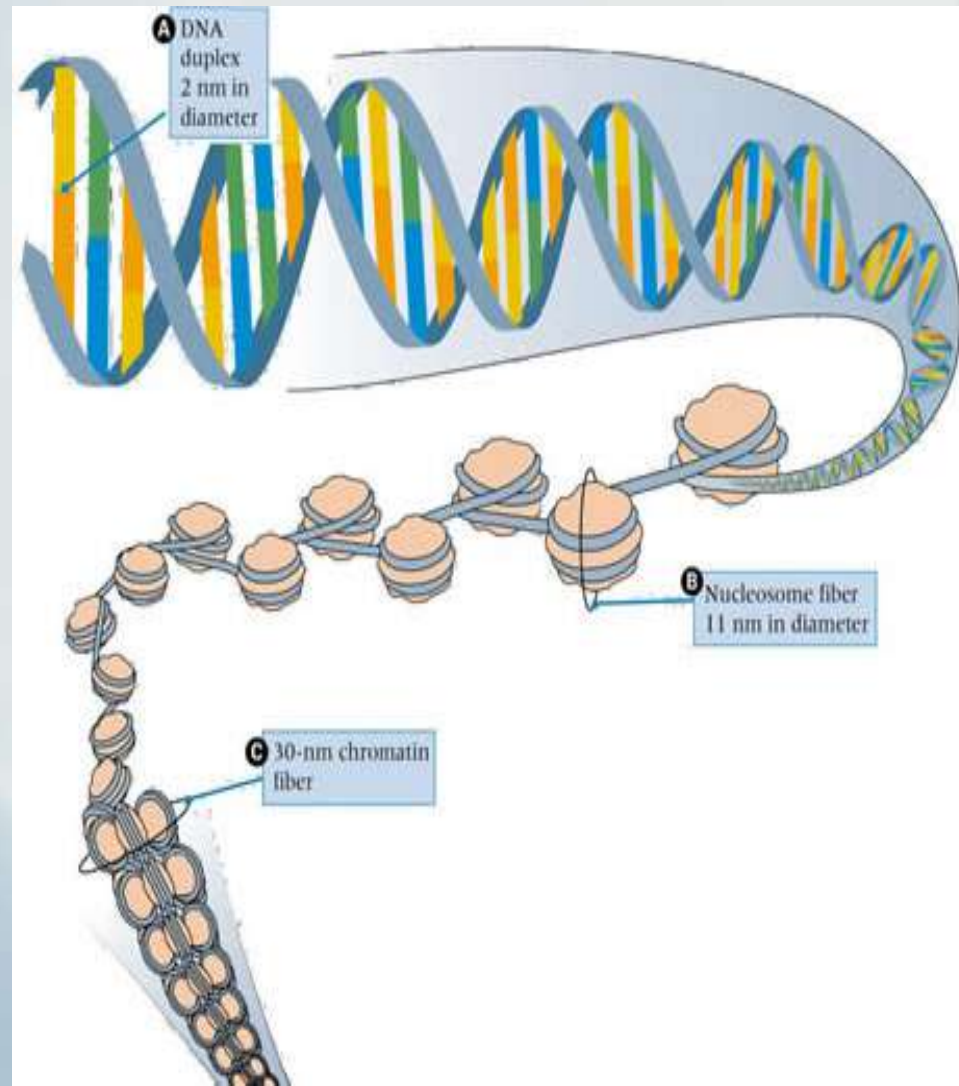
# 12-1 DNA

- A virus that infects bacteria with its DNA to reproduce the virus is known as a Bacteriophage
- Pg 294 (1-5)



# 12-2 Chromatin and DNA Replication

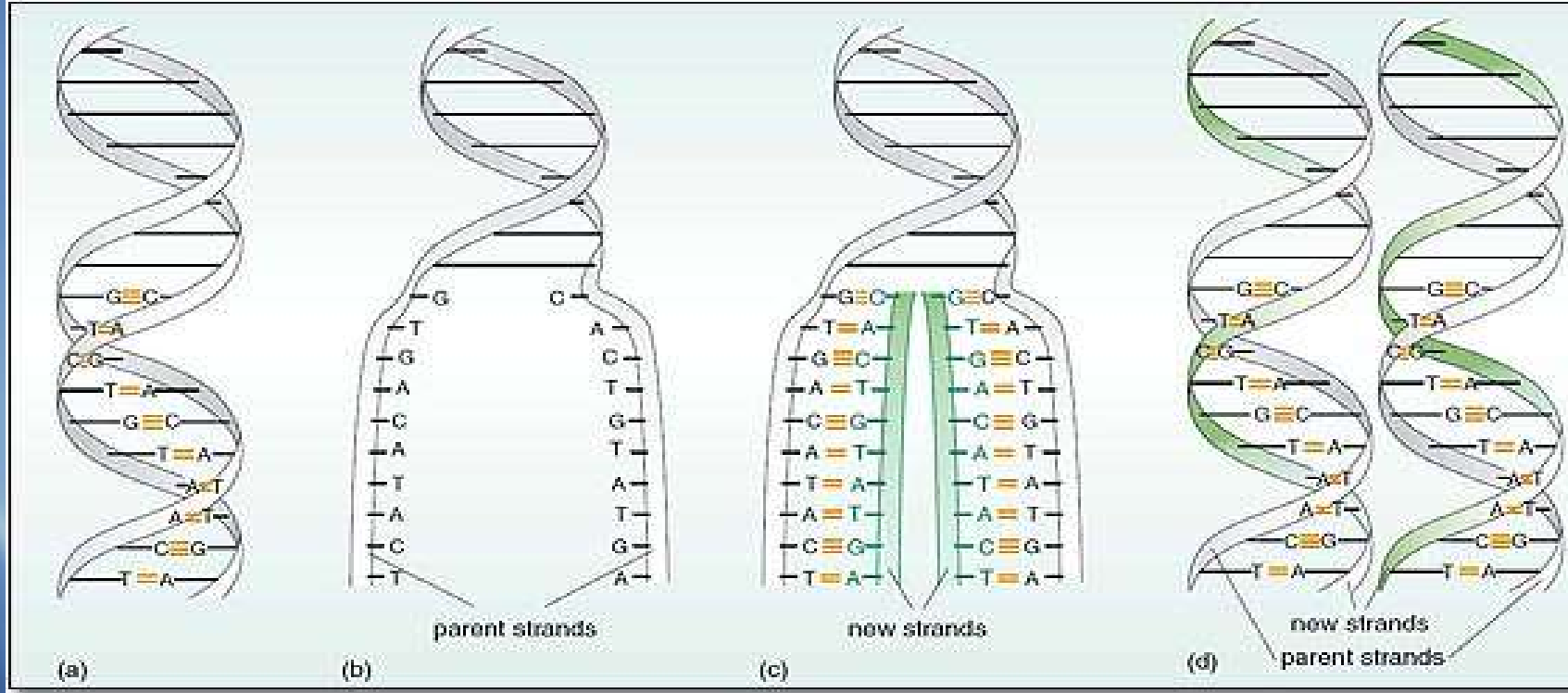
- **Replication-** Process of copying DNA
- Eukaryotic chromosomes contain both DNA and protein, tightly packed together to form a substance called Chromatin
- The proteins that DNA is wrapped around are called Histones





# 12-2 Chromatin and DNA Replication

- Enzyme **Helicase** breaks apart the hydrogen bond between base pairs
- One DNA is split into 2 separate chains an enzyme **DNA polymerase** replaces the missing half of each DNA Strand
- **Mutations** which are when errors occur during this replication process have serious effects on new cells



- Helicase breaks the strand apart
- DNA polymerase puts the strand back together with new base pairs to create 2 strands
- Now there are 2 identical DNA Strands so the cell can go through mitosis and form 2 nuclei

# BookQuestions

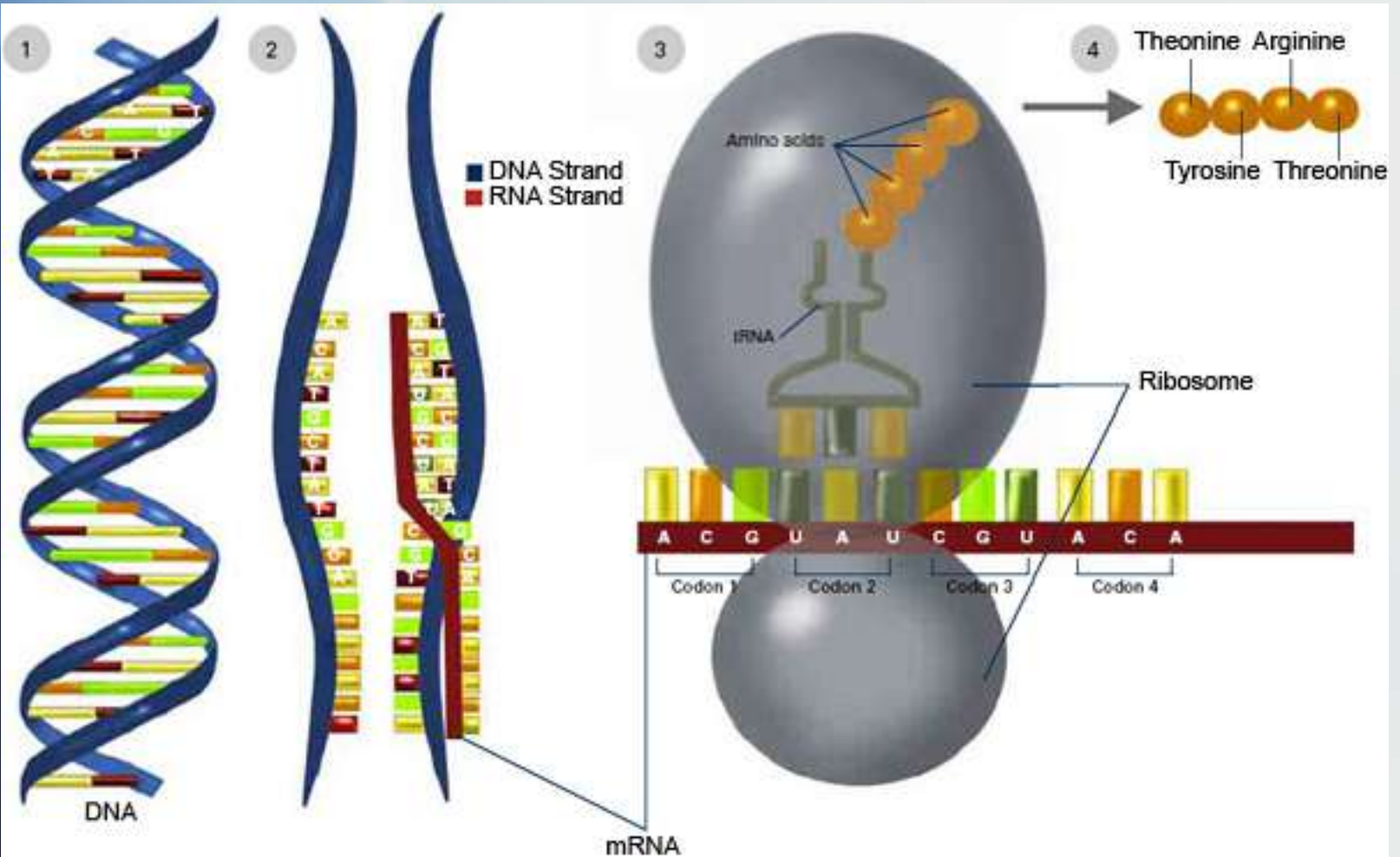
- Pg 299 (1-6)

## 12.3 RNA and Protein Synthesis

- **RNA** is responsible for the movement of genetic information from the DNA in the nucleus to site of protein synthesis in the cytosol
- Similar to DNA but sugar is Ribose instead of Deoxyribose, also RNA lacks thymine but has Uracil

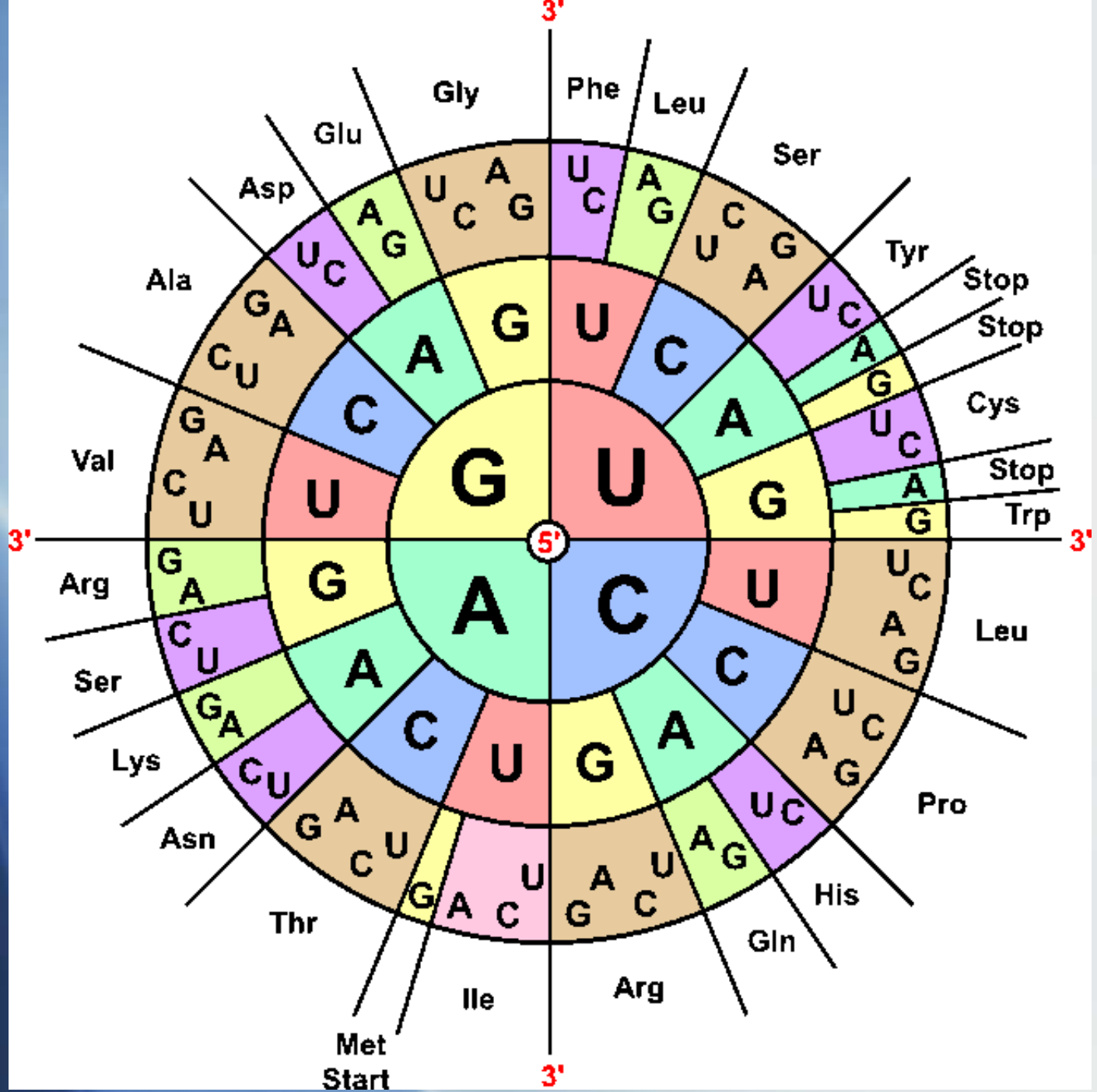
# 12.3 RNA and Protein Synthesis

- **Transcription-** The process by which genetic information is copied from DNA to RNA
- **RNA polymerase-** Enzyme that synthesizes RNA copies from DNA
- **Promoters-** Marks the beginning of DNA chain to be transcribed
- **Termination Signal-** The region of a DNA which tells the RNA polymerase that the nucleotide ends



# 12.3 RNA and Protein Synthesis

- The production of protein is called **Protein Synthesis**
- Proteins are polymers like DNA and RNA but they fold up into 3-dimensional shapes and bind with other molecules(building blocks)
- **Genetic Code-** mRNA sequence that is translated
- Each combination of three mRNA nucleotides is called a **Codon**
  - Each codon codes for a specific amino acid (Piece of a protein)
- **Start Codon = AUG** - Starts translating RNA
- **Stop Codons = UAA, UAG, or UGA** - Stops Translation

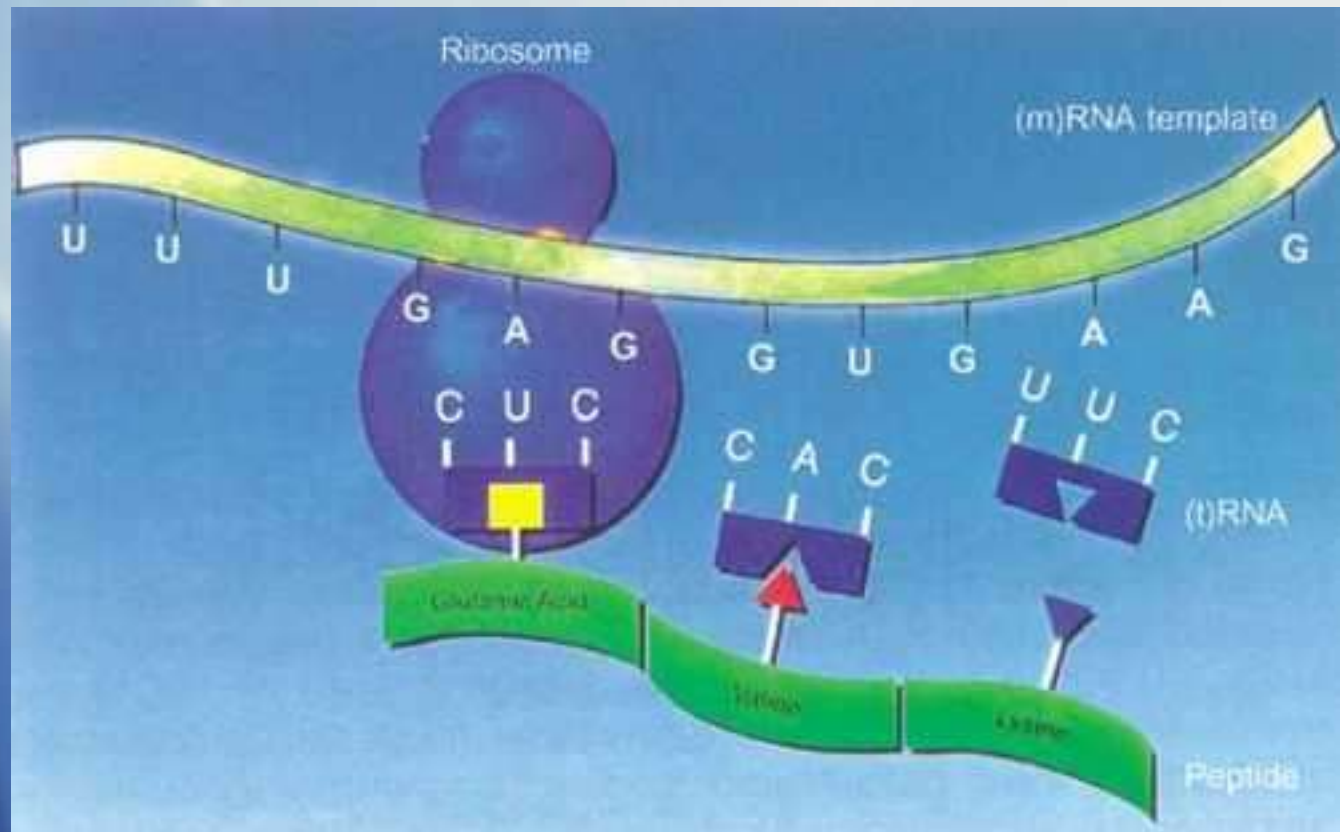




# 12.3 RNA and Protein Synthesis

- The process of assembling polypeptides from information encoded in mRNA is called **Translation**
- The process of translation begins when the RNA leaves the nucleus, migrates to the ribosomes where protein synthesis occurs
- In the ribosome the mRNA codon pairs with its **Anticodon.**
  - Example- Codon ACA would pair with anti codon UGU since Adenine pairs with Uracil in RNA

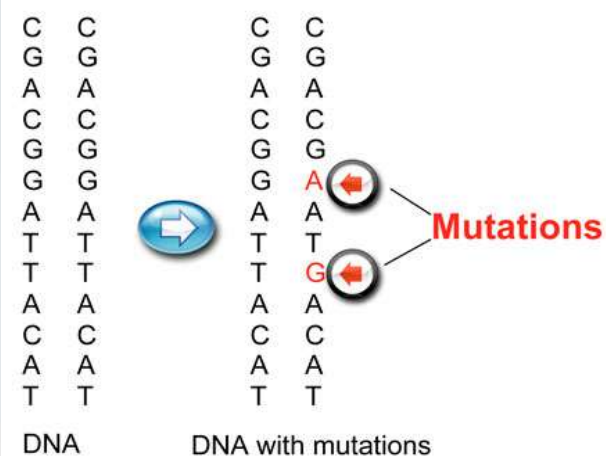
# Ribosome assembling amino acids into Proteins (translation)



# Practice makes perfect

- Pg 306 (1-5)

# 12-4 Mutations



- Cells make mistakes when copying their own DNA, inserting an incorrect base, or even skipping a base
  - These mistakes are called **Mutations**
- Mutations come in many shapes and sizes
  - Mutations that affect a single gene are called Gene mutations, but if they affect the entire Chromosome they are called Chromosomal Mutations

# 12-4 Mutations

- Gene mutations involving changes in one or a few nucleotides are known as Point Mutations

## ORIGINAL SEQUENCE

• UGUAC AUG UAU ACG UCU CAA UGA UCCA  
Met Tyr Ser Thr Gln STOP

## POINT MUTATIONS

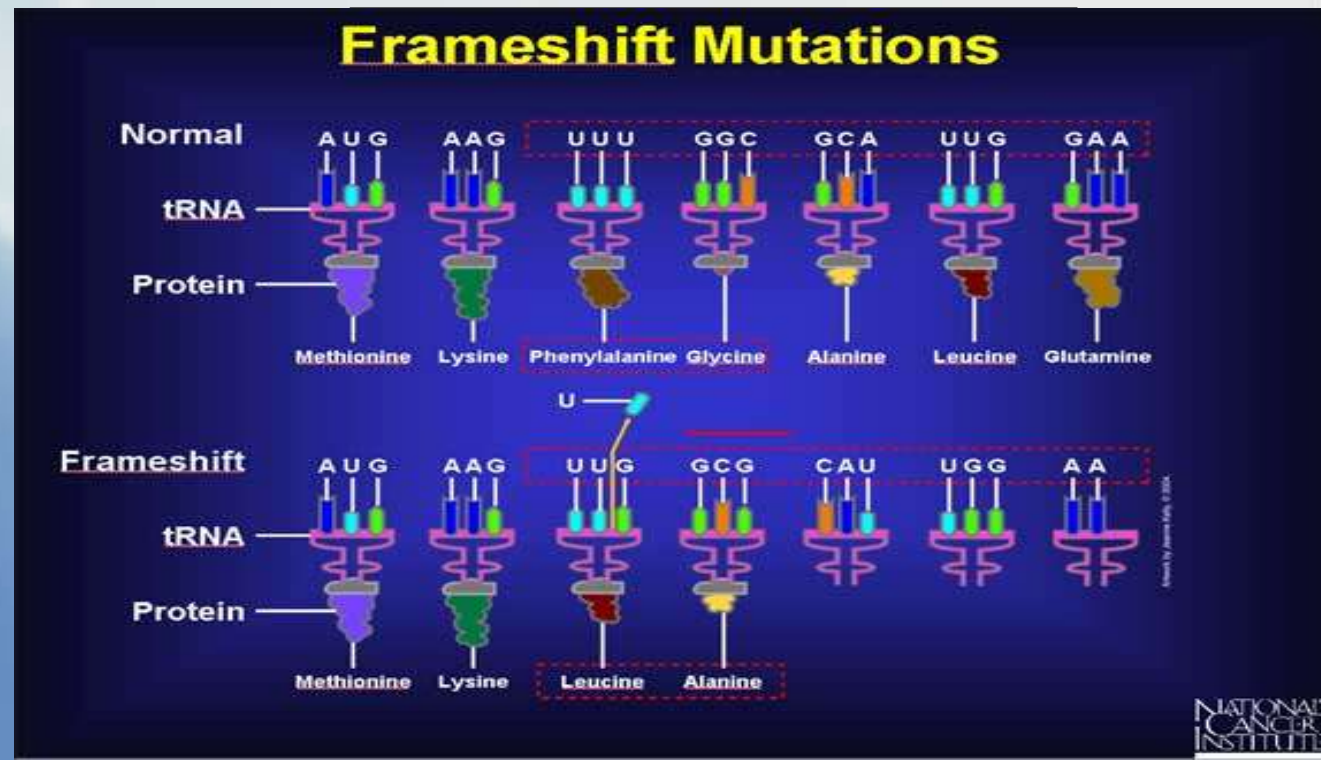
• UGUAC AUG UAU ACG UCU **CAG** UGA UCCA  
Met Tyr Ser Thr Gln STOP

• UGUAC AUG UAU ACG **CCU** CAA UGA UCCA  
Met Tyr Ser **Pro** Gln STOP

• UGUAC AUG **UAA** ACG UCU CAA UGA UCCA  
Met **STOP**

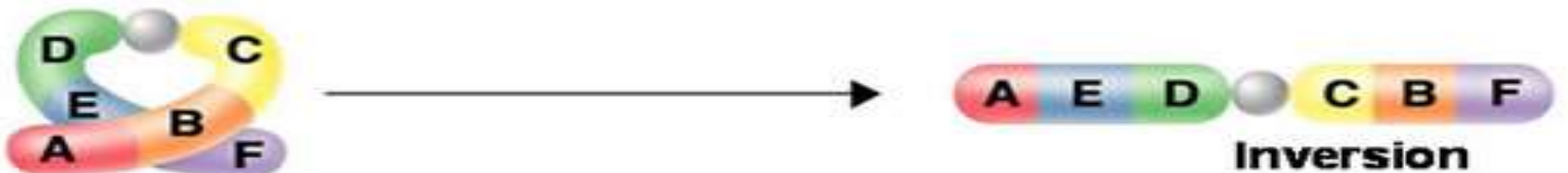
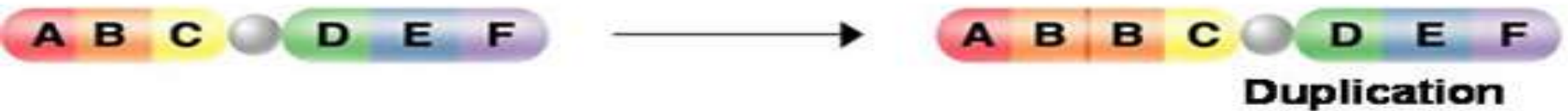
# 12-4 Mutations

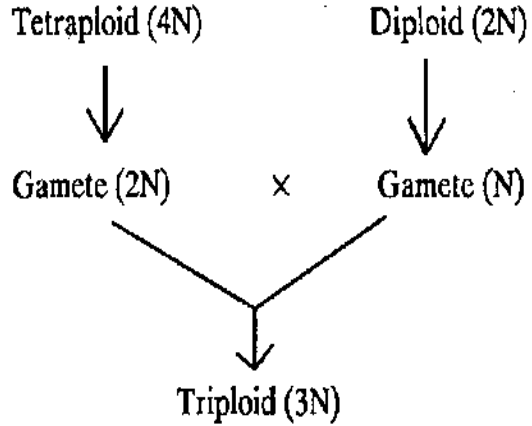
- If a nucleotide is added or deleted, the bases are still read in groups of three but know the groupings are shifted for every codon, these mutations are called Frameshift mutations



# 12-4 Mutations

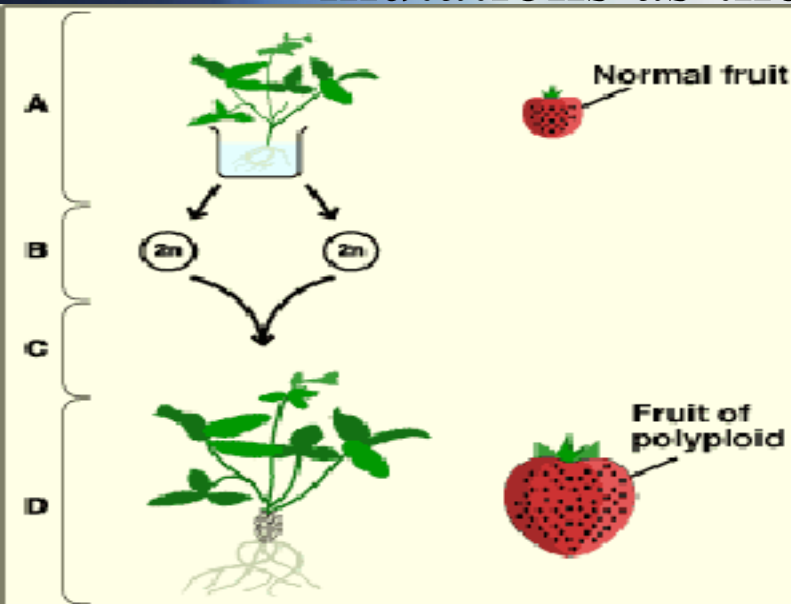
- Chromosomal Mutations





# 12-4 Mutations

- When an organism has more than two sets of chromosomes it is said to be Polyploidy
  - Plants and Animal breeders search for these mutations as they produce better (larger)



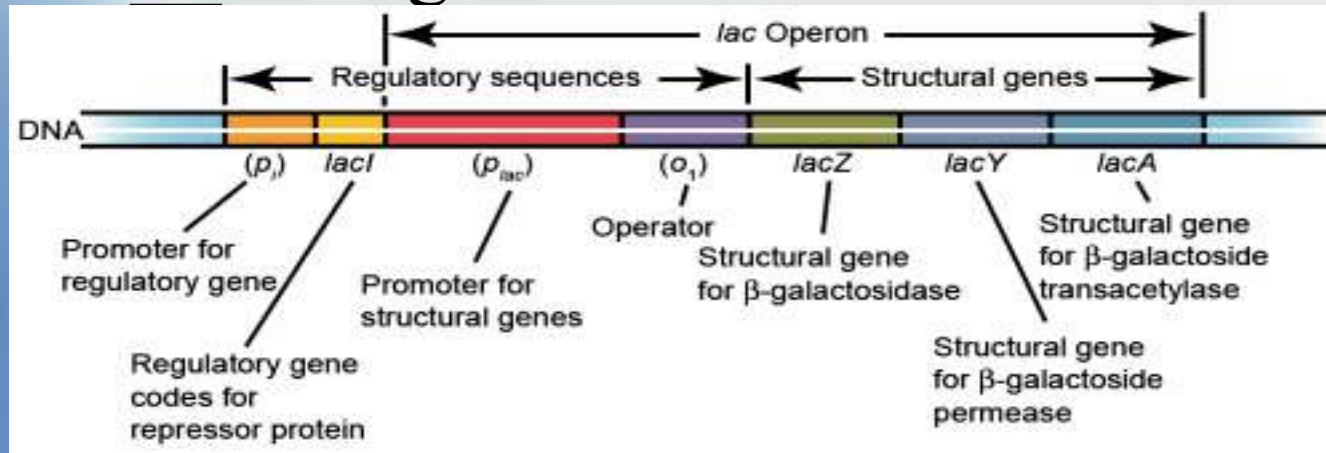


# 12-4 Mutations

- Questions
- Pg 308 (1-5)
- Quiz thursday

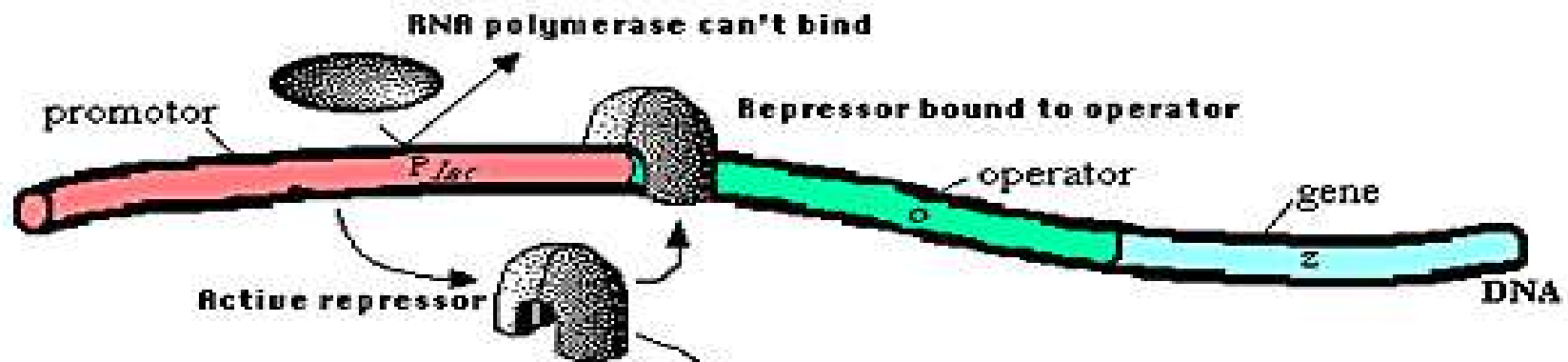
# 12-5 Gene Regulation

- A group of genes that operate together is known as a Operon
- *E. coli* has 4288 protein coding genes
- They are normally grouped and all genes are turned on or off together



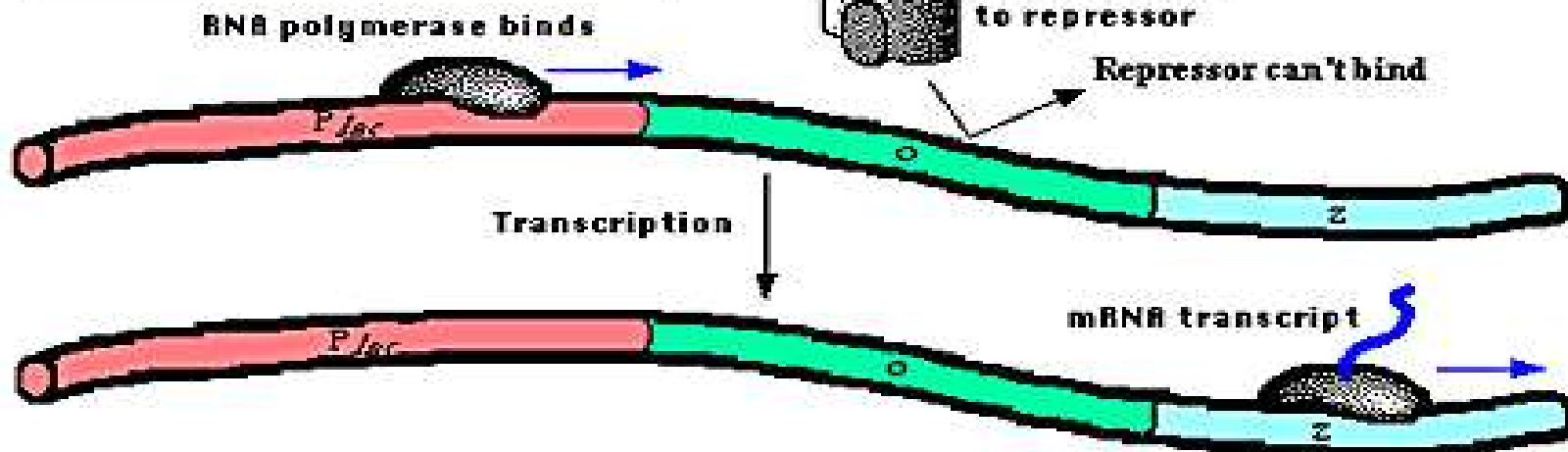
1) + GLUCOSE  
- LACTOSE

Operon off



2) - GLUCOSE  
+ LACTOSE

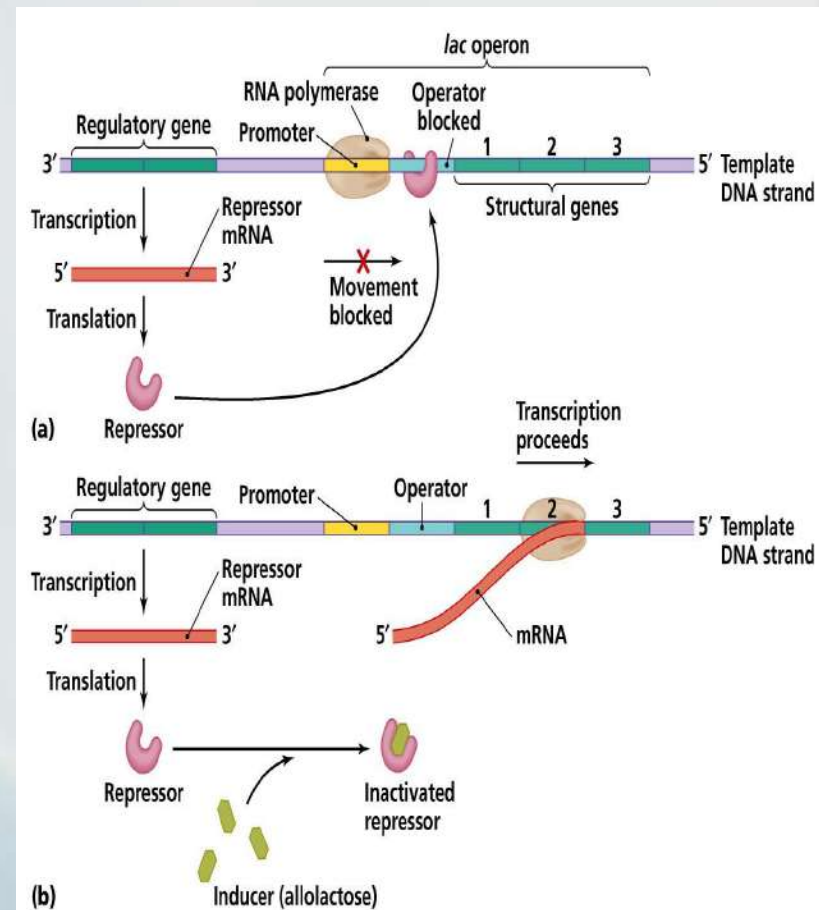
Operon on



Induction of the *lac* Operon

# 12-5 Gene Regulation

- Gene regulation is shown easily in *E. coli* when lactose is present
- The *lac* genes are turned off by repressors and turned on by the presence of Lactose
- The repressors bond to the Operator to prevent production of proteins



# 12-5 Gene Regulation

- Most Eukaryotic genes are controlled individually and have regulatory sequences that are much more complex than those of the lac operon
- Complex organisms must have complex gene control when their cells are going through Differentiation, or creating specialized cells

# 12-5 Gene Regulation

- A series of genes, known as the hox genes, control the differentiation of cells and tissues in the Embryo
- Pg 312 (1-5)

